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Pre-Symposium Workshops

Wednesday, February 26, 2003

Full Day

Back to Basics ... and Beyond: Seating and Mobility Assessment and Prescription Considerations
Sheila Buck, B.Sc.(OT),
THERAPY NOW!, Milton, ON, Canada

This instructional session is designed for the beginning assistive technology supplier or practitioner. Assessment tools and techniques and the resulting implications for use in determining product parameters will be reviewed. Completion of a mat assessment, review of seating materials, and contours, as well as wheelchair measuring, configuration and discussion of tilt/ recline will be covered during this full day workshop. Use of clinical case studies and, where possible, available product will make this day an interactive, hands-on session.
* Beginner

Funding Dilemma: The buck stops where?
Elaine Toskos, OTR, ATP,
Rusk Institute for Rehabilitation Medicine, New York, NY
Rory Cooper, Ph.D,
University of Pittsburgh, Pittsburgh, PA
Gerry Dickerson, ATS, CRTS,
A&J Care, Inc., Glendale, NY
Barbara Levy, PT, ATP,
Thoms Rehabilitation Hospital, Ashville, NC
Mark Schmeler, MS, OTR/L, ATP,
University of Pittsburgh, Pittsburgh, PA

Over the past few years, in the United States, there has been a funding paradigm shift for many people requiring custom wheelchair seating and mobility. Traditionally, people with severe disabilities have often received health insurance from state funded and operate programs. These people are now being moved into the federal program or mandated managed care plans. This shift has resulted in an environment of confusion, less than appropriate equipment provision, and a virtual avalanche of paperwork.

Financing wheelchair and seating technology and services has become a very complex process. It is also a moving target leaving many in the technology service team struggling to understand what can be funded and how to process claims. The service delivery process has also evolved to include new players how have a stake in the outcome but their roles are not clear to the existing team members.
* Intermediate

Applying Research to Daily Practice: An Update on Manual Wheelchair Selection, Configuration and Training (ARDP)
sponsored by: Paralyzed Veterans of America - PVA Spinal Cord Research Foundation

Rory A. Cooper, Ph.D.,
Michael L. Boninger, M.D.,
Mark Schmeler, M.S., O.T.R., A.T.P.,
Alicia Koontz, Ph.D., A.T.P.,
Rosemarie Cooper, M.P.T., A.T.P.
(All faculty, University of Pittsburgh, Pittsburgh, PA)

This advanced clinical symposium will connect state-of-the-art research activities involving manual wheelchair selection, configuration and training to implications for clinical practice. Subjects discussed will include: prevalence, cause and means of prevention of upper extremity overuse injuries in manual wheelchair users; prevalence, cause and means of prevention of neck and low back injuries in manual wheelchair users; Prescribing, setting up, and training manual wheelchair users to maximize function and minimize the risk of injury; Descriptions of manual wheelchair Medicare classes and components that can effect seating including selection of wheels, cushions, back supports, suspension systems, and pushrims; and explanation of special considerations when prescribing manual wheelchairs for individuals with MS or other progressive disorders.
* Advanced

Half Day

Advanced Clinical Applications of Pressure Mapping Technologies
Sponsored by: Vista Medical, Ltd.
Jean L. Minkel, PT,
Minkel Consulting, New Windsor, NY

This half day, hands-on workshop will provide participants an opportunity to understand the clinical applications of pressure mapping technologies, well beyond "picking out the right cushion." Pressure mapping technologies are only tools which provide data. It is up to the team (clinician, supplier and client) to use the data provided to plan an effective intervention. Techniques for using pressure mapping as a noninvasive measurement tool for pelvic positioning will be presented. When used as a pelvic position measurement tool, a pressure mapper is a much more valuable tool for all types of positioning problems, not just for tissue trauma issues.

With relatively easy changes in the number of or size of maps used, these tools can be used for patient education in pressure relief and even wheelchair setup. Using two maps, the relative effectiveness of power seating — tilt, recline or both can be observed, measured and reported to the third party payers. Using a map on the floor, the setup of an ultra-light-weight, multi-adjustable chair can be quantified by recording the weight distribution on the casters versus the rear wheels and a recording of the client's center of pressure position when sitting in the chair. Participants will have an opportunity to interact with different systems and share experiences with those service providers who routinely use this technology in their current seating and mobility practice settings.
* Beginner/Intermediate

Ninthteenth International Seating Symposium

Audience

- Assistive technology practitioners (ATP)
  - Occupational Therapists
  - Physical Therapists
- Assistive technology suppliers (ATS)
- Educators
- Manufacturers
- People with disabilities
- Physicians
- Rehabilitation engineers
- Vocational rehabilitation counselors

Introduction

Presentations will cover evaluation, provision, research, and quality assurance issues in seating and mobility for people with physical disabilities. The symposium will include scientific and clinical papers, in-depth workshops, special topic sessions, and an extensive exhibit hall.

Program Objectives

- Identify seating and mobility interventions for people with physical disabilities
- Discuss service delivery practices
- Know current research
- Understand features and clinical impact of seating and mobility technologies Materials available in alternate formats upon request.

Continuing Education Credit

The University of Pittsburgh, School of Health and Rehabilitation Sciences awards Continuing Education Units to individuals who enroll in certain educational activities. The CEU is designated to give recognition to individuals who continue their education in order to keep up-to-date in their profession. (One CEU is equivalent to 10 hours of participation in an organized continuing education activity). Each person should claim only those hours of credit that he or she actually spent in the educational activity

The University of Pittsburgh is certifying the educational contact hours of this program and by doing so is in no way endorsing any specific content, company, or product. The information presented in this program may represent only a sample of appropriate interventions.

1.6 Continuing Education Units (CEUs) will be awarded to individuals for attending 16 hours of instruction.

Exhibits

The exhibit hall will be filled with commercial and non-profit organizations from North America and abroad. There will be ample opportunity to explore technical seating and mobility options. Now a permanent part of the Symposium, several Instructional Courses, using state of the art techniques and technology, will be held in the Exhibit Hall.

Watch for Instructional Course locations designated “EXHIBIT HALL — Center Stage”.

Wednesday, February 26, 2003

7:00 AM - 6:00 PM

Registration (Paradise Ballroom Foyer)

Thursday, February 27, 2003

7:00 AM

Registration (Paradise Ballroom Foyer)
Continental Breakfast - Florida Hall (Exhibit Hall)

8:30 AM

Opening (Paradise Ballroom)

Elaine Trefler, MEd, OTR/L, FAOTA, ATP
Adjunct Professor
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology

Rory A. Cooper, PhD
Chairman and Professor
Department of Rehabilitation Science and Technology
School of Health and Rehabilitation Sciences
University of Pittsburgh
Director and VA Senior Research Career Scientist of the Center of Excellence for Wheelchairs and Related Technology, VA Pittsburgh Healthcare System

8:45 AM
Sunrise Medical Keynote Address

Natural History of Treatments and Disorders

Stephen J. Tredwell, MD, FRCSC
Professor, Department of Orthopaedic Surgery
University of British Columbia
Division of Paediatric Orthopaedics
Head, Department of Paediatric Orthopaedic Surgery
British Columbia’s Children’s Hospital
Vancouver, BC, Canada

9:45 AM

General Session – Papers – Paradise Ballroom

Development of a Wheelchair Seating Discomfort Assessment Tool (WCS-DAT)

This study was designed to use input from a group of full time wheelchair users who have intact sensation accompanied by an inability to move in order to develop a brief discomfort assessment tool applicable to wheelchair users. This assessment tool will be used in a later research task associated with using dynamic seating to minimize discomfort and eventually will be capable of reflecting changes over time in discomfort levels and be sensitive enough to detect the impact of seating intervention on discomfort.

* Beginner/Intermediate

Barbara Crane, MA, PT, ATP
University of Pittsburgh, Pittsburgh, PA

What Is The Best Way To Propel A Wheelchair?

Manual wheelchair users are at an increased risk of developing repetitive strain injuries at the shoulder and wrist. As more wheelchair users have undergone a kinematic analysis of stroke patterns, at least four distinct patterns have been discovered. Based on the results of these studies guidelines of training wheelchair users in one preferred pattern of propulsion will be presented.

* Beginner

Alicia Koontz, PhD
VA Pittsburgh Healthcare System
Pittsburgh, PA

"Repeated Measures Reliability of a Modified Version of the Seated Postural Control Measure"

The Seated Postural Control Measure was developed to objectively assess the posture and function of children with neurological difficulties in adaptive seating systems. As part of a research project examining the effect of kneeblock and sacral pads on posture and function, the SPCM was used as the main measurement of postural alignment. Preliminary results of a comparison between subject and control groups will be presented which will include both postural alignment and function sections and suggestions will be made for further investigation.

* Intermediate

Rachael McDonald, B.App.Sc. (OT) PostGradDip (Biomechanics)
University College London, London, United Kingdom

Managing Pelvic Obliquity

The pelvis's postural stability and mobility is the foundation of postural control and movement within anyone's seating. Specific cases of children, adolescents, and adults who have pelvic obliquities (asymmetry in two planes), strategies and configurations which have allowed them to maintainpostural control, and to continue to manage independent extremity use will be presented.

* Intermediate/Advanced

Karen Kangas, OTR/L
Shamokin, PA

11:00 AM

Exhibit Hall (Florida Hall)

Walk-about LUNCH
(sponsored by Invacare Corporation)

Center Stage program by Invacare

1:00 PM

Instructional Courses

FOUR-HOUR Session (1:00 PM – 5:00 PM)

1. Power Wheelchairs- The Dynamic Element

This presentation will assist clinicians in the selection and fine-tuning of power wheelchairs. Topics include: how to evaluate the clients needs, factors influencing chair performance, relative merits of Front, Centre and Rear Wheel Drive, how to choose the appropriate control device, and how to use the programmer. The workshop will include hands-on segments where participants will be able to drive the chairs indoors, outdoors, and adjust performance using the programmers. REGISTRATION LIMITED

* Intermediate

Ian Denison, PT, ATP
Doug Gayton, ATP
GF Strong Rehab Centre, Vancouver, BC, Canada;
Susan Johnson-Taylor, OTR/L
Rehabilitation Institute of Chicago, Chicago, IL
David Kreutz, PT
The Shepherd Center, Atlanta, GA

TWO-HOUR Sessions (1:00 PM – 3:00 PM)

2. Providing Appropriate Equipment for the Petite Paediatric Client

This presentation, using several case studies, will demonstrate the assessment process used to decide appropriate positioning and mobility equipment for petite paediatric clients. A degree of custom postural support is essential for successful operation of a power mobility unit. The audience will be encouraged to participate by offering their own unique solutions to the problems encountered in supplying positive intervention, including equipment and training, for this population.

* Intermediate

Sheena Schoger, OT (C)
Children's Rehabilitation Centre of Essex County, Windsor, ON, Canada

3. Functional Positioning / Independent Mobility for Clients with Complex Needs ^

This session not only provides education in dealing with complex mobility needs of persons with mobility impairments, it is also designed to facilitate team-building between prescribing Therapists, Suppliers, and Manufacturers. Case histories are used to explore a variety of complex mobility challenges including physical/functional limitations, funding issues, psychological concerns, environmental barriers, and care giver concerns.

* Advanced

Phil Mundy, P.Eng.
Nancy Balcom, Kinesiologist,

Product Design Group, Inc., Vancouver, BC, Canada

4. Adding Evidence: Single-Subject Designs as a Pragmatic & Rigorous Approach to Clinical Research & Practice

Although research related to wheeled mobility and seating is gradually accumulating there generally is a dearth of empirical evidence to guide and validate clinical practice. Single subject research design (SSRD) is a quantitataive, flexibel, rigorous, clinically orientated approach which can identify whether intervention has produced change. In this workshop we will define and review the various forms of SSRD and its strengths and weaknesses. Participants are encouraged to bring their clinical questions to determine if SSRD is a viable approach to address their practice issues.

* Intermediate

Bill Miller, PhD, MScOT
University of British Columbia, Vancouver General Hospital, and University of Western Ontario, London, ON, Canada
Jan Miller Polgar, PhD, OT (Reg. Ont)
University of Western Ontario, London, ON, Canada

5. Alternative Positioning: Concepts and Considerations ^

The participation in alternative positioning is vital for the maintenance of postural and skeletal symmetry, skin integrity and the performance of vital function. A variety of positions have been used over time, sometimes without regard to their effect on different body systems. This session will address alternative positioning options, their benefits and drawbacks as well as their impact on the individual's ability to function.

* Intermediate

Jill Sparacio, OTR/L, ATP, ABA
Downers Grove, IL ,
Tina Roesler, PT, ABDA,
The ROHO Group, Bellville, IL

6. Development of Equipment As Part of the Chailey Approach to Postural Management

This session will show the range of equipment options that have been developed at Chailey Heritage Clinical Services in the UK that form part of a 24 hour postural management programme, The postural program also includes active exercise and hands on therapy and education. The equipment uses the principles of developmental biomechanics detailed in the Chailey Levels of Ability, to improve motor and functional ability and prevent/ reduce deformity.

* Intermediate

Alice Goldwyn, Msc, BEng
Terry Pountney, MA, MCSP
Chailey Heritage Clinical Services, North Chailey, East Sussex, UK

7. Mat Evaluation Techniques and The Use of Simulation in Decision Making

— EXHIBIT HALL — Center Stage

Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY
Kelly Waugh, MA, PT
Louisville, CO

3:00 PM

Break – Exhibit Hall

3:30 PM

TWO-HOUR Sessions (3:30 PM – 5:30 PM)

8. Multiple Sclerosis - Seating and Mobility Concerns for Changing Needs

Seating and mobility for people with multiple sclerosis present many challenges due to the fluctuation and various presentations of the disease. This course will cover a variety of the problems faced by this population including progressive muscle weakness and exhaustion, tone management, cognitive changes, psychological issues, pain management, weight changes, vision loss, pressure sores and urinary tract infections.

Seating interventions will be discussed from basic manual mobility to power wheelchairs with tilt and head control systems. The management of loaning a facility manual wheelchair to a person going into the community will also be discussed.

* Intermediate

Faith Saftler Savage, PT
Natick, MA
Barbara Sweet-Michaels, PT
Center for Rehabilitation Technology, Helen Hayes Hospital
West Haverstraw, NY

9. Funding: The Challenges and Techniques for Success for All

Today's clinician and supplier are faced with unique and sometimes daunting challenges in attaining funding for essential seating and mobility equipment. This learning experience will explore, in-depth, the skills and mindset necessary to be truly successful in the funding process It will provide an overview of the state of the industry and how government policy is affecting our work then focus on specific documentation skills.

* Intermediate

Stephanie Tanguay, OTR, ATP/S, CRTS
National Seating & Mobility, Royal Oak, MI

10. Sensation, Sensory Processing and Seating & Mobility Systems

With individuals who have sensation and/or who may have altered sensory processing, (like individuals with multiple sclerosis, muscular dystrophy, cerebral palsy, and older age) seating systems must be created differently than providing a singular "best" or "optimal" position. Materials used, seat frames chosen, wheeled and non-wheeled chairs, powered chairs and their powered seat functions must be considered within the context of movement and sensation. Seating must support functional independence, and task performance. This instructional course will share actual cases, and strategies and materials which support sensory integration in individuals within wheeled and mobility systems.

* Advanced

Karen Kangas, OTR/L
Shamokin, PA

11. The “Must Do” Hands on Seating Assessment
This workshop will focus on the relationship between biomechanics, posture, skin and function. Assessment techniques used to gain critical information about the client’s potential neurological, musculoskeletal and functional status as well as skin integrity will be demonstrated with hands on opportunity for participants. Case studies as well as interactive discussion will emphasize the importance of using this process as we strive to justify and be accountable for everything prescribed. Participants are invited to bring a towel and recommended to wear comfortable clothing for the hands-on activities.
  * Beginner

Sharon Pratt, PT
Longmont, CO

12. Theoretical Aspects of Postural Management Provision
This session will explore in depth the theories of neuroplasticty, motor learning, muscle and bone adaptation, muscle activation and biomechanics. The theoretical basis is drawn from research evidence on how these systems change and develop in response to internal and external influences. It will use these theories to demonstrate how changes in motor function and deformity can be achieved by a combination of positioning in a variety of postures for appropriate time periods, mobility opportunities and therapy. These theories will be related to the design of postural management equipment and the importance of achieving postures which are based on sound theoretical principles.
  * Intermediate

Terry Pountney, MA, MCSP
Alice Goldwyn, Msc, BEng
Chailey Heritage Clinical Services,
North Chailey, East Sussex, UK

13. Client Evaluation Demonstration —
EXHIBIT HALL — Center Stage

Client evaluations and fittings will be demonstrated with consumer volunteers. State of the art equipment in the exhibit hall will be used for simulations of positioning and mobility solutions.
  * Intermediate

Adrienne F. Bergen, PT ATP/S
Delray Beach, FL

5:30 PM

Adjournment

5:30 PM

Welcome Reception (Exhibit Hall)

Friday, February 28, 2003

7:30 AM

Continental Breakfast (Exhibit Hall)

8:30 AM

Instructional Courses

ONE-HOUR Sessions (8:30 AM-9:30 AM)

14. Under Pressure! How to Get to the Real Problem and the Solution ^
While it is well documented that pressure ulcers are a concern for the seated client, clinicians are continuously confronted with situations that do not seem to fit the typical clinical expectation. After a thorough review of basic skin care principles including risk assessment, pressure relief, wound staging and statistics, this session will review other special considerations for the seated client. Various case studies that take place in a variety of environmental settings including home, school, recreation, and vocation will be presented.
  * Intermediate

Tina Roesler, MS, PT
The ROHO Group, Belleville, IL

15. Prescribing Wheelchairs For People With Progressive Disorders
Prescribing wheelchairs for people with progressive disorders such as Multiple Sclerosis (MS) has always been challenging. This presentation will relate the latest information on appropriate wheelchair prescription for persons with MS, specifically manual wheelchair use and characteristics of the history and physical examination that may predict successful wheelchair propulsion. In addition, we will explore how powered mobility effects participation in society and performance of ADL’s.
  * Intermediate

Michael L. Boninger, MD
Rosemarie Cooper, MPT, APT
VA Pittsburgh Healthcare System, Pittsburgh, PA; and
University of Pittsburgh, Department of Rehabilitation Science and Technology, Pittsburgh, PA

16. The Second Time Around

As an individual ages within their disability, their needs in relation to seating and mobility will change. Issues inherent with prolonged sitting include maintenance of skin integrity, deformity development, overuse and decreasing endurance. Wheelchair users will eventually experience the “second time around” prescription process for seating and mobility (or the third time around, or the fourth timeÉ). Successful intervention by the assistive technology team depends on issues of timing, acceptance of changing needs and interest in new solutions. Case examples will be used to illustrate real-life situations and solutions.

* Intermediate

Brenlee Mogul-Rotman, BSc, OT(C), OTR, ATP
Toward Independence, Toronto, ON, Canada
Kathryn Fisher, BSc, OT(C) ATS
Therapy Supplies, Toronto, ON, Canada

17. Dynamic Seating: The Best Evidence and Clinical Experience

Traditionally seating components are static and limit or prevent movement, however some clients need a range of movement to allow for their extreme movement patterns due to spasticity, high tone or agitated behaviors. This presentation will describe and show examples of custom and commercial dynamic seating components and clients who have used them, present the best evidence available on dynamic seating including information found in peer-reviewed literature, conference proceedings, and expert clinical opinion and suggest future directions for clinical research.

* Intermediate

Sonja Magnuson, MSc. Rehab Sciences
Mark Dilabio, RT
Sunny Hill Health Centre for Children,Vancouver, BC, Canada

18. Reducing Upper Extremity Repetitive Strain Injuries Through Optimal Wheelchair Set-Up ^

Research has indicated that there is a definitive relationship between manual wheelchair propulsion and the risk, incidence and prevention of repetitive strain injuries of the upper extremities. This course will include an overview of the basic anatomy of the key upper extremity joints involved in wheelchair propulsion, and the common repetitive strain.

* Beginner

Elizabeth Cole, MSPT
Amy Bjornson, PT, ATP
Sunrise Medical, Longmont, CO

9:40 AM

Instructional Courses

ONE-HOUR Sessions (9:40 AM -10:40 AM)

19. It’s Just Like Riding a Bike ... Seating Evaluation and Interventions for Handcycles

It’s Just Like Riding a Bike . . . Seating Evaluation and Interventions for Handcycles Handcycling has become one of the most popular and fastest growing adaptive sports for both recreation and competition. Disabled children and adults around the world are using handcycles for exercise . . . whether for a family ride or a long distance race. The intent of this advanced level instructional session is to present an interdisciplinary approach to evaluation, prescription and modification of handcycles to optimize rider performance, satisfaction and safety. Current research related to handcycle technology and performance will be reviewed.

* Advanced

Kendra Betz, MSPT
VA Puget Sound Health Care System, Seattle division,
Bellevue, WA

20. Vibration Reduction and Its Effects on Wheelchair Users ^

The fact is, the world is not smooth, and wheelchairs in motion often impact with rocks, cracks and bumps. As a result, physics principles of force, acceleration and energy are dissipated as vibrational energy. Unfortunately, this energy manifests itself as damaging wear and tear to the wheelchair and its user. This presentation will show that damaging vibrational energy can be dissipated effectively and efficiently and provide solid health benefits.

* Intermediate

Patrick Meeker, MS PT
The ROHO Group, Inc.
Lexington, KY

21. 24-Hour Positioning and Identifying Barrier Tasks in the Multidisciplinary Care of Pressure Wounds in the Community

This presentation will describe a novel multi-disciplinary framework for pressure wound assessment and healing in the community: The ATM Framework has three distinct phases: assessment of the pressure wound, treatment of the pressure wound and maintenance of the closed or healed wound.

* Advanced

Jillian Swaine, B.Sc. (OT)
Salimah Mitha , Bsc, R.D
Sue Munroe, B.Sc. (OT)
Karen Lagden, RN, ET
Occupational Therapy Services, Calgary, AB, Canada

22. A Comparison Between Parents' and Therapists' Views of Their Child's Individual Seating Systems

Parents and therapists often have differing views as to the effectiveness, appearance and ease of use of individual children's seating systems. This instructional course discusses the results of a research project in which questionnaires were developed and administered to address this issue. The subjects were parents and therapists of children with cerebral palsy taking part in a 6 month case controlled trial. The literature about working with families, with a particular emphasis on evidence base for clinical practice will be reviewed with key differences between areas of importance relating to adaptive seating systems between therapists and parents emphasised. The final part of the session will consist of discussion with the participants as to the implications of the results, and suggest some strategies for influencing everyday clinical practice.

* Intermediate

Rachael McDonald, B.App.Sc(OT),
PostGradDip (Biomechanics)
University College London, London, UK

23. Clinical Application of the Wheelchair Seating Standards

Part one of the International Wheelchair Seating Standards (ISO 16840) concerns definitions of body and seat measures related to a wheelchair-seated individual. Work has begun on creating a clinical guideline that will accompany this document and will make the information in the standard accessible to clinicians world wide. Clinical training and validation of the information used in the standard is an important step in this process. This session will concentrate on the integration of the information in this standard into seating and wheeled mobility practice and its applicability to many areas of clinical work.

* Advanced

Barb Crane, MA, PT, ATP
University of Pittsburgh, Pittsburgh, PA
Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY
Kelly Waugh, MA, PT
Louisville, CO

24. Electronic Information Resources
— EXHIBIT HALL — Center Stage

Today, a collection of WWW bookmarks or favorites can easily replace a file drawers full of product brochures and catalogs. Do you have the Internet information tools you need to find data to support your practice in seating and mobility? This presentation will give you the links you need to stay current.

* Beginner

Mary Ellen Buning, PhD, OTR, ATP
University of Pittsburgh, Pittsburgh, PA

10:40 AM

Break

11:00 AM

Paper Session

Functional Benefits of a Dynamic Pelvic Stabilization System

The HipGrip is an innovative dynamic pelvic stabilization device that assists the wheelchair user in maintaining proper pelvic posture while allowing functional pelvic movements. It allows the pelvis to pivot forward about the hip joint while providing variable resistance to bring the pelvis back into its neutral posture. It also provides a stable base from which to perform functional tasks, such as reaching.

* Advanced

Peter Axelson, MSME
Beneficial Designs, Minden, NV

The Relationship Between Pelvic Alignment, Trunk Alignment and the Force Applied by a Kneeblock in Children with Cerebral Palsy

The theory behind the use of kneeblock and sacral pad to control the hips and pelvis has been examined in a three year research project. This paper examines the body alignment parameters of pelvic alignment and trunk alignment in 3 planes and analyses these with the amount of forwards force measured through a kneeblock to examine the relationship between force and postural alignment. Clinical implications of the results, and suggestions for further investigation will be presented.

* Intermediate

Rachael McDonald, B.App.Sc(OT), PostGradDip
(Biomechanics)
University College London, London, UK

Redesigning the Wheelchair Pushrim for Injury Prevention

It is well established that manual wheelchair users (MSU) have a high prevalence of repetitive strain injuries of the shoulder and wrist. These injuries are believed to be caused by overuse of the upper extremities. Because of the importance of mobility and transfers in daily life, many MWUs ignore pain and trauma to their hands and arms and continue with everyday activates, regardless of the potential harm. This paper reviews the most recent advances in the development of a pushrim that changes the biomechanical factors found to be related to injury and propulsion efficiency.

* Beginner

Alicia Koontz, PhD
VA Pittsburgh Healthcare System, Pittsburgh, PA

Purpose, Use, and Fabrication of a Custom Made Dynamic Backrest

This presentation will address the role and medical purpose of a dynamic backrest in the overall seating system. The purpose and fabrication techniques (utilizing existing products) of the original design will be demonstrated and discussed using a case study format.

* Advanced

Jim Dawley, ATS, CRTS
Rehab Health Care/ Children's Hospital of the King's
Daughter's, Norfolk, VA

Instructional Courses

ONE-HOUR Sessions (11:00 AM — 12:00 PM)

25. The Client, the Team, the Equipment..Maintaining Continuity and Achieving Goals

Continuity of care, education, support and communication are keys to the success of our clients in maintaining skin integrity, independence and goal achievement. This presentation will use a case study to describe one with a stage 4 ischemic ulcer which has put a halt to her education, independence and has changed the provision of therapy and care.
* Beginner

Brenlee Mogul-Rotman, OT
Toward Indpendence, Richmond Hill, ON, Canada

26. Using Contoured Seating for Increased Head and Trunk Control in Individuals with Severe Disabilities

This instructional couse will address the concerns of older children and adult clients with severe scoliosis/trunk deformities/ pelvic and leg deformities. Some clients benefit from seating systems that right the shoulders and head while supporting the pelvis/lower trunk in an oblique position thus reducing the amount of external supports they need and allowing the client to utilize their own trunk and head control for often the first time The risks/benefits of combining this seating approach with current tilt-in-space wheelchairs will be addressed.
* Advanced

David W. Kemp, OTR, BCP, ATP
The Daniel M. Carney Rehabilitation Engineering Center, Wichita, KS.

27. Power Kids

This course will offer the evidence basis for power mobility in the pediatric population, an advanced level review of seating and electronics appropriate for severely involved and very young children, and specific examples of actual power kids. The participant's will leave understanding why power mobility must be introduced early (18 months and younger) and how assistive technology allows access for even the most challenging clients.
* Beginner

Virginia Paleg, PT
SIlver Spring, MD
Janice Fisher, PT, ATP
The Hospital for Sick Children, Washington, DC

28. Transit Options! What Is Different About Wheelchairs with the Transit Option? – EXHIBIT HALL – Center Stage

This session will review available wheelchair transit options currently commercially available. Standards for such devices and concepts for new designs will also be addressed.
* Beginner/Intermediate

Douglas Hobson, PhD
University of Pittsburgh, Pittsburgh, PA

12:00 PM

Walk-about Lunch - Exhibit Hall-
included in registration

1:30 PM

Instructional Courses

ONE-HOUR Sessions (1:30 PM — 2:30 PM)

29. Contoured Seating Using Foam-in-Place Technology

This course will describe the advantages and drawbacks of using of foam in place (FIP) technology as a medium for providing seating and positioning for individuals with developmental disabilities. The factors involved in determining use of FIP rather than other methods of contouring, the mechanics of the fabrication process, and therapeutic techniques used during fabrication will be discussed, particularly in light of individuals with severe developmental disabilities.
* Intermediate

Karen Hardwick, PhD
Austin State School, Austin, TX

30. Checking the Blindspot - A Case Study in Assistive Technology

As Assistive Technology Practitioners (ATP), the decisions we make when recommending wheeled mobility and seating components are, for the most part, based on the sum of our past experiences. We all understand that there are "things that we know" and "things that we don't know". This course will give the participant a third consideration...that there are "things that we don't know we don't know" or "blind spots". Whether you classify yourself as a "beginner", "intermediate", "advanced", or "master" level practitioner in Assistive Technology, this workshop will be about discovering and eliminating the blind spots in your practice.
* Intermediate

Joan Padgitt, PT, ATP
Denver, CO

31. Geriatric Mobility: Strategies for Success ^

It is well documented how the size of our elderly population is rapidly expanding. Not only is our elderly population as a whole getting larger, but also the population itself is getting older. As the size of this group increases, so do their needs for assisted mobility, effective positioning, and comfortable seating. This presentation will address the aging process and relate functionally how these processes impact the selection of the appropriate seating and mobility devices.
* Intermediate

Michael Babinec, OTR/L, ATP
Invacare Corp., North Olmsted, OH

32. Manual Wheelchairs and Codes ^

As more and more funding sources adapt Medicare codes for reimbursement of seating and mobility equipment, the need for a clear understanding of the criteria for these codes is critical for anyone prescribing or supplying this equipment. Medicare requires that both the equipment and the needs of the client meet specific criteria in order to qualify for that code. In this course we will look at codes for manual wheelchairs and discuss the equipment requirements for each code. We will also present the appropriate client requirements for each code, as they relate to the equipment requirements and what each type of wheelchair offers. Codes K1 through K9 will be detailed. In addition, appropriate reimbursement of a variety of accessories and options for manual wheelchairs will be discussed.

* Beginner

Elizabeth Cole, MSPT
Amy Bjornson, PT, ATP
Sunrise Medical, Longmont, CO

33. Aging with Dignity & Grace - Striking a Balance Between Comfort and Function

This workshop will look at some of the most common issues among the seated elderly, as well as, some of the possible solutions. Limited resources seem to be the single biggest reason why poorer assistive technology is more common than rare in long-term care facilities. Case studies, along with interactive discussion will address conceptual solutions, technology, educational solutions, and justification based on.

* Intermediate

Sharon Pratt, PT
Longmont, CO

34. To Tilt or Not to Tilt ^

New Technology is now available to provide dynamic orientations in space on a multitude of wheelchair frames. It is often confusing for clinicians to decide who would benefit from this technology and how to justify this to funding agencies. Using case studies, this presentation will provide some insight into the age old questions; why, who and how do we use dynamic tilt to enhance the comfort and function of our clients.

* Intermediate

Gloria Leibel, OT (C)
Bloorview Macmillan Children's Centre, Toronto, ON, Canada
Allan Boyd,
Motion Concepts, Concord, ON, Canada
Christel Meisinger
Motion Specialties Inc., Toronto, ON, Canada

35. Client Evaluation Demonstration — EXHIBIT HALL — Center Stage

Adrienne F. Bergen, PT ATP/S
Boca Raton, FL

2:30 PM

Break

3:00 PM

Paper Sessions

TRACK A - Clinical Issues

Moderator:
Jessica Presperin Pedersen, MBA, OTR/L, ATP
Presperin Pedersen Assoc., Chicago, IL

Custom Seating and Mobility for an Individual with Fibrodysplagia Ossificans Progressiva

An 18 year old African American male with a diagnosis of Fibrodysplagia Ossificans Progressiva (FOP) is referred to the Seating Systems Clinic for evaluation. FOP is a hereditary disease in which hetertrophic bone is deposited in tendon, muscle and ligaments. This patient presents with multiple lesions and deformities in all peripheral joints and spine. The presentation will discuss the team decision making process that resulted in an outcome of a superlative mobility aide and other technologies that increased his quality lifestyle and independence.

* Intermediate

Penny Powers, MS, PT
Vanderbilt University Medical Center, Nashville, TN

A RCT (Randomized Clinical Control Trial) to Compare the Effectiveness of Occupational Therapy Seating Intervention with the Conventional Seating Intervention in Postural Control for Elderly with Sitting Problem

The aim and objective of this study is to investigate the treatment outcome between the Occupational Therapy seating intervention and the conventional seating intervention in elderly with seating problem. Most previous studies of seating intervention for the elderly showed that Occupational Therapy seating intervention demonstrated significant improvements in terms of seating posture, functional performance, decrease in pressure sore and frequency of sliding out etc. However, very few of these works have a control group in their study designs that weaken their power of studies and thus the effect of generalization. Interventional/experimental study of single blinded randomized clinical trial design is used in this study. Baseline Data comparison of the experimental and control group will be compared for their baseline characteristic in terms of: age, gender, diagnosis and potential confounders.

* Intermediate

Anna Wu, MS
Caritas Medical Centre, Hospital Authority, Hong Kong, NA

The Spinalis Model: Using a Network of Medical Specialists and Consultants During the Assessment of Seating Problems for Individuals With SCI

The Spinalis Model seating pressure, and custom design of wheelchair backrest.

* Intermediate

Marie Alm, RPT, MSc
Spinalis Clinic - Karolinska Hospital, Stockholm, Sweden

To Describe Seating in Individuals with Complete Thoracic SCI by Using a Combination of Clinical Methods

This presentation will present various methods (documentation of wheelchair properties, measurements of posture from photographs, examiner's classification from photographs and subject's reports) of evaluating persons with thoracic SCI for a wheelchair and seating system. Also, a design for a wheelchair backrest that improves lumbar and lateral support will be presented.

* Intermediate

Marie Alm, RPT, MSc
Spinalis Clinic - Karolinska Hospital, Stockholm, Sweden

Cost And Quality Outcome Of A Power Wheelchair Leasing Program For Health Plan Members With Terminal Disease

Mark Schmeler, MS, OTR/L, ATP
University of Pittsburgh, Pittsburgh, PA

TRACK B - Technical Issues

Moderator:
Martin Ferguson-Pell, PhD
University College of London, Stanmore, UK

Whole-Body Vibration Analysis of Four Different Wheelchair Cushions

The effects of whole-body vibration (WBV) exposure during wheelchair mobility have been found to be detrimental to the health of humans. Different direction transmissibility, transfer function between seat and head vibration for thirty-two subjects were analyzed. Cushion selection can effect the WBV during manual wheelchair propulsion and may decrease the risk of secondary injuries for wheelchair users.

* Intermediate

Songfeng Guo, PhD
University of Pittsburgh, VA Pittsburgh Healthcare System, Pittsburgh, PA

The Comparison of Cushion Coverings in Custom Molded Seating

A single subject study was completed to compare the difference in pressure relieving qualities of coverings of custom molded seating. Through the use of pressure mapping technology, comparisons were made between vinyl covered and foam cushions (without vinyl). Other areas addressed were the provision of total contact and comfort.

* Intermediate

Jill Sparacio, OTR/L, ATP, ABA
Downers Grove, IL

Classical Thermodynamics of Wheelchair Cushions and Temperature Intevention

The use of miniature temperature and humidity data acquisition devices allows real-time measurement of heat and moisture trapping in wheelchair cushions. This information can then be used to understand the endothermic and exothermic cycles demonstrated by a given wheelchair cushion. This information allows the user to understand the thermodynamics of their unique seating environment and be aware of activities or locations that can cause significant heat buildup in a cushion. An effort at temperature intervention is documented utilizing a temperature moderating cushion now commercially available.

Evan Call, MS
Weber State University / EC Service Inc., Bountiful, UT

Design and Provision of Custom Cushions to Help Prevent Recurrence of Pressure Ulcers in People with SCI and History of Chronic Pressure Ulceration

The service delivery model to address the cyclical pattern of pressure ulcer development in clients with SCI, including issues in pressure mapping both at home base and as a mobile service, will be presented. Techniques to acquire data to design cushions such as interface pressure mapping (TekScan ClinSeat) and mapping surface anatomy will be described as well as factors needed for designing and fabricating a cushion.

* Intermediate

Gilbert Logan, BEng, MSc, Grad Dip Bus Admin, PhD
Royal Brisbane Hospital, Brisbane, Queensland, Australia

The Use of Heart Rate to Measure Wheeling Efficiency

Wheeling efficiency is oxygen uptake (ml) normalized for body weight (kg) and distance wheeled (m) (ml/kg/m). This is a popular method used in gait analysis and has been used to a lesser degree in assessing wheelchair function. The use of oxygen analysis is cumbersome and expensive. Heart rate has been shown to be a reliable predictor of oxygen consumption in walking and running in normal adults and children. If heart rate could be used to assess wheeling efficiency, it could be a useful and affordable clinical tool to assess wheelchair set up. The purpose of this study was to determine if wheeling efficiency could be measured using heart alone vs using oxygen consumption. Results indicate that for individuals with spinal cord injury with lesion levels T6 and below prediction was good. For those with higher lesions, oxygen consumption would have to be used.

* Advanced

Bonita Sawatzky, PhD
British Columbia's Children's Hospital and Vancouver Hospital, Vancouver, BC, Canada

Instructional Courses

ONE -HOUR Sessions (3:00 PM-4:00 PM)

36. Clinical Application of Power Tilt and Recline Systems — EXHIBIT HALL — Center Stage ^

This presentation will look at the importance of utilizing power tilt, power recline and power tilt/recline combination system to meet the multiple challenges of the patient populations that require this advanced technology An overview of the similarities and differences between what tilt and recline systems provide for the client will be discussed, including differences in pressure and shear reduction and in postural control.

* Intermediate

Amy Bjornson, PT, ATP
Sunrise Medical, Erie, CO

4:00 PM

Chris Bar Research Forum
sponsored by ROHO Inc.

Chair:
Geoff Bardsley, PhD
TORT Centre, Ninewells Hospital, Dundee, Scotland

The 2003 Chris Bar Research Forum is a British Parliamentary style debate focusing on the need for comfort in wheelchair seating.

The motion to be debated is as follows:
This House believes that comfort is irrelevant in the practice of wheelchair seating and that discomfort is simply a pain in the butt!

5:30 PM

Adjourn

5:45 PM

Research Project for Seating and Mobility Clinicians

Purpose of this study is to determine if a test used to measure knowledge clinicians use to prescribe wheelchairs and seating systems measures what it is intended to measure, clinical expertise.

Study funded by: University of Pittsburgh Medical Center on Spinal Cord Injury and the VA Research and Development Center of Excellence on Wheelchairs and Related Technology

Saturday, March 1, 2003

7:00 AM

Research Project for Seating and Mobility Clinicians

Purpose of this study is to determine if a test used to measure knowledge clinicians use to prescribe wheelchairs and seating systems measures what it is intended to measure, clinical expertise.

Study funded by: University of Pittsburgh Medical Center on Spinal Cord Injury and the VA Research and Development Center of Excellence on Wheelchairs and Related Technology

8:00 AM

Continental Breakfast

8:00 AM

Special Session

An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)

Moderator:
David Cooper, MSc, RT
Sunny Hill Health Center for Children, Vancouver, BC, Canada

Participants:
Peter Axelson, MSME
Beneficial Designs, Inc., Minden, NV
Michael L. Boninger, MD
University of Pittsburgh, VA Pittsburgh Healthcare System, Pittsburgh, PA
Mary Ellen Buning, PhD
University of Pittsburgh, Pittsburgh, PA
Rory Cooper, PhD
University of Pittsburgh, VA Pittsburgh Healthcare System Pittsburgh, PA
Susan Johnson-Taylor, OTR/L
Rehabilitation Institute of Chicago, Chicago, IL
David Kreutz, PT
The Shepherd Center, Atlanta, GA

Instructional Courses

TWO-HOUR Session (8:30 AM — 10:30 AM)

37. Palm Devices - Toys or Tools ?

This session will speak to the use of the PDA (Palm/Pocket PC) in the assessment process, for record keeping, as a clinician/therapist toolkit, and as a method of retaining information for evidence based outcome issues. The speaker has a wide range of experience with these devices - and without a doubt has made almost every possible error, and suffered every form of data loss possible.

* Intermediate/Advanced

Doug Gayton, ATP
Ian Denison, PT, ATP
GF Strong Rehab Centre, Vancouver, BC, Canada

38. Special Seating Issues in Bariatrics

Bariatric medicine is coming to the forefront of the rehabilitation field and more clients are being referred for seating intervention in order to re-enter their communities when they have lost mobility skills and have medical complications. In order to meet the needs of this population, seating clinicians must creatively apply the available seating interventions to this population. Several seating challenges occur with this unique group of wheelchair users, some of which can be met with currently available seating technology and some require customized interventions. This presentation will involved presentation of current seating equipment, discussion of case studies and an opportunity for group problem solving and brainstorming.

* Beginner

Stephanie Tanguay, OTR, ATP/S, CRTS
National Seating & Mobility, Troy, MI
Jean Minkel, MA, PT
Minkel Consulting, New Windsor, NY
Barbara Crane, MA, PT, ATP
University of Pittsburgh, Pittsburgh, PA

39. Configuring Powered Mobility Systems for Children

The times have changed. However, the use of powered mobility with veryyoung children and its configurations to support adequate and safe use have not.Children are not being considered as candidates for powered systems as the systems are being configured identically to systems for adults. How the chair performs, where the parts are mounted, how the seating is devised are ~U stin IIsmall" replicas of adult configurations. This course will demonstrate how to O'eate systems for children and how their actual configuration will support inaeased independent mobility.

* Intermediate

Karen Kangas, OTR/L
Shamokin, PA

10:45 AM

Paper Session – Transportation Safety Issues

Incidence of Motor Vehicle Accidents in Individuals Who Use Wheelchairs

This paper presentation provides preliminary results of an ongoing study examining the occurrence of motor vehicle accidents and resultant injuries in individuals who use wheelchairs. Information on the injury risk to wheelchair riders in transportation situations is very limited. Most of the data available focuses on incidents occurring while the vehicle is stationary. A pilot survey study has been initiated to examine the occurrence of accidents and injuries to wheelchair users while using motor vehicle transportation.

* Intermediate

Shirley Fitzgerald, PhD
University of Pittsburgh, and VA Pittsburgh Healthcare System, Pittsburgh, PA

Wheelchair Transportation Safety: Occupant Restraint Preferences from Adult and Pediatric Users

Many wheelchair users use their wheelchairs as motor vehicle seats when in transit. Wheelchair occupant restraint systems are typically used to secure the occupant during transport in motor vehicles. Many of the wheelchair occupant restraint systems (WORS) that are used today have shown to be difficult to use, uncomfortable and provide poor belt fit for the wheelchair seated occupant population. The survey provides in depth information of WORS usage patterns versus user characteristics as well as users' opinion on alternative occupant restraint systems.

* Intermediate

Linda van Roosmalen, PhD
University of Pittsburgh, Pittsburgh, PA

Senior's Perception of Their Safety While Using a Private Vehicle

As seniors age, the incidence of disability and age related health problems increases, along with concerns about how these age related factors influence safe transportation seniors and others. The purpose of this study was to explore the perceptions of seniors (60 years and older) regarding: 1) knowledge and use of vehicle safety features, 2) management of safety of self and others, and 3) experiences entering and exiting vehicles. Results indicated that seniors considered factors about themselves and the environment (external issues and vehicle specific issues) when managing their own safety and that of others. Issues such as the 'fit' between the senior and the vehicle, their familiarity with the safety features, and their beliefs concerning these features and relevant legislation contributed to their perception of safe transportation They have implications to vehicle design or modification, sale and advertising of cars to seniors, and health promotion.

* Intermediate

Jan Miller Polgar, PhD
The University of Western Ontario, London, ON, Canada

Instructional Courses

ONE-HOUR Sessions (10:45 — 11:45 AM)

40. The Clinical Approach to Pediatric Seating, Positioning & Mobility: "Objective, Not Subjective, Assessment"

This course will present simple objective measures for cognition, vision and neuromuscular status, which can be utilized when trying to match an assistive technology device with a person in order to improve the quality of life for that individual. It will also include the importance of the team approach and the involvement of your client and his family during every step of this process.

* Beginner

John R. Stull, L/PTA, ATP
Voorhees Pediatric Health System, Winslow Twp., NJ

41. The Fit-Function Relationship ^

Examine the long-term implications of proper fit on the health and functional independence of manual wheelchair users. In recent years, the impact of long-term manual wheelchair use has become an important consideration when providing new equipment to first-time users or replacing existing equipment for clients with years of manual wheelchair experience. This session will present clinical considerations for equipment selection including postural and physiological considerations, realistic functional assessment, and discuss the important role of the client and/or caregiver in the decision process.

* Beginner

Marty Ball
TiSport, Pine Plains, NY,
Tina Roesler,
The ROHO Group, Bellville, IL

42. Forum: Wheelchair Seat Cushion Coding: Issues and Answers

This session will discuss ways to use the constructs defined in the ISO standards document to categorize cushions, as well as, present data about the reliability and validity of these tests. Test methods have been defined within wheelchair cushion standards that reflect cushion performance. These tests include interface pressure, loaded contour depth, sliding tendency, and horizontal stiffness. If these test methods produce a valid reflection of cushion performance, then they have the potential for categorizing cushions. In addition, information will be presented about how the lack of definitions and test methods for stability, postural control and lifespan hindered the establishment of cushion categories that reflect these features.

* Beginner

David Brienza, PhD
University of Pittsburgh, Pittsburgh, PA
Stephen Sprigle, PhD, PT
Georgia Institute of Technology, Atlanta, GA
Martin Ferguson-Pell, PhD
University College of London, Stanmore, UK

11:45 AM

Special Session

Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?

Moderator:
Adrienne F. Bergen, PT ATP/S
Delray Beach, FL

Participants:
Laura Cohen, PT, ATP
University of Pittsburgh, Pittsburgh, PA
James Fiss, CRTS
Rehab Medical, Inc., St. Louis, MO
Susan Johnson-Taylor, OTR/L
Rehabilitation Institute of Chicago, Chicago, IL
Kathy Riley, PT, ATP, CRTS
National Seating and Mobility Inc., Mooresville, NC
Mark E. Smith, MA
Pride Mobility Products

12:45 PM

Adjournment

^ Indicates presentation by a representative of a product manufacturer

Nineteenth International Seating Symposium
Faculty

Marie Alm
Spinalis Clinic, Karolinska Hospital
SE 171 76
Stockholm, Sweden
marie.alm@spinalis.se

"The Spinalis Model: Using a Network of Medical Specialists and Consultants During the Assessment of Seating Problems for Individuals With SCI"
Paper Session - Friday - 3:00 pm

"To Describe Seating in Individuals with Complete Thoracic SCI by Using a Combination of Clinical Methods"
Paper Session - Friday - 3:00 pm

Peter Axelson
Beneficial Designs, Inc
1617 Water St., Suite B
Minden, NV 89423
peter@beneficialdesigns.com

"Functional Benefits of a Dynamic Pelvic Stabilization System"
Paper Session - Friday - 11:00 am

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

Michael Babinec
Invacare Corp.
27981 North Park Dr.
North Olmsted, Ohio 44070
mbabinec@invacare.com

"Geriatric Mobility: Strategies for Success"
Instructional Course (one hour) – IC 31 - Friday - 1:30 pm

Marty Ball
TiSport, LLC
1426 East Third Avenue
Kennewick, WA 99337
mball@tilite.com

"The Fit-Function Relationship"
Instructional Course (one hour) - IC 41 - Saturday - 10:45 am

Geoff Bardsley
TORT Centre
Ninewells Hospital
Dundee, DD1 9SY Scotland, United Kingdom
geoff@tortc.tuht.scot.nhs.uk

"Chris Bar Research Forum"
Chair - Friday – 4:30 pm

Adrienne Bergen
13727 Plaza Mayor Dr
Delray Beach, Fl 33446
adriennebergen@aol.com

"Client Evaluation Demonstration – Do I Really Need All This Information?"
Instructional Course (two hour) - IC 13 - Thursday – 3:30 pm

"Client Evaluation Demonstration – Do I Really Need All This Information?"
Instructional Course (one hour) - IC 35 – Friday – 1:30 am

"Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?"
Special Session Moderator – Saturday - 11:45 am

Kendra Betz
VA Puget Sound Health Care System, Seattle Division
17400 NE 19th Place
Bellevue, WA 98008
kendra@betzfamily.com

"It's Just Like Riding a Bike . . . Seating Evaluation and Interventions for Handcycles"
Instructional Course (two hour) - IC 19 Friday 9:40 am

Amy Bjornson
Sunrise Medical
7477 East Dry Creek Parkway
Longmont, CO 80503
1-888-333-2572 x 8227
amy.bjornson@sunmed.com

"Reducing Upper Extremity Repetitive Strain Injuries Through Optimal Wheelchair Set-Up"
Instructional Course (one hour) - IC 18 Friday 8:30 am

"Medicare Reimbursement: The Client's Needs and the Equipment Have To Meet the Code!"
Instructional Course (one hour) - IC 32 Friday 1:30 pm

"Clinical Application of Power Tilt and Recline Systems - How to Determine Client Need and Ensure Proper Funding"
Instructional Course (one hour) - IC 36 Friday 3:00 pm

Michael Boninger
University of Pittsburgh
School of Medicine, Department of Physical Medicine and Rehabilitation;
VA Center of Excellence on Wheelchairs and Related Technology
VA-Pittsburgh Healthcare System
201 Kaufmann Building
Pittsburgh, PA 15213
mlboning@pitt.edu

"Applying Research to Daily Practice: An Update on Manual Wheelchair Selection, Configuration, and Training"
Pre-Symposium Workshop - Wednesday

"Prescribing Wheelchairs for People with Progressive Disorders"
Instructional Course (one hour) - IC 15 Friday 8:30 am

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

Alan Boyd
Motion Concepts
84 Citation Dr.
Concord, Ontario L4K 3C1, Canada
aboyd@motionconcepts.cc

"To Tilt or not to Tilt"
Instructional Course (one hour) - IC 34 Friday 1:30 pm

David Brienza
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
dbrienza@pitt.edu

"Forum: Wheelchair Seat Cushion Coding - Issues and Answers"
Instructional Course (one hour) - IC 42 Saturday 10:45 am

Sheila Buck
Therapy Now!
811 Graham Bell Ct.
Milton, ON L9T 3T1 Canada
therapynow@interhop.net

"Back to Basics and Beyond: Seating and Mobility Assessment and Prescription Considerations"
Pre-Symposium Workshop - Wednesday

Mary Ellen Buning
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
mbuning@pitt.edu

"Electronic Information Resources"
Instructional Course (one hour) - IC 24 Friday 9:40 am

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

Evan Call
Weber State University / EC Service Inc.
1851 South Oakmont Drive
Bountiful, UT 84010
ecall@aol.com

"Classical Thermodynamics of Wheelchair Cushions and Temperature Intevention"
Paper Session - Friday - 3:00 pm

Laura Cohen
University of Pittsburgh
VA Center of Excellence on Wheelchairs and Related Technology
7180 Highland Drive, Building 4
Pittsburgh, PA 15206
ljcst22@pitt.edu

"Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?"
Special Session Panelist - Saturday 11:45 am

Elizabeth Cole
Sunrise Medical
7477 East DryCreek Parkway
Longmont, CO 80503
elizabeth.cole@sunmed.com

"Reducing Upper Extremity Repetitive Strain Injuries Through Optimal Wheelchair Set-Up"
Instructional Course (one hour) - IC 18 Friday 8:30 am

"Medicare Reimbursement: The Client's Needs and the Equipment Have To Meet the Code!"
Instructional Course (one hour) - IC 32 Friday 1:30 pm

Dave Cooper
Sunny Hill Health Centre for Children
3644 Slocan ST.
Vancouver, BC V5M 3E8 Canada
dcooper@cw.bc.ca

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Moderator - Saturday 8:30 am

Rory Cooper
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Human Engineering Research Laboratories
VA-Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
rcooper@pitt.edu

"Applying Research to Daily Practice: an Update on Manual Wheelchair Selection, Configuration, and Training"
Pre-Symposium Workshop – Wednesday

"Funding Dilemma: The Buck Stops Where?"
Pre-Symposium Workshop - Wednesday

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

Rosemarie Cooper
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Human Engineering Research Laboratories
VA-Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
rcooperrm@pitt.edu

"Applying Research to Daily Practice: an Update on Manual Wheelchair Selection, Configuration, and Training"
Pre-Symposium Workshop - Wednesday

"Prescribing Wheelchairs for People with Progressive Disorders"
Instructional Course (one hour) - IC 15 Friday 8:30 am

Barbara Crane
University of Pittsburgh
1717 Penn Ave Apt. 617
Pittsburgh, PA 15221
bacst62@pitt.edu

"Development of a Wheelchair Seating Discomfort Assessment Tool (WCS-DAT)"
Paper - Thursday 9:45 am

"Clinical Application of the Wheelchair Seating Standards"
Instructional Course (one hour) - IC 23 Friday 9:40 am

"Special Seating Issues in Bariatrics."
Instructional Course (one hour) - IC 38 Saturday 8:30 am

Jim Dawley
Rehab Health Care
5873 Poplar Hall Dr
Norfolk, VA 23502
jimdawley@surfbest.net

"Purpose, Use, and Fabrication of a Custom Made Dynamic Backrest."
Paper Session - Friday - 11:00 am

Ian Denison
GF Strong Rehab Centre
4255 Laurel St
Vancouver, BC V5Z 2G9 Canada
idenison@vanhosp.bc.ca

"Power Wheelchairs- The Dynamic Element"
Instructional Course (4 hour) - IC 01 Thursday 1:00 pm

"Palm Devices - Toys or Tools?"
Instructional Course (two hour) - IC 37 Saturday 8:30 am

Gerry Dickerson
A&J Care Inc.
8000 Cooper Avenue
Glendale, NY 11385
email: gdcrts@aol.com

"Funding Dilemma: The buck stops where?"
Pre-Symposium Workshop – Wednesday

Mark Dilablio
Sunny Hill Health Centre for Children
Therapy Department
3644 Slocan Street
Vancouver, BC V5M 3E8 Canada

"Dynamic Seating - The Best Evidence and Linical Experience"
Instructional Course (one hour) - IC 17 Friday 8:30 am

Martin Fergusen-Pell
University College of London
Center for Disability Research & Innovation
Stanmore, HA7 4LP United Kingdom
email: m.ferguson-pell@ucl.ac.uk

Paper Session Moderator - Friday - 3:00 pm

"Forum: Wheelchair Seat Cushion Coding - Issues and Answers"
Instructional Course (one hour) - IC 42 Saturday 10:45 am

Janice Fisher
The Hospital For Sick Children
1731 Bunker Hill Road, N.E.,
Washington, D.C. 20017
jfisher@hospsc.org

"Power Kids"
Instructional Course (one hour) - IC 27 Friday 11:00 am

Kathryn Fisher
Therapy Supplies
104 Bartley Drive
Toronto, ON M4A 1C5 Canada
kfish@sympatico.ca

"The Second Time Around"
Instructional Course (one hour) - IC 16 Friday 8:30 am

Jim Fiss
Rehab Medical Inc
10770 Midwest Industrial Drive
St. Louis, MO 63132
stlrcr@aol.com

"Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?"
Special Session Panelist - Saturday 11:45 am

Shirley Fitzgerald
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Human Engineering Research Laboratories
VA-Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
email: sgf9@pitt.edu

"Incidence of Motor Vehicle Accidents in Individuals who use Wheelchairs"
Paper - Saturday 10:45 am

Doug Gayton
GF Strong Rehab Centre
4255 Laurel Street
Vancouver, BC V5Z 2G9 Canada
dgayton@vanhosp.bc.ca

"Power Wheelchairs- The Dynamic Element"
Instructional Course (4 hour) - IC 01 Thursday 1:00 pm

"Palm Devices - Toys or Tools ?"
Instructional Course (two hour) - IC 37 Saturday 8:30 am

Alice Goldwyn
Chailey Heritage Clinical Services
North Chailey
East Sussex BN8 4JN United Kingdom
Alice.Goldwyn@southdowns.nhs.uk

"Development of equipment as part of the Chailey Approach to postural management"
Instructional Course (two hour) - IC 06 Thursday 1:00 pm

"Theoretical Aspects of Postural Management Provision"
Instructional Course (two hour) - IC 12 Thursday 3:30 pm

Songfeng Guo
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Human Engineering Research Laboratories
VA-Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
sguo@pitt.edu

"Whole-Body Vibration Analysis of Four Different Wheelchair Cushions"
Paper Session - Friday - 3:00 pm

Karen Hardwick
Texas Department Mental Health Mental Retardation
3707 Far View Drive
Austin, Texas 78730
karen.hardwick@mhmr.state.tx.us

"Contoured Seating using Foam in Place Technology"
Instructional Course (one hour) - IC 29 Friday 1:30 pm

Doug Hobson
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260

"Transit Options! What Is Different About Wheelchairs with the Transit Option?"
Instructional Course (one hour) - IC 28 Friday 11:00 am

Susan Johnson Taylor
Seating and Mobility Clinic
Rehabilitation Institute of Chicago
345 East Superior Street
Chicago, IL 60611
email: staylor@rehabchicago.org

"Power Wheelchairs- The Dynamic Element"
Instructional Course (4 hour) - IC 01 Thursday 1:00 pm

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

"Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?"
Special Session Panelist - Saturday 11:45 am

Karen Kangas
R. D. 1, Box 70
Shamokin, PA 17872
kmkangas@ptd.net

"Managing Pelvic Obliquity"
Paper - Thursday 9:45 am

"Sensation, Sensory Processing and Seating & Mobility Systems"
Instructional Course (two hour) - IC 10 Thursday 3:30pm

"Configuring Powered Mobility Systems for Children"
Instructional Course (two hour) - IC 39 Saturday 8:30 am

David W. Kemp
The Daniel M. Carney Rehabilitation Engineering Center
5111 E. 21 st N. - P.O. Box 8217
Wichita, KS. 67208
DavidK@cprf.org

"Using Contoured Seating for Increased Head and Trunk Control in Individuals with Severe Disabilities"
Instructional Course (one hour) - IC 26 Friday 11:00 am

Alicia Koontz
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
Human Engineering Research Laboratories
VA-Pittsburgh Healthcare System
5044 Forbes Tower
Pittsburgh, PA 15260
akoontz@pitt.edu

"Applying Research to Daily Practice: an Update on Manual Wheelchair Selection, Configuration, and Training"
Pre-Symposium Workshop - Wednesday

"What is the Best Way to Propel a Wheelchair?"
Paper - Thursday 9:45 am

"Redesigning the Wheelchair Pushrim for Injury Prevention"
Paper Session - Friday - 11:00 am

David Kreutz
Shepherd Center
2020 Peachtree Rd.NW
Atlanta, GA 30309
david_kreutz@sheperd.org

"Power Wheelchairs- The Dynamic Element"
Instructional Course (4 hour) - IC 01 Thursday 1:00 pm

"An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)"
Special Session Panelist - Saturday - 8:30 am

Gloria Leibel
Bloorview Macmillan Children's Centre
350 Rumsey Rd.
Toronto, ON M4G 1R8 Canada
gleibel@bloorviewmacmillan.on.ca

"To Tilt or not to Tilt"
Instructional Course (one hour) - IC 34 Friday 1:30 pm

Barbara Levy
Thoms Rehabilitation Hospital
Seating & Mobility Clinic
68 Sweeten Creek Road
Asheville, NC 28803

"Funding Dilemma: The buck Stops where?"
Pre-Symposium Workshop - Wednesday

Gilbert Logan
Royal Brisbane Hospital
125 McCaul Street, Indooroopilly
Brisbane, Queensland 4068 Australia
Gilbert_Logan@health.qld.gov.au

"Design and Provision of Custom Cushions to Help Prevent Recurrence of Pressure Ulcers in People with SCI and History of Chronic Pressure Ulceration"
Paper Session - Friday - 3:00 pm

Sonja Magnuson, M.Sc.
Sunny Hill Health Centre for Children
3644 Slocan ST.
Vancouver, BC V5M 3E8 Canada
smagnuson@cw.bc.ca

"Dynamic Seating - The Best Evidence and Linical Experience"
Instructional Course (one hour) - IC 17 Friday 8:30 am

Rachael McDonald
University College London - The Institute of Child Health
Great Ormond Street Hospital for Children NHS Trust, The Wolfson Centre
Mecklenburgh Square
London, United Kingdom WC1N 2AP
r.mcdonald@ich.ucl.ac.uk

"Repeated Measures Reliability of a Modified Version of the Seated Postural Control Measure"
Paper - Thursday 9:45 am

"A Comparison Between Parents' and Therapists' Views of Their Child's Individual Seating Systems."
Instructional Course (one hour) - IC 22 Friday 0940

"The Relationship Between Pelvic Alignment, Trunk Alignment And The Force Applied By A Kneeblock In Children With Cerebral Palsy."
Paper Session - Friday - 11:00 am

Patrick Meeker
The ROHO Group, Inc.
3424 Laredo Drive
Lexington, KY 40517
pmeeker@bigfoot.com

"Vibration Reduction and Its Effects on Wheelchair Users"
Instructional Course (one hour) - IC 20 Friday 9:40 am

Bill Miller
University of British Columbia, Vancouver General Hospital
University of Western Ontario
Centre for Clinical Epidemiology and Evaluation
VGH Research Pavilion, 828 West 10th Ave,
Vancouver, BC V5Z 1L8 Canada
bcmiller@telus.net

"Adding Evidence: Single-Subject Designs as a Pragmatic & Rigorous Approach to Clinical Research & Practice"
Instructional Course (two hour) - IC 04 Thursday 1:00 pm

Christel Meisinger
Motion Specialties Inc.
82 Carnforth Road
Toronto, Ontario M4A 2K7
cmeisinger@themotiongroup.com

"To Tilt or not to Tilt"
Instructional Course (one hour) - IC 34 Friday 1:30 pm

Jean Minkel
Minkel Consulting
112 Chestnut Avenue
New Windsor, NY 12553
jminkel@aol.com

"Advanced Clinical Applications of Pressure Mapping Technologies"
Pre-Symposium Workshop – Wednesday

"Mat Evaluation Techniques and The Use of Simulation in Decision Making""
Instructional Course (one hour) - IC 07 Thursday 1:00 pm

"Clinical Application of the Wheelchair Seating Standards"
Instructional Course (one hour) – IC 23 Friday 9:40 am

"Special Seating Issues in Bariatrics"
Instructional Course (two hour) – IC 38 Saturday 8:30 am

Brenlee Mogul-Rotman
Toward Independence
34 Squire Drive
Richmond Hill, Ontario L4S 1C6 Canada
brenleemogul@sympatico.ca

"The Second Time Around"
Instructional Course (one hour) - IC 16 Friday 8:30 am

"The Client, the Team, the Equipment..Maintaining Continuity and Achieving Goals"
Instructional Course (one hour) - IC 25 Friday 11:00 am

Phil Mundy
PDG Inc.
8385 St. George Street, Unit #10,
Vancouver, BC V5X 4P3 Canada
phil_mundy@prodgroup.com

"Functional Positioning / Independent Mobility for Clients with Complex Needs"
Instructional Course (two hour) - IC 03 Thursday 1:00 pm

Joan Padgitt
5030 W 33rd Avenue
Denver, CO 80212
jepadgitt@juno.com

"Checking the Blindspot - A Case Study in Assistive Technology"
Instructional Course (one hour) - IC 30 Friday 1:30 pm

Virginia Paleg
420 Hillmoor Dr
SIlver Spring, MD 20902
bpaleg@wam.umd.edu

"Power Kids"
Instructional Course (one hour) - IC 27 Friday 11:00 am

Jan Miller Polgar
The University of Western Ontario
School of Occupational Therapy, Elborn College
1201 Western Road
London, Ontario N6G 1H1 Canada
jpolgar@uwo.ca

"Adding Evidence: Single-Subject Designs as a Pragmatic & Rigorous Approach to Clinical Research & Practice"
Instructional Course (two hour) - IC 04 Thursday 1:00 pm

"Senior's Perception of Their Safety While Using a Private Vehicle"
Paper - Saturday 10:45 am

Terry Pountney
Chailey Heritage Clinical Services
North Chailey
East Sussex BN8 4JN United Kingdom
Terry.Pountney@southdowns.nhs.uk

"Development of equipment as part of the Chailey Approach to postural management"
Instructional Course (two hour) - IC 06 Thursday 1:00 pm

"Theoretical Aspects of Postural Management Provision"
Instructional Course (two hour) - IC 12 Thursday 3:30 pm

Penny Powers
Vanderbilt University Medical Center
Department of Rehabilitation Services
Room 1700 TVC
Nashville, Tennessee 37232-5677
penny.powers@mcmail.vanderbilt.edu

"Custom Seating and Mobility for an Individual with Fibrodysplagia Ossificans Progressiva"
Paper Session - Friday - 3:00 pm

Sharon Pratt
646 Gay Street
Longmont, Colorado 80501
sharronpra@msn.com

"'The " Must Do" Hands on Seating Assessment'."
Instructional Course (two hour) - IC 11 Thursday 3:30 pm

"Aging with Dignity & Grace -
Striking a Balance Between Comfort and Function"
Instructional Course (one hour) - IC 33 Friday 1:30 pm

Jessica Presperin Pedersen
Presperin Pedersen Associates
5816 N. Moody Avenue
Chicago, IL 60646
email: prespeders@aol.com

"Clinical Issues - Paper Session – Track A"
Moderator – Friday 3:00 pm

Kathy Riley
National Seating and Mobility
113 Teaberry Ct.
Mooresville, NC 28115
email: kriley1949@aol.com

"Damned If We Do, Damned If We Don't. Whose Job is the Paperwork Anyway?
Special Session - Saturday 11:45am

Tina Roesler
The ROHO Group
100 N. Florida Avenue
Belleville, IL 62221
TLRoesler@aol.com

"Alternative Positioning: Concepts and Considerations"
Instructional Course (two hour) - IC 05 Thursday 1:00 pm

"Under Pressure! How to Get to the Real Problem and the Solution"
Instructional Course (one hour)I - IC 14 Friday 8:30 am

"The Fit-Function Relationship"
Instructional Course (one hour) - IC 41 - Saturday - 10:45 am

Faith Saftler Savage
74 Cottage Streeet
Natick, MA 01760
fsaftlersavage@rcn.com

"Multiple Sclerosis - Seating and Mobility Concerns for Changing Needs"
Instructional Course (two hour) - IC 08 Thursday 3:30 pm

Rich Salm
Peak Wheelchairs
500 S. Arthur Avenue Ste 200
Louisville, CO 80027
rsalm@peakwheelchairs.com

"Checking the Blindspot - A Case Study in Assistive Technology"
Instructional Course (one hour) - IC 30 Friday 1:30 pm

Bonita Sawatzky
British Columbia's Children's Hospital
Dept of Orthopaedics,
4480 Oak Street
Vancouver, BC V6H 3V4 Canada
bsawatzky@cw.bc.ca

"The Use of Heart Rate to Measure Wheeling Efficiency"
Paper Session - Friday - 3:00 pm

Mark Schmeler
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology;
UPMC Health System, Center for Assistive Technology
3010 Forbes Tower
Pittsburgh, PA 15213
email: schmelermr@msx.upmc.edu

"Applying Research to Daily Practice: an Update on Manual Wheelchair Selection, Configuration, and Training"
Pre-Symposium Workshop - Wednesday

"Funding Dilemma: The Buck Stops Where?"
Pre-Symposium Workshop - Wednesday

"Cost and Quality Outcome of a Power Wheelchair Leasing Program for Persons with Terminal Disease "
Paper Session - Friday - 3:00 pm

Sheena Schoger
Children's Rehabilitation Centre of Essex County
3945 Matchette Rd.
Windsor, Ontario N8M 2X5 Canada
sschoger@childrensrehab.com

"Providing Appropriate Equipment for the Petite Paediatric Client"
Instructional Course (two hour) - IC 02 Thursday 1:00 pm

Mark E. Smith, MA
Pride Mobility Products
182 Susquehanna Ave.
Exter, PA 18643
msmith@pridemobility.com

"Damned If We Do, Damned If We Don't. Whose Job Is the Paperwork, Anyway?"
Special Session Panelist - Saturday 11:45 am

Jill Sparacio
4600 Roslyn Road
Downers Grove, IL 60515
OTSpar@aol.com

"Alternative Positioning: Concepts and Considerations"
Instructional Course (two hour) - IC 05 Thursday 1:00 pm

"The Comparison of Cushion Coverings in Custom Molded Seating"
Paper Session - Friday - 3:00 pm

Steven Sprigle
Center for Assistive Technology & Environmental Access
Georgia Institute of Technology
490 Tenth St
Atlanta, GA 30332
sprigle@arch.gatech.edu

"Forum: Wheelchair Seat Cushion Coding - Issues and Answers"
Instructional Course (one hour) - IC 42 Saturday 10:45 am

John R. Stull
Voorhees Pediatric Health System
39 Windingbrook Drive
Winslow Twp., NJ 08004
jstulljr@aol.com

"The Clinical Approach to Pediatric Seating, Positioning, & Mobility: Objective, Not Subjective, Assessment"
Instructional Course (one hour) - IC 40 Saturday 10:45 am

Jillian Swaine
Jillian Swaine Occupational Therapy Services
7103 Christie Briar Manor SW
Calgary, Alberta T3H 2G5 Canada
info@jillianswaineots.com

"24-Hour Positioning and Identifying Barrier Tasks in the Multidisciplinary Care of Pressure Wounds in the Community"
Instructional Course (one hour) - IC 21 Friday 9:40 am

Barbara Sweet-Michaels
Center for Rehabilitation Technology
Helen Hayes Hospital
Route 9 West
West Haverstraw, NY 10993

"Multiple Sclerosis - Seating and Mobility Concerns for Changing Needs"
Instructional Course (two hour) - IC 08 Thursday 3:30 pm

Stephanie Tanguay
National Seating and Mobility
721 North Vermont
Royal Oak, MI 48067
email: nsm33@nsm-seating.com
stephanie.tanguay@mailcity.com

"Funding: The Challenges and Techniques for Success for All"
Instructional Course (two hour) - IC 09 Thursday 3:30 pm

Elaine Toskos
Rusk Institute for Rehabilitation Medicine
400 East 34th St.
New York, NY 10016-4998
etoskos@hotmail.com

"Funding Dilemma: The Buck Stops Where?"
Pre-Symposium Workshop - Wednesday

Stephen Tredwell
Professor, Department of Orthopaedic Surgery
University of British Columbia
Division of Paediatric Orthopaedics
Head, Department of Paediatric Orthopaedic Surgery
British Columbia's Children's Hospital
4480 Oak Street
Vancouver, BC, V6H 3V4, Canada

"Natural History of Treatments and Disorders"
Keynote - Thursday 8:45 am

Linda van Roosmalen
University of Pittsburgh
5044 Forbes Tower
Pittsburgh, PA 15260
lvanroos@pitt.edu

"Wheelchair Transportation Safety: Occupant Restraint Preferences from Adult and Pediatric Users"
Paper - Saturday 10:45 am

Kelly Waugh
851 Trail Ridge Drive
Louisville, CO 80027
kgwaugh12@earthlink.net

"Mat Evaluation Techniques and The Use of Simulation in Decision Making""
Instructional Course (one hour) - IC 07 Thursday 1:00 pm

"Clinical Application of the Wheelchair Seating Standards"
Instructional Course (one hour) - IC 23 Friday 9:40 am

Anna Wu
Caritas Medical Centre, Hospital Authority
Occupational Therapy Department
111 Wing Hong Street
Shamshuipo, Kowloon, Hong Kong.
awu7808@hotmail.com

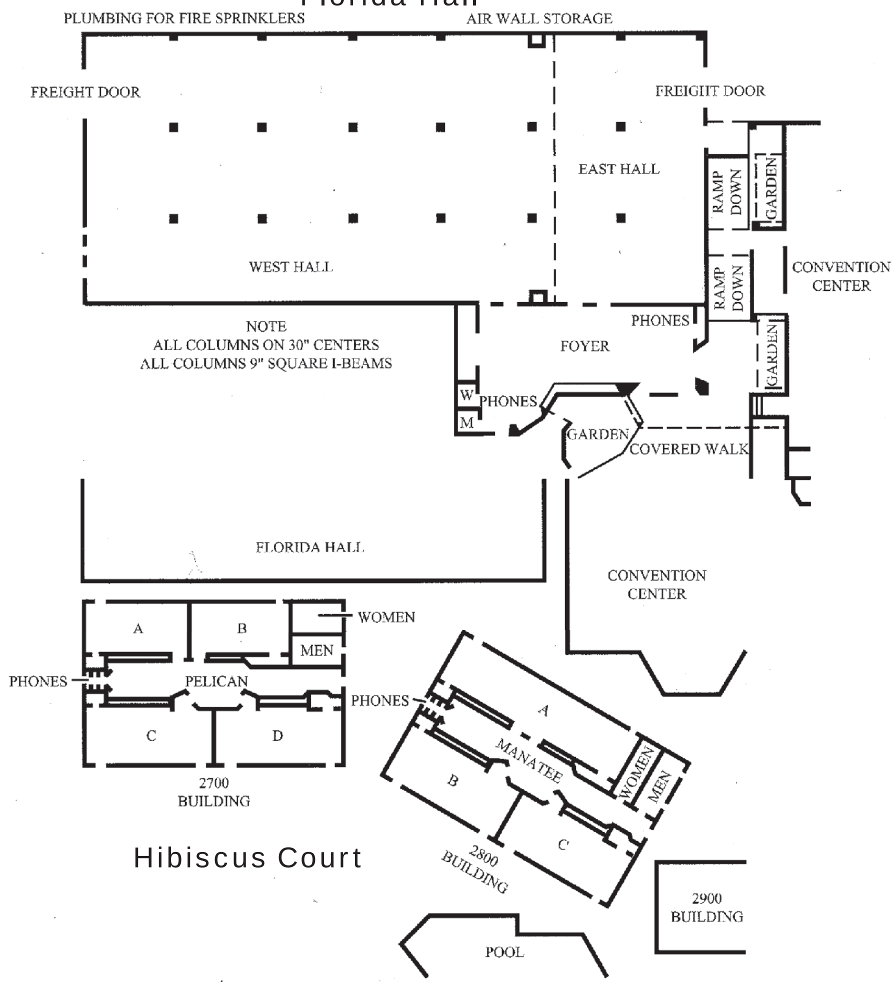
"A RCT (Randomized Clinical Control Trial) to compare the effectiveness of Occupational Therapy Seating Intervention with the Conventional Seating Intervention in Postural Control for Elderly with Sitting Problem"
Paper Session - Friday - 3:00 pm

Course Director

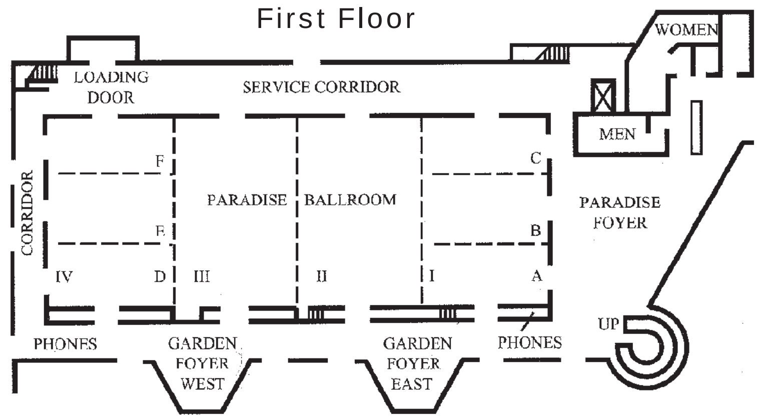
Elaine Trefler, MEd, OTR/L, FAOTA, ATP
Adjunct Professor
University of Pittsburgh
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260
etrefler@pitt.edu

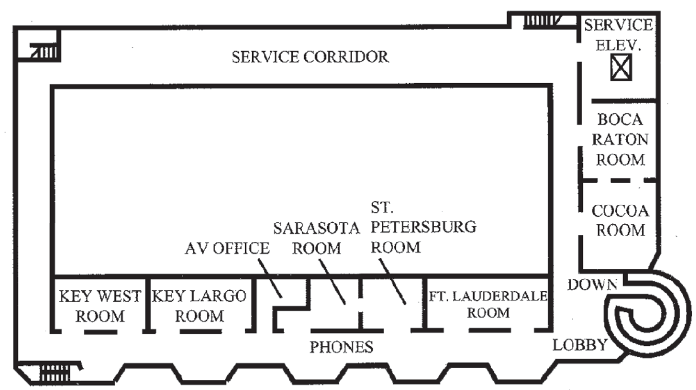
Hotel Floor Plan

Florida Hall



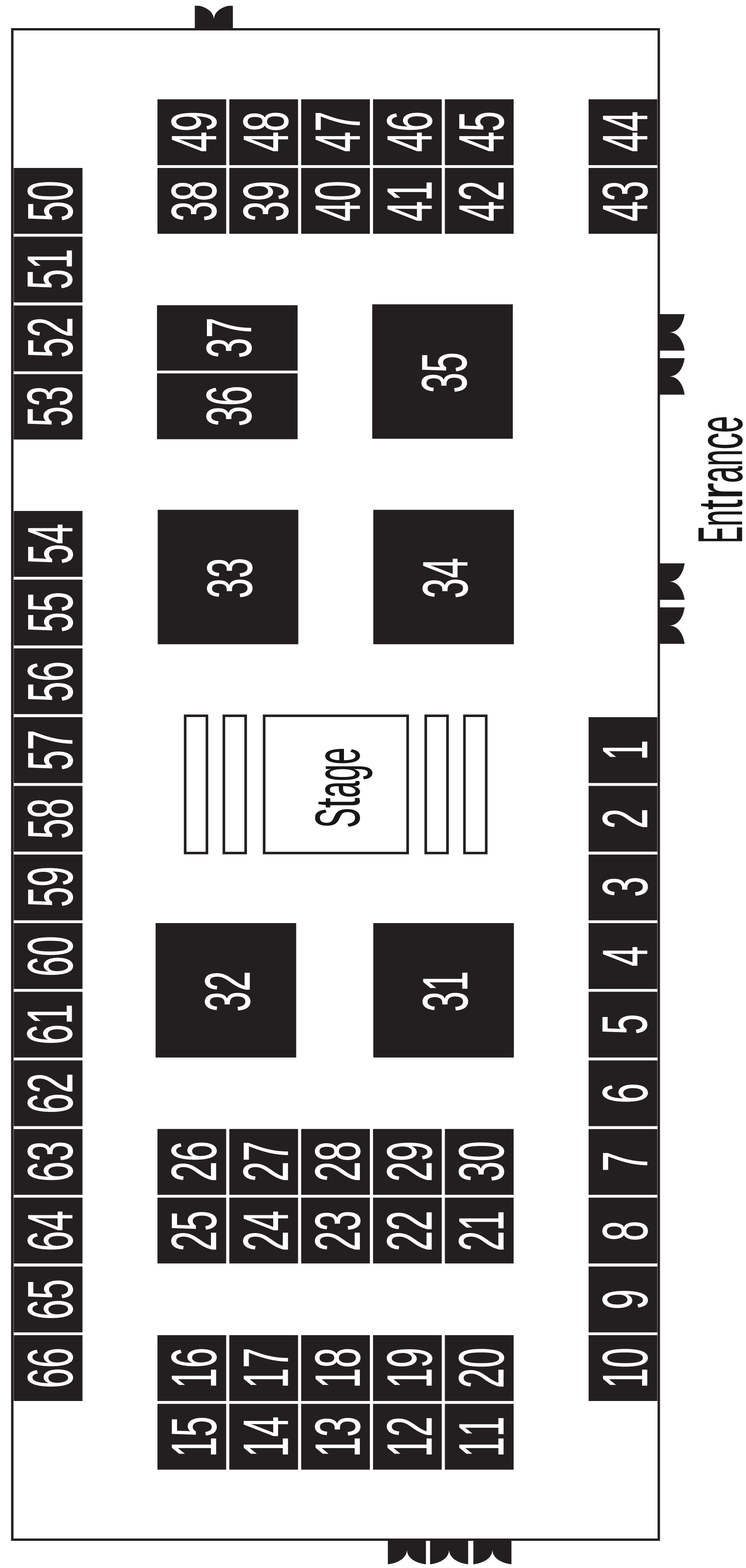
First Floor





Second Floor

Exhibit Hall Floor Plan



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Booth number: 20
Leigh Robinson
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Invacare Corporation
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www.invacare.com

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Marken International Inc
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www.markeninternational.com

Metalcraft Industries
Booth number: 40-41
Bob Jones
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Fax 608-835-9180
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www.metalcraft-industries.com

Motion Concepts
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Fax 1-888-433-6834
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www.motionconcepts.com

Mulholland Positioning Systems
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www.richardsonproducts.com

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Snug Seat
Booth number: 1, 2
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www.snugseat.com

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Sunrise Medical
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www.sunrisemedical.com

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Therafin Corporation
Booth number: 39
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Mokena, Illinois 60448
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www.therafin.com

TiSport
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Wes Egert
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Kennewick, WA 99352
509-586-6117
Fax 509-586-2416
E-mail wegert@tilite.com
www.tilite.com

Three Rivers
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Ron Boninger
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Mesa, AZ 85202
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Fax 480-833-1837
ron@3rivers.com
www.3rivers.com

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www.vgm.com

Varilite
Booth number: 21, 22, 29, 30
Kevin Coleman
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E-mail: kevin.coleman@varilite.com
www.varilite.com

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www.vistamedical.org

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Brooklyn, NY 11232
718-768-8002
Fax 718-768-8020
E-mail: wenzelite@aol.com
www.wenzelite.com

Whitmyer Biomechanix, Inc.
Booth number: 37
Kelly McDonald
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Tallahassee, FL 32308
850-656-9448
Fax 800-897-7479
E-mail: kelly@whitbio.com
www.whitbio.com

Nineteenth International Seating Symposium

Thursday, February 27, 2003

Natural History of Treatments and Disorders

Stephen J. Tredwell, MD, FRCSC

For the next 45 – 50 minutes we're going to discuss the concept of balance. I propose to start with normal balance as exemplified by the interplay required for normal musculoskeletal development using the hip as a model. From this, we'll progress to categories of imbalance, and from these try to blend the natural history of the disease processes with the natural history of treatment. From there, I propose to examine the disease processes as they balance with the patient and the patient's perception of "good". From there, we will try to balance the patient's good with that of society as a whole. I hope to show that this balance is more of a dynamic synergy than a static balance. The talk will go from specific to general, from the development of normal to pathology.

The Hip Joint

The forces across the hip joint are a complex interplay of muscle attachments, force, and spherical geometry. It is the interplay of the force and the geometry that influences the growth and the development of the joint. The hip joint itself is genetically pre-determined with clefting of the joint to form a discrete entity at around 52 days. The induction of the joint is directed by several gene groups, chief amongst them GDF5 which induces a dense cellular aggregation of the sight of the future joint, and is later expressed in the synovium NWNT14, which induces a cascade to joint formation. At birth, the normal hip joint has a depth to diameter ratio of .4; that is, it's about 40% of a spherical cup progressing through to the adult acetabulum at .6 of a sphere. The maturation of the acetabulum is a complex interplay between forces about the joint.

Pathology and patho mechanics can affect hip joint development. The four major subheadings are abnormal position, abnormal forces, abnormal motion, and super-imposed growth. Abnormal position is best exemplified by the developmental dysplasia of the hip, the so-called congenital dislocation. Without the normal concentric reduction, there is failure in the correct development of the acetabulum and femoral shaft. Abnormal forces can either be static or dynamic. The absence of abductor of muscle power as seen in some patients with athrogryposis or spina bifida produce a vector imbalance that will produce abnormal development of the hip despite the hip being located at birth. Strategies for correction must include both repositioning and rebalancing. Abnormal forces, which are comprised of abnormal tone and abnormal balancing of vectors, cause gradual mal-development of the joint as the child matures. This is most commonly seen in spastic quadriparesis. The remedies, be they spasticity modification, tendon lengthening, or actual boney surgery, must keep in mind that although early remodeling may be achieved, the central problem can produce deformity throughout the growing years. In summary, the normal hip development requires concentric location of the femoral head into the acetabulum and a balanced equilibrium of forces and motion about the joint.

Although pathology is probably the most easily described of the spectrum under discussion, balancing that pathology with the patient and their wishes can be difficult. The patient's desired functioning role enters into decision-making, and this desired functioning can be referred to as the patient's good. Good is not a monolithic concept but a complex entity that consists of several, not always compatible, components. One can propose a hierarchy of goods, the chief amongst these would be the ultimate good, the so-called good of last resort, which is that central concept or belief that defines us a philosophical being. The core values that we hold define our goods of last resort and they vary from person to person. Next in the hierarchy would be the good of the individual, which is the freedom to make one's own decision, and centers around issues of autonomy. Following this is the particular good of the moment or the patient's best interest, which includes one's personal view of the present and introduces the concept of quality of life issues. The biomedical good or the effects of the intervention on the natural history of the disease process that treatment can provide is the good that the patient seeks from the health professional; and balancing this with the patient's hierarchy of goods can be a complex interchange between a therapist and patient. The goals of the patient and their view of themselves should modify the end results for treatment advice.

Balancing the patient with society is another level of complexity in itself. Our inherent belief that life and health are chief amongst all goods, and everything else is therefore lesser is an old philosophy, the first proposed by Rene Descartes. The corollary of this then is that health care must then be distributed on grounds of equality. The natural conclusion of this, however, is expressed as a rescue principle where one would sacrifice all for minimal gain in quality of life. The so-called rescue principle was expounded at a time when the gap between philosophy and rhetoric and what is medically possible was not so large, and it may not be as appropriate today as it was 200 years ago. In modern technology, all modern health systems have some form of rationing or priorization, be they waiting lists in the socialized medical schemes or degree of insurance coverage in the more entrepreneurial. One can advance sound arguments for excellence standards of care; however, these treatment algorithms to be the best use for society need to be of proven value. The measurement of quality of treatment and the balance of expenditure and benefit to society introduces concepts that are due over the past 10 years. To measure the quality of a treatment may be inherently discriminatory and therefore modifications to quality measures that include concepts such as all individuals should have a fair chance for an equal opportunity to enjoy the fruits of life within the constraints posed upon them by nature need to be advanced as part of the equation. A quality of life adjustment should not be made for a condition that is unrelated in any way to the treatment being considered. However, it might be argued that it could be made for a condition that is clearly related to the treatment being considered. It is this complex interplay between anatomy, pathology, the patient, and society that challenges us to evolve solutions that give the patient the best opportunity for a complete and productive life.

Development of a Wheelchair Seating Discomfort Assessment Tool (WCS-DAT)

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Abstract
In this early phase of a multi-phase study, qualitative research using ethnographic techniques was performed in order to obtain information that would generate the content for a wheelchair seat discomfort assessment tool. Ten full time wheelchair users were interviewed, the interviews were transcribed and the data were analyzed and used to build the Wheelchair Seating Discomfort Assessment Tool or WCS-DAT. Future phases of this research will be used for testing the reliability of this assessment tool.

Background
There are few examples of tools quantifying comfort or discomfort in the research literature. This is possibly due to the difficulties involved in this process. One of the difficulties involved is presented by the subjective nature of comfort and discomfort[1]. Another difficulty is in determining what to measure – comfort or discomfort[2]. This is because there has been a general lack of agreement on the meaning and nature of comfort [1, 3]. The tools most often used in research related to sitting discomfort or comfort are the General Comfort Rating Scale[2] and the Chair Evaluation Checklist[4]. Others include Barkla's [5] chair assessment tool for rating chairs for a specific purpose, Corlett and Bishop's [6] Body Part Discomfort Scale, and the Chair Feature Checklist used by Drury and Coury [7] and Fenety[8]. All of the aforementioned tools relate to the evaluation of office chairs or other seats used by able-bodied populations. In the wheelchair seating research arena there was one attempt to create a comprehensive assessment of wheelchair seat comfort and discomfort, but to date, there has been no psychometric testing performed on this assessment tool[9].

These tools were examined for use in this project, but were found inadequate to meet the specific needs of this research. For this reason, a portion of this research was devoted to the development of a tool that might be used for assessing discomfort among full time wheelchair users.

Research Question
For this qualitative research task, the main question involved is "can individuals with sensation, who use wheelchairs full time, describe concepts of discomfort and comfort in such a way that a comprehensive tool to measure levels of discomfort may be developed that is valid on its face?"

Methods
Subjects: Subjects were all full time wheelchair users who had limited ability to shift their weight or change their seated posture, but had intact sensation. Diagnoses included muscular dystrophy, multiple sclerosis, amyotrophic lateral sclerosis, and polio or post polio syndrome.

Data Collection: All 10 subjects were visited in their homes or other convenient locations. Subjects signed consent forms in order to be enrolled in the study and for permission to audiotape the interviews. Each subject was then interviewed utilizing a semi-structured ethnographic interview process. There were 10 grand tour questions (see Table 1) and each grand tour question was followed up with multiple probes related to the subject's grand tour response. Interview questions were open-ended in order to allow subjects to fully develop and express their thoughts and ideas. The interviews ranged in length from 20 to 60 minutes with an average of 30 minutes per subject.

Data Analysis: The interview tapes were transcribed into text files and prepared for importation into Nu-Dist version 4 (N4) qualitative analysis software. The questions and responses were divided into short text units, with each text unit containing no more than one thought or idea. These transcripts were then imported into N4 for the purpose of analysis. Coding of the transcript materials was done as each interview was completed (prior to the completion of all the interviews). This was done in order to monitor the data and determine when a point of saturation of ideas or concepts was being reached. It had been estimated that it would take approximately 10 interviews to reach a point of saturation on this particular topic. Saturation was reached when new interview transcripts were fully coded with existing codes and new codes no longer needed to be created. This was reached by interviews 9 and 10.

A preliminary coding structure was built into the N4 project data base that included 11 basic categories – one of these was used to contain basic demographic information and the other 10 each contained one of the topics covered in the grand tour questions. This gave the coding a preliminary structure and is considered a form of "top-down" coding. The remainder of the coding structure was built using a "bottom-up" coding methodology [10, 11]. There were 103 unique codes identified from this data. After all documents were coded the coding tree was built within the N4 software. This coding tree was then analyzed to determine the content necessary in constructing the WCS-DAT tool.

Following the construction of this tool, it was distributed to all research participants for a member-checking process. All participants were then called for a follow-up interview to confirm the relevance of the tool that was created from their input.

Table 1: Grand Tour Questions Used for Qualitative Interviews

1.	When you are sitting in your wheelchair, what does the word discomfort mean to you?
2.	When you are sitting in your wheelchair, what does the word comfort mean to you?
3.	How are comfort and discomfort alike?
4.	How are comfort and discomfort different?
5.	What kinds of things cause you to be uncomfortable?
6.	What kinds of things allow you to be more comfortable?
7.	How are discomfort and pain alike or different?
8.	How does using your wheelchair affect your levels of discomfort?
9.	How does using your wheelchair affect your levels of comfort?
10.	Is there any thing else you can tell me about your experiences with comfort and discomfort that we have not covered?

Results

The subjects interviewed used 16 unique descriptors of discomfort and 13 unique descriptors of comfort. In addition to this, there were 10 body areas described as being particularly noticeable when discomfort occurred. An analysis was performed of each of these descriptors to determine where commonalities existed. In this analysis, 8 of the discomfort descriptors and 6 of the comfort descriptors were discussed by at least two of the interviewees. See Table 2 for examples of these descriptors. Back and lower body discomfort was noted by several of the subjects, with buttocks being the most frequently identified region for discomfort. When similar concepts were combined into more global categories, the two themes that developed most strongly were the importance of shifting or repositioning ones body in managing levels of discomfort and the physical symptoms of discomfort. In addition, the critical role of support and positioning of a wheelchair was discussed by 9 of the 10 individuals interviewed.

During the member-checking process, some of the statements used in the tool were clarified, but all participants felt the content to be appropriate and relevant and there were no major changes recommended.

Table 2: Examples of Comfort and Discomfort Descriptors used by Subjects

Discomfort descriptors	Number of subjects	Number of text units	Comfort descriptors	Number of subjects	Number of text units
Aches and pains	10	32	Absence of discomfort	5	28
Need to move	8	30	Good position	4	20
Pressure points	4	9	Multiple factors	4	10
Poorly positioned	3	19	No pain	4	8
Unable to concentrate	3	7	Able to concentrate	3	13
Embarrassment	2	18	Feeling good	2	2
Frustration induced	2	13	Not thinking about discomfort	1	6
physical stress induced	2	4	Can stay in chair longer	1	4
Stiffness	1	11	Able to relax	1	3
Instability	1	10	Relief	1	3
Irritability	1	6	Social environment	1	3
Not comfortable	1	6	Enjoy sitting in chair	1	2
Psychological discomfort	1	1	Positive attitude	1	2

Discussion

The goal of this qualitative research study was to glean important information from wheelchair users regarding the concepts of comfort and discomfort in order to build a valid wheelchair seating discomfort assessment tool. Several formats for such a tool were suggested by the literature – particularly the ergonomics research that has been done. It was decided to use a three part tool. Part I of the tool is used to collect information regarding factors that directly affect discomfort in one's wheelchair such as, the amount of time spent in one position in the chair and whether the individual in the chair was transferred and positioned properly to begin with. Part II contains 8 statements related to discomfort and 5 statements related to comfort and asks individuals to rate their level of agreement with these statements on a 7 point Likert scale. Part III includes 7 body areas for which the individual rates a degree of discomfort intensity based on a 0 to 10 scale. This part also allows individuals to write in an additional body area if they have a particularly uncomfortable area that is not identified and it also asks them to rate an overall or general discomfort intensity on this same 0 to 10 scale. This tool was developed directly from the information obtained in the interviews which was cross-checked with information found in the related literature. Member checking revealed that the content in the tool did in fact represent the perceptions of the participants, and was determined to be a thorough and concise tool to quantify levels of discomfort for individuals sitting in wheelchairs.

Future Research Plans

Test-retest reliability, to date, has indicated that the WCS-DAT is highly stable, and reliability testing continues. Next, this tool will be used as a measure of discomfort with a group of wheelchair users. This will be one of many outcome measures tracked over time during the introduction of a newly designed dynamic seating interface. This dynamic seat will be the object of long term trials with several wheelchair users in order to determine its efficacy in relieving discomfort. During this final stage of research there will also be a feature analysis performed in order to determine which features of the new wheelchair seating system are most critical or important to the wheelchair users tested. This information will be used to guide future development of a new dynamic seating technology to be available to the end-user.

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What is the Best Way to Propel a Wheelchair?

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Manual wheelchair users are at an increased risk of developing repetitive strain injuries at the shoulder and wrist (1-3). Sie interviewed 103 subjects with paraplegia and found historical or physical examination evidence of carpal tunnel syndrome (CTS) in 66% (1). Over 50% of the survey respondents with spinal cord injury in Nichols et al.'s study reported shoulder pain which was particularly related to wheelchair use and transfers (3). A magnetic resonance imaging study of the shoulders of 28 individuals with paraplegia revealed a high prevalence of distal clavicle osteolysis and early signs of rotator cuff disease (4). Most of these individuals were also asymptomatic.

Research has shown that the technique by which a person pushes a wheelchair is related to the development of shoulder abnormalities and CTS (5;6). Boninger et al. performed nerve conduction studies to assess the degree of median nerve dysfunction in 34 individuals with paraplegia who used manual wheelchairs on a daily basis (5). They also performed a biomechanical analysis of wheelchair propulsion at two different speeds common during daily mobility. Analysis of the data indicated that increased rate of loading and peak weight-normalized propulsion force was associated with greater median nerve dysfunction. In addition, stroke cadence was also correlated with median nerve dysfunction. These results were not too surprising considering the findings of ergonomic studies on risk factors associated with CTS. A number of studies have shown a link between high force, highly repetitive tasks and risk of CTS. (7-9) Silverstein et al. performed a biomechanical investigation on a number of jobs and found that those with high force and high repetition were associated with CTS (9). Their definition of high repetition was a cycle time of less than 30 seconds. The cycle time of a propulsive stroke is approximately 1 second which fits in this category. Therefore, individuals who apply greater forces and more rapidly load the pushrims at higher cadences may be at an increased risk for developing median nerve injury.

A longitudinal study conducted by Boninger and co-workers investigated the progression of shoulder injury as diagnosed using magnetic resonance imaging and the association with propulsion forces for 14 individuals with paraplegia (6). The subject sample were separated into two groups – those who had increased shoulder pathology after two years and those who showed no increase or had slight improvements in shoulder pathology. The group with advanced shoulder pathologies were found to produce greater weight-normalized forces in the radial direction (toward the hub) than the other group (> 5% of body weight). As forces act equal and opposite, the forces exerted on the pushrim are transmitted equally and opposite to the upper limb. This would imply that the radial 'reaction' forces experienced during wheelchair propulsion drive the head of the humerus up into the rotator cuff and coracoacromial arch which overtime can lead to injury. Modification of the wheelchair user's technique to reduce radial forces to less than 5% of body weight could potentially minimize the risk of shoulder injury.

Despite what is known about the relationship between wheelchair propulsion technique and injury, wheelchair users receive little to no information on how best to propel a wheelchair to lessen their risk of injury. It may be possible to modify the way one pushes a wheelchair or the way the wheelchair is setup to lower injurious forces. The stroke pattern has been found to influence the biomechanics of wheelchair propulsion. While the path of the hand is constrained by the arc of the pushrim during the delivery of propulsive forces and torques, there is more freedom in upper extremity motion when the hand is off of the rim and preparing for the next stroke. Several groups have studied propulsion patterns during wheelchair propulsion and the relationship between pattern type and various biomechanical measures (10-13). Until recently it was thought that only two kinds of stroke patterns existed: circular and pumping. The circular pattern followed the path of the pushrim. The pumping pattern had a short and abrupt stroking style that only followed the pushrim for a small arc. As more wheelchair users have undergone a motion analysis of stroke patterns, at least four distinct patterns have been discovered: arc, semi-circular, single-looping over and double-looping over.

1) Semi-circular (SC) – recognized by the hands falling below the pushrim during the recovery phase.
2) Single looping-over-propulsion (SLOP) – identified by the hands rising above the pushrim during the recovery phase
3) Double looping-over-propulsion (DLOP) – begins with the hands rising above the pushrim then crossing over and dropping under the pushrim during the recovery phase
4) Arcing (ARC) – occurs when the hands follow an arc along the path of the pushrim during the recovery phase.

While the single-looping over form of propulsion seems to be adopted by most wheelchair users with paraplegia (11), the semi-circular technique may be more beneficial. In this pattern of propulsion, the user's hand drops below the pushrim during the recovery phase. The semi-circular pattern has been associated with lower stroke frequency (11), greater time spent in the push phase relative to the recovery phase (11), less angular joint velocity and acceleration (10), and increased efficiency (13). The semi-circular pattern makes sense in that the hand follows an elliptical pattern with no abrupt changes in direction and extra hand movements. It is the same pattern that is followed by wheelchair racers (14).

Based on these results, it would be wise to train wheelchair users to:

- Use long and smooth strokes that limit high-impacts on the pushrim
- Allow the hand to naturally drift down when letting go of the pushrim; make an effort to keep the hand below the push-rim when not in contact with the pushrim

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Repeated Measures Reliability Of A Modified Version Of The Seated Postural Control Measure

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Introduction

The Seated Postural Control Measure (SPCM) (Fife et al, 1991, Roxborough, et all, 1994) was developed to objectively assess the posture and function of children with neurological difficulties in adaptive seating systems. As part of a research project examining the effect of kneeblock and sacral pads on posture and function, the SPCM was used as the main measurement of postural alignment. This paper examines the variability over the lead in period with a group of children with cerebral palsy.

The SPCM is a tool that has potential to aid in objective assessment of seating position and change in seating position. Although validity and reliability have been established to some extent, full validity is still being explored, and further research is required to develop this (Gagnon et al, 2002). The objective nature of the assessment means that it also has potential as an outcome measurement tool for research purposes.

Methods

The subjects were children with four-limb cerebral palsy, of either predominantly spastic or dystonic movement patterns, who use an adaptive seating system with a sacral pad and kneeblock arrangement in order to help control their posture. 36 families gave consent to the project, with 33 families taking part in the project. The children ranged in age from 5 years to 15 years with the majority between 8 and 11 years, and weight range was between minimum of 16 kg and maximum of 57kg. Children were seen 6 times over the course of 4-6 months, on a monthly basis (2-5 weeks). At the third visit, the children's kneeblocks were removed for a period of 3-4 weeks. This paper concentrates on the reliability of the first 3 (pre-intervention) measurements.

The reliability of the SPCM was established for the purpose of this project in two pilot studies, one with children with disability and one with children without disability, and found to have acceptable reliability. Following the pilot, the measure was slightly modified, by withdrawing postural alignment item 20 (Head Rotation) and functional item 8 (picks up raisin and places into mouth) following practical difficulties with administration.

Results

Data was divided into the joint angle data in degrees and the recommended categories (1-4) of the Seated Postural Control Measure. On superficial analysis using simple ANOVA (Field, 2002), the variability in joint angle was found to be unacceptably high with a Coefficient of Variation (CV) of 0.41 - 0.47 for within groups (i.e. patient-to-patient variability), and CV of 0.29 to 0.84 between groups (i.e. day to day variability) (Table 1). Within group variability was unsurprising given the variability of the children participating in the research project.

Table 1. Coefficient of Variation Range

	Coefficient of Variation Range Degrees only	Coefficient of Variation Range Categories
Within groups	0.41 - 0.47	0.12 - 0.37
Between groups	0.29 - 0.84	0.06 - 0.43

Categorising the joint angles into the categories suggested by the SPCM reduces the variability considerably, and puts between group (i.e. day-to-day) variability into an acceptable range (</= 0.20) for all joints except head, lumbar curve and left hip rotation. The most reliable categories across both degrees and SPCM categories were trunk lateral shift and pelvic tilt (angle CV between groups 0.09, category CV between groups 0.06).

Discussion

These results show an interesting difference between the SPCM categories and angles measured in degrees, with both patient-to-patient and day-to-day variability unacceptably high for all categories measured on joint angle alone. However, when using the SPCM categories, most categories showed acceptable repeatability, with the exceptions of head lateral tilt and head anterior posterior tilt, lumbar curve and left hip rotation. Head position is perhaps understandable as this is most likely to vary considerably, however, lumbar curve and left hip rotation (but not right hip rotation) are more difficult to explain. It is interesting that the most reliable measure over time is pelvic tilt. In the future, in order to factor out the patient-to-patient variability, we plan to perform a repeated measures design analysis to further explore the reliability of the measure in both absolute angle and categorical measurements.

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Managing Pelvic Obliquity

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Introduction:
Pelvic obliquity is an asymmetry of the pelvis in two planes. It is most often observed and measured by comparing the ASIS's (anterior superior and inferior spine of the pelvis or "hip bone") to each other. It may also be verified clinically by additionally palpating the ischial tuberosities and /or comparing the PSIS's (posterior superior inferios spine, if palpable.) This is accomplished initially when the patient is seated. The therapist places her thumbs on the ASIS's to compare locations. To be symmetrical, these two points should look and feel symmetrical, e.g. the therapist's thumbs should be located "evenly" and""equally" to each other. If one side is retracted or more forward, than the other side, and if one side is more elevated than the other, then a pelvc obliquity can be demonstrated.

These clinical findings should be palpated in both a seated posture, and in a supine position (patient out of chair, lying on back, on a mat). Pelvic obliquity can also be described as a pelvic rotation, as rotation is a component in the obliquity.

Most of the time, I have found in my clinical practice, that pelvic obliquity is due to a spinal scoliosis. However, it can also often accompany a subluxated or dislocated hip, a femoral resection, and/or any other type of post status hip surgery or hip problem.

Pelvic obliquity also affects pelvic mobility. Pelvic mobility must also be examined by the therapist. It can be somewhat limited, severely limited, or it can be absent, with a fixed obliquity.
Understanding and Accommodating an Obliquity in Seating for Function:

Historically, a pelvic obliquity has been presumed to be accommodated by simply changing a seat cushion to reflect or support the elevated side of the pelvis. I have found that this approach is lacking. The pelvic and shoulder girdle are the key supports of upright posture. Their relationship to each other is critical and dependent. A pelvic obliquity by its very nature carries with it a rotational component. This rotation is reflected in the patient's body by the shoulder girdle as well as by the pelvic girdle. The extremities and their control are a reflection of the stability of the two girdles, the shoulder and pelvic girdles.

Consequently, a pelvic oblqiuity not only affects pelvic stability, and pelvic mobility, it directly affects upper extremity and head control.
In short, a pelvic obliquity is not a fixed position, it can be measured at particular points in time (during an assessment) but by its very nature, the skeletal structure of it, is still managed muscularly. Control of the musculo-skeletal system, is through the central nervous system which is constantly responding to sensory information.

In short, a pelvic obliquity is never simply an orthopedic anaomoly, but rather the most obvious symptom of how seating must drastically change to support functional postural control and extremity use.

If a pelvic obliquity is only supported by changing the depth of the seat cushion on one side, then the patient's functional use of postural control and extremity use will not be supported. For functional control, the pelvic obliquity must be viewed with the shoulder girdle in tandem, and in task performance. As the two relate and reflect each other, then the shoulder girdle must be examined with the pelvis in positions of function.

Most often the back of the seating system must also be altered. It must often also reflect an asymmetry. This change in back placement, supporting the shoulder girdle in alignment over the pelvic obliquity will allow the patient to maintain or increase functional postural control as well as extremity control.

In fact, when both surfaces have been altered, in relation to each other, and to the patient's activity, the patient's postural control will increase, head control will be exhibited, and tension will leave the extremities.

Often, with children or adults who have additional hypertonicity, this level of tone is not expected to change, but rather seen as a symptom of their medical diagnosis. However, all patients' tone is reduced or increased as the body "senses" or integrates its sensory information into postural control. Tone should increase as needed with tasks, and decrease with less use. The additional tone often seen demonstrated in patients with pelvic obliquities, I have found, is actually a reflection of the body feeling that it is not able to control itself, and is therefore “over-holding” itself with additional tone, to try and”“keep” the body upright. When seating supports an alignment which is patient based, and based on each patient’s shoulder girdle and pelvic girdle integration, then postural control will not utilize this’“additional” tone. Instead, the patient’s body will be more relaxed, yet functional. Tone will automatically decrease as the pelvis and shoulder girdle will now be able to manage the weight bearing they are expected to do, for functional extremity and head control. However, if the pelvic and shoulder girdle are not assisted simultaneously, or if one or the other is expected to remain symmetrically placed, then postural control is greatly compromised, tone is increased, tension is added to the body, and endurance and accuracy of control is greatly reduced.

This may mean that a seat must be wider than expected, as the shoulder girdle may need to be located more over to one side than the other. However, when this happens, additional pelvic support may be needed. This could include small pelvic guides, separately placed, to support each side of the pelvis, NOT placed symmetrically, but actually placed at each side, separately. It must be determined which side of the body appears to be not the “dominant” side, but rather where the body is apparently “leaning” to actually gain upright control. This side may need a hip guide, too. In short, a split hip guide (two parts) one placed at the hip itself, and the other along the thigh. Either of these guides (or all, pelvic and/or hip) may also need to be angled, not only angled in relation to the front and back, but also angled towards or away from the seat itself (the bottom of the hip guide almost under the patient, while the top of the hip guide is located farther away.) In short, to accommodate the obliquities and their subsequent rotation, for functional postural control and extremity use, all parts of the seating system must be angled, and not angled symmetrically to each other, but placed for support at each part of the patient.

Trunk supports must also change. However, if the back is angled, the trunk supports will need less alteration, as the back will reflect the movement needed

POWER WHEELCHAIRS – The Dynamic Element

Ian Denison PT, ATP
Doug Gayton ATP
David Kreutz PT
Susan Johnson Taylor OTR/L

The process by which a power wheelchair is chosen usually begins with an assessment of the client and ends with the client taking delivery of their new chair. This workshop is designed to help clinicians understand what happens after the assessment and before delivery.

OBJECTIVES

By the end of the workshop participants should understand:

1. A process by which a client can select the most appropriate chair for their situation.

2. How the basic design of a power chair determines its performance envelope.

3. How much impact programming can have on the chairs performance.

Power chairs are primarily designed to do two things:

* Seat a person comfortably.
* Move through a variety of environments.

This presentation is solely concerned with the latter. The past decade has seen a wealth of presentations dealing with the need to seat a person. This issue has been the focus of most seating clinics and justifiably so. We recognize that this should be the first concern, we also appreciate that power chairs are designed to move. Once the client is seated appropriately, we believe it is the clinician's responsibility to optimize their client's ability to go where they want.

The workshop will cover:

* Assessing the client for a mobility device.
* Driver Input alternatives and selection.
* Factors that contribute to wheelchair performance.
* Programming for optimal performance.
* Indoor and outdoor performance of various chairs

No Seating Assessment is complete unless the dynamic element is considered. If the chair is going to move, the clinician has to know how the client will control the chair, now and in the future. They have to determine reliable repeatable movements and match those movements to available technology. The clinician has to establish the environment that the chair will be driven through and match the chairs performance to the clients needs and abilities.

In an effort to make sense of the performance potential of the various chairs we had to create a classification system.

Traditionally power chairs have been classified as Rear wheel drive (RWD), Mid wheel drive (MWD), or Front wheel drive (FWD). Our experience led us to classify chairs according to the drive wheel location relative to the system centre of gravity (chair and user) and the percentage of weight passing through the drive wheels. This classification makes it easier to understand and to predict how a chair performs.

The user will get to try a large number of current power chairs both indoors and outdoors and discuss the strengths and weaknesses of each chair with experts. They will also have an opportunity to try various input devices and use a programmer.

POWER WHEELCHAIR TEST

If you can answer these questions give this workshop a miss.

1. Why can a chair that goes up a steep hill easily be uncontrollable down the same hill?

2. Why do RWD chairs have a greater range than equivalent FWD chairs?

3. Which chairs give the smoothest ride on uneven terrain?

4. What does the expression turn in it's own radius mean?

5. Why can't you turn a chair that has all its weight on its casters?

6. In what circumstances can a LR RWD negotiate smaller areas than CWD chairs?

7. Which way will a chair turn when it exceeds its critical side slope angle?

8. Which configuration will most likely spin its wheels on a curb cut?

9. How fast should a chairs top speed be?

10. Which configuration is most likely to meet the needs of a specific client?

11. At what point in the selection process do you consider the input device?

12. How can programmers affect chair performance?

Providing Appropriate Equipment for the Petite Paediatric Client

Sheena A. Schoger, DipOT, OTReg (Ont.)

It is generally acknowledged (though only relatively recently by manufacturers) that children are not simply small adults. Wheelchairs and seating systems have gradually become available with dimensions and options more appropriately sized for the paediatric client. The growth pattern of a child with a congenital condition such as Spina Bifida or one who develops Cerebral Palsy at, or shortly after birth, does not often mimic the growth pattern of the "normal" paediatric population. Prematurity can be a"major factor influencing growth patterns. Failure to thrive and many other conditions may accompany prematurity. Lower extremity length is often limited in children who do not walk or in those who have conditions such as Spina Bifida.

Size is also greatly dependent on age. A 2 year-old, with no physical disability, is considered to be petite as compared to a 10 year-old or even other 2 year olds. Primary considerations for this "normal" 2 year old are size appropriate car seats, diapers and clothing. As this child ages and grows, one must "shop for fit" for many necessary and non necessary products including shoes, golf clubs, ice skates or even violins. However all of these are available with a host of options and features sized for the"“normal" child. Not so for the petite paediatric client when providing seating and mobility products.

Many of you who have worked with the paediatric population will have run into the problem of having to make do with equipment that is not only too massive but which does not take into consideration the different body dimensions of the population we serve. The combined factors of prematurity, failure to thrive, age, disability and non-weight bearing, as well as familial diminutiveness, often present us with major headaches when prescribing equipment for these clients.

Through the use of case studies, this presentation will consider the paediatric client, from differing perspectives, including the very young child, the petite young child, and the petite older child. We will consider and discuss mobility issues, dependant and independent, power vs. manual, as well as seating issues - custom fabricated products vs. 'off the shelf' and the importance of appropriate modification of this equipment to allow it's use with other than the recommended population.

Age and/or level of disability should never be the sole determining factor when deciding on equipment for any child. Many of my clients with physical disabilities are also legally blind or are cognitively challenged, however these factors should not automatically preclude prescription of independent mobility products, especially power mobility. If these children, with visual or cognitive limitations, were to have no physical disability, they would be allowed, even encouraged to be independently mobile and so the fact that they cannot walk should have no bearing when making these mobility decisions. Obviously, the description of 'legally blind' is not the same as total blindness and there are many levels of cognition, some of which would definitely preclude independent mobility, whether physically challenged or not.

Most children develop early motor and cognitive skills almost accidentally. The baby learns to roll after collapsing from propping on extended arms in prone. One day the child reaches a toy after having rolled and he then learns that he can get to other items of interest by rolling. This is when the family's pet cat learns to run as the baby approaches. The child then learns to sit, crawl, pull to stand, walk and run, all in response to something that has peaked his interest, having first performed a motor task accidentally. This then leads incrementally to these greater feats. Our children with special needs are no different from the "normal" population in this regard. These children should be allowed to meet recognised milestones, even if modified, by prescribing and modifying appropriate equipment. This includes high chairs, when the child would not be able to sit independently, adaptive strollers, to allow full participation in family activities and wheelchairs to allow independent manual mobility when possible and power when this would not be possible otherwise. Because the average "“normal" child walks between the ages of 8 to 15 months[1], this is the ideal time to provide mobility equipment. Many children who have a diagnosis of Spina Bifida are provided with a 'caster cart' at a very early age.

This allows them to explore their environment. They develop visual and sensory perception through mobility experience that leads to further development, physical and cognitive.

When children with special needs are provided with mobility equipment at an early age, initially they are unable to move purposely in any direction. This is no different from the "normal" child when first learning to walk. The earlier a child is provided with appropriate seating and mobility equipment, the more normal his overall pattern of development will be. Power mobility, provided to the most challenged children, is the most visible evidence of this, regardless of whether they may eventually walk.

When first given the opportunity to use power mobility, the child will often move in circles, in one direction. Eventually he will achieve movement in different directions and from there he will become more and more proficient in mobility. This may happen very quickly or over a prolonged period and is no different from the "normal" child learning to roll, crawl, walk and run. "Normally" mobile children learn to duck after hitting their head under the table as they explore their environment. Children with challenges have a more difficult task, as it is their equipment that 'feels' the barriers in their environment and equipment often prevents the required access for direct discovery; the child is not able to reach the cat to pull it's tail. In comparison, the child exploring in a wheelchair may instead learn to run over the cat's tail with his wheelchair.

If independent mobility is withheld from a child at an early age, the child may demonstrate learned dependence. He may become passive or cognitively lag behind his peers. This child is experientially deprived and the long-term effects of early deprivation can be devastating. At the same time, children should have supportive seating components prescribed that will provide the appropriate stability and alignment required to allow function at an optimal level. A system that interferes with required movement or access, or does not provide the necessary stability, alignment and support, does a disservice to our client. A prescriber sometimes has to compromise to allow function, but the pros and cons have to be carefully weighed prior to making these important decisions.

Our clients often start out in the NICU, where the primary consideration is keeping the baby alive. They are positioned in postures exactly opposite to the "normal" baby, in patterns of full extension and arm and leg abduction with external rotation, often not having developed normal fetal flexion because of prematurity. This is necessary to maintain full chest/lung expansion etc. Generally, NICU personnel are now trying to provide, when possible, more normalised positioning for these babies. This is where our work should start and we may be called in to the unit to provide recommendations and/or postural support for positioning the baby in the incubator. This has to be maintained after the baby goes home, however the parent often has little or no knowledge of how to accomplish this.

On discharge, these babies "float" in infant car seats. Contoured foam, placed laterally under the seat cover, but usually not behind the baby, can provide the required positioning and support. We are often called to the NICU to provide this support to allow safe transport home. This allows for first contact with the parents and opportunity for early education. Depending on the baby's condition at discharge, there may be a referral for therapy services, but if not, referral may be delayed for many months. These babies then come in presenting with abnormal tone and postures, are often extremely irritable, and the parents are very anxious.

Other than modified car seats and supine positioners, the next piece of equipment our children require is a stroller and/or high chair. Yes, there is speciality rehabilitation equipment available, however at this point, the family often recognises that their child has problems but often is not ready to acknowledge this publicly, through visible specialty equipment. This is where an innovative therapist and/or technician can provide the required postural support in commercial highchairs and strollers. Of course the success and simplicity of this depends on the severity of the movement disorder.

To maximise potential development of good motor control of the eyes and mouth, as well as anti-gravity movement of the body in general, it is essential that the child develop stable sitting at an appropriate age. Children will normally achieve momentary, unstable sitting without using arm support when placed in position between 3 and 7 months[1]. It is therefore imperative that our children are provided with effective support in sitting at an equivalent age. Custom fabricated inserts, which fit in highchairs, strollers and other commercially available baby equipment, can allow for this. Our material of choice is Ethafoam, a closed cell foam that is heat bondable and which can be relatively easily configured to meet the custom requirements of our petite clients. As the baby grows, he will become more proficient in sitting and in other functional activities when using this modified equipment. With advancing age, the child may continue to demonstrate poor function outside of this supportive equipment. It then becomes important that the family be provided with information about their other options. This usually, but not always, includes speciality rehabilitation equipment. It is at this time that prescribers begin to run into problems because of the baby's petite dimensions.

For the more severely disabled child, the Kid Kart Express by Sunrise Medical is often readily accepted by parents and is one piece of equipment that is both versatile and appropriately sized for the petite client. Parents have reported that parents with "normal" children, when encountered in shopping malls, etc. have asked where such a stroller may be purchased. This product provides for a variety of postural configurations as well as a host of user options, such as manual tilt in space, recline, a transit option, a power base and indoor base(s). This stroller can also be positioned so that the child can be either forward or rear facing. This may be a very important feature for the young child who may be experiencing severe separation anxiety, (not uncommon in this population) or for the child with sensory impairment such as vision and hearing. The prescribing therapist is challenged to look at the child, not only as he presents today, but also to envision the changes that may occur with time, with development, and with the evolution of greater functional independence. This stroller can provide these options for the client for many years. A 2 year-old child is appropriate in a stroller base, however a similar sized child in a stroller, if older and/or attending school, may be regarded and treated by peers and adults as a baby, very dependent and cognitively immature. It is therefore very important to give the impression of a mature child, which is readily achieved if the child is using a wheelchair base, power or manual, even if still using the stroller's more supportive seating system.

The Kid Kart seating system can be purchased with a standard or adjustable contoured seat cushion, in either standard or long length, as well as standard or tall back dimensions. The seat and back shell assemblies, available in 2 sizes, can readily be grown in length and/or height to accommodate the child's growth, which is often linear rather than in girth. Further positioning options can then be added to provide the required support and alignment including: a variety of headrests; lateral trunk supports, fixed or swing away, large or small, straight or contoured; small or large lateral pelvic support; lateral thigh support; medial knee support; as well as pelvic belts, anterior trunk supports, shoe holders, footstraps and trays. This system also has a height adjustable indoor floor base, which allows it to be used as a high chair, as a floor sitter, or at an intermediate height so as to be appropriate for interaction with the child's "normal functioning" peers. The child can thus be orientated appropriately according to circumstance. As previously mentioned, this seat can be mounted on a stroller base in forward or rear facing orientation; on an indoor base, fixed or height adjustable; on a power base or, as we have done, custom mounted on a manual wheelchair base.

Very small wheelchairs, with seat sizes from 7" deep x 10" wide, such as the Quickie Kidz from Sunrise Medical, or the Action Comet from Invacare, also are very useful for the petite child with higher physical function who requires less postural and/or positional support. These wheelchairs are extremely useful for this population, allowing good mobility with excellent access to the child's environment in the home and in the earliest school years. However, there can still be major problems encountered by the child when using these chairs. For example, a child using a small wheelchair in crowds may have great difficulty seeing and being seen, as he is so low to the ground and also is not at eye level with his peer group. If the child is transported to school in a vehicle for the disabled, these small wheelchairs can be difficult to tie down appropriately. There may be larger children in larger wheelchairs sharing the vehicle so that the petite child now not only is dwarfed by comparison in body size, but also by the equipment. In this situation the child may be fearful and upset, yet is not readily seen by the driver or attendant on the bus. A solution to this problem may be to use a car seat, however these are not only difficult to tie down on school bus seats, but also requires that the child be lifted into the seat by the parent, driver or attendant, which is not always allowed. Although the child may be safer, the wheelchair itself still may not be safely stowed on the bus or may even have to be left behind. There are numerous manual wheelchairs, manufactured both by Sunrise Medical and Invacare, as well as other manufacturers, that have configurations suitable for the petite child, and which place the child at a higher level. These wheelchairs have seats that can be as small as 10” x 10” (and can even be customised to provide shorter seat depths) and are usually growable. They have various footrests, armrests, wheel configurations, styles, etc. which allow for more appropriate fitting to the child, however it is when seating components are required that the”“fit” is more difficult to achieve, regardless of the wheelchair, and is even more difficult if the child is expected to self propel a manual wheelchair.

Of the power wheelchairs, the most popular, by parents and children alike, is the Dynamo with the Versa Seat, by Pride Mobility, which affords the clinician the opportunity to use a variety of seating solutions. This chair, once seen by parents, usually breaks down most emotional barriers to power mobility. This wheelchair is a mid wheel drive chair which is readily adopted by the paediatric client who has never driven a power chair before. The Quickie Zippie P500, by Sunrise Medical, is a standalone power wheelchair that allows for a variety of seating options and can also be used as a power base with the Kid Kart Express seat. The Invacare Power Tiger wheelchair, also a standalone wheelchair, is also a versatile system that can be paired with the Action Orbit wheelchair. These wheelchairs allow for a cheaper solution for provision of a manual system, which often is necessary for a variety of reasons, by requiring only the addition of a manual base and not the whole system. Obviously there are many other power wheelchairs, which can be used with the paediatric client, but for the petite client, I believe these are some of the most appropriate.

Custom fabricated seating systems are difficult to make small enough for the petite paediatric client unless ABS plastic or similar thin, yet strong materials are used as a foundation. Padded, off the shelf belts such as those made by Body Point tend to be too large and clumsy for the petite client and rigid pelvic stabilisers, such as made by Metalcraft, are also far too large to fit appropriately most of the time. Daher offers a line of specialty products that do allow for better fit to the petite child incorporating neoprene as the support and/or padding material. The Embrace, a rigid pelvic stabiliser, has been developed by a team in Toronto but is not yet in production. The Embrace support pad is thin and flat, making it much more suitable for the petite client, as it allows the pelvic mobility required to function well in a seated position, especially when spasticity is present.

Backrests, such as the Jay 2, require a 14 3+ wide wheelchair, however this width makes it difficult for the petite client to reach the wheels. These backrests can be custom mounted on top of the wheelchair back posts on narrower chairs, instead of between them, however the laterals will still be too wide apart to provide the required support. The backrest foam and even the mounting surface of the laterals must then be cut to allow the laterals to hug the body appropriately. The Pin Dot KSS seating system will fit smaller wheelchairs, (10”+) without customisation, but often does not offer the required support because of its minimal contouring. One of the most versatile back support systems I have found is the Infinity line by Invacare. This product comes in a variety of sizes with multi adjustable mounting hardware. It too, is designed to fit 14 3+ wide wheelchairs and can be custom mounted. The laterals on these backs are made of metal that can easily be custom bent to provide much more intimate trunk support. They can also be cut in height to allow the back to be used by a much smaller child while still being able to be grown to their maximum height and width, ultimately offering a cost saving. This back system can be very useful for the petite client, especially when in a power wheelchair.

The provision of custom fabricated seating systems, often used in conjunction with customised off the shelf systems, can provide the petite paediatric client with the opportunity to be both self mobile and functional, thereby encouraging maximum social, cognitive and functional growth.

Motor Assessment of the Developing Infant & the Alberta Infant Motor Scale, by Martha C. Piper & Johanna Darrah

Functional Positioning / Independent Mobility for Clients with Complex Needs

Phil Mundy, P. Eng
Nancy Balcom, Bachelor of Science in Kinesiology

This program is intended for individuals involved in assessment and delivery of mobility devices, primarily wheelchairs and device mounting systems. Prescribing healthcare professionals and equipment providers will work together throughout this seminar. The target audience includes people who are involved in client assessment, delivery and servicing of positioning and mobility devices. The seminar objective is to provide practical instruction in assessing and dispensing adaptive mobility devices for people with disabilities.

Outline

The presentation draws on clinical experiences of prescribing therapists, Home Medical Equipment dealers and PDG staff during their work developing various mobility related products with an emphasis on manual wheelchair positioning, bariatrics, individuals exhibiting high agitation, and device mounting applications. In developing ‘special application’ mobility devices, PDG staff gathers input from all sources to facilitate development of equipment that meets the intended-client need.

Issues that make seating/mobility a challenge when working with complex needs

The following list provides an introduction.

- Physical problems - This is often the first issue that comes to mind when identifying aspects contributing to increased complexity.

- Functional limitations - The balance between function, physical limitations and therapeutic goals requires often requires compromise.

- Environmental Barriers - In cases where the environment limits options, the team may have to compromise in their efforts to find a workable mobility solution.

- Care Giver issues - Issues for caregivers may conflict with client issues and need to be addressed.

- Funding issues - Relatively uncomplicated cases can become difficult to address if funding issues limit options available to the team.

Case Presentations

Case histories will be used to demonstrate a variety of unique solutions. Each case will be done with emphasis on the process used to work through delivery of sophisticated equipment. Information will be presented in a way that delineates the relationship between physical need, functional goals, and equipment design.

- Clients are introduced via power-point presentation. Information needed for attendees to become familiar with functional limitations will be reviewed including disability, functional status, environment, equipment funding issues, etc.

- The ‘Dealer’ prospective will present information in a way that matches functional needs with available equipment options. Case presentations will include discussion relating to a variety of potentially appropriate products along with the rational for selecting the specific product used.

- The ‘Manufacturer’ prospective will cover product design aspects that make the chosen device especially appropriate for the case under consideration. If custom modifications are involved, they will also be addressed.

Client Presentations – The following are only a few of many case histories available.

Bariatric Client
Fred needs an extra wide wheelchair with a variety of custom modifications. PDG's web site includes case histories featuring people of all shapes and sizes. Issues of special interest include self-propulsion, carrying extra-heavy loads, and the process of getting the wheelchair to 'fit'.

Frail / Marginal Mobility Client
Clients who are frail and have general weakness often have difficulty mobilizing a wheelchair.PDG Wheelchairs can be configured for 'minimal effort' propulsion. Ruth is one of several frail elderly clients included in PDG 'Case Histories'. A little tilt, wheels in the right place, and feet firmly on the ground made a big difference for Ruth.

High-Agitation ClientClients with high agitation often require products with many specialized features. PDG presents several clients requiring unique solutions. These wheelchairs feature extra-high stability, shock absorbing materials and components that stand-up to heavy use.

Manual Tilt-in-SpaceSam needed a tilt system that he could operate independently. The Stellar allowed Sam to live at home with maximum independence since he can 'wheel' and change his seat tilt independently.

Device Mounting SystemTom uses a Scotty LapTop tray to hold his communication device. His system is called a 'Kristen Center Mount Pedestal Tray'., PDG's Scotty LapTop Systems are extremely adjustable, suiting a wide variety of device mounting applications.

Adding Evidence: Single-Subject Designs as a Pragmatic & Rigorous Approach to Clinical Research & Practice

Bill Miller, PhD, OT
Jan Miller-Polgar, PhD, OT

Overview

Single-subject research design (SSRD) is a quantitative, flexible, rigorous, clinically oriented approach that provides an ideal method to identify whether intervention has produced change in the targeted outcome within an individual. Thus, SSRD is one method that provides clinicians with an evidence-based approach that can be used to validate their daily practice and contribute to research. This quasi-experimental research approach, in which the subject acts as their own of control and uses repeated measurements of the targeted behaviour or outcome over time is ideal for the area of wheelchair and seating practice. SSRD primarily relies on visual analysis and requires minimal statistical manipulation. In this workshop we will define and review different SSRD designs using relevant examples relevant to the area of wheelchair and seating and wheelchair practice.

Defining SSRD

SSRD has a number of pseudonyms including: Single case experimental design, Time series design, Small-N design, Single system designs, Within-subject comparison, and idiographic research. Ottenbacher (1986) and Bloom and Fishcer (1982) suggest the following definition. SSRD involves studying a single individual or system by taking repeated measurements of 1 or more dependent variables and systematically applying and sometimes, withdrawing or varying the independent variable.

Why Chose SSRD?

There are many reasons to choose SSRD. Perhaps the most compelling reason is that when conducting research using group designs there is always potential for a small number of individuals from the larger sample to benefit from an intervention that has been deemed ineffective (and vice versa) regardless of how homogeneous the sample. Therefore SSRD allows examination of individual differences. Next because of the nature of working in a unique and specialized area (wheelchair and seating) it can be difficult to obtain a large enough sample size that is reasonably homogeneous to conduct a meaningful group comparison study. SSRD is also relatively easy to do (and less expensive). The very nature of the process of conducting a SSRD mimics practice. Therefore if conducted correctly SSRD can provide a powerful method of validating practice by providing evidence that certain treatments or equipment work. In fact, SSRD is ideal for evaluation when assistive technologies are used. Finally, if you are contemplating a larger experimental study then SSRD can be an excellent technique to collect pilot data.

More About SSRD

First developed by psychologists, SSRD are a collection of designs that have been evolving for over 100 years. These designs can be used to answer research question and generate or test hypotheses. Analysis is usually conducted visually by plotting data points on a graph and looking for trends. Simple methods of statistical analysis are now becoming in vogue.
SSRD involves at least one;

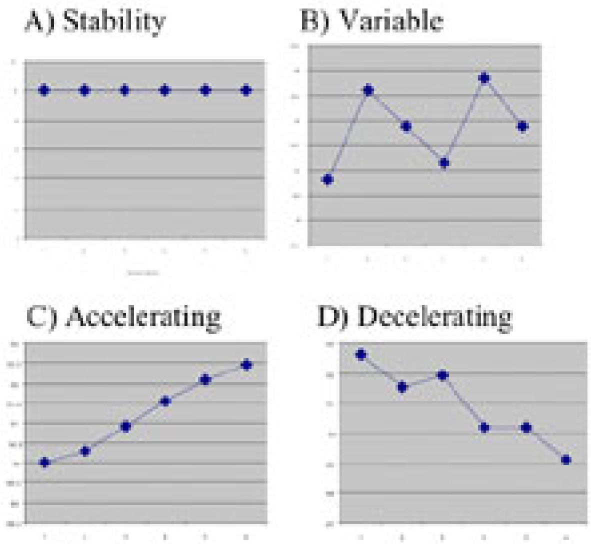
- Subject (individual or clinical unit/department)
- Baseline period or "A" Phase– a series of repeated measurements with no intervention
- Intervention period or "B" Phase – a series of repeated measurement after introduction of the experimental or independent variable to see if change occurs
- Dependent variable which must be quantifiable
- Independent variable (treatment or intervention)

SSRD Phases

Baseline / A Phase(s)

A minimum of one baseline and sometimes multiple baselines are used. Baseline is usually the first phase, prior to treatment which reflects the natural state. However, a baseline phase can be introduced if treatment is withdrawn. This phase provides a standard for evaluating the treatment effect. Frequent measurements, a minimum of 3 but preferably 5 or more, are repeated until stability demonstrated (sometimes stability is never achieved though). Figures A-D provide different examples of what may happen after data points are plotted. Figure A – stability; B-variability; c-accelerating stability; d-decelerating stability

Sample Baseline Phases

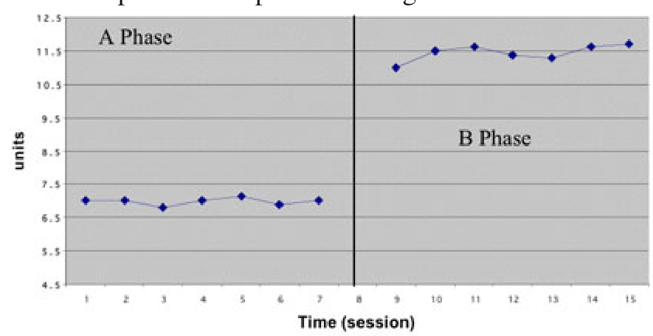


Intervention Phase(s)
After the baseline phase the independent variable (IV) or treatment/intervention(s) is introduced. Depending on the type of design it may be appropriate to consider multiple treatments. Once again frequent and multiple measurements of the dependent variable are necessary. A minimum of 10 data points are suggested if statistical analysis is to be considered. Ideally the length of this phase should match but may exceed the baseline phase.

Dependent Variable
The dependent variable (DV) is the variable of interest. While the DV doesn't need to be a standardized test it must be quantifiable. Common outcomes of interest include a frequency count, duration or magnitude. Some examples include, the number of times a power wheelchair user hits a wall; amount of time a person can sit in their chair; or a change in pain after switching to a new seat cushion. Regardless of the type of outcome the reliability calculating the total % agreement, point by point % agreement or kappa statistic should be calculated.

Simple Design (A-B)
The AB design is the simplest of all SSRDs. It consists of 1 baseline and 1 treatment phase. The simplicity of the design results in many limitations that threaten the internal validity and ultimately the findings. Specifically we cannot be absolutely certain that the results occurred because of the introduced treatment or some other factor that started at the same time as the treatment. Additionally, natural improvement may explain the results. Several things can be done to overcome these limitations including; replication by studying more subjects, add more phases and or treatments,

Example of a Simple A-B Design



Withdrawal Designs (A-B-A or A-B-A-B)
As the name implies in these designs treatment is withdrawn. Though there are many alternatives here are two.

A-B-A
Here a single baseline phase is introduced as the intervention is taken away. If there is a return to baseline as shown in the figure we have stronger evidence of a cause and effect relationship. That is the IV leads to change in the DV. Even if we don't get a full return to baseline there is support of a causal relationship. Limitations of this design include: ethical dilemmas related to treatment withdraw and the target variable (DV) should be reversible.

A-B-A-B
In the ABAB design, 2 phases, another baseline and treatment phase are added. The results from this type of design provide increased confidence that the treatment is influencing the outcome. The limitations observed in the ABA are similar for this design.

Multiple Treatment Designs
These designs introduce more than one treatment either within the same or alternate phases. Many

different configurations exit however there are two primary forms; alternating and interactive.

Alternating Multiple Treatment
In this design rapid alternation of 2 or more treatments, or a placebo and treatments are introduced. Treatments can be alternated within same session or session to session. The advantage of this approach is that results are immediate and that a baseline is unnecessary (although highly recommended). Limitations include the potential for order bias, and the target behaviour must be clear and occur rapidly. Order bias can be reduced by randomizing or counterbalancing treatments.

Interactive (A-B-BC-B-BC)
In this design multiple combinations of different treatments and/or sequences of treatment(s) are used. In addition, withdrawal of all treatment may be done. Under this unique and complex design, assessment of separate and joint effects of 2 or more treatments be evaluated and interactions can be tested.

Multiple Baseline
These designs involve measurement of 3 or more subjects, conditions or behaviours. Using a simple A-B design format baseline measurement is conducted for of all. Once stability is established in at least 1 subject, condition or behaviour, treatment is introduced for one while the baseline is continued for the others. After the treatment effect stabilizes then treatment is introduced for the next or other subject, condition or behaviour until all have had treatment. This form of design is particularly useful when behaviours are nonreplicable and when it is unethical to withdraw. The replication of this design overcomes the simple AB format and the associated flaws to limitations with internal validity.

SSRD Analysis
Visual analysis of data plots is the most common form of interpreting the results of these studies. However, statistical analyses are becoming more common. Visual analysis focuses on trends and levels between adjacent phases. Levels refers to changes in the value or magnitude of dependent variable after intervention. To experience claim a difference in level a distinct jump between the values of the last and first values of adjacent phases must occur. It is also helpful to have an a priori definition of change in level. Trends refer to changes in the direction of the plotted line and are best described as accelerating, decelerating, stable or variable.

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Alternative Positioning: Concepts and Considerations

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Participation in an alternative positioning program is vital for the maintenance of postural and skeletal symmetry, skin integrity and the performance of vital function. For children and adults with postural asymmetries and limitations in movement, repositioning is dependent on caregivers who must possess the knowledge and skills to reposition them in an aligned and comfortable manner. It is our job as health care providers to educate the caregivers. Often, the caregiver will position these clients in a routine manner, but it is not always optimal to meet the client's needs.

Alternative positioning has been used over time for the maintenance of many body systems. These include skin integrity, postural and skeletal alignment, respiratory and digestive abilities. The use of positioning alternatives, including side lying, prone, supine and supported standing, can provide viable options to enhance these body systems while also providing comfort and greater ability to participate in functional tasks. The optimal goal needs to focus on function.

Prior to identifying appropriate positions for use, the benefits and drawbacks of each positioning option need to be fully understood. In evaluating each position, potential pressure areas need to be identified. Other considerations include the impact of gravity, the affect on the client's tone presentation, the impact on vital functioning (respiratory, heart rate, etc.), and the impact on the client's sensory systems. Clinical considerations should include position tolerance/comfort, available range of motion, current skeletal asymmetries (both fixed and flexible), skin integrity/history, respiratory status and the control or management of oral secretions. Careful evaluation of all areas needs to be completed prior to prescribing an alternative positioning regime. Furthermore, the equipment used must be carefully considered.

The actual features of the positioning device are frequently overlooked during the assessment process. These features are vital to address as they may make the position contraindicated. One of the primary features to assess includes the actual support surface of the equipment. This needs to be evaluated similar to a wheelchair cushion. Does it provide the type of contact that is required? For example, total contact may be needed while the surface can only provide planar support. What type of medium would best meet the client's needs? Does the surface allow for immersion into the medium or is more rigidity needed in order to maintain alignment? If the latter is identified, how will this impact pressure management? Other than the support surface, assessment of the cover is needed. Similar questions need to be addressed, including does the cover restrict the full benefit of the support surface?

Along with the clinical aspect of equipment selection, other issues need to be addressed. The main factor for use includes cost effectiveness. This needs to address the initial purchase price, need for modifications and repairs, durability, and ultimately the quality of the product for use over time. Since it can be difficult to obtain third party funding for alternative positioning devices, it is important for proper choices to be made initially.

Once the appropriate equipment is selected, trials should be completed to be sure that the positions chosen will be effective for the client. Different positions will facilitate different results so prioritizing functional goals is important. For example, if your primary concern is respiratory function you may choose the side lying position. In this position, a more aligned airway can be achieved.

The effects of gravity on the chest wall are fewer than supine or prone options, making the respiratory effort more efficient. The drawbacks of side lying also need to be examined to determine if the respiratory benefits are sufficient. There is greater potential for pressure problems especially on the weight bearing shoulder and hip. Long term use of side lying can also exaggerate general rounding of the spine and a posterior pelvic tilt unless the surfaces used are more rigid for positioning support. In order to maintain the position in proper alignment, straps may be needed however these can then limit chest expansion for inspiration. Side lying may provide optimal visual field orientation when on one side however completely limit it when positioned on the other side.

Once all positions have been evaluated, optimal positions need to be prioritized and a time frame needs to be established. Once again, this is based on individual needs and assessment findings. Positions need to be implemented on a trial basis with very close supervision. Once the position has been found to be safe and the duration established, training of other caregivers can occur.

The use of alternative positioning options can be an effective method to maintain proper alignment, preserve or enhance vital function and facilitate one's ability to participate in functional tasks. The evaluation process can be long and tedious in order to provide optimal support in a safe manner. In addition to evaluating the client's physical status and needs, the qualities of the equipment need to be assessed. Education of staff, caregivers and the client is also vital to ensure appropriate intervention and facilitate understanding of the chosen protocol. Only if a thorough evaluation and team approach is taken, will positioning programs be successful over the long term.

Development of Equipment as part of the Chailey Approach to Postural Management

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Introduction
Over the past 15 years both research and clinical experience has been used to develop equipment that forms an integral part of the Chailey Approach to Postural Management. The approach is based on the biomechanical principles of the Chailey Levels of Ability and covers the 24 hour period. The approach uses positioning, hands on treatment and active exercise that is backed up by a programme of education.

The Chailey Levels of Ability are a validated assessment tool for defining lying, sitting and standing posture. The Levels were designed for use with individual's with low levels of physical ability. They are based on a normal development model and have been successfully transferred for use with children with cerebral palsy(Green et al. 1995; Pountney et al. 1999).

Postural management equipment aims to control an individual's posture in different positions such as lying, sitting and standing. Individuals, most frequently children with cerebral palsy, who are unable to maintain these postures independently are positioned in equipment that enables them to achieve these postures. Children are positioned so that their joints are in a neutral position to reduce the possibility of muscle length imbalance. A higher level of ability should be possible in the equipment as the number of motor tasks requiring attention are reduced and therefore concentration can be focused on specific motor or cognitive tasks. The equipment designed in this way provides a correct starting position for movement and opportunities to practice consistent movement patterns within limited boundaries. Security to achieve practical activities is gained and the long term aim of prevention or reduction of the development of deformity.

The postural management equipment that has been developed at Chailey Heritage Clinical Services provides a consistent position each time it is used. Several different sizes of equipment are available and as the equipment is being mainly used with children who can grow quite rapidly and therefore the equipment has been designed to be easily adjustable for growth.

Traditionally seats and standing supports have been the main pieces of equipment used to provide postural control but more recently the importance of a symmetrical lying position is being addressed with equipment. It is a position that that people with disabilities are often in for up to 10 hours a day. The importance for opportunities for active exercise has also been recognised.

Seating systems
The first type of postural support that became commonly available was seating. Several types of different systems were developed but one of the most commonly used and the type adopted at Chailey was the moulded seat. Although a moulded seat provides support and a shape that conforms this type of seating has several disadvantages including that the support holds the occupant in a fixed posture and unable to move about. The seat is not adjustable for when the occupant grows or changes shape. The posture achievable is poor and it is difficult to provide correction to posture.

Development of Caps II
Due to the limitations of the available seating systems Chailey was commisioned to develop a seating system which was able to correct posture and was adjustable for growth or a change of posture. The seat, originally named the Chailey Adaptaseat, provided these requirements. Following a period of in house manufacture and provision that allowed some modifications to the initial design to be made the seating system was relaunched as the Caps II (Chailey Adjustable Postural Support) and sold throughout the UK by Active Design. The company was set up to promote, educate, manufacture and sell products developed as a result of the research carried out at Chailey.

The CAPS II seating system is designed to emulate an upright sitting posture. It is an adjustable seat that provides a stable sitting base, trunk support and shoulder girdle protraction and provides the foundation for active movement of the head, arms and hands. The basic seat design consists of a cushion on a horizontal base, ramped forward from the gluteal crease to support the femora in a horizontal position. A sacral pad maintains the pelvis in an upright position and this stepped forward from a curved backrest to account for the difference in thoracic and pelvic dimensions. The sacral pad extends to the lumbosacral junction. The kneeblock maintains the pelvic position by applying a force through the femora to the hip joint. The force of the sacral pad and kneeblock are applied equally and in opposite directions and serve to maintain the pelvis in an upright position. These forces are at a minimum when the pelvis is in a neutral plane. Lateral thoracic and pelvic supports help to maintain the trunk and pelvis in a symmetrical position. The seat length is crucial to achieving correct pelvic alignment(Pountney et al. 2000).

The kneeblock and sacral pad can be used to prevent windswept deformities developing or to control existing windsweeping. The kneeblock corrects the asymmetry by bringing the adducted hip into a neutral position by an abduction force on to the medial aspect of the thigh but with no contact to the front of the knee; the abducted hip is brought into neutral position by an adducting force on the lateral aspect of the thigh; derotation of the pelvis is achieved by the force pushing back through the femur of the previously abducted hip by the kneeblock which is in contact with the knee anteriorly. The sacral pad and lateral pelvic pads counteract the forces applied by the kneeblock(Green et al. 1991; Pountney et al. 2000).

The Caps II has been designed so that it can fit into a range of different bases to allow it to be used in a variety of places. The type of bases that it interfaces to includes manual wheelchairs, powered wheelchairs, indoor wheeled bases and buggies. Some of the bases have a tilt in space facility which may be appropriate for those needing a rest position or to assist with transferring in and out of the base.

Floor Sitting Seats

As part of the funded project into prevention of deformity particularly looking at hip dislocation a need was identified for a developmental posture for the younger children in floor sitting. This is a posture that children adopt as part of normal development when they are learning to sit from a position with their weight in front of their base. The seat was designed so that children could be easily placed in it with no need for straps. The seat can be used to help develop trunk control and the child's hands are free from propping and therefore they are able to use them for play.

Lying Supports

The Chailey lying support is intended to be used as part of the 24 hour postural management programme for daytime use and sleeping. It can be set up for use in prone and supine. The lying support is adjusted and fitted to each child and requires no further adjustment each time it is used. The child must be positioned carefully to ensure the pelvis is correctly aligned. As the child grows the support can be adjusted for growth(Pountney et al. 2000).

The corrected posture is achieved by using a firm surface to alter the loadbearing surfaces. The lying support gives a neutral or anteriorly tilted pelvis, a slightly abducted hip position and a symmetrical pelvis provided by an abduction block, lateral supports and a pelvic strap. Trunk symmetry is achieved by using lateral pelvic and thoracic supports and a protracted shoulder girdle position and chin tuck is provided by a head and shoulder girdle support.

Standing supports

The Chailey standing support aims to position a child so that loadbearing takes place through flat feet, vertical femora, anteriorly tilted pelvis, an upright trunk posture and provides sufficient control to be able to move away from the support. The shoulder girdle is protracted allowing free arms and hands for activity.

The elements of the standing support, which enable this posture to be achieved are a horizontal standing base, with adjustable foot supports providing the correct standing base and a contoured support for the trunk and thighs, which is angled slightly forwards from the vertical at the hips so that the trunk is supported forward over the base. This contoured surface needs to be fairly soft so that it allows some active hip and knee extension. Lateral pelvic and thoracic supports act to stabilise the pelvis and maintain symmetry whilst an abduction wedge maintains the hips in a slightly abducted position. A narrow anterior thoracic support will allow protraction of the shoulder girdle and free movement of the arms. A pelvic strap stabilises the pelvis whilst a loose chest strap allows some movement of the upper body. The tray is positioned at elbow height which is appropriate for play(Green et al. 1993; Pountney et al. 2000).

Tricycles

Active exercise is an important component of the Chailey Approach to Postural Management. This can be achieved by using a tricycle that has been adapted to suit the needs of the children using it. The adaptations that were developed at Chailey include a long wide saddle seat with an anterior support, wrist supports with straps and shoe plates with straps(Mulcahy et al. 1991).

Customised Options

As the equipment has been used and developed over the years limitations for people with particular needs have not been able to be addressed with the standard equipment. To overcome this several products have been developed to help position these individuals.

Side Lying Supports

Some people are not able to lie or sleep in supine. This may be due to a medical problem. It is always preferable to be in a supine or prone position as it is possible to achieve a more symmetrical position but when this is not possible a customised support can be designed to give a symmetrical sleeping position.

Caps II with Lynx Backrest

For those who have some degree of fixed spinal deformity but are still able to sit with a level pelvis the Caps II seat is now available with a Lynx backrest. Lynx is a sheet made from interlocking X shaped links. This allows a three dimensional shape to be formed to suit the shape of the occupant. The Lynx sheet is mounted to the Caps II backrest tubes by an aluminium tubing framework. The finished backrest is upholstered. The seat needs specialist knowledge to be able to set it up. It is also possible to adjust the backrest for a change in shape of the occupant.

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Seating/Positioning Evaluation Instructions

Jean L. Minkel, PT

1. Observe the individual in an unsupported sitting position.
   Ask individual to raise their arms, if possible.
   Are they a:
   A. Hands free sitter
   B. Hands dependent sitter
   C. Prop sitter

POSITION IN SUPINE ON A FIRM MAT

2. What are the available pelvic mobility and lower extremity joint ranges?

A. Check available pelvic mobility:

1. Anterior/Posterior pelvic mobility:

   a. Posterior rotation: Position yourself on one side of the person. Using your hand closest to their head, locate and hold the ASIS closest to you. Use your arm closest to their feet to hold under their knees. Flex their hips and knees at the same time until the thighs rest on their stomach and the buttocks has rocked up off the mat surface. Person is rolled up into a ball, lumbar spine rounded, pelvis is posteriorly tilted.

   b. Anterior rotation: Start with thighs on chest position (see above). Keep one hand on the ASIS. With the other arm behind the knees, slowly extend the hips and knees until the legs are straight. Take your arm out from under the knees and reach across the person's body and slide your palm under the pelvis on the opposite side of the body. (To gain leverage, if you are kneeling next to the client, you will need to assume a half-kneeling position and turn your body to face the top half of the persons body.) Rock your own body back pulling on the backside of the pelvis to create an exaggerated lumbar lordosis and pull the pelvis into an anteriorly tilted position.

2. Pelvic Obliquity:
   Place each of your thumbs on the persons ASIS. Rest the web space of your hand and your index finger on the pelvic crest. Note the "resting" orientation of the pelvis. Kneeling next to the person, place one arm under the knees, support the legs in a flexed position. Pull both legs toward you, flexing the trunk on the side closest to you and extending the opposite side. Maintaining this trunk flexed position, let the feet rest on the mat and re-palpate the ASIS. The side closest to you should be higher than the opposite side. Move yourself to the other side and repeat the procedure. Can you return the pelvis to a midline position? If not, which side is higher than the other?

3. Pelvic Rotation:
   Start with the pelvis in a centered position. Position yourself in a 1/2 kneeling position next to the person. Place your palm on the ASIS closest to you. With your other hand reach behind the person and place your hand over the posterior pelvic crest. At the same time, push down on the ASIS and pull up on the posterior pelvic crest to rotate the pelvis. Reverse you hand position. Slide your palm from the ASIS closest to you around the back to the posterior pelvic crest. Move your hand from the posterior crest forward and place your palm on the ASIS. Repeat the rotation, this time in the opposition direction.

   Before proceeding, Position the pelvis in the best "corrected" position possible. Record findings about pelvic mobility on assessment form.

B. Check hip flexion in supine while palpating the pelvis in the best corrected position.

1. Hip Flexion with stable pelvis. Kneel next to the person. With your hand, which is closest to their head, hold the pelvis. Thumb on ASIS, web space and index finger on crest. With the your other hand hold the back of the leg closest to you, under the knee and flex at the hip. As you move the hip toward 90 degrees of flexion, slow down. Concentrate on your thumb and index finger, when you feel movement of the pelvis under your thumb, stop and observe the amount of hip flexion. Repeat the movement starting back with 45 degrees of flexion and slowly flexion until you feel the pelvis start to "rock". Record results on form.

Move to the other side of the body. Find and hold the ASIS and pelvic crest. Position your arm under the knee closest to you and repeat the procedure. Record results on form.

C. Knee extension with the hip flexed

1. Hamstring range - 2 joint muscle.
   Maintain your position kneeling next to the person. Hold the ASIS and the pelvic crest with the hand closest to the person's head. Slide the other arm under the knee and wrap your hand onto the knee cap, your elbow and forearm should be supporting the lower leg. Flex the hip to range available, without pelvic rocking. Now extend the knee by pushing the knee cap and extending your elbow toward the ceiling. As the knee extends, concentrate on any movement you may feel under your thumb, indicating the pelvis is being pulled into a posterior tilted position. Record your findings on form.

   Move to the other side and repeat the procedure. Record.

D. Hip abduction /adduction and rotations

1. Start with one leg extended on the mat.
   Flex the other leg at the hip and the knee.
   With a flexed hip, slowly abduct the hip and then adduct. Return to a midline position and rotate the lower leg, internally then externally.
   Caution: Subluxed or dislocated hips often have limitations in joint range, especially in abduction and possibly external rotation. Record findings on form.

   Move to the other side of the body and repeat both procedures with the other leg.

   If the person naturally assumes a windswept deformity, it is critical to determine the available passive abduction and adduction range, and not position the hip into a neutral position, if range is not available.

E. Ankle and Foot position:

   Can the foot be positioned so that the sole of the foot is a weight bearing area. If foot deformities prevent the sole from being a weight bearing area, determine which part of the foot will need to be supported while in the sitting position. Holding a "corrected" foot position is most often best accomplished with an orthotic and not from extensive modifications to the footrests.

3. Skin Inspection
   A. Check all weight bearing areas
      1. Note areas of persistent redness
      2. Note size, shape and location of any open areas
      3. Determine mechanism of trauma:
         a. pressure
         b. shear
         c. moisture

Sitting - up: Integrate findings from supine evaluation into supported sitting

4 Sit the individual up against gravity.
   A. Assist the person to assume a sitting position over the edge of the mat. Ask to remove a shirt (or at very least lift the back of a shirt to see spine and pelvis. Position yourself behind the person, placing your legs on either side of theirs and provide pelvic support with the inside of your thighs.

   Position the hips in the available amount of flexion found during the supine eval. Let knees flex under the mat, if 90 degrees of flexion is not available with hips flexed.

   Palpate spinous processes from cervical through sacral regions.

   1. Mobility of lumbar spine
   2. Scoliosis - flexibility
   3. Kyphosis - flexibility
   4. Hyperlordosis - flexibility

5. Determine location and amount of support to achieve and hold balanced position.

   1. Maintain your leg position to provide pelvic. Position your hands on the trunk to provide support and trunk control, then observe:

      A. Head position
      B. Upper/lower extremity position
      C. Effect of tilt or recline

   2. Determine whether you are able to "correct" into a desired position or are you accommodating a fixed position. How much force are you hands and legs applying to the person to hold this position? (Minimal, Moderate, Maximal force).

3. Can you find a "mutually agreed" position? A position which allows the person to be relaxed, functional and feel well supported. Can the person or their caregivers get them into this position?

6. Record observations - See Evaluations Findings.

7. Put it altogether

   A. Is the pelvis flexible or is it fixed in a position?
      1. Will your intervention need to reduce a flexible deformity or accommodate a fixed deformity?

   B. Think about the recorded hip range in terms of the angle between the seat surface and the backrest.

   C. Do the hamstring muscles have enough flexibility to allow the feet to rest on standard foot plates?

      To keep the hamstrings on slack, will the footplate need to be closer to the front edge of the seat?

   D. Are the spinal curves flexible or fixed?
      1. Will your intervention need to reduce a flexible deformity or accommodate a fixed deformity?
      2. How much support is needed to maintain the agreed upon position?
      3. Where will the supports need to be located?

Seating Evaluation Findings

Supine Assessment

1. Pelvic Tilt:
   - Neutral achieved ☐
   - Fixed Posterior Tilt ☐
   - Fixed Anterior Tilt ☐

2. Pelvic Obliquity
   - Neutral achieved ☐
   - Right Higher ☐
   - Left Higher ☐

3. Pelvic Rotation
   - Neutral Achieved ☐
   - Right side forward ☐
   - Left side forward ☐

4. Hip Flexion
   - Right ____ degrees
   - Left ____ degrees

5. Knee Extension
   - Right ____ degrees
   - Left ____ degrees

6. Hip abduction / adduction
   - Right, neutral achieved ☐
   - Right, _____________ (ab or adducted) ☐
   - Left, neutral achieved ☐
   - Left, _____________ (ab or adducted) ☐

7. Foot Position
   - Right: Weight bearing on sole ☐
     - Medial weight bearing ☐
     - Lateral weight bearing ☐
     - Weight bearing on toes ☐
   - Left: Weight bearing on sole ☐
     - Medial weight bearing ☐
     - Lateral weight bearing ☐
     - Weight bearing on toes ☐

8. Describe Supported/ corrected Upright Sitting Position:

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1. Wheelchairjunkie.com
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Using a Planar Seating Simulator as Part of a Comprehensive Wheelchair Seating Assessment

Kelly G. Waugh, MA, PT

I. INTRODUCTION

A commercial planar seating simulator is an incredible tool, one which can increase your creativity and problem solving during a wheelchair/seating assessment, improving the accuracy of your planned seating interventions, and improving the success that those interventions will have in meeting the functional and therapeutic needs of the client.

The use of planar seating simulation is extremely useful with individuals who have moderate to severe postural and orthopedic dysfunction, or individuals who are difficult to support in a sitting position on the edge of a mat table due to extremely poor sitting balance or postural insecurity.

Using a planar seating simulator allows you to focus on the person, not the products. By seating the individual on neutral, flat surfaces, you eliminate many of the numerous variables which can affect how a person is sitting. This allows a more objective, analytical approach to problem solving, as you start with simple flat surfaces at certain angles and dimensions, then systematically make changes or add components and features – even placing commercial products onto the simulator – to more accurately determine which features are having a positive vs. negative affect on the person's posture, comfort and function.

It is important to remember that seating simulation is only one component of the seating evaluation. It must be preceded by a thorough client interview and a hands-on mat examination.

II. ASSESSMENT PROCEDURES TO COMPLETE PRIOR TO DOING PLANAR SEATING SIMULATION

A. CLIENT INTERVIEW

1. Gather background information
2. Observe individual in current seating equipment
3. Set preliminary goals (for seating and for mobility)

B. MAT EXAMINATION

1. Assess muscle tone, movement patterns, skeletal deformity and range of motion limitations as they relate to sitting
2. Determine fixed vs. flexible components of all postural deviations, gravity eliminated. More specifically, you need to observe and note how active movement or passive change of limb position in one body segment can affect the posture, orientation or tone of another body segment, especially the pelvis and spine
3. Obtain preliminary angular and linear body measurements. Most critical to obtain for accurate simulation are:
   *range of motion at hips, knees and ankles, for the 3 key seating angle measures
   *thigh length, for seat depth measurement

C. WHAT IS YOUR PRELIMINARY POSTURAL PLAN?

From information gathered so far, you should be able to determine a preliminary postural plan, which you will try out and finalize during seating simulation with planar surfaces.

Postural Alignment Plan: How does this person's lower extremities need to be aligned in order to achieve the maximum alignment in the pelvis/spine, trunk/head? What is this person's best potential for alignment, gravity eliminated? Based on your mat exam, what are the desired/optimal body segment angles in sagittal plane? (Thigh/Trunk Angle, Thigh/Leg Angle, Leg/Foot Angle). You will use these numbers to set up the seating angles on your simulator.

These three angles -
Seat to Backrest Angle, Seat to Legrest Angle and Legrest to Footrest Angle - will need to be individualy determined for each person, based on several variables, the most important of which is

joint range of motion. Your planar seating simulation will help you finalize these angles. The following chart summarizes how joint range of motion information is translated into these equipment angles

	Joint Motion		Body Segment Angle		Equipment Angle
ANGLE	Hip Flexion	→	Thigh to Trunk Angle	→	SEAT TO BACKREST ANGLE
	Knee Flex/Ext	→	Thigh to Calf Angle	→	SEAT TO LEGREST ANGLE
ANGLE	Ankle DF/PF	→	Calf to Foot Angle	→	LEGREST/FOOTREST ANGLE

III. PLANAR SEATING SIMULATION

In what position/posture/orientation in space is the individual going to be the most comfortable, safe, healthy and functional? And what type of support surfaces are necessary to achieve this optimal posture? Using a planar simulator will help you determine this more accurately and efficiently!

A. What is PLANAR SEATING SIMULATION?
   1. Assessment of client in sitting position using planar surfaces to help simulate the desired sitting posture using a minimum of seating equipment variables initially. This is different than product simulation.
   2. A commercial planar seating simulator is a device which is adjustable in all surface angles, dimensions and tilt in space, with various adjustable support pieces available for trial. The primary support surfaces are planar, meaning without contour.

B. Benefits OF planar seating SIMULATION
   The purpose is to simulate the desired sitting position (or help determine the desired sitting position) in order to further define needs, objectives and final equipment properties. You've done your mat exam; now you will be looking at postural alignment, motor control, function and comfort, with the addition of two factors: gravity and some simple support surface intervention.

   1. More accurate assessment of consumer's postural potential and objectives, as well as specific seating equipment properties required. By simply seating someone on flat surfaces set up with critical equipment properties such as seat to backrest angle, seat to legrest angle, tilt, seat depth, etc, you can significantly change someone's posture. You can get the individual well stabilized and aligned at the pelvis and trunk, which then allows you to more accurately assess motor control, functional potential, the need for peripheral components and the required properties of support surfaces. Is has been my experience that a client's postural response to firm, non moving surfaces is very different to their response to examiner's hands offering support while seated on the edge of a mat table. This provides a more "real" assessment of their postural potential.

   Changing the position and orientation of an individual's body segments, with respect to each other and with respect to the ground, changes the contours of the posterior surfaces of the body (especially with orthopedically involved individuals), so it is critical to determine this desired alignment PRIOR to making decisions about the placement and shape of supporting surfaces. (This is why I feel strongly that it is important to also do a planar simulation prior to doing a custom mold.)

   Use of a simulator also facilitates the problem solving process because you can vary the properties of the system easily and quickly, and then actually observe the client's response (and ask their opinion!), thus assessing and comparing the effectiveness of different system parameters (such as angles, tilt, types of surfaces, etc).
   2. Increased accuracy of final measurements: The simulator also assists in accurately translating the individual's angular and linear body measurements, support needs, therapeutic and functional objectives into finalized equipment properties. Taking measurements directly from a simulator with desired components in place, set up with consumer sitting in desired position/posture, increases the accuracy of critical linear, angular and placement dimensions, and helps to communicate these dimensions accurately to technicians responsible for setting up the new seating system.
   3. Increased consumer satisfaction: Consumer can "feel" various positions/postural options, as well as certain postural supports, and is able to give critical feedback, becoming a more active and informed participant in the decision making process. Consumers and

caregivers can see/feel responses, can better understand the pros/cons of various seating strategies and their rationales, and make a more informed decision about seating system parameters being recommended.
4. Increased accuracy can save time and money: Increased accuracy up front during evaluation will decrease time spent on adjustments and modifications later in the process.
5. Helps with justification for funding: You can take photos of individual in the simulator, showing improved posture over current seating, and you can better delineate specific postural objectives and the rationale for recommended seating components, adjustments or modifications.

IV. PROCEDURE FOR PERFORMING PLANAR SIMULATION USING A COMMERCIAL SIMULATOR

A. SET UP SIMULATOR
1. Set primary seating angles according to mat exam measurements (Seat to Backrest Angle, Seat to Legrest Angles R/L, Legrest/Footrest Angles R/L)
2. Set seat depth (according to thigh length or "available sitting depth" measurement if need to be windswept)
   Hint: it is much better to start with seat depth too short, to make sure you can get good control posterior to pelvis. So err on side of being too short rather than too long
3. Adjust panels to achieve approximate back height
4. Will you need a piece of foam on seat? (for increased comfort or if person is at risk for skin breakdown)
5. Start with biangular back adjustment flat
6. Attach a headrest if needed
7. Have accessory lateral components organized on table so can access quickly

B. ASSIST then POSITION CLIENT IN SIMULATOR
1. Position pelvis into person's optimal alignment (as determined during mat exam) and attach pelvic positioning belt
2. Stabilize feet on footplates; adjust to achieve desired lower extremity alignment, based on mat exam findings
3. Adjust seat depth if necessary
4. Starting at pelvis and moving down, then up, sequentially, apply support pieces as necessary to achieve stability and optimal alignment. Allow time for postural adaptation before adding more supports. Experiment with different positions, orientations, angles, secondary components, and surface properties in order to finalize postural and functional objectives. Finalize primary seating angles and dimensions first, then move on to problem solve about need for secondary surfaces and other surface properties needed, such as contour.
   In what position/posture/orientation-in-space is the client going to be the most comfortable, safe, healthy and functional? Where is surface contact needed to achieve postural objectives? Where are the key points of control? What is the shape of that body area? How much contact is needed? How much, if any, contour is needed? Is custom contour needed?

C. Follow this general procedure when experimenting:
1. Observe:
   tone and movement, alignment, function
2. Ask:
   Ask client how they feel, thoughts/ideas; Ask caregiver how they think person looks/feels (if client is non verbal)
3. Put Hands On:
   to learn more about tone, movement, pressure at contact surfaces, forces client is generating, etc.
4. Apply interventions: (change properties)
   First simulate surface support with your hands, then simulate with equipment surfaces, additional simulator components, foam pieces or wedges
   – in a systematic manner so that you can accurately assess the affect of different parameters

Sample Parameters to Vary:
- Angles between primary surfaces (the 3 seating angles)
- Orientation in space
- Support surfaces - Add or take away primary or secondary supports
- Placement of support surfaces, for example, attachment point of straps to alter angle of pull, moving thoracic supports up/down, adjusting lateral/medial knee supports or pelvic supports, headrest placement

- Type of support surfaces: planar, contoured, molded; different headrests, etc
- can also compare/contrast different commercial seat cushions in simulator, once other parameters are set
  5. Observe response:
     Changes in posture, tone, movement, alignment, function (such as UE movement, head control, switch access, breathing, swallowing, etc
     If client is verbal, ask how they feel! Get input from caregivers.
  6. Problem Solve:
     What are the sources of the problems seen initially in existing equipment?

Remember to compare postural alignment/correction achieved during simulation to alignment achieved in supine mat exam. Are we getting the same amount of correction achieved on mat? Less? More? Why?

V. FROM OBJECTIVES TO PROPERTIES TO PRODUCT

A. REFINING OBJECTIVES AND PROPERTIES

It helps to start articulating specific objectives during simulation...Refer back to the team's preliminary goals, and begin to set specific objectives as you determine the source of problems (What are we trying to do here???...How are we preventing the extensor thrust?)

Should be an active problem solving process. Articulate to team members what you are trying to achieve with each surface, angle, adjustment and generate discussion. Solicit opinions from all team members - everyone has a unique and valuable viewpoint

Objectives can be related to
- Positioning and alignment of body; range of motion issues
- Motor control, movement patterns, muscle tone and abnormal reflexes
- Health (skin breakdown, breathing, swallowing, etc)
- Social/Emotional/Behavioral issues
- Functional tasks and abilities
- Environmental issues, including caregiver needs

To help you to formalize client seating objectives and properties, ask yourself these questions:
- In what areas of the body does client need stability, and where does he/she need mobility?
- What movements do we want to prevent, or discourage?
- What movements do we want to allow, or facilitate?
- What functional abilities do we want to preserve, improve, or facilitate acquisition of ?

Support Surface Properties
The following properties need to be considered when determining desired support surface parameters:
- Surface shape (or profile)
- Surface firmness and/or flexibility
- Dimensions
- Placement
- Attachment features

Always review agreed upon objectives and properties at the end of session with client and team! After team is satisfied with the posture and all seating parameters have been determined, final seating angles, dimensions and support surface placement dimensions are measured directly off the simulator or simulated equipment surfaces for accuracy, and documented on a measurement form.

B. From seating properties to products:

Once the properties needed in the postural support system have been determined, these are then "translated" into a specific choice of seating product or product components, either commercially available or custom fabricated components

Hint: Resist the urge to start talking about products too soon! Describe what is needed (talk in the language of "properties"), then discuss what products have the desired features.

Multiple Sclerosis – Seating and Mobility Concerns for Changing Needs

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Wheelchair positioning and mobility is a high priority for individuals with multiple sclerosis (MS). Individuals with MS experience many changes over a period of years. Systems need to be adjustable to accommodate the changes. Areas of concern include increased muscle weakness with increased postural changes especially in the head/neck and trunk, increased tone that effects upper and lower extremities, increased memory loss that effects mobility, increased/decreased sensory awareness that effects ability to delineate pain and discomfort and psychological impact of the disease.

This course will review the pathology of MS and specific issues that effect the person with MS. Seating interventions will be discussed from basic manual mobility to power wheelchairs with tilt and head control systems. The methods for modifying systems as person changes will be investigated. Equipment maintenance and wheelchair positioning in both home and facility settings will be discussed.

Muscle Weakness and Fatigue

Muscle weakness and fatigue have a major effect on a person with MS. As the individual loses strength and functional abilities, dependence on mobility equipment increases. As a person loses upper extremity function, the need for power mobility increases. Power mobility may assist the individual in conserving energy and decreasing fatigue. If the person is also demonstrating a loss in trunk and head control, a tilt in space system may be necessary. Most individuals start driving a power wheelchair with their hand. If they lose this ability, they may need to be evaluated for a head control system or a sip'n puff system. Electronic equipment on the power wheelchairs should be adjustable to meet the person' changing needs.

Tone Management

Many individuals demonstrate varying degrees of difficulty with managing involuntary muscle contractions. Spasticity can affect both upper and lower extremities and trunk. Range of motion may be difficult to assess and actual shortening may not be present. However, even without range limitations, an individual' movement pattern will effect posture and function in their wheelchair and accommodations need to be made to the seating system.

Medications are frequently used to reduce spasticity including but not limited to: baclofen, zanaflex,, botox and phenol blocks. Knowledge regarding the various types of medication intervention is important for a better understanding of short and long-term effects. Possible changes with medications include reduction of pain, increase in range of motion and decrease of muscle spasms. Although medications may make a big difference in spasticity management, wheelchair seating should be able to accommodate limitations associated with the spasticity. For instance, prior to medication, an individual demonstrates limitations in movement for knee extension and requires a seat to calfrest angle of 75°. After medication, the same individual now requires a seat to calfrest angle of 90°. The seat to calfrest angle should be set at 90° with flexibility provided to shift the footplates rearward in the future to accommodate increased tightness/tone over time depending on the overall problems that the individual presents and the type of medication being used.

Cognitive Issues

Cognitive impairments affect up to 50% of people with MS. The most common types of impairment include delayed information processing, difficulty maintaining attention, impaired recent memory and reduced ability to reason, problem-solve, plan and sequence actions. Some individuals benefit from cognitive retraining and specific cues for remembering. Many others can not be assisted in this area.

Cognition impacts wheeled mobility. For instance, an individual may be capable of propelling a manual wheelchair but “forget” that she can reach down and complete the task. This person should be verbally encouraged to move the chair and may always require cues. Power mobility may be appropriate for an individual with increased upper extremity weakness but a careful assessment must be completed to ensure the individual is a safe driver. Since MS is a changing condition, reassessment of cognitive skills may be needed if individual begins to demonstrate poor driving skills. The person may "forget" how to stop the wheelchair or how to avoid other people in wheelchairs. Retraining or removing driving privileges may be necessary. Safety needs to be a priority so no one is harmed.

Psychological Impact

MS effects a person' quality of life. People diagnosed with MS pass through typical stages of grieving including denial, anger, frustration and depression. Although technology can improve a person' quality of life, psychologically, the person may not be ready to accept the technology. As the needs of a person with MS change: walking independently —› walking with cane or walker —› manual mobility —› power mobility so to does the acceptance of the various types of equipment. The diversity of equipment and the ability to trial equipment assists individuals with acceptance but the process may take many months or even years.

Pain Issues

Individuals with MS (up to two thirds) exhibit some type of pain during the course of their disease. The most common types of episodic pain include trigeminal neuralgia, paroxysmal limb pain and headache. The most common types of chronic pain include dysesthetic extremity pain and chronic back pain.

Trigeminal neuralgia is pain occurring along the distribution of a peripheral nerve, specifically the 2nd and 3rd divisions of the trigeminal nerve that innervates the face, cheek, and jaw. Paroxysmal limb pain is a burning, aching or itching of very short duration that most often affects the extremities. Dysesthetic extremity pain is a burning, prickling, tingling, tight, dull, or warm type of pain that is persistent and usually affects the legs and feet but may also involve the arms and trunk. Chronic back pain is usually associated from the mechanical stress put on muscles, bones and joints from the disability.

It is important to determine the source of the pain to ensure appropriate medication or wheelchair modifications are performed. If a person complains of foot pain, the footplate position and shoes must be assessed to determine if this is the cause of the pain and modified accordingly. However, many times the seating position is appropriate and is not directly related to the pain. In those cases, the individual is referred to the doctor for further evaluation and medication.

Weight Changes

Individuals with MS frequently gain weight when they become dependent on a wheelchair for mobility. The weight gain may be associated with decreased activity level (due to decreased strength/ function), medication and/or fluid retention. The increase in weight effects the person' width and fit in a wheelchair. Wheelchairs may have been ordered with a fixed width since growth was not expected and a new system would need to be purchased to accommodate the changes. Consideration of possible weight changes needs to be included in the prescription of equipment.

Pressure Sores, Urinary Tract Infections, Incontinence

Management of these areas is a combination of good positioning and good nursing. Areas of concern to prevent the development of pressure sores and urinary tract infections include position in bed or in wheelchair, nutrition, hydration, infection control procedures and types of padding for incontinence problems. The type of seat cushion and amount of incontinence padding under a person' buttocks and the degree of moisture will effect the development of pressure sores and comfort. Chronic incontinence needs to be assessed medically to determine appropriate management of bladder symptoms.

Vision Loss

Visual difficulties affect 80% of people with MS. Optic neuritis (inflammation of the optic nerve) is characterized by unilateral vision loss, sequential involvement of opposite eye, visual field defects, diminished color perception, pain in or around the eye or visual phenomena.

Loss of vision can increase the difficulty of driving a power wheelchair but does not eliminate a person from driving. It is important to determine if the person has functional driving vision. This entails knowing if the person is able to see the shape of another person or wheelchair and differentiating the walls and door openings for indoor driving. Outdoor driving skills include the ability to differentiate curb cuts from the curb and to be aware of the potholes in the road as well as car traffic. The person with visual loss needs to be observed to ensure they are safe drivers. Some individuals are safe in an indoor setting but have difficulty when out in the community. Limitations on locations to drive may need to be enforced to ensure safety.

Speech Loss
Diminished speech volume or loss of speech can make communication very difficult for people with MS. An evaluation for a voice amplifier or augmentative communication devices should be completed with recommendations for an appropriate means for transporting the device on the wheelchair.

Equipment Maintenance
Power equipment maintenance is a very important issue. Problem areas include module failure, joystick failure, motor failure, tilt failure and battery failure. Individuals residing at home may need to wait from 1 week to 3 months for repairs to occur. Individuals residing in a facility will wait just as long for the repairs but may have better access to temporary repairs, loaner power equipment or loaner manual equipment. This is critical to an individual who is dependent on their equipment to get out of bed and have mobility throughout the day.

Charging power wheelchairs is the responsibility of caregivers. In a home setting, consistency of caregivers can ensure charging of systems and determining quickly if there is a charging problem. In a facility setting, training is imperative to ensure caregivers are charging chairs properly on a regular basis. Damage to charger cords can be a problem due to multiple users. Notifying appropriate personal quickly when chair does not charge properly can make a big difference in the amount of down time a person experiences while waiting for wheelchair repairs.

Wheelchair Positioning
Positioning an individual properly in their wheelchair is a constant challenge. Consistency of caregivers and the ability of the caregiver to understand the positioning needs of an individual are extremely important for the comfort of the individual. In facility settings and at home, positioning training is very important for carryover on a daily basis. Improper positioning increases fatigue, pain and functional abilities and good positioning is an ongoing challenge.

Summary
People with MS experience many changes over their lifetime, sometimes dramatically and other times extremely slowly or not at all. It is important that this population has a good network of doctors, nurses and therapists to assist them during times of change especially if the individual is residing at home. In facilities, individuals have direct access to professionals. This can assist in timely reassessments for new problems that arise and modifications to seating and mobility equipment to ensure safety, comfort and continued independence in wheelchair mobility.

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Funding: The Challenges and Techniques for Success for All

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Securing funding is every bit as difficult and challenging as determining what equipment will best meet a consumer's needs. Actually, in many ways it can be more difficult. As the technology continues to improve, the rules of the funding game continue to change. Each year there is a new array of manual wheelchairs, power wheelchairs, seat and back supports and alternative control systems.

The options available to the physically challenged consumer are vastly improved from ten years ago. Think about that. In 1993, titanium wheelchairs were unheard of in the common market. If available, they would have been considered a "luxury" item or labeled a "sports chair". In the 1980, many Medicaid offices considered any rigid frame chair a "sports chair". Today, many consumers receive rigid wheelchairs as their initial mobility device and Medicaid is funding some titanium chairs... with the proper justification, of course!

In 1993, belt driven power chairs were still a standard for the majority of manufacturers. The majority of power chairs available had cross braces and belts and pulleys. Today, power bases with modular designs and various seat systems are standard.

If the equipment is so much better, why is it so hard to get approvals?

Technology has certainly changed all of our lives. It has created options and opportunities for many of the consumers we work with. At the same time, many consumers who need rehabilitation technology have limited access due to funding constraints. Some insurance companies do not fund any medical equipment. Some insurance policies allow for "one wheelchair per lifetime". We are dealing with a healthcare system designed to serve health people who may become ill but will definitely "get better". Our healthcare system is not designed to meet the needs of life long rehabilitation based consumers.

The U.S. healthcare system does not value "mobility". The same insurance that will deny payment of a K-14 power wheelchair at $18,000.00 will pay for a lower extremity prosthesis at $65,000.00 to $85,000.00 each. Why? Because the U.S. healthcare system values walking. The orthotics and prosthetics industry has fought long and hard to be licensed and recognized as professionals who provide a medical and technical piece of equipment.

In the re/hab industry, we are not licensed as professionals who are providing a medical and technical piece of equipment. We are taking the initial steps to validate our specialty with RESNA certification for ATP (assistive technology professionals) and ATS (assistive technology suppliers) and with NRRTS membership and the required CEUs for yearly renewal. But we have a long road ahead. We constantly have to prove who we are and what we do. Each time we evaluate a consumer and spec out a mobility base and/or a seating system, we must include a careful summary of the process and explain the need as well as the rational.

What to include in a letter of justification

Demographics: Include the consumer's name, age, primary diagnosis, height and weight. Be sure the social security # is in plain view at the top of the letter and at the top of each page. Include the Medicaid ID # if applicable.

Medical history: Primary and secondary diagnosis. Include any diagnosis that is relevant to the seating and mobility needs and describe the condition. Is the consumer ambulatory? If so, document distance, assistive device and the amount of assistance required. This can be a critical point for Medicare recipients who may be considered ineligible for a wheelchair if they ambulate with any level of independence at home. List orthopedic changes/ deformities. List specific joint range of motion limitations that pertain to seated positioning and/or functional operation of the wheelchair. Limitations of strength (as it pertains to operation of the wheelchair). Skin integrity: include history of and current pressure sores, size, stage and location. Pictures are always helpful.

Current equipment: Manufacturer and model, including serial #, when purchased and what supplier provided it. Describe what is wrong with current equipment. It is not enough to say “inappropriate” or “does not fit”. Be specific. If the consumer has gained or lost weight, state what has happened and why, if possible. Example: “weight gain of 30lbs. due to steroid treatment for MS exacerbation” or “PEG tube placement for nutrition due to inadequate oral intake, resulting in weight gain of 28 lbs. in three months”. If the client has grown, reference documentation (if available) for height. Also, prior measurements for a seating evaluation can be referenced. Can existing equipment be “grown” to accommodate changes in size? This is an important point. Some funding sources may ask for quotes for changes to an existing wheelchair and for a new chair. These costs might not be that different, especially if the labor time required to “grow” the frame is included as a cost.

Consumer’s needs. (Also known as Goals of the intervention): What should the new wheelchair or seating system do? Is the goal to increase the client’s time out of bed? Achieve independent mobility? Decrease the occurrence of pressure sores? This can be simply stated “At this time, John Doe requires a new power wheelchair with a tilt in space seat for independent mobility and independent pressure relief at home and school”.

So far, so good...
At this point, the need for equipment has been established. Now it’s time to describe how the recommendations were determined. It is important to document and reference this process. For manual wheelchairs, evaluating various weight wheelchairs demonstrates an attempt to determine the least costly alternative that will meet the consumer’s needs.

For example: “Jane Doe was evaluated with a standard weight manual wheelchair (list manufacturer and model) which she was unable to propel. A lightweight manual wheelchair (list manufacturer and model) was evaluated, however Jane Doe could not propel on the carpeted surfaces within her home. An ultra lightweight manual wheelchair (list manufacturer and model) with an adjustable axle set in a forward position (note amount) was evaluated. Jane Doe demonstrated independent mobility throughout her household on all floor surfaces.”

Describing all items tried and the outcome with each will help explain why the less expensive item won’t work... and that is ultimately the key. Document and state the items you are recommending are the least costly alternative that will meet the consumer’s needs.

Keep in mind – all third party payers are trying to pay the least amount possible. Medicaid is government-funded insurance (made up of both state and federal funds) for the indigent. Medicaid does not want to buy the “Cadillac” of wheelchairs; they want to buy the “Yugo”. It is the responsibility of the team members to combine their efforts and explain why the consumer needs a particular device and how it will meet their needs.

List each component and justify it’s provision: Beginning with the base or frame, list each item and why it is necessary or it’s purpose in relation to the overall seating & mobility system. List the manufacture and frame style, dimensions of the seat, armrest style, lower extremity support option, back support, wheel locks, anti tips, rear wheels and push rims, casters, seat surface, additional positioning devices. It is helpful for the letter writer to reference a copy of the order form so as to include all necessary items and to present similar components together. For example;

24" Mag wheels with pneumatic tires and flat free inserts are required as the rear propulsion wheels on the chair. These wheels are selected as a low maintenance option due to Mrs. Doe’s inability to perform pneumatic tire maintenance. The treaded surface of these tires is necessary for mobility on carpeting within the home environment. Plastic coated handrims are required due to Jane’s decreased hand function. The coated rims are necessary for her to propel the wheelchair on carpeted surfaces within her home.

Certainly, the more complex the technology, the more detailed the justification letter. Power equipment has the addition of electronics and control interfaces as well as various power seat functions such as tilt in space or reclining seat systems.

In Conclusion... End the justification letter with a brief summary of the client's need and the alternative to the equipment being requested. If the consumer is nonambulatory and does not have a wheelchair, the alternative might be "confinement to bed". If they previously utilized a lightweight manual chair and their status has changed, the alternative to a power chair might be "dependent for all mobility. The involved team members should sign this letter, with the doctor's name listed first.

Dos and Don'ts for funding

Medicare has possibly the most rapidly changing rules for funding. For years one of the quickest ways to have a wheelchair denied was to include justification for mobility outside the recipients home. Medicare's guidelines had become very specific for the mobility device to be a covered benefit for household mobility only. However, during 2002, there were specific requests for information pertaining to advanced activities of living outside the home in consideration for funding of K-0005 (ultra lightweight manual) wheelchairs in Region B. For other manual chairs and power chairs, the requirements remain the same: medically necessary for household mobility only.

It is always better to make the initial submission as comprehensive as possible. The best chance for approval is with a well-documented summation of the evaluation, needs, simulation and recommendations. Requests for additional information are time consuming. Denials are frustrating and appeals are costly. All involved team members should be willing to participate in the appeal process.

Do not use generic letters! Letters should be consumer specific.

Use pictures to support your request. Photos of pressure sores, orthopedic deformities and even current chair vs. assessment or trial chair if it illustrates change. This is a powerful tool and it makes the claimant more "real".

Know your audience. Medicare is very black and white. (Someone meets the criteria for a powered mobility device or they don't). Medicaid is many shades of gray.

Be careful about "loaner" and "rental" equipment. Providing a discharge chair on loan pending authorization for definitive equipment is one thing. If a supplier submits to Medicaid for rental of that equipment, the perception is that the rental equipment is adequate to meet the consumers needs. For example, a C-7 level SCI client is discharged from the rehab hospital and the supplier provides a Breezy pending authorization for the GPV prescribed. If the supplier bills Medicaid for rental of the Breezy, the GPV might be denied since the consumer has been able to "use" a lesser chair. Clinicians should ask if the supplier plans to bill for rental or wait for authorization.

"Plan B" - Alternative funding sources in your state or community which may assist with funding, especially co-payments.

A follow up picture of the consumer in the definitive product with a sort of "thank you note" will allow funding source to see a glimpse of the good that comes from approvals.

Resources

Financing Assistive Technology – A Handbook for Rehabilitation Professionals.
The George Washington University Regional Rehabilitation Continuing Education Program. 2nd Edition, spring 1998.

MEDLINE www.nlm.nih.gov

Sensation, Sensory Processing, and Seating and Mobility Systems

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Course Outline

I. Introduction

A. Definition of Terms

1. The Senses
    a. Five, usual: Taste, Touch, Sight, Hearing Smell
    b. Others needed: Proprioception, Balance & Equilibrium

2. Sensation
    a. Deep Pressure (pressure over or around joints/girdles)
    b. Vibration (tested with actual vibrator)
    c. Pain (pin prick)
    d. Temperature (hot/warm; cold/cool
    e. Light Touch (feather)
    f. 2 point localization (tool similar to a drawing compass)
    g. Stereognosis (recognizing familiar objects in hand with eyes closed)
    h. Proprioception (verbally describing upper extremity's position with eyes closed, or imitating posture of one upper extremity which therapist moves with opposite extremity)

3. Visual-Motor; Perceptual-Motor; Sensorimotor
    a. Spatial Relationships, Visual Discrimination, Figure-Ground Visual Closure, Visual Memory
    b. Perceptual-Motor, Balance and Posture, Body Image & Differentiation

4. Neurodevelopmental Treatment (NDT)
    a. Cephalo-caudal development
    b. Key points of movement; Shoulder and Pelvic girdle
    c. Co-contraction
    d. Co-activation
    e. Developing righting and equilibrium by inhibiting primitive reflexes

5. Focus of Characteristics of Motor Behaviors
    a. Initiating and Isolating independent movements/Voluntary control
    b. Simple Transitions
    c. Complex transitions

6. Endurance and Fatigue

B. Sensory Integration

1. Tactile Sense
2. Kinesthetic/Proprioceptive Sense
3. Positioning/Vestibular Sense
4. Coordinated Visual Sense
5. Motor Planning, how sensory system is more important

C. Some Characteristics/Behaviors within Sensory Systems

1. Tactile System laughs readily, too often or too high (?hysterical) fears movement, extra sensitive to unfamiliar adult's handling doesn't eat for some adults has strong preferences for textures, including food & clothing extra sensitive to temperature "tactilely defensive"

2. Tactile/Kinesthetic Patterns intact, defensive, neglectful of body part, collapsing trunk upon touch, overly sensitive to single touch in single spot

3. Proprioceptive System can test, cannot test observed while weight bearing

4. Tactile/Kinesthetic/Proprioceptive Processing posturally not upright; Postural Insecurity overly sensitive to handling collapses into caregiver when assistance provided over-targets or under-targets with extremity (foot while ambulating, hand while feeding) found leaning to one side or the other most often slow to weight-bear upon initiation of motor act repeated, obsessive touching of self

5. Vestibular processing and Equilibrium Reactions poor balance when sitting or standing found leaning to one side or the other most often afraid of quick movements, worried with transfers unable to right self, without visual cues from a mirror
   holds shoulders behind pelvis
   holds trunk and head in extension, with pelvis fixed and posterior tilt

6. Motor sequencing
   unable to complete a functional motor act
   completes motor act with assistance, never does independently
   resists activity
   seems confused about routines
   can complete task with repeated practice
   inconsistent behavioral performance

E. Physiological Process of movement
   1. Initiation of motor acts, new patterns vs. automatic ones

   2. Transitional patterns, a precursor to isolation of movement

   3. Equilibrium reactions and postural security (a personal relationship to gravitational forces) are developed through active/ dynamic and independent movement, & are dulled by lack of movement.

   4. Impact of independent mobility & cognitive exploration & understanding

   5. Stability, is an active "holding on"

   6. Consistent process of movement based on sensory-motor information

   7. Importance of routines, for predictable anticipation of motor acts

   8. Importance of novelty, for consistency development

   9. Repetition of act. vs. repetition of activity

   10. Isolated patterns develop through functional demand and use (cognitive and emotional),NOT from "motor" or "visual-motor"practice.

III. Intervention/Treatment Strategies

A. Observation
   1. Postural Insecurity
   2. Interest of Activities
   3. Independent control

B. Seating and Positioning
   1. How many seats/positions experienced?
   2. How do transitions occur?
      a. Adult physically managed
      b. Adult verbally managed
      c. Communication initiates, child directed
      d. Child managed
   3. Play equipment vs. Work/Travel Equipment

C. Mobility
   1. In what situations
   2. Powered chair/mobility within activity

D. Seating Changes to be made
   1. Treatment Techniques
   2. Sensory Integration/Postural Insecurity
      a. Use of Anterior Tilt
      b. Use of "Barrier" Plastazote vest
   3. Understanding the Child's Use of her Tone/ especially "driving from thepelvis"; pushing against headrest/footplates; extensor "thrust/ spasm"
   4. Knee support
   5. Working with child OUT of chair
   6. Adding seating changes to specific task participation
      a. High interest tasks
      b. Everyday, functional tasks (eating/ transfers)
      c. Developing Seating Tolerance

IV. Shared Case Studies

Interesting Further Reading:

This is not a bibliography, as I have shared with you, instead my own understandings and musings as a treating therapist who has had so many wonderful children as a part of my clinical life. However, I do attempt to base my observations, thoughts, and attitudes not only on experience but also on current and past readings, and studies of others. These books I have found particularly helpful to me, I offer them to you for further study yourself, if you so choose. This is by no way a comprehensive list, but rather a good beginning.

1. Sensory Integration and learning disorders by A. Jean Ayres, copyright 1972, Los Angeles: Western Psychological Services
2. Any other book or article written by A. Jean Ayres
3. Sensory Integration, Theory and Practice by Anne G. Fisher ScD, OTR, Elizabeth A. Murray, ScD, OTR and Anita C. Bundy, ScD, OTR copyright 1991; published by F. A. Davis Company, Philadelphia
4. The Child's Conception of the World, by Jean Piaget (1969), Littlefield, Adams & Co., Totowa, New Jersey
5. The Origins of Intelligence in children by Jean Piaget (1952) New York: W. W. Norton
6. The Mechanisms of Perception by Jean Piaget (1969), New York: Basic Books
7. The First three Years of Life, by Burton L. White, 1975, The Hearst Corporation, Prentice-Hall, New York, New York
8. The Child with Special Needs by Stanley Greenspan and Serena Wieder, 1998,Perseus Books, Reading, Massachusetts
9. Early Diagnosis and Intervention Therapy in Cerebral Palsy edited by Alfred Scherzer, 2001, ISBN: 0-8247-6006-9, Marcel Dekker, Inc., New York, Basel
10. Any papers, monographs or articles by Berta Bobath
11. Any and all books by T. Berry Brazelton
12. Any and all books by Eric Ericson (Child in Society, the Development of Autonomy)

Tests referred to:
1. MVPT-R, Motor-Free Visual Perception Test
2. TVPS, Test of Visual -Perceptual Skills (non-motor)
3. Purdue Perceptual Motor Survey
4. Ayres' Southern California Sensory Integration Tests and Praxis Tests
5. Sensory Integration Inventory-Revised for Individuals with Developmental Disabilities by Judith Reisman, and Bonnie Hanschu, 1992
6. Frostig program for development of visual perception,By Marianne Frostig

The “ Must Do” Hands on Seating Assessment

Sharon Pratt, PT

This workshop will focus on the relationship between biomechanics, posture, skin and function. Assessment techniques used to gain critical information about the client’s potential neurological, musculoskeletal and functional status as well as skin integrity will be demonstrated. Case studies as well as interactive discussion will emphasize the importance of using this process as we strive to justify and be accountable for everything prescribed.

The Assessment Process
- Client referral
- Client interview
- Client evaluation
- Client objectives
- Equipment parameters
- Product options
- Equipment simulation
- Equipment prescription
- Training and delivery
- Client follow up
- Successful outcome

Client Interview
- Health history
- Psychosocial skills
- Self management skills
- Existing seating & mobility
- Life roles and goals
- Environmental demands
- Transportation
- Occupational demands
- Funding options
- Preference for power or manual
- Cognitive status
- Vision
- Ability to maintain equipment

Client Evaluation

Mat Evaluation
- Supine on a firm surface
- Looking for the available pelvic and lower extremity joint ranges as related to the seated position

\- Pelvis
- Anterior/posterior
- Rotation
- Lateral side flexion

\- With pelvis in optimal position and knees flexed, assess hip:
- Flexion
- Ab/Adduction
- Rotation

\- With pelvis and hip in optimal alignment for seating, assess:
- Knee extension:
- Hamstring range

\- Ankle & Foot:
- Dorsiflexion/Plantarflexion

\- Trunk & Head
- Contact with the surface

\- Shoulder
- Scapular excursion
- Shoulder Joint Abnormalities

\- Anatomical measurements
- Trochanter to trochanter
- Firm surface to back of knee
- Chest depth

\- Skin Inspection
- Weight bearing surfaces
- Areas of redness
- Open sores

Sitting Evaluation (On a firm surface)

- Accommodate for orthopedic findings from supine:
  - Sitting
  - Posture
  - Balance
- Pelvis
  - Anterior/posterior range
  - ASIS level/obliquity
  - Rotation
- With pelvis in optimal alignment, assess trunk:
  - Optimal position in space
  - Posterior gravity assisted support
  - Midline orientation / lateral support
- With pelvis & trunk in optimal alignment,
  - Assess head
  - Midline orientation
  - Balance
  - Function
- Anatomical measurements in sitting:
  - Widest part/hips
  - Back of buttock to popliteal fossa
  - Popliteal fossa to heel
  - Seat surface to back support height
  - Seat surface to flexed elbow
  - Seat surface to occiput
  - Trunk width

Identify Objectives

- Orthopedic
  - Flexible – not tolerable of correction/ reduction
- accommodate
  - Flexible – reducible -correct
  - Fixed - accommodate
- Skin
  - Low Risk
  - Moderate risk
  - High Risk
- Function
  - Dependent
  - Independent
- Manual
- Power
  - Access to transportation/environment
- Comfort

Prioritize objectives to guide compromise

Seating/Mobility Evaluation Report

Name: ________________ Age: ____ Sex: M/F____

Diagnosis: 1-_______________ 2-______________________________

Primary Care Giver: ____

Medical History (surgeries, skin, and contraindications):

____

____

____

Reason for Referral: ____

____

____

Current Equipment (size, model state of disrepair): __________________

____

Living Environment: ____

Transportation Issues: ____

Employment Status: ____

School: ____

Recreation/Hobbies: ____

____

Self-Care Skills: ____

____

Name: ____________________

Transfers (type/independence):___________________________________

____

Additional Technological needs:

____

____

____

____

Insert picture if applicable:

Assessment findings summary

	ASSESSMENT FINDINGS	OBJECTIVES (GOALS)	PRODUCT PARAMETERS	PRODUCT
PELVIS				
HIP R & L				
L.E.'S R& L				
SKIN				
TRUNK				
U.E.'S				

	ASSESSMENT FINDINGS	OBJECTIVES (GOALS)	PRODUCT PARAMETERS	PRODUCT
HEAD				
NECK				
BALANCE				
REPOSITION				
PROPULSION				
TRANSFERS				

Measurement Chart

	ANATOMICAL MEASUREMENTS	SEATING SYSTEM MEASUREMENTS	MOBILITY BASE MEASUREMENTS
TROCHANTER			
HIPS OR WIDEST POINT			
SEAT DEPTH R/L			
LOWER LEG R/L			
FOOT LENGTH			
FOOT WIDTH			
SCAPULAR HEIGHT R/L			
SHOULDER HEIGHT			
SEAT TO TOP OF HEAD			
SEAT TO BENT ELBOW			
TRUNK WIDTH			

	ANATOMICAL MEASUREMENTS	SEATING SYSTEM MEASUREMENTS	MOBILITY BASE MEASUREMENTS
TRUNK DEPTH			
FOREARM LENGTH			
*FLOOR TO TOP OF HEAD (Taken in mobility base)			
SEAT TO OCCIPUT (N)			

*Must take measurement in simulated system

Plan:

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Prepared by Sharon Pratt, PT
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Date: __________

Theoretical Aspects of Postural Management

Terry Pountney PhD MA MCSP
Alice Goldwyn BSc Eng,

The term postural management will be used to describe the 24 hour management of an individual's postural control which includes positioning equipment, orthotics, active exercise, hands on therapy and education for users. Knowledge from the fields of neurology, musculoskeletal adaptation and biomechanics can inform the design and potential in the provision of positioning equipment and help.

Theoretical Models of Motor Control
Theoretical models of motor control and development offer explanations of how postural management can be used to direct motor development and improve motor activity. Three models will be described. The neuromaturational model of motor development is used as a basis for many neurodevelopmental treatment techniques. It proposes that the changes in motor skills result solely from the maturation of the central nervous system proceed in a cephalocaudal and proximal distal direction and move from primitive mass movement and reflexes to voluntary controlled movements (Piper et al. 1994). The effect of the environment is presumed to have little impact on the child's progress and therefore would only support the use of postural management interventions to reduce reflex activity and alter muscle tone.

The dynamic systems theory (DST) moves the focus away from the neurological basis of motor development and broadens its perspective to include all areas of development (Turvey et al. 1982). The DST recognises the central nervous system as an important component in achieving motor performance but suggests that other factors may also be highly influential. Such factors will include cognitive ability, motivation, muscle strength, biomechanics, the task and the competency of other sensory systems. Changes in any aspect of the system can have an impact on the motor outcome. Appropriately prescribed postural management programmes can affect both body functions and structures and improve dramatically the levels of activity and participation (WHO ICF-10).

The Neuronal Group Selection Theory considers how movement repertoires are selected and suggests that the structure and function of the nervous system are dependent on early movement patterns (Hadders-Algra 2000; Sporns et al. 1993) . This process is divided into three phases. During the initial phase the nervous system explores all possible variations of movement, in the second phase the most effective patterns are selected and finally motor repertoires are created which offer multiple solutions and adaptations to tasks. Early postural management intervention could offer an opportunity to affect early movement selection by directing movement patterns towards more normal and symmetrical patterns of movement. By altering movement selection the course of development for children with neurological impairment may be improved. Secondary variability may be affected by later provision of postural management.

Neural and musculoskeletal plasticity
Postural management provision should be designed to complement and reinforce therapy treatment to increase opportunity for changing motor patterns. Changes to a motor pattern within the nervous system requires 100,000 repetitions for a consistent competent movement pattern to be laid down (Kottke 1980). Physiotherapy is not sufficient to make significant changes if abnormal patterns are experienced through the rest of the day. Functional activities are required to achieve neuroplasticity and will be maintained but non-functional movements will be disconnected and movements which are used frequently have a larger representation in the cortex (Kidd et al. 1992) Fundamental changes to an approach which provides sufficient functional opportunities

Freezing degrees of freedom offers a theory of skill acquisition which works by freezing out unwanted movements and allows concentration on the movements to be learnt. Postural management equipment can act in this way to improve functional ability (Turvey et al. 1982; Vereijken et al. 1992). Higher levels of function are possible within equipment which provides stability with movement as the number of motor tasks requiring attention at any one time is reduced and concentration can be focused on specific motor or cognitive tasks. Postural control and movement are a complex interaction of central and peripheral nervous system mechanisms and adaptations occurring in the musculoskeletal system. It is a circular mechanism whereby changes in one area result in adaptations in another. Individual's with impaired motor systems will not exhibit normal movement patterns and consequently the stresses placed upon the bone and muscle will differ from the normal situation and are reflected in the development of the musculoskeletal system.

Changes, which occur in the musculoskeletal system can have a more profound effect on functional ability than the original neurological damage. The nervous system, muscle and bone are extremely plastic tissues which are constantly changing to meet the functional and mechanical demands placed upon them. Postural management interventions offer the potential to direct these changes in a beneficial way. Plasticity occurs in young children in response to a variety of influences including maturation, growth, myelination and activity.

Muscle length changes occur frequently in individual's with neurological impairment as a result of growth, immobility, disuse and persistent asymmetry. The mechanism of these changes is not fully understood however muscle imbalance between opposing muscle groups can lead to a vicious cycle of increasing shortening and lengthening. Recent work suggests that rather than muscle fibre length it is the fibre diameter that is reduced as a result of weakness. This leads to shortening of the muscle aponeuroses (Shortland et al. 2002). Options for changing muscle include surgical interventions, orthotics, positioning equipment and strengthening. Strategies which involve immobilisation may conflict with theory of muscle weakness and need strong justification. Periods of gentle stretch are recommended as a method of changing muscle length. Sleep is an ideal time for this as muscle activity, which is often constant during the day is reduced at night and is recommended as the time for length changes to be achieved without resistance(Lespargot et al. 1994).

Appropriately designed positioning equipment should be viewed as a starting position for movement and not a static support.

Muscle tone has long been the focus of physiotherapeutic interventions, however, there is no evidence that reducing muscle tone has an impact on motor dysfunction, the prime causes of which are attributable to weakness, fatigue and lack of co-ordination(Carr et al. 1995; Dietz et al. 1983). Several factors contribute to changes in muscle tone and can be divided into non - neural and neural mechanisms. Non-neural factors include the intrinsic stiffness of the muscle, tendon and connective tissues muscle, inertia, muscle viscosity, length and fibre type. Neural mechanisms include spasticity, co-contraction of muscle groups and associated movements due to body imbalance
(Carr et al. 1995; Chapman et al. 1982; Dietz et al. 1983)[Lin, 1994 #1178. Interventions to address muscle tone need to address the underlying causes. Maintenance of muscle, tendon & connective tissue length, provision of a stable position and opportunities for movement can all be addressed by postural management equipment in a variety of positions.

Julius Wolff in 1892 stated: "Nothing else is necessary to achieve normal or almost normal shape than to make normal or almost normal the stressing of deformed bones...the normal shape must be regenerated by the remodelling force when the stressing becomes normal""(Wolff 1986)

Stresses on bone are produced intrinsically by muscle activity and extrinsically by gravity and positioning. Bone responds to a variety of stresses including compression, shear, torsion, bending and tension. The type and duration of load will, in the early stages of growth, be a determining factor in the differentiation of tissue types.

Growth plates in the bone provide little resistance to forces acting upon them and children are therefore vulnerable to the effects of abnormal forces. The imbalance of muscle pull around a joint can result in asymmetrical loading of the epiphysis. Increased loading on one side of the epiphysis may slow growth on that side and cause a change in the direction of growth (LeVeau et al. 1984) Perpendicular forces produced by muscle pull or gravity acting across the epiphyseal plates, can cause bone growth to spiral away from the epiphyseal plate (Arkin et al. 1956) e.g. scoliosed spines and femora of subluxed hips. Lack of compression due to limited weightbearing will limit bone growth and cause reduced bone density (Stuberg 1992).

In postural management equipment the direction of forces applied to the body needs careful consideration and should offer symmetrical and where possible intermittent loading of the bone and growth plates.

Biomechanics

Early motor development in lying, sitting and standing are related to changes in loadbearing and accompanied by changes in the position of the head, shoulder girdle, trunk, pelvis and limbs. These biomechanical changes occur concomitantly throughout the body, there is no directional element to developing motor ability and are directly related to functional activity(Green et al. 1995). The impact of correct biomechanical alignment on muscle activation and firing has been demonstrated. Children without cerebral palsy placed in a crouch gait posture exhibited similar muscle activity to children with cerebral palsy ((Woollacott et al. 1996)). This work suggests that positioning equipment should aim to replicate normal positions and movement to enhance activity and function and prevent consequent deformity.

Abnormal movements are a contributing factor to the development of deformity. Habitual patterns of movement, which happen in a limited range of movement, prevents the regular full range of muscle stretch required to prevent deformity occurring. Abnormal patterns of movement may develop because a child's initial starting position for the movement is unstable and leads to compensatory mechanisms to maintain a stable position. Windswept deformity at the hip progressing to scoliosis is a prime example of a deformity which may arise from such abnormal compensatory movements.

The mechanism for maintaining stability is altered in children with cerebral palsy and support to aid stability has been shown to decrease these differences (Brogen et al. 1996)Equipment provided at the correct level of ability can enable a child to move freely within and out of a stable base without fear of falling.

Conclusion

There is a wealth of knowledge from the fields of neurology, musculoskeletal and biomechanics which provide support for postural management interventions as a method of improving motor and functional ability. This knowledge is can guide prescription of postural management programmes to ensure treatment aims are being successfully addressed.

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Do I really need all this information??

Adrienne Falk Bergen PT ATP/S

During the 30 years that I have been doing assessments for seating and wheeled mobility I have learned that a thorough assessment always results in a better result. Whenever a short cut is taken, and some critical information is missed, the result is usually less than satisfactory. This results in a need to "patch" the final product to make it work. Patching takes extra time, and since neither time, nor the materials needed to make the "patch" can be billed to a third party funder, everyone looses. The consumer must wait longer to get their equipment, and the equipment may be less than optimal. The clinician and supplier must spend added hours on fittings, delivery and followup. The supplier usually winds up supplying additional parts and/or equipment, or in the worst case taking the equipment back and paying a restocking fee to the manufacturer.

In an effort to standardize the assessment process and assist newer clinicians in gathering information, a series of forms were devised and posted on my web site, RehabCentral.com. Each of the forms guides the team along a path that will ensure a thorough assessment. The process begins with a good intake interview to gather pertinent information that may affect the intervention plan and/or the final outcome. This must include information about the entire environment where the equipment will be used. The environment includes the home, transport methods and comments about any other locales where the equipment will be utilized. Assessment of the client in his existing equipment and discussions about the equipment with the family and the consumer give the examiners valuable information about what has and has not worked in the past. It affords the team an opportunity to describe the user's posture and function in the equipment he already owns. A photograph is usually helpful in supporting the written word.

This initial intake should be followed by a complete mat evaluation in both supine (gravity eliminated) and sitting (gravity added, accommodation made for ROM limitations found in supine). This portion of the assessment will allow the examiners to see the underlying potential for good postural alignment without the influence of gravity. Once any interfering limitations are noted the client is brought to sitting with accommodation for the limitation. Support is given as needed to produce the best result possible, and the examiner notes how much support is required and whether or not the posture can be corrected. Simulation at this stage is very helpful, whether with the examiner's hands or a simulator. The simulator leaves the examiner's free to move around the supported client, make changes and observe over a long period of time.

This detailed assessment is recorded, along with complete measurements to provide a baseline from which intervention planning can begin. Once intervention planning and product trials are complete the complete recommendation can be written and justified using the forms included in the Justify section of the site. If questions come up during the funding process, or during the ordering phase, the complete assessment document can be used for further decision making, often without having to revisit with the client. Fittings and delivery should then go smoothly.

Nineteenth International Seating Symposium

Friday, February 28, 2003

Under Pressure!
How To Get To The Real Problem And The Solution.

Tina Roesler, MS, PT, ABDA

While it is well documented that pressure ulcers are a concern for the seated client, clinicians are continuously confronted with situations that do not seem to fit the typical clinical expectation. It is documented that 85% of seated clients will develop pressure ulcers at some time, and 66% of these will occur on the pelvis. They occur on the sacrum, ischial tuberosities, and greater trochanters predominantly. Financially, it impacts the health care system costing Medicare alone between two and four billion dollars a year. While 70% of documented pressure ulcers affect the elderly, the remaining 30% may affect clients that clinicians consider at low to moderate risk. It is important to take a close look at risk factors, recognize the impact that lifestyle may have, and look beyond the wheelchair seating surface or the recumbent support surface when considering pressure reduction or pressure relief.

First, clinicians need to complete a thorough clinical assessment of the clients' previous skin history, lifestyle, and past medical history. While many seating specialists are being consulted to address the seating system, it is important to complete a full seating assessment that includes current equipment evaluation, functional evaluation, and visual skin inspection. This last step is often overlooked and the clinician relies on previous reports or medical records.
It is important to visually inspect the wound to

1. Identify what type of wound it may be: Is it caused by pressure? Is there excessive moisture? Is it a shear wound?

2. Document changes to the wound over time and see the impact that new seating interventions may have. 3. Assess if the seating solutions identified will impact the wound or is further consultation with a wound specialist necessary. Realistically, clinicians cannot make appropriate recommendations until they are aware of what they are dealing with. Photography is also recommended to document wound progress and share with the client. Seeing the wound, often for the first time, may give the client a better understanding of their risk factors and encourage them to take more responsibility for prevention and healing. Once the clinician has visually inspected the wound and completed a mat evaluation, equipment options should be considered. While the focus tends to be on the wheelchair cushion, it is important to look at the entire list of risk factors and take lifestyle and function into consideration.
While there are a variety of risk assessment tools that are utilized, sometimes a simple list of risk factors will provide more information.

First, there are extrinsic risk factors. These are the only factors that will be affected by the choice of support surface. They include pressure, friction, shear and moisture. Through the use of appropriate seating surfaces the clinician can minimize, not eliminate, these risk factors. Due to the ability to impact these four areas, it is easy to overlook intrinsic risk factors. While the seating system may not impact these things, it may guide the clinician to the root cause of the skin integrity problem and lead to long-term solutions for the end user. While the list of intrinsic risk factors is long, there are a few that we must pay special attention to.

1. Previous skin breakdown – no matter the cause or the length of time since injury, previous history puts a client in a higher risk category. Once a wound has healed, the skin is at best, 70-80% the strength it was previously. This is why it is usual to see multiple breakdowns at the same site. These clients need skin protection no matter the initial cause of the injury.

2. Nutrition— if the body does not have the nutrients required to facilitate wound healing, even the best seating interventions may fail. All clients with wounds should be referred for a nutrition evaluation. A client may appear healthy, but if they consume fast food for 2-4 meals a day, they are probably lacking some vital nutrients.

3. Activity level – this risk factor is important to consider. While decreased activity level increases risk, high activity level does not always decrease risk. While an active individual may be healthier, it does not eliminate other risk factors. For example, a client with a complete spinal cord injury (SCI) may be functionally independent and very active, but they are still at risk due to extrinsic factors and other intrinsic factors such as spasticity, loss of muscle mass, lack of sensation, and decreased blood flow. 4. Smoking – the affect that smoking has on blood flow is well documented and must be considered when addressing skin integrity issues. 5. Effects of medications – identify medications being utilized and know the effect they may have on tissue and blood flow. Long-term steroid use, for example, will impact tissue strength and healing time.

Although the list could continue, clinicians must also use their investigative talents to identify potential problems. Simple observation of transfer technique, normal sitting posture, and pressure relief technique will provide an abundance of information that could impact decisions. Furthermore, it is important to ask lifestyle questions that may have an impact. These should minimally include:

1. Transportation – does the client drive a car/truck/van; how do they transfer into the vehicle, do they drive for long periods of time

2. Vocation – just asking if the client is employed is not enough. Find out where, for how long, and what kind of activities their vocation entails.

3. Recreation/sport – does the client participate in activities outside of work/home? Clinicians need to identify lifestyle activities that may put the client at risk. Positioning in sports chairs, lack of pressure relieving surfaces in recreational equipment, and types of transfers done may be where the problems occurred. Identify these areas and educate the client about the risk.

4. Alternate seating surfaces – where does the client spend time besides the wheelchair? Ask about vehicles, household seating surfaces (sofa, recliner, dining room, floor), recreation, extracurricular activities, school, and work. Do not assume the client is either in the wheelchair or bed 24 hours per day.

These questions may seem ordinary, but it is easy for the clinician to focus on the client in the immediate setting of the clinic and make assumptions about lifestyle and activity. Discuss a usual day with the client and investigate questionable activities. For example, a 12 year old was evaluated in a clinical setting for a stage IV pressure ulcer. A mat evaluation was completed, the cushion was assessed, and skin inspection was done. It appeared that the cause was not related to the seating system, although there were members of the team that kept pointing to the wheelchair cushion. The client and his mother reported that he enjoyed playing video games after school for many hours at a time. The simple question was asked: "Where do you sit when you do this?" The answer was, on the hard wood floors without a seating support surface. The question had not been asked over the course of months, but the solution became simple and the wound eventually healed with the correct interventions and change of habits.

Ask the questions that will help get to the root of the skin integrity problem and investigate all possible causes. Continue with thorough clinical evaluations, identify all risk factors, and be a good investigator. Clinicians should not assume clients are always doing the right thing and often need to focus on client education and responsibility.

Seating and wound care must be approached systematically and clinicians need to consider the atypical scenarios that are actually more common than they might assume. The seating and wound care team must continuously keep up with changes in wound care and seating technology and approach skin integrity issues in a holistic manner. While it is clear that not all wounds are preventable, a focused evaluation that is client centered and considers lifestyle choices will take clinicians a step closer to solving this costly and time-consuming problem. It may lead the clinician to alternative solutions or facilitate the understanding that there are limitations to clinical interventions.

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Prescribing Wheelchairs for People with Progressive Disorders

Michael L. Boninger, M.D.
Rosemarie Cooper, MPT, ATP

Pathology, Progression, and Prognosis of Common Progressive Disorders

- Amyotrophic Lateral Sclerosis
- Multiple Sclerosis
- Muscular Dystrophies
- Other Disorders

Risk Factors Associated with Progressive Disorders

- Falling
- Social Isolation
- Depression
- No clear entry into rehabilitation system

Causes of Delayed Prescription of Wheelchairs

- Acceptance of further decline
- Fear of deconditioning
- Need for other changes
    - —Home modifications
    - —Vehicles all

Considerations in Wheelchair Selections

- Likely length of use
- Effective of disease progression
- Delays in device delivery

Specifics

- Manual wheelchairs
    - —Attendant propelled
        - -Comfort
    - —Ultralight
- Power Assist
- Scooters
- Power wheelchairs
    - —Controller
    - —Tilt-in-space & Recline
    - —Seating system
    - —Vent Tray
    - —Other Assitive Technology
- Model Programs
- Loaner for Rapidly Progressive Disorders

- Other Considerations

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The Second Time Around

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Normal aging affects all systems of the body: skin, muscles and bones, heart, lungs, urinary system, gastrointestinal system, nervous system. Spinal cord injured individuals will experience the affects of aging, as will the able bodied individual. There are three phases that follow the onset of a disability. They are

- Acute restoration
- Maintenance
- Decline

Acute restoration is the initial process of moving from having limited to no functional abilities immediately following onset of disability to regaining the maximum amount of functional ability possible. This phase includes the initial rehabilitation stage and is completed within approximately two years post injury or onset of disability. The maintenance phase is a lengthy but undefined period of time. This long phase involves the individual maintaining the level of function that was established during the initial phase following injury. The last phase, that of decline, is a gradual process with the onset of physiological aging changes. All changes, whether individually or collectively, cause steady erosion of organ reserve and an overall decrease in function.

Not only does health status decline with an increase of chronological years, but decline is also related to years post onset of injury/disability. Therefore, as a person with a disability ages both chronologically and by accumulated years post onset, the effects of aging and vulnerability to changes increases.

Aging and related physical changes begin at any time following the onset of a disability. Development of these changes, primarily muscle weakness, fatigue, pain, joint overuse and skin breakdown appear more related to duration of disability rather than chronological age. There changes are also seen in younger people with disabilities typically occurring earlier in life, for example, spinal cord injury, polio, cerebral palsy, spina bifida and traumatic brain injury. Growth itself causes physical changes such as muscle imbalance, muscle and joint tightness, orthopedic deformities, postural changes, joint subluxation/ dislocation and changes in skin integrity. As weakness, muscle imbalance and abnormal tone act on the body over time, difficulties in seating and positioning appear even in a young person.

The young adult, who becomes disabled, such as the individual with a spinal cord injury, will develop changes similar to their able-bodies counterparts, although these changes tend to occur 10-20 years earlier. As technology and survival rates have increase in the past two to three decades for many traumatic disabilities, the young adult is now still chronologically in their early to middle adulthood years, however, is more mature I relation to their disability age.

The geriatric individual who has already undergone many of life's aging changes, and who becomes disabled, will now have the normal aging process compounded with changes related to their new disability. The phases of disability for this individual may be altered in time and progression because of the already present, and perhaps accelerated changes related to aging.

As an individual ages within their disability, their needs in relation to seating and mobility will change. Issues inherent with prolonged sitting include skin integrity, deformity development, overuse and endurance. Skin integrity is a major concern for any individual whose sensation has been impaired by disability. Age related factors contributing to pressure sores in the able-bodied population include decrease in tissue elasticity, muscle wasting and loss of subcutaneous fat, impaired tissue metabolism and circulation that result in an increase in healing time, decreased activity level and disease processes. Add these factors to a disabled individual with decreased mobility, the need to be in a sitting position, loss of sensation and other contributing factors, and you will find the aging individual with a disability at severe risk for pressure sore formation. This individual also has less flexibility and the potential for greater shearing forces when positioning in sitting. Not only is skin at risk, but improper positioning leaves the body at risk for developing deformity.

Kyphosis, scoliosis, pelvic obliquity, windswept deformity, rotation etc. are only some of the common deformities seen with the seated population, especially as the time post onset increases and abnormal muscle tone and imbalance effect positioning. These deformities cause difficulties with comfort, functional ability, body functioning and overall well being. Left uncorrected or unaccommodated, the aging individual will lose functional abilities, and be at risk for further medical complications. They may also suffer from increased pain and become more disables as they lose the ability to maintain their social and personal roles and responsibilities.

With age and as a result of overuse, the individual with a disability will decline in relation to endurance for activity and ability to complete tasks. Mobility in a manual wheelchair may become limited or impossible. Fatigue and pain may increase and again lead to a decrease in overall function that will in turn lead to disuse, weight gain and further complications.

The use of cushions and back supports are in imperative part of the overall seating and mobility system. The mobility system itself is another aspect within the individual's environment that will impact on function and may require change as one ages. Successful intervention has serious implications for a client's daily function and independence and requires that a client be prepared to make compromises. A more complex system may lead to increased barriers, both physical and social, and may have greater stigma associated with it. The client must see a benefit associated with a new or modified system, and this system must facilitate improved or maintained level of function. The innovations of technology have impacted the type of mobility system that the individual with a spinal cord injury may benefit from. Frame design, weight of the device, suspension, power add-on systems, accessories have all allowed for the individual to optimize positioning, function, safety and long term use. Any modifications to a system should be consistent with the client's current functional abilities, and be suitable for modification as this function changes, both for the better and for the worse. Prevention of deformity, enhancement of quality of life and interaction within the community and social network should be achieved through the seating and mobility system.

Changes related to aging with a disability threaten an individual's independence. Only if the client "buys
into" the need for and benefits of change, will seating and mobility intervention be successful. The goal is to bridge the gap between losing function and gaining independence. This goal can be achieved with the innovations of technologyÉ

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Dynamic Seating Components: The Best Evidence and Clinical Experience

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INTRODUCTION:
Due to extreme extensor patterns caused by spasticity, high tone or agitated behaviours, some clients require positioning that allows for a range of movement. Traditionally seating components have been static and restrictive thus preventing movement. Dynamic seating components allow movement within a predetermined range. The most common components that are routinely made dynamic are chest straps, seat backs, headrests and footrests. These components are used to help reduce a client's seating issues such as skin breakdown, discomfort, pain and equipment failure. Even though clinical experience that supports dynamic seating is limited, there is a growing interest in both the theories behind postural control; dynamic seating; and conducting research to test it. The purpose of this presentation is threefold: first, to describe and show examples of custom and commercial dynamic seating components and clients who have used them; second, to present the best evidence available on dynamic seating including information found in peer-reviewed literature, conference proceedings and clinical opinion; and, lastly, to discuss and explore future directions for clinical research.

DEFINITIONS OF DYNAMIC:
The American Heritage ¨ Dictionary of the English Language, Fourth Edition Copyright © 2000
Adj: 1. Of or relating to energy or objects in motion
2. Characterized by continuous change, activity, or progress
3. Marked by intensity and vigor, forceful.
Webster's Revised Unabridged Dictionary, © 1996, 1998 Micra Inc.
1. Of or pertaining to dynamics: belonging to energy or power; characterized by energy or production of force.
Oxford Reference Online
Adj 1. energetic, active 2. Of motive force. 3. Of force in operation. 4. Of dynamics

DEFINITIONS OF DYNAMIC SEATING:
"Dynamic seating can be defined as seating that allows controlled, balanced, and supported movement, while at the same time providing stability for the person using the device" (Siekman, 2000).
Dynamic seating is "a seating system that reacts to the forces exerted by the sitter consequently allowing hip extension of the sitter and displacement of the back panel" (Brown, 2002).
The authors' definition of dynamic seating: Dynamic seating components are specifically designed to move as a result of vigorous and forceful movements exerted by a client.

CASE EXAMPLES
- Medical Background
- Seating History and Context
- Dynamic Seating Components
- Results

BEST EVIDENCE is defined in occupational therapy as "the client-centred enablement of occupation based on client information and a critical review of relevant research, expert consensus and past experience" (CAOT, et al., 1999).

LITERATURE REVIEW conducted based on a three-part question (population, intervention/comparison, outcome). Do dynamic seating components increase sitting tolerance and comfort for people with neuromotor impairments?

Population:
neuromotor impairments, cerebral palsy brain injury, spina bifida (SB)
Keywords:
Cerebral palsy, brain injury, SB, myelomeningocele, muscle tone, neuromotor, neurological, spasticity, dystonia, agitate

Intervention:
dynamic seating components
Keywords:
Seat, sit, posture, motor control, wheelchair

Outcome:
sitting tolerance and comfort
Keywords:
Pressure, pressure sore, pressure ulcer, pain

Electronic searches were conducted based on the above keywords.

Electronic sites searched include: Clinical Evidence, ACP Journal Club, National Guidelines Clearinghouse, Best Bets, PEDro, Joanna Briggs, Cochrane Collaboration, Cochrane Child Health, Keeping Current:CanChild Research Reviews, DARE, AACPDM, PubMed and OVID.

Summary of electronic search: There was almost no mention of dynamic seating or positioning in the electronic search. The National Guidelines Clearinghouse has a brief summary on the treatment of pressure ulcers and it states: " Use of dynamic support surface if the patient cannot assume a variety of positions without bearing weight on a pressure ulcer, if the patient fully compresses the static support surface, or if the pressure ulcer does not show evidence of healing" (National Guideline Clearinghous, 2000). The full-text copy of this guideline does not expand on the details of dynamic support surfaces.

Hand searches of the evidence lead to more relevant information.

The sources of the hand searches are the International Seating Symposium, Canadian Seating & Mobility Conference and RESNA conference proceedings. Dynamic components are not new. Pin Dot Products advertised their EndoFlex¨ seating system as having "dynamic lumbar support allows for free and easy movement" in 1989. Two articles in RESNA 1996 describe case studies where dynamic seat to back angles were custom fabricated to address both client and caregiver issues (Evans and Nelson, 1996, Orpwood, 1996). These and other case study presentations identify similar reasons for initiating dynamic seating components, which can be attributed to client, caregiver or equipment factors (Ault, et al, 1997, Conner, 1997, Cooper and Broughton, 2001, Cooper et al., 2001, Meeker and van der Heyden, 2002). The clinical rational for using dynamic seating components for a client include a reduction of pain due to extreme spasms, agitation or pressure and consequently increasing comfort and sitting tolerance. Caregivers have also benefited by being able to transfer and position a client in his/her system with more ease and for longer times as compared to rigid systems. Lastly, case studies report that static equipment frequently fails for these clients therefore dynamic components are tried to reduce the need for technical repair. All these reports show that dynamic seating components had a positive result for the clients and or caregivers. This review of the literature reveals that the level of evidence is at the descriptive, case report level (Butler, 2001), which is valuable, but lacking the scientific study to link dynamic seating components as the best intervention to solve the above mentioned clinical problems.

RESEARCH DIRECTION

The literature shows a logical development from case studies of one-of designs in the late 1990's to detailed descriptions of the technical fabrication of those one-of designs and the categorization of commercial products to meet these needs in the early 2000's. Brown (2001) conveniently describes commercial products, target end-users, the dynamic component and benefits in a table that is a relevant summary.

Most importantly the need for research is identified. The RERC website and the "white papers" from the "Wheelchair Seating: A state of the science conference on seating issues for persons with disabilities" (Brubaker & Brienza, 2001) clearly points us in a research direction. The white paper on postural control (Trefler and Schmeler, 2001, p.22) states some gaps: "Éwe do not have many dynamic seating/wheelchair components that move with the person during episodes of high tone and return to a resting position. Perhaps this is related to not having the evidence that dynamic components are effective in managing high tone as it relates to posture." And, "Standards of practice related to the application of seating technology, especially for people with abnormal tone and fluctuating needs, is limited to anecdotal textbook type information." These authors advocate for standardized clinical measures of posture, understanding of tone and its functional affect on posture. Current research is underway which marks the addition of objective and quantifiable information that will contribute to our understanding of the use of dynamic components in seating (Zetwanger, et al, 2001, Brown, et al., 2001, Brown, 2002).

So where do we go from here? The valuable clinical observations and technical experience needs to be framed in existing theories of postural and motor control and supported using strong yet clinically feasible research designs. Design such as N-of-1 randomized controlled trials, ABABA designs, alternating treatments and multiple baseline across subjects are appropriate for the heterogeneous population of small numbers relative to regional area (Butler, 2001). Outcome measures need to be functional and objective yet directly related to why dynamic seating components are selected as the best intervention for the clinical problem. The role of the clinician-as-researcher needs to be acknowledged in terms of time and skills to build a research knowledge base sufficient to develop and carry out small yet strong clinical studies. Partnerships between clinicians and academic researchers would be valuable. Significantly, the research needs to be shared in a way that it is credible, reproducible and widely distributed.

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Reducing Upper Extremity Repetitive Strain Injuries Through Wheelchair Set-Up

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The existence of upper extremity (UE) repetitive strain injuries (RSI) among manual wheelchair users is a growing topic for concern. Evidence suggests that an increased incidence of pain reported among manual wheelchair users is related to an increased level of activity among this population, and an increase in the number of "aging" manual wheelchair users. Evidence also indicates that prolonged wheelchair use can lead to pain and that this pain increases with increased time spent in the wheelchair. Other factors or activities, such as transfers, age and environment, also appear to play a role. To effectively reduce the incidence of RSI, we must first understand basic UE anatomy, the etiology of RSI and what strategies can be employed to prevent RSI.

Repetitive strain injuries are damage to soft tissue (tendons, ligaments, nerves) or bony structures that are caused by frequent repeated motions. This results in inflammation, compression and/or tears in the structures, which in turn causes decreased vascularity and resulting necrosis. RSI among manual wheelchair users are most commonly seen in the shoulder, elbow and wrist joints.

The Upper Extremity Joints

The shoulder complex is comprised of the glenohumeral, sternoclavicular, acromioclavicular and scapulothoracic joints. These joints are formed by bones held together against gravity by a combination of bony geometry of the joint surfaces, integrity of the ligaments and capsules, and resting muscle contractions. The rotator cuff muscles and the scapulothoracic muscles are critical in maintaining this joint integrity and function.

The rotator cuff or "SITS" muscles function to maintain the humerus in the shoulder joint, assist in UE abduction and rotation, and prevent elevation of the humerus into the acromion. With damage to these muscles, an imbalance is created around the joint, resulting in loss of ability to depress the head of humerus, impaction of the head into the acromion during UE movements, and impingement of the underlying structures. Effects include tendonitis and tears of the biceps and rotator cuff tendons, inflammation of the subacromial bursa, and increased capillary pressure and decreased circulation within joint.

The scapulothoracic muscles function to control movement of the scapula on the trunk and ribs, including facilitation of scapular rotation and prevention of scapular "winging" during UE abduction and flexion. Scapular rotation causes elevation of the acromion, which prevents humeral impaction. This allows full UE ROM and helps to maintain stability of the glenohumeral joint. With injury and resulting muscle imbalance, the acromion does not rise sufficiently and there is impingement of underlying structures and limits to full abduction and flexion. Full ROM can be achieved only with over-stretching of some muscles, resulting in further compromise of glenohumeral joint stability.

In the elbow joint, wrist and finger flexors and extensors attach to the lateral and medial distal humerus (epicondyles) and cross over both the elbow and wrist joints. Repeated motions of the elbow joint can result in muscle tears, inflammation and tendonitis (medial epicondylitis from overuse of wrist and finger flexors or lateral epicondylitis from overuse of wrist and finger extensors).

At the wrist joint, the carpal tunnel, formed by ligaments running across the wrist, contains the wrist and finger flexors and extensors, and the median nerve. Repeated contractions of these muscles cause thickening of the tendons and resulting decreased space in the tunnel. In addition, repeated extreme wrist flexion and extension causes increased pressure within the tunnel, leading to impingement of the median nerve with resulting pain and sensory loss (carpal tunnel syndrome).
Characteristics of Manual Mobility That Affect RSI Development

1. Wheelchair Propulsion Itself

During manual wheelchair propulsion, UE muscles are required to propel the weight of the wheelchair plus the weight of the user. These small muscles must generate the large output of power normally generated by larger LE muscles and they must do this while in abnormal positions. The muscles become over-stretched and overused, resulting in imbalance and eventual injury. Many manual wheelchair users also have an existing muscle imbalance due to weakness or paralysis of specific muscles as a result of their injury, condition or disease process. The stronger muscles already compensate for weaker muscles when used for ADLs or for balance and support. Wheelchair propulsion requires even more work from these already compromised muscles.

Wheelchair propulsion also involves repetitive movements of the UEs, including repeated downward force of the UE onto the pushrim. Repeated shoulder extension and elevation and wrist and finger flexion occur during initiation of each stroke and repeated shoulder flexion and depression and wrist and finger extension occur at the end of each stroke. These repetitive motions result in overuse of some muscles and overstretching of others. In addition, repetitive wrist and finger flexion and extension cause thickening of the tendons and risk of carpal tunnel syndrome.

Stress and damage can be minimized by positioning the UEs to allow the most efficient stroke during propulsion, reducing the amount of force required per stroke and reducing the frequency of strokes required to propel a specific distance. These factors must be considered when selecting an appropriate wheelchair, choosing options, and making adjustments to the chair.

2. Wheelchair Weight and Quality

Stress to the UEs increases with increased weight of the wheelchair, increased weight of the user and increased challenge from the environment (rough terrain and/or inclines). The heavier the chair, the greater the forces generated by the UE muscles during propulsion and the greater the risk for injury. The lightest chair possible should be chosen for any active user. However, weight alone should not be the only factor considered, since lightweight is not a substitute for good quality. A higher quality chair (i.e. made from high strength aluminum with high quality construction) has less flex and is therefore more efficient and requires less force to propel. Higher quality parts (i.e. sealed bearings, tighter tolerances for non-moving parts and increased ease of motion for moving parts) provide less roll resistance and less force to propel.

3. Rear Wheel Position

Positioning the rear wheels rearward on the frame has the following results:

- The user's COG is positioned further forward, putting more weight over the casters and less weight over the "drive wheels". This can make the chair harder to propel and create increased stress and greater risk for UE injury.
- Wheel access is decreased. Since the wheels are further behind the user, the shoulder must work in more extension when initiating a stroke. This creates a poor lever arm of force, an inefficient stroke that requires greater force from the UE and increased risk of injury.
- The overall length of the wheelchair is increased, creating an increased turning radius and decreased maneuverability.
- Rearward stability is increased.

Positioning the rear wheels further forward on the frame has the following results:

- The user's COG is positioned rearward putting less weight over the casters and more weight over the "drive wheels". This can make the chair easier to propel with decreased risk of UE injury.
- Wheel access is increased. Since the wheels are closer to the user, the shoulder is working in a more neutral position when initiating a stroke. This creates a more efficient lever arm of force, a more efficient stroke that requires less force from the UE and decreased risk of injury.
- The overall length of the wheelchair is decreased creating a decreased turning radius and increased maneuverability.
- Rearward stability is decreased (the chair is "tippier")

For each user, the wheels should be positioned to create the maximum ease of propulsion that can be achieved with the most optimal rearward stability. An adjustable axle plate can provide small increments of fore and aft adjustments of the rear wheels to find the position that brings the wheels closest to the user without making the wheelchair too unstable.

4. Rear Wheel Height

The height of the rear wheels is determined by vertical position on the frame and by wheel size. This in turn affects the seat to floor height and the user's access to the wheels. If the rear wheels are too low or too small the user cannot effectively or efficiently reach them. Without access to enough of the wheel, a short inefficient stroke is used, requiring greater effort and increased stress to the UE muscles. If the rear wheels are too high or too large, the shoulders are always elevated during propulsion, the humerus is forced into the acromion and there is increased risk of impingement.

For each user the wheels should be positioned to create the most optimal rear wheel access that can be achieved with the desired seat to floor height and wheel size. Raising the axle plate on the frame can bring the wheels closer to the user (higher) while lowering the rear STFH. Lowering the axle plate on the frame can bring wheels further from user (lower) while raising the rear STFH.

5. Rear Wheel Lateral Position

The rear wheels can be brought closer to or further from the frame by adjusting the threaded axle sleeve in or out. Positioning the wheels too far from the frame results in poor UE position and inefficient use of the muscles during each stroke. Additionally, the UE muscles are required to function for proximal stability, as well as, for distal mobility, causing further stress. Adjusting the wheels closer to the frame results in improved UE position and more efficient use of the muscles. Stress is decreased since the muscles are required to function solely for distal mobility (propulsion).

Lateral wheel position can also be changed by adding camber. This brings the wheels closer to the user, resulting in increased performance of the chair, improved access to the wheels and potentially decreased stress to the UEs. However, this also increases the overall width of the chair, which could affect accessibility.

When the rear wheels are positioned close to the user by adjusting horizontal, vertical and lateral position, the muscles are used in their most efficient positions. The angle over which force is applied to the pushrim is increased, the maximum amount of force required per stroke is decreased and the frequency of strokes is decreased, all of which can reduce the risk of injury.

6. Type of Rear Wheel and Tires

The risk of RSI is decreased with a lower amplitude of force and a decreased frequency of force per stroke. The weight and roll resistance of the rear wheels, determined by the type of rim and tire, affect the force required to propel the wheels.

- Rim type – Spoke rims are lighter, have less roll resistance and less flex and are
- more efficient, however, they do require some routine maintenance. Mag wheels are heavier, have more roll resistance and more flex and are less efficient, however, they do have the advantage of being maintenance-free. When choosing the rim type, it is important to consider that an ounce of weight added to the rear wheel is like a pound of weight added to the frame.

- Type of tire – Solid tires require no maintenance, do not go flat and have minimal to no tread, so they provide less roll resistance. However, they have less grab on uneven surfaces and much less shock absorption. Pneumatic tires provide better shock absorption and have increased tread to provide better grab on uneven surfaces. However, they also have more roll resistance, require maintenance and are at risk of going flat. Airless inserts provide the same tread as pneumatics and are flat-free and maintenance-free like solids. However, they are significantly heavier and provide very little shock absorption.

- Type of caster

- Smaller casters provide less roll resistance on level surfaces and are easier to turn, but are harder to roll over rough surfaces. Larger casters provide more "grab" over rough terrain and obstacles, but are harder to roll over level surfaces and require more effort to turn. Narrower casters roll easier across hard surfaces, while wider casters roll easier through soft.

- Caster, fork and stem bolt combination – A longer fork with a shorter stem bolt results in a longer turning radius (“trail”) and more effort to turn. A shorter fork with a longer stem bolt results in a shorter turning radius (“trail”) and less effort to turn. When possible, choose this latter combination to achieve the greatest ease of propulsion with the desired seat to floor height and desired caster size.

- Choose the rear wheels and casters as if they were the “shoes” of the wheelchair. Look for the combination that will provide the user with the optimal ease of propulsion while meeting their functional needs during all activities, over all environments, each and every day.

7. User’s Position In The Wheelchair

Proper positioning in the wheelchair is another significant factor in providing efficient propulsion and reducing the risk of RSI. Optimal positioning contributes to an upright, neutral pelvis and trunk. This in turn, promotes optimal UE position for better rear wheel access and increased stroke efficiency. A variety of factors will affect the user’s position in the chair.

- Angle in space – if the wheelchair orientation is straight upright and the user does not have

- sufficient trunk control and balance, he/she is unable to maintain upright against gravity without sliding into a posterior pelvic tilt and increased kyphosis. This brings the UEs further from the rear wheels resulting in poor access and stress during propulsion. If a slight tilt in space is provided in the frame, the effects of gravity are reduced, the user can maintain a neutral pelvis and upright trunk and UE position is more conducive to efficient propulsion.

- Seat to back angle – most frames provide a standard 90º seat to back angle. If the user lacks adequate pelvic control, there is potential to slide forward into a posterior pelvic tilt and increased kyphosis. This results in poor UE position for propulsion. For some users, a contoured seat is sufficient to secure the pelvis in proper position. For others, a closed seat to back angle (squeeze) with a seat to back angle < 90¡ is needed to secure the pelvis. This helps to maintain optimal pelvic and trunk position and maintain optimal UE access to the rear wheels. This also brings the user lower into the frame and closer to the wheels (vertically), which might also improve access. Factors to consider when choosing a squeeze frame include the potential for increased ischial pressure, increased risk of hip flexion contractures and potential interference with transfers.

- Back height and angle – proper back height and angle is critical in providing the optimal amount of support for balance and posture while allowing optimal UE function.

- If the back is too high, scapular mobility and UE range are compromised, causing short, inefficient strokes and increased risk of damage. If the back is also too vertical, the trunk is pushed forward and upright position is difficult to maintain. The user slides into a posterior pelvic tilt to maintain balance, further compromising UE position. If the back is too low, there is inadequate support for stability and balance. This also results in the user sliding forward into a posterior pelvic tilt to maintain upright. The optimal back height for each user provides sufficient support for stability and posture while allowing maximum scapula movement and UE excursion during propulsion.

- Adding a back angle can also contribute significantly to proper positioning. A back angle supports the top posterior pelvis in a neutral position and allows the spine to extend over the pelvis. This promotes thoracic extension and an upright trunk. It is critical when providing a back angle that the pivot point of the back is positioned at the anatomical pivot point or the PSIS.

- Back type – the type of back support can play a significant role in maintaining optimal posture and UE position. Sling upholstery provides little support, especially if it is loose and “hammocked”. Without a solid support to push against, the user must bring the trunk back into optimal position after every stroke or use shorter, less efficient strokes in order to maintain upright. This results in wasted energy and increased stress to the UEs. Adjustable upholstery, solid backs and/or contoured backs provide additional support to the trunk. This reduces energy waste and increases the efficiency of each stroke. Increased support can also help to maintain optimal posture and achieve optimal UE positioning for propulsion

- Proper fit of the wheelchair – If the wheelchair is too wide, there is increased risk of the user assuming abnormal postures, including pelvic obliquity, scoliosis and pelvic rotation. These pelvic postures can contribute to poor UE access to the rear wheels, poor UE position during propulsion and increased risk for damage. The type of manual wheelchair chosen will determine the options for seat widths available. Standard and lightweight wheelchairs generally provide limited choices of narrow (16"), standard (18") and wide (20") seat widths, while ultra-lightweights provide multiple seat widths, usually in 1" increments. The latter can be configured to meet the individual's size and shape requirements to provide optimal rear wheel access and pelvic/trunk positioning.

Other Factors Contributing to RSI

1. Transfers and Pressure Relief – push up transfers and pressure reliefs can significantly contribute to the development of RSI. These activities involve brief, high impulse loading of the UEs as they lift the weight of the body by pushing down against the transfer surface. This forces the humerus into the acromion and increases the pressure in the shoulder joint by as much as 4 times. In addition, the wrists are weight bearing while in extreme flexion. The amount of force required for these activities depends on the transfer height and the user's trunk stability.

2. Height of the User's Environment – when performing tasks from a seated position in a wheelchair, the UEs are ~ 45 cm lower in relationship to the environment compared to the standing position. For many activities, this requires using the UEs in increased abduction and flexion, causing increased stress on muscles and joints.

RSI are an increasing problem among manual wheelchair users. Unfortunately, the pathology often precedes the symptoms, therefore it is crucial to take measures to reduce the risk of occurrence and provide intervention before the condition becomes chronic. Anyone involved in the selection and prescription of manual wheelchairs should know how to fit and measure for seating and mobility equipment, what questions to ask the client, what evaluation information is needed for proper selection, what equipment is available (including features, benefits and trade-offs of each model and available options), and how to justify the equipment. Most importantly, the prescriber should know what adjustments in the seating and wheelchair frame can be made, which adjustments would optimize each user's function and how to make these adjustments.

It's Just Like Riding a Bike . . .
Seating Evaluation and Interventions for Handcycles

Kendra Betz, MS, PT

Handcycling as an adaptive sport
- Growing awareness and popularity for recreation and competition
- International Handcycling Federation: sanctioned competitive sport 2004 Paralympics in Athens

Handcyle Anatomy 101 and Terminology

- Upright: high sliding seat, easier transfers, short distance recreation

- Recumbent: low seat, advanced transfers, recreation & competition
    - Lean Steer – seat swings on frame with body lean to turn; 3 fixed wheels
    - Pivot steer – hand crank pivots on frame to turn; 2 rear wheels fixed

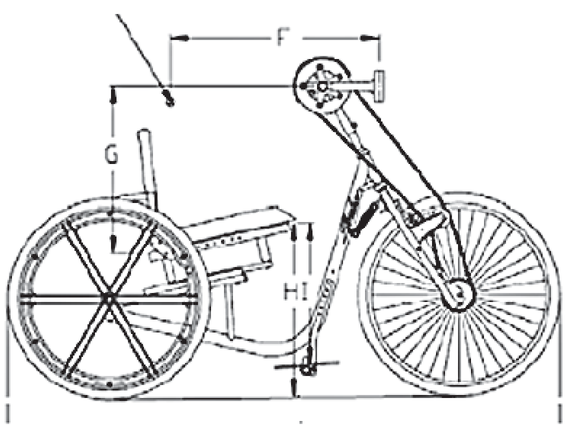

Figure 1
Quickie Mach 2 Upright

A schematic drawing is presented to depict typical features of an upright style handcycle. The seat height is similar to that of a manual wheelchair. The backrest is reclined approximately 15 degrees. The handcycle rider would sit in a near upright position with knees flexed slightly beyond 90 degrees and feet supported on footplates below the seat. The synchronous hand crank is positioned at mid chest level.

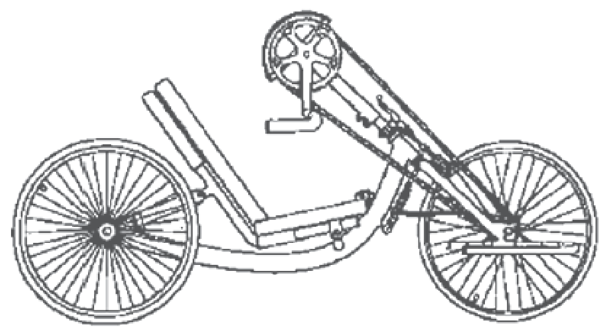

Figure 2
Top End XLT Pro Recumbent

A schematic drawing is presented to depict typical features of an recumbent style pivot-steer handcyle. The seat is low to the ground. The backrest is reclined approximatey 30 degrees. The handcyle rider would sit in low to the ground with knees extended in front of the seat and lower legs supported near the front wheel axle. The synchronous hand crank is positioned at mid chest level.

Handcycle Selection and Configuration

Should be a comprehensive assessment similar to that for high end manual chairs
- Thorough client background review with specific needs identified
- Seating/posture evaluation
- Equipment trials
- Customization of end product

Background/needs assessment

Medical Background: disability, surgeries, current fitness level

Identification of cycling goals:
- Recreation, fitness, competition?
- Distance and terrain anticipated?

Functional skills: transfers, balance, UE function, chair stow
Support systems for riding (clubs/teams, family, friends)
Transportation & storage of the equipment

Seating/Posture Evaluation

Anthropometrics: height, weight, physique
Sitting in wheelchair: identifies posture presentation in usual seating system
Short sitting on firm mat: removes influence of the chair
Supine on firm mat: removes influence of gravity
Sitting on bike: demonstrates influence of bike configuration

What are we looking for in the seating evaluation?

Postural presentation/musculoskeletal alignment in frontal, sagital, transverse planes

- Deviations from "normal"
- Fixed or flexible? General rule is correct flexible, accommodate fixed
- ROM: any limitations to accommodate? Neuromuscular coordination
- Tone: extensor and/or flexor synergies, influence on position
- Strength: trunk, extremities
- Functional skills: balance, transfers, pressure release, adaptive strategies

Equipment Trials

Need to know the options available and associated factors

- Bike options for adults and children
  Upright vs. Recumbent
  - Pivot steer vs. lean steer
  - Adjustable vs. custom configuration
  - Components available on various models

Seat and back options

- Seat/back sizes, designs, positions available
- Specific adjustments possible
- Ability to customize with alternative products
  - Cushions, backs, laterals, hip guides, cranks, pedals

Seating Interventions on Handcycle — — — — —
Case Examples

Comfort

- Critical factor that must be considered/assessed with all modifications
- Sense of balance and equipment control may be the "comfort report"
- Sustained postures and repetitive motion for many hours

Skin protection

- Seat configuration: solid vs. sling seat, shape, size
- Cushion options: low profile needed for low COG and crank clearance
- Pressure releases: more difficult to do during prolonged rides
- Goal is to optimize pressure distribution, prevent skin breakdown

Postural support

- Utilize available adjustments for fine tuning
- Provide appropriate base of support based on posture eval findings/trials
- Consider after market products, creative interventions to optimize support

Joint preservation

- Prevention of repetitive strain injuries through proper bike configuration
- Arm crank height and distance from trunk adjusted
- Seat and back orientation optimized
- Wrists maintained in neutral position
- Education for injury prevention
  - Transfers: avoid using crank housing or backrest for push
  - Straps: may exacerbate injuries in a rollover
  - Training: utilize appropriate endurance progression

Performance

- Recumbent: pivot or lean steer is rider preference based on trials
- Stable, lightweight, aerodynamic
- Adjustments in rider position/support to optimize power output
- Accessory options: cranks, pedals
- Postural support that is not inhibitory
- Consistent training

Other Handcycles of Interest

One-Off Titanium All Terrain Handcycle: "truly a mountain bike"
Angletech: propelled by both legs and arms
Mobility Engineering: 2-wheeler with out-riggers
Brike international: recumbent 3-wheeler foot pedal

"Handcycle Clinic" at VA Puget Sound Health Care System, Seattle

Interdisciplinary approach: RT, PT, MD, OT, Equipment Tech

Specific eligibility guidelines for sports equipment

Comprehensive evaluation

Equipment trials

Prescription of bike, customization

Support/encouragement for goal oriented cycling program

Handcycling Research

Published research limited (Janssen 2001, van der Woude 2000)

Recommendations for research

- Bike design and configuration for optimal performance
- Seating recommendations for skin protection, support
- Injuries associated with handcycling; prevention of injuries
- Handcycling as an aerobic exercise
- Long term compliance with cycling vs. other sports/exercise

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It's a Rough Ride Out There!

Patrick Meeker, MS PT

As kids, we all experienced the bumpy bus ride to school. The vibrations from the road and the bus sent shock waves through us. After paper wad fights and passing notes, we couldn't wait to get off the bus. Our clients in wheelchairs suffer the same shocks and vibrations, but on a consistent, day-long basis. Therefore, wheelchair and equipment manufacturers have developed products aimed at reducing the transmission of vibration to the client. This is accomplished by using chair and components specifically designed to dampen vibration before it reaches the user. Numerous studies have shown a link between whole body vibration (WBV) and various health risks, including low back pain[1].

Back to School

Before we can begin understand why some stuff reduces vibration and other stuff doesn't, we need to return to physics class. Vibration can be easily defined as "energy in motion." Vibrational waves are defined in hertz (Hz), or cycles per second. Vibrational intensity, whether increasing or decreasing, can be defined as acceleration. We often use the term "deceleration," but to physicists, the sudden stop at the end of a fall is really negative acceleration, hence the saying, "it's not the fall that kills you; it's the sudden stop at the bottom." Lastly we have the concept of conservation of energy. Energy cannot be created or destroyed; therefore, when the vibrational energy hits the wheelchair, it's got to go somewhere. And this is where we come in.

It's a Rough Ride Out There

So imagine rolling down any sidewalk in any city and running over the cracks and expansion joints in the concrete. This sudden (negative) acceleration imparts a large burst of energy into the wheels of the chair. This input energy can be classified as kinetic energy, or the moving waves of vibrations through the chair. It may also be in the form of stored energy, or potential energy, like in a compressed spring. The result is miniscule deflections in the caster forks and tires and absorption of energy. Both of these forms of energy are dispersed in three ways: work, noise and heat. Work is the wear and tear on the equipment and person. Noise is vibrations in the sound spectrum, given off by the squeaky wheel bearing or loosened bolts in the frame. Lastly, heat is given off in small quantities as the result of internal friction between two adjacent moving parts.

A typical curb drop onto the front casters generates about 200G's. That's 200 times your body weight times gravity in one drop! To minimize these forces and keep them from jarring your fillings loose, the wheelchair tends to absorb some of this energy by dissipating work, noise and heat through the front caster fork, pneumatic tires, frame, seat base and cushion. The idea for materials and devices specifically designed to reduce this tremendous vibrational energy started in the occupational and transportation markets.

The Survey Says...

Whole body vibration exposure has been determined to be a significant risk factor for industrial, agricultural and transportation workers. This exposure led to the development of the international standard, ISO 2631[2]. Based on a variety of laboratory and workplace studies, it sets the vibration exposure limit that workers may be subjected to during a routine workday. Most limits are in the 5-8 Hz range, which remarkable corresponds to the level which the human body finds most difficult to dissipate. This research is extremely limited in wheelchair users, however, but key concepts can be paralleled. The way the human body responds to vibration is different between individuals by gender, and even between different tissues in the body. Why is this important? WBV has been shown in numerous studies to be a major contributing factor in the genesis of low back pain (LBP). LBP is the number one cause of medical disability among workers in industrialized countries and costs the U.S. in excess of 80 billion dollars per year. One reason is the spine consists of two very different structures stacked on top of each other; a bony vertebral body and a ligamentous and fluid-filled intervertebral disc. This significantly impacts the behavior and attenuation properties of a vibrational wave traveling through the spine. The wave travels easier through the spine's bony segments and becomes more disrupted and creates micro-tears in the circumferential fibers of the disc. Over time, this may lead to a herniated disc. WBV has also been linked with GI dysfunction, decreased visual performance and immune system deficits.

Measurement of vibration includes four physical factors: intensity, frequency, direction and duration (Table 1).

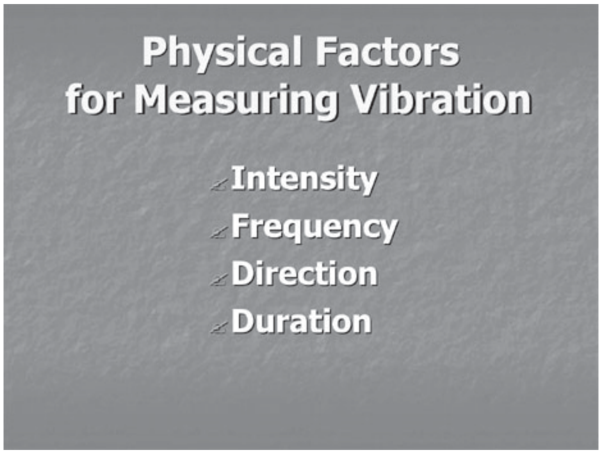

Table 1

The ISO standard uses these measurements to determine human exposure limits. These limits are evaluated to determine safe working conditions for efficiency, comfort, health and safety. By using these standards, vibrational exposure to the wheelchair user may also be inferred. Common sense dictates that driving down the road in a car equipped with shocks and springs designed to reduce occupant vibration would obviously help those using wheelchairs for mobility. To this end, wheelchair and equipment manufacturers have designed products to help reduce vibration in key areas based on impact forces.

From Model T to Cadillac (in a wheelchair)
The initial impact point in most 4-wheel driving situations in a wheelchair is through the front wheels. An Iowa State University study has shown that using front forks with shock-absorbing polymers reduced impact g-forces by at least 75% at the fork assembly. (Figure 1)

Figure 1

The remaining vibrational energy passes through the frame and components and into the user. Through the combined use of a pressure-relieving wheelchair cushion and shock-absorbing castors, damaging vibrational energy was reduced by nearly 95%[3].

So what does this mean for the wheelchair user? After a thorough evaluation by a therapist, seating specialist and/or assistive technology supplier, a client's risk of vibration exposure can be assessed and appropriate products can be prescribed. This may potentially have a marked effect on the client's long-term health and increase the life of the wheelchair. In an age of limited resources and dwindling reimbursement, the ability of a product to survive its 'lifespan' becomes even more important. Total DME (durable medical equipment) expenditures increased 45% and Medicare DME expenditures increased 64% between 1993 and 2000[4]. This trend will probably continue secondary to aging of our population, and this doesn't include potential additional medical costs associated with seated dependent usage of wheelchairs, namely, pressure ulcers.

Prescription of products aimed at vibration reduction may take more of a long-term role in wheelchair setup and client satisfaction. Can reduction in long-term vibration exposure keep a new wheelchair in tip-top shape longer? It may be inferred that if we can reduce the detrimental effects of vibration to the user, these benefits may also carry over to the equipment. Our clients may also increase functional mobility by tackling obstacles that rigid systems may made too difficult to overcome. Endurance may increase secondary to decreased fatigue and increased comfort. People may stay in their chairs longer, stay on the job longer, or take part in more recreational activities because their "functional window" has opened. Stability, and ultimately, safety improves when significant obstacles are encountered, the change in motion caused by the obstacle is significantly reduced. This may be the difference in keeping somebody in the chair or picking them up off the ground.

So the next time you take that ride in a bumpy subway, bus or hopped-up Honda Civic, remember how physics, vibrational energy and health risks go hand-in-hand. Then consider there are ways to improve a wheelchair users' ride by significantly reducing vibration by using complementary products at the site of impact, primarily shock absorbing wheelchair forks and pressure reducing cushions. And maybe you won't hear, "it's a rough ride out there!"

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24-Hour Positioning and Identifying Barrier Tasks in the Multidisciplinary Care Of Pressure Wounds in the Community

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Sue Munro, B.Sc. (O.T.)
Karen Lagden, RN, ET
Salimah Mitha, B.Sc., R.D

Pressure wound healing protocols have typically only included assessment and treatment. They often do not include how to maintain a closed wound. Many of these wound care protocols have been derived from a medical model and typically include detailed protocols for when to use specific categories of wound care products and dressings. This presentation will describe a novel multi-disciplinary framework for pressure wound assessment and healing in the community: The ATM Framework. This framework has three distinct phases:

1. Assessment of the pressure wound. This includes a multidisciplinary approach to assessment of the wound and etiology of the pressure wound. The assessment is a comprehensive forms package that is designed to be modular. The modules are divided up into several categories: Background Information, Assessment of Risk, Nutrition & Feeding, Wound, Positioning, Surfaces, Tasks, Tools & Strategies and Goal Setting. When appropriate, a module can be pulled from the package and given to the client and their team to complete. The goal of the forms package is to provide an opportunity to review all the information within the team to establish goals with the client. Action plans are made for each goal. A review date is set for the goals and action plans.

In the Tasks section of the assessment package, there is a tool that is given to the individual and their parents, caregivers and school staff. This enables the wound care therapist to efficiently assess the variety of tasks and surfaces that the individual is sitting/lying on. It has been surprising to find that many of the wounds have not derived from sitting in a wheelchair. Many have been "unearthed" using this Tasks Tool (e.g. sitting in a school chair without a cushion, toilet seat).

Time	Tasks (list all functional activities, tasks, routines)	Environment	Partners	Position, Seating, Mobility
EXAMPLE				
9 am – 11: 30 am	Wake up routine…	Bedroom,	spouse	Standard mattress, Invacare commode chair, sliding board transfer with pulling on clothes.
11:30 – 12:00	Breakfast	Kitchen	caregiver	Power wheelchair (Jazzy 1120) with Jay 2 backrest, Stimulite 18 x 18 contoured cushion, standard footrests.
12:00 – 1:30 pm	Sitting at the computer	Bedroom		Same as above

Table 1. Above is a sample of the multi-disciplinary assessment protocol (Tasks Section). The Client's Daily Schedule requires the client to list their routine and the equipment and strategies that they are presently using in a 24-hour period.

Please fill in the position and seating/mobility device the client is using for each task.

In addition to listing each surface the client is sitting or laying on in a 24-hour period, the family is requested to identify barrier tasks to wound healing.

Barrier Tasks	By client? By family? By teacher? By other team member?	Describe
EXAMPLE		
1. Sitting at the computer	Spouse	Client is so engrossed in computer use that he doesn't perform a pressure reliefs. The wheelchair does not have power tilt. The wheelchair cushion is questionable as well in terms of the best static pressure reduction cushion.

Table 2. From the above Client's Daily Schedule, list 5 tasks that are perceived by the client, family and/or other team members to be a barrier – to prevention, healing or maintaining a healed wound.

2. Treatment of the pressure wound. This includes traditional wound care concomitant with off loading the wound site and nutrition intervention. Case examples of equipment and nutritional strategies used in this treatment phase will be shown.

3. Maintenance of the closed or "healed" wound. This is the most challenging phase. Equipment and strategies for maintaining wound closure are critical to prevent the wound from reoccurring.

Case studies will be used to present the Tasks and Barrier Tasks section of the assessment forms package. Case studies include clients with diagnoses of spinal cord injury, multiple sclerosis, and palliative.

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A Comparison Between Parents' And Therapists' Views Of Their Child's Seating System

R. McDonald
S. Wirz
R. Surtees

Background

Much literature is available to support that adaptive seating for children with cerebral palsy is valuable to help with the development of motor skills, functional and adaptive skills and in helping to prevent fixed deformity (Pain et al, 1996, Pountney et al. 2002; Mulcahy et al. 1988, Reid et al. 1999, Myhr and von-Wendt, 1991, Green and Nelham, 1991, Hulme et al. 1989, Pope et al. 1994, McClenagahan et al. 1992). Clinical practice suggests further reinforces this. However, there is little objective research evidence as to what type of adaptive equipment may be of most benefit for the child and their family.

Clinical experience, backed by some literature has shown that clinicians and parents may have differing opinions on their children's adaptive equipment (McConachie & Pennington, 2002, Reid et al 1999). The differences in opinion may be reflected in information giving, understanding and communication difficulties, resulting in unhappiness with equipment and perceived 'non-compliance'. Parents have been reported to show that information shared with them about their child and their child's equipment can be of mixed benefit (Pain, 1999). Furthermore, White (1997) showed that there is a need for greater collaboration between therapists, carers and users of special seating systems in order for the systems to be satisfactory.

Two similar questionnaires have been developed in order to address whether there were differences between the opinions of parents and therapist of children with cerebral palsy in relation to their individual seating systems, and to identify the nature of those differences. The first questionnaire is designed for parents and the second for therapists dealing with adaptive seating.

Methods - Questionnaire Development

The questions asked derived from clinical practice in the neurodisability service at Great Ormond Street Hospital for Children NHS Trust, and discussion with local therapists, wheelchair therapista and parents. The questionnaires are identical except for language ('Your child' for parents, 'the child' for therapists). The questions in the questionnaires are arranged into 4 areas: 'Ease of Use', 'Appearance', 'Seated Function' and 'Comfort'. A separate section ascertains background information (such as how long the child spends in the seating system, how long they have had the seat) and asking what the parent/therapist like and do not like about the seating systems.

The questionnaires were initially developed and sent to therapists and parents for review, and the questionnaires were then modified in terms of style and language in response to this process. Apart from one parent who objected to the question about appearance, all parents and therapists agreed that the subject content was appropriate. Again, apart from one parent who felt the questionnaires should emphasize the safety of the seating systems, none of the parents/therapists wanted to add any further topics. The subjects were the parents of children attending neurodisability clinics and the therapists were occupational therapists and physiotherapists from Great Ormond Street Hospital for Children NHS Trust, all of whom were experienced with children who use wheelchairs/adaptive seating systems. To ensure reliability of the questionnaires, the forms were sent to participating parents and therapists over a 6-8 week period on three separate occasions. 32 families were approached; 6 parents completed all three repeated measures and 8 parents completed interviews. Each parent and therapist completed the questionnaire three times with an average gap of 4 weeks.

In order to test the value of the questionnaire, parents and therapists who had completed the questionnaires three times were then interviewed. The purpose of the interviews was to ensure the reliability of the questionnaire information (triangulate the data) and gather information about the topics and areas that were important to the interviewees. Respondents were asked their opinions of the questions asked and their response to the question for their own child or the child they worked with. At the end of the interview interviewees were asked what they liked and didn't like about the questionnaire and what further questions would they like to be asked. Eight interviews were conducted with parents and 4 conducted with therapists. The written records were then analysed using a thematic analysis approach (Ritchie & Spencer, 1994). The themes of the 8 parent interviews were then arranged into 12 topics. These were then compared to the therapist interviews.

The responses to the questionnaires were evaluated for consistency of response. The most consistent and least consistent areas on the questionnaires were different between therapists and parents. Practical issues are consistent for both parents and therapists, but that there was a difference in the areas of comfort and appearance. The parent group was least consistent in appearance, but most consistent at replying about their child's comfort. However the therapists were most consistent in the questions about appearance, but not as consistent in the area of comfort or function. Whilst the therapists concentrated on technical issues, developing skills and the management of children's posture, parents were particularly concerned with day to day child management issues (such as getting a child in and out of a car), difficulties with emotional and socialization skills (such as the development of a postive body image), and the safety of the systems. None of the therapists took into consideration the carers' own needs and health (i.e. weight and ease of use) when considering the equipment.

Main Project - Subjects and Methods:
The subjects for the main project were the parents and therapists of children with four limb cerebral palsy. Subjects were recruited through clinic appointments, or through their local paediatric occupational therapist or physiotherapist. 36 children were recruited into the project, with 59 families approached. 34/36 parents 31/36 therapists returned the questionnaire. The questionnaires were sent to the parents together with a consent form, parent information sheet and stamped self-addressed envelopes.

Results

There was general agreement between parents and therapists that the seating system had been provided for postural management, although, several in both groups suggested it was only one of a number of factors, such as transport, mobility, and ease of use. Surprisingly, there was disagreement as to whether the child'm main chair was self drive powered mobility or attendant propelled manual chair. No children in the cohort used self-propelling wheelchair bases. When answering the question 'Does the child's seating system achieve what you had wanted it to', there was a normal distribution for both parent and therapists, although slightly skewed towards being completely satisfied. This was interesting considering the qualitative comments made in the second section of the questionnaire. The questionnaire consists of 23 categories, and interestingly, there tended to be general agreement between parents and therapists on the rating scale.

The background section asks information about how long children have had their seating system, time they use the seat every day and what other equipment they use. However, there is also the opportunity for respondents to write down what they like and dislike about the seating system, whether there are times that the child is comfortable or uncomfortable in their seat and other comments that they would like to make. This data was analysed using keywords and grouped into similar categories. Both parental and therapy respondants had positive aspects to the chair, including improving sitting position and comfort. Nearly all of the parents and two thirds of the therapists had negative views of the seating system. The parental group responses concentrated three main areas: the practical aspects of the seat (such as 'heavy' and 'cumbersome') the appearance of the seating system ('looks ugly') and safety concerns ('front top heavy so easily topples over'). The therapy responses were not as coherent or consistent as the parent group, and tended to concentrate on the child's position in the chair ('still manages to sit with a kyphotic posture'). Only two of the therapists mentioned the appearance of the chair.

Discussion

In the pilot interviews, both parents and therapists expressed that they found the questionnaires useful and would like to have the opportunity to answer such questions prior to attending a wheelchair/ seating clinic appointment. Comments were made that this could aid communication at the time of the appointment. Following the results of the main study, this would appear to be a practical use for such a questionnaire. With further development and validation, It would seem appropriate to use the questionnaire for setting agendas in advance of a clinical appointment and serve as a basis for discussion. In particular, the sensitivity of the initial scaling section requires further development. However, with an agreed agenda prior to an appointment, this may help to improve the discussion between parents and therapists and therefore increase efficiency of such an appointment in terms of time saved in a long-term sense by achieving a satisfactory result in the first instance.

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Clinical Application of the Wheelchair Seating Standards

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Background
Many clinicians have been frustrated by current terminology and the lack of consistency in a methodology for describing seated postures. The wheelchair seating standards work has been progressing primarily at the international level and is reaching final acceptance stages in several areas. One of these standards under development introduces standardized terminology and definitions for quantification of seated posture. This is part 1 of the ISO 16840 series of seating standards. This part of the international standard should be released for the draft international standard (DIS) voting in Spring, 2003. The DIS stage is the final voting stage that allows editorial comments to the document and is a longer and more complex voting process requiring, among other things, translation of the document into several languages. Once an international standard has progressed to this point, its substance is technically no longer subject to major revisions. The plan throughout the development of this standard was to provide a standard that would be useful not only for scientific research, but also for clinical practice in all areas of the service delivery process. Work has already begun on developing the tools necessary for clinicians to be able to utilize the concepts in the Part 1 standard. This work will continue with refinement based on feedback from audiences such as this one. Successful implementation should allow clinicians to improve their clinical practice in the area of wheelchair seating.

Purpose/Objectives
The purpose of this workshop is to present the concepts in Part 1 that relate directly to clinical practice and to introduce some preliminary tools and techniques that may help to facilitate integration into current clinical practice settings. Many of the concepts will be quite new to most seating clinicians. In addition to its intended use as a clinical tool, these concepts may be used by seating suppliers and manufacturers, so that all members of the seating team will be able to "speak the same language." This workshop will provide a hands-on experience in which therapists and others might gain practical experience using the proposed terminology and concepts. It is expected that feedback from participants will be very helpful in planning future developments.

Foundational Concepts
The following concepts are elements of the integrated measurement system that, when used together with the proposed terminology, permit the objective description and recording of a person's seated posture in their wheelchair.

1. Global coordinate system: In order to take a measure of any kind, that will have consistency across facilities and over time, agreement must first be reached on what recognized coordinate system, from the many possible, will be used as the standard. After much debate, the following coordinate system was chosen. The direction of the positive X, Y, and Z axes, relative to the seated person and as viewed by the observer, is defined in Figure 1 below. This has been termed the Global Coordinate System because it remains fixed in orientation and thereby serves as the constant reference to which all linear measures can be made- for the person, their support surfaces, and their wheelchair (only the person is shown in Figure 1). Figure 1 also shows the three dimensional location of the origin (0,0,0p) of the coordinate system for the person.

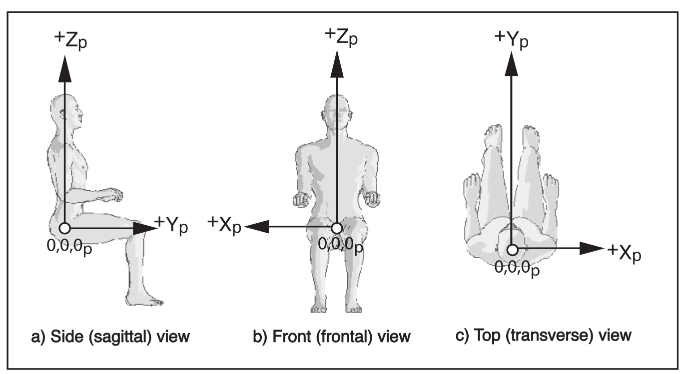

Figure 1- Defination of Global coordinate system

As seen in figure 1, there are three views in which measures are considered – sagittal (side), frontal (front) and transverse (top), thereby giving an approximate 3-D representation. Linear values of measurements can be positive or negative depending on the direction they extend from the $0,0,0_p$ center.

2. Integrated Measurement System – There are really three coordinate axis systems-– one for the person (termed, seated anatomical axis system (SAAS), one for their postural support devices (termed, support surface axis system (SSAS), and one for the wheelchair (termed, wheelchair reference system (WRS). Though described separately, each has been designed to allow for integration with the other two systems to describe the integrated measurement. The integration then provides a description of the seated posture of the person, the dimensions and placement of their postural support system and the set-up of the wheelchair.

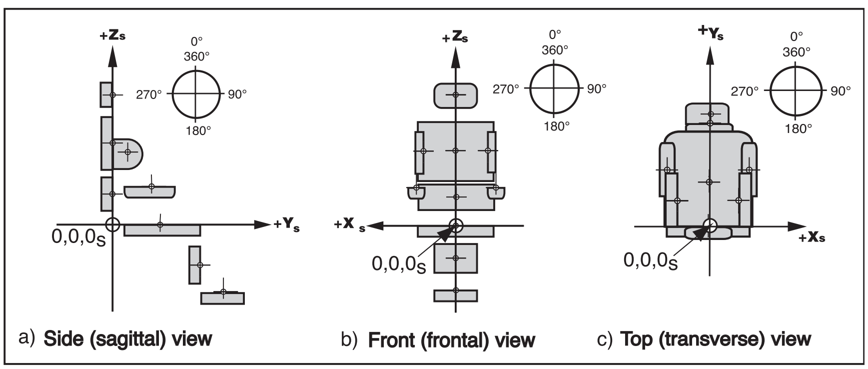

Figure 2 – Support Surface Axis System

3. Compass Rose– Regarding angular measures, a decision must be made as to what standard method will be used to measure and describe angular positions of body segments and their support surface components. After much debate, it was agreed that a 360 degree measurement system, termed the compass rose, seemed to offer the most advantages. As can be seen in Figure 3, this approach begins with 0 degrees aligned with the +Z axis and measures degrees continuously to 360 degrees in a clockwise direction. Therefore, angular measures are always positive and range from 0 degrees to 360 degrees. This method is used for all angular measurements in all positions.

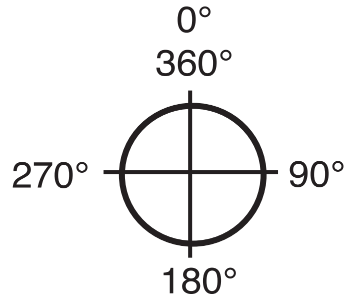

Figure 3: Definition of the angular measurement system

4. Absolute vs. Relative Angular Measures:
The standard proposes use of two types of angular measures. It is clinically important to be able to define the orientation of body segments both with respect to other body segments (as this reflects joint position), and with respect to a fixed outside reference (as this reflects orientation in space). Angles formed by two adjacent body segments are called relative angles, while angles that represent the orientation in space of a singular body segment are called absolute angles.

5. Body Segments, Anatomical Landmarks and Segment Lines:
In order to define absolute and relative angles of the body, it was first necessary to identify the specific body segments of interest, and then be able to specify their orientation. In order to accomplish this, body segments, anatomical landmarks and the anatomical location of a line on each segment (termed segment line) are defined in each of the three views. Measurements of deviations of segment lines from the designated reference axis in the compass rose, projected to the three orthogonal planes, permit the measurement and recording of body segment angles.

6. Support Surface Geometric Center and Reference Lines:
Determination of absolute and relative angles of support surfaces required an additional step in this process. Because support surfaces are not universal in their size, shape or configuration there is no way to define them based on an assumed size, shape, or configuration. For this reason, the concept of the support surface geometric center was necessary. This hypothetical point on any support surface has a consistent definition regardless of the size, shape, or configuration of the particular support surface

involved. Unlike a body segment line, which has a natural point of rotation, the support surface geometric center is actually at the center of the support surface, so rotation occurs around it in any direction. This necessitates defining a reference line which extends out of the support surface geometric center and which is then used in determination of absolute and relative angular positions of that support surface. As with body segments, these reference lines are defined within each of the three planes.

Measures Defined in the Standard
The following is a summary of the types of measures defined in this part of the Wheelchair Seating Standard (ISO 16840-1):

1. Angular Measures:
- Body Segment Absolute Angles (eg. Sagittal Pelvic Angle)
- Body Segment Relative Angles (eg. Pelvis to Thigh Angle)
- Support Surface Absolute Angles (eg. Frontal Foot support Angle)
- Support Surface Relative Angles (eg. Sagittal Seat to Back support Angle)

Terms are defined for absolute angles in all three views (sagittal, frontal and transverse), while terms for relative angles are defined in the sagittal view only.

2. Linear Measures:
- Linear Body Measures (eg. Buttock/thigh depth, scapula height, foot depth)
- Support Surface Size Measures (eg. Seat depth, foot support width, back support length)
- Support Surface Location Measures (eg. Lateral support frontal location, back support sagittal location)

Clinical application of this standard – “Why bother?”
The application of this seating standard will elevate the level of clinical practice and will assist in validating our seating outcomes and the need for both our specialty services and the equipment we recommend. Currently, we have very few “scientific” ways of quantifying what we do and why it is important to those we serve. As we are challenged more and more to demonstrate the need for our services and for the fulfillment of our recommendations, this standard will become essential to practice in seating.

Electronic Information Resources

Mary Ellen Buning, PhD, OTR, ATP

Today, a collection of WWW bookmarks or "favorites" can easily replace several file drawers full of product brochures and catalogs. A number of Internet information tools exist that can help you find data to support your practice in seating and mobility. WheelchairNet, as a compilation of a vast number of resources focused on Wheeled Mobility use and adaptive living, serves as a portal to extensive information to guide and inform clinical practice. WheelchairNet, a project of the RERC on Wheeled Mobility at the University of Pittsburgh, is located at http://www.wheelchairnet.org/. In the latest analysis of statistics (Nov.2002), an average of more than 180 persons visit the site each day. The clinician-oriented site, RehabCentral.com, continues to offer daily reports from the floor during MedTrade and serves as a forum for practitioners to discuss approaches to intervention. This site continues to benefit from the efforts of Steve Silverman and Adrienne Bergen.

Many manufacturers initially developed their websites with a "business to business" flavor with extensive listing of parts and product administrivia. Over the past 3 years they have taken a greater interest in developing websites that can educate and informs clinicians and consumers about their products. Photos, feature summaries and links to related information are doing more to allow review of products without requiring access to notebooks, brochures, etc. Ex

Another aspect of Internet use will affect your practice. According to the Pew Internet and American Life Study the Internet has become a powerful way for consumers to get health related information. (Fox & Rainie, 2000) Fifty-two million American adults, or 55% of those with Internet access, have used the Web to get health or medical information. The majority of these "health seekers" go online at least once a month for health information (Fox & Rainie, 2000). A great many health seekers say the resources they find on the Web have a direct effect on the decisions they make about their health care and on their interactions with doctors or therapists. They get ideas about questions to ask and awareness of related factors, for instance, transport safe wheelchairs. Not only are people using it to learn about their options but are gathering second opinions and looking beyond the advice of their primary health information source.

The results of a study of how consumers use the web in anticipation of wheelchair decision-making events show that those exposed to the resources of WheelchairNet for 6 weeks felt significantly more "ready" to engage in wheelchair decision making, whether alone or in partnership with their assistive technology professionals. Their wheeled mobility knowledge was significantly greater than those in the control group. Additionally, those in the experimental group were much more likely to rate the usefulness of the Internet above other sources of wheelchair information. They ranked the Internet 4th behind personal experience, their rehabilitation therapist and the opinion of other wheelchair users. (Buning, 2001)

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Functional Benefits of a Dynamic Pelvic Stabilization System

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ABSTRACT
The HipGrip is an innovative dynamic pelvic stabilization device that assists the wheelchair user in maintaining pelvic stability while allowing functional pelvic movements. The HipGrip allows the pelvis to pivot forward about the hip joint while providing variable resistance to bring the pelvis back into its neutral posture. The HipGrip provides a stable base from which to perform functional tasks, such as reaching. The objective of this study was to demonstrate how the HipGrip performs for people with different seating needs. To demonstrate that the HipGrip maintains pelvic stability throughout a range of movements and enhances upper body function, 25 subjects are participating in an ongoing study comparing the HipGrip to their personal seating systems. Improved pelvic stability while using the HipGrip was demonstrated by performing a series of postural measurements documenting the pelvic position in the wheelchair before and after movement occurred. Increased upper body function while using the HipGrip was demonstrated by having subjects perform a functional forward lean test. Using a single subject design, results obtained with the subject using the HipGrip were compared to results obtained with the same subject using their personal seating system.

Background
There is a direct link between a stable pelvis position and improved upper body function and postural stability (1), but the pelvis is also dynamic and natural movements should be allowed to occur (2). Currently available pelvic supports may not control undesired pelvic movement or tend to fix the pelvis in a static, non-functional position often promoting posterior pelvic tilt. The HipGrip is a dynamic pelvic stabilization device that will accommodate 6.4 cm (2.5 in) of pelvic rotation, 6.4 cm (2.5 in) of pelvic obliquity, and 30 degrees of anterior or posterior tilt. The HipGrip supports the user through range of movement and then guides the pelvis back into neutral posture (3).

Figure 1. The HipGrip
This figure is of the HipGrip installed in a wheelchair. The HipGrip consists of a padded rear shell, a padded front belt, a pivot mechanism, and wheelchair attachment hardware.

methods
Subjects used their own wheelchair with its original configuration and then repeated testing with the HipGrip installed. All of the subjects did not have the upper body control to complete the Modified Functional Reach Test (4) so a functional forward lean test was derived to assess forward lean. Pelvic obliquity and fore/aft position of the pelvis in the wheelchair were first recorded with the subject sitting in their upright resting position. Postural measurements were repeated after activity was initiated to assess how well pelvis position was maintained. Forward movement in the wheelchair was calculated as the difference between the average of the left and right distance from the lateral femoral condyle to a wheelchair frame reference pre and post activity. The Sitting Assessment Scale (SAS) was used to analyze posture (5). The SAS is a standardized test that evaluates head, trunk, and foot control, and also arm and hand function.

Results

Case studies of three subjects are presented as examples of typical results. All subjects found the HipGrip comfortable and aesthetically pleasing.

Case 1 – Spinal Cord Injury C5-6 (Incomplete)

Subject 1 was a 37-year-old male who used a manual, sports-type wheelchair with a foam cushion. Subject 1 had moderate pelvic obliquity that was decreased with use of the HipGrip (from 8 degrees to 5 degrees). Subject 1 had less forward movement in the wheelchair (by 0.4 cm) during activity while using the HipGrip. Posture was improved (SAS scores increased for trunk control and arm function, all other SAS categories remained the same) and more forward lean (12.0 cm) was achieved using the HipGrip. Subject 1 found the HipGrip easy to use and reported that the HipGrip enabled him to reach further and improved his posture.

Case 2 – Cerebral Palsy (Moderate)

Subject 2 was a 24-year-old female who used a powered wheelchair with a Jay GS seat cushion, solid back, lateral trunk supports, and lap belt. Subject 2 had moderate pelvic obliquity that was decreased with use of the HipGrip (from 17 degrees to 6 degrees). Subject 2 had less forward movement in the wheelchair (by 4.5 cm) during activity while using the HipGrip. Posture was improved (SAS scores increased for foot control, all other SAS categories remained the same) and more forward lean (7.0 cm) was achieved using the HipGrip. Subject 2 reported that the HipGrip made her feel more stable.

Case 3 – Cerebral Palsy (Severe)

Subject 3 was a 32-year-old female who used a standard manual wheelchair with an anti-thrust cushion, contoured back, lateral trunk and hip supports, sub-ASIS bar, and a head support. Subject 3 had spinal instrumentation from C7 to the pelvis. There was no spinal flexion; her trunk flexed forward as a unit. Subject 3 had mild pelvic obliquity that was decreased with use of the HipGrip (from 6 degrees to 3 degrees). Subject 3 had no change in forward movement in the wheelchair during activity while using the HipGrip. Posture was not changed (SAS scores remained the same) indicating that the HipGrip held this subject as well as the sub-ASIS bar, although more forward lean (5.5 cm) was achieved using the HipGrip. Subject 3 found the HipGrip easy to use and reported that the HipGrip made her feel more secure.

Discussion

Preliminary data indicate that the HipGrip reduced unwanted pelvic movement while allowing functional movement within a prescribed range. It is anticipated that upper body function of wheelchair users with a variety of disabilities will be enhanced by the HipGrip. Future research will include a total of 25 subjects participating in this study.

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text description of figure

The Relationship Between Pelvic And Trunk Aligment And Force Measured Through A Kneeblock In Children With Cerebral Palsy

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R. Surtees
S. Wirz

Introduction

This paper examines the pelvic and trunk alignment of children with cerebral palsy, using an adaptive seating system with a sacral pad and kneeblock to control the pelvis and measured on a modified version of the Seated Postural Control Measure (SPCM) (Roxborough et al 1994).

One commonly used seating system in the United Kingdom has been developed along biomechanical principles and involves the use of a sacral pad and kneeblock arrangement to control the pelvis (Green & Nelham, 1991). It is proposed that this arrangement will improve pelvic stability, thereby improving trunk control. The sacral pad and kneeblock in theory work together to push the pelvis into a neutral position and maintain it, by providing opposing forces (Green & Nelham, 1991). However this has not been objectively proven, and information about such systems has tended to be descriptive in nature (Reid & Rigby, 1996). Furthermore, there has been concern raised over the use of kneeblock and sacral pad arrangements regarding possible secondary effects on trunk control and alignment.

Methods

25 children with cerebral palsy were examined. Parents of the subjects were approached through their occupational therapist or physiotherapist. As a pre-requisite of inclusion, the children were those using an adaptive seating system with a sacral pad and kneeblock arrangement in order to help control their posture. 36 families gave consent to the project, with 33 families beginning the project. However some of those children did not use the chair in the standard manner, or were too small for the kneeblock force measurement unit, and therefore a modification was made to the device. These results will be analysed separately. The results of the initial visit to 25 children are presented here.

The children had either predominant spastic or dystonic movement patterns. They ranged in age from 5 years to 15 years with the majority between 8 and 11 years, and weight range was between minimum of 16 kg and maximum of 57kg. Children were seen 6 times over the course of 4-6 months, on a monthly basis (2-5 weeks). At the third visit, the children's kneeblocks were removed for a period of 3-4 weeks. .

The children were assessed using a modified version of the Seated Postural Control Measure (SPCM) (Roxborough et al, 1994) to gain the pelvic and trunk degree measurements. Following this the children's own sacral pad was removed and replaced with the examiners sacral pad which has the 12 cell matrix of the Oxford Pressure Monitor (IPM-12) attached to it. The subjects own kneeblocks were removed and replaced with the kneeblock device containing force transducers. The kneeblock device was adjusted so that the proportions were as close to the children's own kneeblocks as possible.

Results

3 pelvic parameters and 3 trunk parameters were analysed together with mean sacral pad pressure as measured on the IPM-12 and the force exerted through the kneeblocks. The force data was taken from a steady state force and averaged. The difference between left and right kneeblock measurement was also measured. The results were analysed using Pearson's correlation, and are presented in table 1.

Table 1: Correlation table of Pelvic and Trunk Parameters, Force and Pressure Measurements

		PELVIC OBLIQUITY	TRUNK LATERAL SHIFT	PELVIC TILT	TRUNK INCLINATION	PELVIC ROTATION	UPPER TRUNK ROTATION	FORCE MEAN COMBINED	FORCE MEAN DIFFERENCE
TRUNK LATERAL SHIFT	Pearson Correlation	.500*							
	Sig. (2-tailed)	.011							
PELVIC TILT	Pearson Correlation	.137	.425*						
	Sig. (2-tailed)	.513	.034						
TRUNK INCLINATION	Pearson Correlation	-.093	-.016	.462*					
	Sig. (2-tailed)	.659	.940	.020					
PELVIC ROTATION	Pearson Correlation	.525**	.525**	.361	.174				
	Sig. (2-tailed)	.007	.007	.076	.405				
UPPER TRUNK ROTATION	Pearson Correlation	-.269	-.170	-.244	-.192	-.199			
	Sig. (2-tailed)	.193	.416	.240	.358	.340			
FORCE MEAN COMBINED	Pearson Correlation	-.024	-.189	-.414*	-.375	-.170	.033		
	Sig. (2-tailed)	.909	.365	.040	.065	.416	.875		
FORCE MEAN DIFFERENCE	Pearson Correlation	.092	-.041	-.328	-.219	-.350	.143	.433*	
	Sig. (2-tailed)	.660	.844	.110	.293	.087	.496	.031	
MEAN PRESSURE	Pearson Correlation	.020	-.161	.000	.096	.038	.065	.162	-.233
	Sig. (2-tailed)	.925	.443	.998	.647	.856	.757	.438	.263

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Discussion

The results of the analysis are interesting and show some unexpected results. No relationship between force measured at the kneeblock and pressure measured at the sacral pad was seen. This implies that the force at the kneeblock is not countered at the sacral pad must therefore be dissipated elsewhere – perhaps throughout the back of the chair. The relationship between total combined force and difference between the kneeblocks is also positively correlated indicating that as the mean forces increase the difference between the force on each side becomes more evident.

A negative correlation between combined force and pelvic tilt was shown – indicating that an increase in force leads to a decrease in pelvic tilt. Furthermore, pelvic tilt was shown to positively correlate with trunk lateral shift and trunk inclination, indicating that an improvement in pelvic position has a secondary improvement in trunk position.

These are preliminary results that require further analysis and discussion. Never the less it is becoming apparent that while there is some positive evidence for the use of adaptive seating systems that use a sacral pad and kneeblock to help control posture, the results do not support published rationales for using such a system.

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Redesigning the Wheelchair Pushrim for Injury Prevention

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It is well established that manual wheelchair users have a high prevalence of repetitive strain injuries of the shoulder and wrist (1). These injuries are believed to be caused by repetitive and stressful activities of daily living such as wheelchair propulsion and transfers. Because of the importance of mobility and transfers in daily life, many MWUs ignore pain and trauma to their hands and arms and continue with everyday activates, regardless of the potential harm. While there have been many technological advancements in the design of manual wheelchairs and wheelchair technology, little attention has been given to developing technology to prevent repetitive strain injuries. It was this realization that has motivated researchers to redesign the interface between the user and the wheelchair in an effort to alter propulsion biomechanics reduce the risk of injury.

Since the beginning of independent wheelchair propulsion, the circular metal tube attached to the wheel rims, referred to as a pushrim, has been the standard device used for propulsion. This is likely due to its simple design, ease of use, low cost, minimal maintenance, and facilitation of functional self-propulsion. However, wheelchair users find that the common pushrim style doesn't meet their needs for effective propulsion. In a survey of one hundred and seventeen manual wheelchair users (MWUs), Perks et al. found that only 39% of the users propelled with the pushrims only, 54% gripped the tire and rim together, and 7% used only the tire (2). This suggests that over 60% of the users were dissatisfied with solely using the pushrim. In an effort to meet the need for a more effective self-propulsion device, new alternative propulsion assist devices have been developed, however, they have failed to gain wide acceptance and use. For instance, hand crank and lever drive systems have likely been unpopular because they tend to add more width and weight to the wheelchair, compromise arm space and are cumbersome to deal with when transporting the wheelchair. Despite the numerous interfaces available to propel a wheelchair, the pushrim remains the most widely accepted propulsion assist device to date.

A patent search of pushrim/handrim designs resulted in 6 US, European, and International innovative designs:

- EP (European Patent) 0 363 780 "Rad fur einen RollstŸhl," 1989 – Heinemann
- US patent #4,366,964 "Wheelchair hand rim," 1983 – Furey et al.
- US patent #5,927,739 "Dual friction wheelchair hand Rim," 1999 – Evling et al.
- International patent WO 00/18346 "Wheelchair hand rim with friction," 2000 – Nicklasson et al.
- US patent #6,120,047 "Low impact hand rim apparatus for hand-propelled wheelchair," 2000 – Axelson et al.
- US patent #6,276,705 "Wheelchair hand rim," 2001 - Baldwin et al.

Only two of these patented concepts (US patent #5,927,739 and #6,276,705) are available as US commercial products by Sun Metal Products, Inc. (Warsaw, IN) and Three Rivers Holding (Mesa, AZ), respectively. While inventors state in their patents that their pushrim designs 'facilitate gripping', 'reduce the potential for repetitive strain injury', 'improve control and mobility', and 'increase mechanical efficiency', few research studies have been done to substantiate these claims.
The pushrim described in US Patent #6,276,705 (University of Pittsburgh, Pittsburgh, PA), referred to as new ergonomic pushrim (NEP) has undergone initial testing to determine its effectiveness in reducing injury. The design is based on increasing the surface area available for gripping the pushrim and selectively coating parts of the pushrim with high friction materials. Unlike the standard pushrim, there is no gap between the pushrim and the side of the tire. Bridging the gap is a contoured surface that can be used to contribute towards forward propulsion under the pressure of the thumb. A second rim concentrically added to the existing (standard rim) was intended to create a more natural grip for the fingers and create more surface area for the palm to contact during propulsion. Preliminary studies with unimpaired individuals and a small group of individuals with paraplegia compared the NEP performance to that of the standard pushrim design (3). Individuals pushed a wheelchair equipped with SMART^{Wheels} (force and torque

sensing wheels) on a wheelchair dynamometer. The trials consisted of steady-state, acceleration and braking conditions. A motion analysis system recorded upper extremity movements during propulsion. Compared to the standard rims, the NEPs significantly increased power output and mechanical efficiency. Also interesting was the decrease magnitude of wrist extension when using the NEPs. Extremes of wrist extension during a repetitive task have been associated with the development of carpal tunnel syndrome. The reductions observed in wrist range of motion, improved mechanical efficiency and power input may theoretically reduce the likelihood of developing carpal tunnel syndrome. An analysis of the braking forces revealed that individuals with paraplegia were able to stop their wheelchairs using less force and torque when using the NEPs (4). These findings imply that a pushrim with improved hand coupling may require less effort, is easier to control and is safer than a standard pushrim when performing mobility tasks, such as braking.

Other innovative pushrim designs that have undergone scientific testing to determine their potential to minimize injury originated from inventors at Beneficial Designs (Mindin, NV). They have developed a series of 'compliant' interfaces for pushrim/tire attachment. In place of the rigid standoffs that are typically inserted to attach the rim to the tire, a 'Shock Mount', 'Extension Spring' or 'Bungee Cord' is used. After performing a biomechanical analysis similar to that described above, the 'Extension Spring' concept was found to reduce impact loading by 30% and peak forces by 6.6% (5). A slight reduction in peak forces was also found with the 'Shock Mount'. Both the 'Extension Spring' and 'Shock Mount' interfaces were designed to allow translational displacement relative to wheel which may have contributed to reducing the impact during propulsion. Since impact loading has been associated with carpal tunnel syndrome (6), using this type of interface may minimize the risk of injury. As an added benefit, the 'Extension Spring' concept was found to reduce ventilation by 30%, oxygen consumption by 23% and heart rate by 7.9% suggesting less effort was needed to propel with this type of compliant interface (7).

Work continues on improving these pushrim developments. Three Rivers Holdings has streamlined the NEPs through weight reduction (original NEP weighed four times more than the standard pushrim) and a textured high-friction, high-profile top surface. Beneficial Designs has created a new compliant interface with a means to adjust the degree of compliancy. As these designs are perfected and being used in the general MWU population, we will hopefully find a decrease in the incidence of upper extremity problems.

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Purpose, Use And Fabrication Of A Custom Made Dynamic Backrest.

Jim Dawley, ATS, CRTS
Rosemary Julian, P.T.

Our purpose is to provide a means of placing a patient with abnormal and uncontrollable movement securely and safely in a dynamic wheelchair seating system and at the same time preserve an acceptably supportive and secure seated position.

The Adaptive Seating Program for The Children's Hospital of the King's Daughters and Eastern Virginia Medical School in conjunction with Rehab Health Care have been presented with three specific patient population groups with the following problems:

- completely broken back canes or frame
- excessive wear and tear on footrest hangers and failure of the system.
- excessive wear and tear on headrest mounts and failure of the system.
- injury to self due to forceful and uncontrollable movement resulting in forceful contact with wheelchair components.

The three groups of patient population are:

Group A:
The patient who exhibits strong extensor thrust activity involving the trunk and lower extremities secondary to increased tone.

Group B:
The patients with self-stimulating behavior including head banging, head and upper trunk banging and/or rocking movement.

Group C:
Patient with extensive forceful and other unspecified abnormal movements. This may include choreo-athetosis or ballismus.

Considerations:

- Should we try to strengthen the frame and mounting hardware so as to absorb the forces and attempt to prevent extensor thrust activity?
- Should we or could we build a seating system that allows extensor thrust activity and if so how much?
- Should the patient be allowed to move into the spastic posture or should it he prevented?
- Dynamic foot plates, dynamic headrest systems and dynamic backrests are on the market and available. The dynamic backrests pivot at the seat to back angle and are not appropriate to meet our needs.
- A prototype completely dynamic seating system allowing movement at all junctions was introduced several years ago in Pittsburgh but is not to our knowledge on the market at present. However this idea stimulated our interest and consideration in this project.

For clinical application, the idea of a completely dynamic seating system. We conjecture that we would not be able to secure the patient in the chair without securing the pelvis. Therefore a fixed seat-to- back junction is necessary.
We decided that we should and could place a patient with abnormal and uncontrollable movement securely and safely in a dynamic wheelchair seating system and provide an acceptably supportive position at rest and that we should try doing this by stabilizing the pelvis.

Method:
The pelvis is secured by providing a lower fixed backrest segment. The upper part is dynamic and mounted on gas springs using separate and different hardware. The height of the lower section extends to approximately T-9 level. The upper section extends to shoulder level and allows movement of the upper body above the fixed point. The exact level of fixation depends on the nature of the patient's behavior and movement patterns and the amount of restraint versus movement needed or desired. This is decided by observing and noting the patient 's movement. Consideration is then made as to the weight of the spring i.e. the amount of resistance to be used. We may also consider the use of a dynamic headrest and/or footrest mount in conjunction with the dynamic upper backrest.

The following parts make up the Dynamic backrest:

- Two Solid back inserts
- Two Miller's Adaptive Technologies Dynamic headrest interfaces
- Two Auto lock Mounting blocks
- Two Multi-plane Vertical adjustment bars
  Two Horizontal adjustment bars with Sockets

Fabrication:
The seat and the lower backrest are essentially a normal seating system. i.e. solid seat and back insert connected to the wheelchair frame with hardware. A full width backrest, particularly the upper section, as opposed to a drop-in backrest should be used, as it will cushion the patient against injury caused by the shoulders hitting the back canes.
The mounting hardware used must be secure enough to withstand the forces of the patient's movements. Freedom Design's Econo-Eze hardware has been successful. With larger patients, the Transport Econo-Eze has been necessary in order to prevent the hardware from working loose.
The upper back insert is attached to the lower back insert with two Miller's Adaptive Technologies Dynamic headrest mounts. The Dynamic mounts must be attached with T-nuts and not wood inserts or wood screws. Because of this care in ordering and assembly is necessary. This back can be ordered with a custom T-nut pattern, or can be ordered in parts and the T-nuts positioned and inserted by the ATS.
When positioning the Dynamic mounts on the backrests, they should be spaced as far apart as possible but close enough to the center so as not to hit against the back canes. This will prevent the back from twisting when uneven forces are placed upon it.

Once assembled, the upper backrest should be flush with the lower backrest so as to present smooth surface, with a small gap at the junction, which will allow movement of the upper back insert. It should be placed in the wheelchair fame approximately 2 to 4 inches in front of the back canes to allow enough room for the movement.

Findings and discussion:
Group A: The patient who exhibits strong extensor thrust activity involving the trunk and lower extremities secondary to increased tone and Group C: Patient with extensive forceful abnormal movements.

- Patient's with a previous history of damage to the wheelchair related to forceful movement have had no further such problems. The first system was delivered in February 2000. In addition we have had no incidents of breakdown or repair to any of its components used in the new dynamic system.
- Reduced incidence of soft tissue damage.
- Decision regarding weight of springs and resistance used can only be guessed at and ultimately we have relied on trial and error to determine if minimal, moderate e or heavy resistance is needed.
- Additional use of dynamic headrest is usually unnecessary in this group.
- Use of dynamic footplate mounts has been successful in preventing broken footplate mounts and footplates. However the use of dynamic footrest mounts "feeds into" any existing asymmetry of spastic forces. This may result in more extension in one lower extremity than the other coupled with pelvic asymmetry and spinal rotation.
- Shearing and skin injury due to too much movement against seating components must be considered.
- Attachment of the lateral thoracic supports must be considered carefully. Generally the lateral support should be attached to the fixed lower segment of the backrest but this may interfere with the desired height of the lower back segment. We still have difficulty with this problem.
- When this system is used with a tilt in space wheelchair, the weight of the patient in the chair compressed the springs so the upper part is pressed back as far on to the back canes and this puts the patient in a position of too much upper body extension. This problem is solved by adding a removable pin to secure the springs in place when tilted.

Group B: The patients with self-stimulating behavior including head banging, head and upper trunk banging or rocking movement.

- Good results achieved in this group. Forces have effectively been removed from the frame and the patient has appeared comfortable with no increase in self- stimulation reported and some reports of decrease in self-stimulation: This may be due to increased comfort or to the calming effect of the allowed stimulating behavior.
- Overall we suggest that it may be beneficial to allow a controlled amount of self-stimulation.
- Incidence of soft tissue damage has been reduced.
- Shearing injury to the skin has not been a problem in this group.
- The addition of dynamic headrest mount with a padded headrest pad has helped when excessive head bagging is involved.
- Attachment of the lateral thoracic supports must be considered carefully. Generally the lateral support should be attached to the fixed lower segment of the backrest but this may interfere with the desired height of the lower back segment. We still have difficulty with this problem.

Suggestions for follow up studies.
Further research and collection of data on the effects of the controlled dynamic seating system on the amount of self-stimulation in Group B patients may prove useful.

The Client, the Team, the Equipment.. Maintaining Continuity and Achieving Goals.

Brenlee Mogul-Rotman B.Sc.O.T., OTR, ATP, OT Reg(Ont.)

Case History

Jennifer is a 31-year-old woman who was involved in a motor vehicle accident on April 26, 2000. She was rendered a T12-L1 paraplegic as a result of this accident. Following discharge from her initial rehabilitation at an inpatient facility, Jennifer moved into an apartment and was living independendently. She performed all daily tasks and began a community college course on an every day basis. She worked out at a fitness centre and began playing wheelchair basketball on a weekly basis.

Jennifer is a full time manual wheelchair user. Following discharge home, she smoked, was overweight and displayed limited compliance and judgement at times. Her manual wheelchair, cushion and back support were prescribed while at the inpatient facility and delivered once she was at home. There was no follow up by the prescribing facility and Jennifer was referred for seating and mobility intervention by an occupational therapist in the community. Upon physical assessment, Jennifer presented with a left pelvic obliquity and scoliosis (caving in on the right side). Her current seating system was not sufficiently supporting her or correcting her flexible deformities.

Jennifer received occupational therapy intervention on an as needed basis and was in the process of beginning investigations into a more suitable seating system to meet her needs. She was referred for physiotherapy treatment to assist with the correction of her deformities and upgrade her transfer ability and overall physical status.

In July 2001, Jennifer noted a “red mark” at the area of her left ischial tuberosity. She believed that she might have hit her brake during a transfer, causing this red mark. Within days she was admitted to hospital with a Stage 4 icshemic ulcer. Jennifer was hospitalized for one week and then discharged home with full services and team consultation. Her case manager was able to organize attendant care and nursing in addition to OT and PT. A dietician was consulted and medical consultation was ongoing.

Jennifer received a combination of traditional wound care and a period of time on Vacuum Assisted Closure (VAC) machine treatment. At it’s worst, the wound was 14.5 cm deep with a diameter of approximately 3cm at the surface. Jennifer was regularly feverish and feeling ill. She experienced numerous bladder infections and was on and off antibiotic treatment.

Between July and October 2001, the wound went through numerous changed and treatments. Healing appeared to be stalled. Through October to December 2001, medical consultations determined that Jennifer appeared to suffer from osteomyelitis and was a candidate for musculocutaneous flap surgery, to be performed in January 2002.

Surgery was performed on January 15, 2002 with admission to the rehab facility for a 6-week period of time post surgery. Jennifer is now returning to her school schedule on a part time basis and is returning to an active lifestyle and independence.

Ischemic Ulcers

Stages of icshemic ulcers:

- Stage I- Non-blanchable erythema of intact skin. Discoloration of skin, warmth or hardness also may be present.
- Stage II- Partial thickness skin loss involving epidermis and/or dermis. The ulcer is superficial and presents clinically as an abrasion, blister or shallow crater.
- Stage III- Full thickness skin loss involving damage or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. The ulcer presents clinically as a deep crater with or without undermining of adjacen tissue.
- Stage IV- Full thickness skin loss with extensive destruction, tissue necrosis, or damage to muscle, bone, or supporting structures. Undermining and sinus tracts may also be associated with Stage IV ischemic ulcers.

Risk Factors contributing to development of ischemic ulcers:

- Extrinsic Risk Factors- Pressure, shear, friction, moisture
- Intrinsic Rick Factors- Age, nutrition, disease process, medication, lack of sensation, smoking, radiation, immobility, history of ischemic ulcers, obesity, malnutrition, infection, incontinence, edema, dehydration

Treatment Team and Approach

Jennifer has benefited and continues to benefit from a multi disciplinary treatment team dedicated to ensuring her optimal health, safety and independence. Her team was decreased following discharge from her initial rehabilitation to the intervention of a case manager and as-needed occupational therapy intervention. She continued with ongoing medical follow up with her family doctor. With the development of her Stage IV ischemic ulcer, Jennifer's team increased to include personal attendants, nursing, physiotherapy, dietician, physicians (family doctor, plastic surgeon, physiatrist). Also included as a part of the consulting team were various equipment vendors. Although all team members are community based, coordination of services and comparison of ideas and strategies was ongoing with all team members, including Jennifer. Jennifer currently continues to have ongoing medical and nursing follow up, case management, partial attendant care (for heavy, time consuming tasks), physiotherapy and occupational therapy.

Adaptive Equipment

The prevalence of ischemic ulcer development in the spinal cord injured individual is high. Prevention and education is key. In Jennifer's case, the development of the Stage IV ulcer required immediate changes and modification to not only her seating system, but all other surfaces that she would use, present and future. Jennifer's cushion required change in order to assist in the healing of the ulcer, prevention of further skin breakdown and to assist in the correction of her deformity. Her bed required a therapeutic support surface to protect her and assist in healing. Although Jennifer was on bed rest for over 5 months, her schedule included being up in her wheelchair 3 times per day for 15 –30 minutes. She continued to perform bowel care on the toilet and continued to shower on a padded shower chair. Her exercise and fitness routine was lost and her physical status deteriorated. The following adaptive equipment was put in place immediately upon development of the ischemic ulcer and remains in place to date:

- Roho High Profile Quadtro cushion
- Dual Flex short back support
- Roho Mattress Overlay System (full bed length- 4 sections)
- Roho Low Profile cushion for use on shower transfer bench
- Easy Stand 6000 Glider

Conclusion

The cost of treating and healing ischemic ulcers in staggering. This cost is increased amoung the spinal cord injured population who frequently require surgical intervention of close stage IV ulcers. There is a risk of recurrence of skin breakdown following surgical management of the ulcer. Diligent post-surgical care is important. Positioning and use of pressure redistributing support surfaces is strongly recommended. The client requires education, information and support from all team members to ensure a decrease in risk factors and successful management of daily tasks and responsibilities. Assessment, determining goals and following an action plan will assist the client in successfully recovering from skin breakdown and loss of productivity and allow them to achieve their goals and chosen life roles.

"Optimal, cost –effective patient care requires the integration of research findings into practice and a continuing assessment of outcomes attained, which cannot be achieved unless care is continuous and multidisciplinary."

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Using Contoured Seating for Better Head and Trunk Control in Individuals with Severe Disabilities

David W. Kemp, OTR, ATP, BCP

Goals

Become familiar with how contoured seating can improve daily issues with those who have severe disabilities

Become familiar with the evaluation process

Be aware of the pros and cons to doing contoured seating

Be aware of contraindications to doing aggressive contoured seating

Understand the general process of providing a client with an aggressive contoured seating system

Contoured Seating

Individualized seating that can be formed directly to the client in order to correct or accommodate position. Has been used for many years to provide form fitting seat and backs to children and adults who cannot be comfortable in off the shelf seating.

Examples

Signature 2000

Contour U (Invacare)

Sure Shape

Prairie Seating

Foam-in-Place

Silhouette (Invacare)

Problems

- Expensive
- Does not grow well
- Hot
- Tall seat to floor height
- Usually requires a larger wheelchair
- Heavy

Advantages

- More able to correct / accommodate
- Good for general pressure relief
- Looks good
- Great comfort
- Sometimes the only choice for deformity

Common Diagnosis

- Cerebral Palsy
- Traumatic Brain Injury
- Near Drowning
- Other conditions that have deformities
- Conditions that have severe posturing

Common Clinical Conditions

- Scoliosis
- Kyphosis
- Other conditions that have deformities
- Conditions that have severe posturing

Correction vs. Accommodation

One of the most misunderstood problems with advanced seating. If a client has a fixed deformity or if a condition is difficult to correct, then accommodation of the position is the only choice. If a client's position is corrective with little effort the this should be done. Many long-term wheelchair users cannot (or will not) tolerate much correction. Get them early!

Fixed Orthopedic Condition

Refers to when an aspect of the body does not move well. It could mean a fixed (frozen) joint or a curve in the back

Note: If a joint takes a great deal of effort to move, then it should be considered fixed

Fixed areas of the body can have a severe functional impact on all aspects of living

Reducible Orthopedic Condition

Refers to when a client may position themselves in a poor position, but with external support, they can achieve a straight or functional posture

How can you tell what is what?

- Find a therapist with experience who has treated neurological and orthopedic conditions
- Find a therapist who understands wheelchairs and seating
- Do a thorough mat evaluation
- Get a medical history
- Do a simulation
- Evaluation
- Background
- Medical History
- Mat Evaluation
- Wheelchair Recommendation

Goals

- Writing it Up

Background
Get a detailed explanation from caregivers on what they view as the most important problems in the care of their loved ones.
Often centers around mealtime problems, drooling, sliding out of wheelchair, eye contact, excessive sleeping, etc..

Medical History
- Diagnosis
- Pressure Problems
- Respiration
- Growth Potential
- Weight History
- Bowel and Bladder Control
- URIs/Dysphagia

Mat Evaluation
- Tone
- Motor
- Transfers
- Balance
- Sensation
- Ability to shift weight
- Pain
- Contractures and deformities

Wheelchair Recommendations
- Consider seat to floor height
- Consider size and accessibility
- Consider weight-shifting
- Consider transport issues
- Consider manual vs. power
- Consider ability to pay and maintain
- A Case for Tilt-in-Space

Contraindications to contour
- a past history of pressure sores
- a past history of severe circulation problems
- clients with poor temperature self-regulation
- a client who moves significantly in their systems
- clients who are self-mobile
- clients who self-transfer
- clients who have an unstable history of growth or weight change

Process
1) Evaluation / Simulation
2) Scanning / Forming
3) 3rd Fit / Mock Fit
4) Final Fit

Process with Tim
Tim :
Age: 31
Diagnosis: Cerebral Palsy
Condition: Totally dependent, non-verbal, Profound retardation
Lives in small care home with 24 staff, transported in large van with raised roof
Problems: Major discomfort, difficult to feed due to head position, staff have improvised to hold him in position, breathing problems, severe muscle tone, history of pressure sores

Mat Evaluation
Severe Scoliosis convexity to left/ lumbar/thorasic/ cervical curve — slight ability to reduce
Severe tone with posturing noted
Upper extremities: high tone, non-functional,wrists flexed
Lower extremities: high tone, bilateral dislocated hips, Pelvis is oblique and rotated, limited hip and knee flexion available, windblown hips to right
Head control is poor - related to tone

Current Wheelchair/Seating
Invacare Tiger Tilt-in-Space 18" Wide
Signature 2000 Seat and Back
Multiple Pillows and Bolsters
Recommendations
New Signature Seat and Back
Donated Invacare Solara 18" / long
1 1/2" Double Pull Padded Pelvic Belt
Dynaform Slim-cut Harness
Custom Padded Foot Board
Whitmyer Pro1 S with left facial pad

Conclusion and Questions

Power Kids

Virginia Paleg, PT
Janice Fisher, PT, ATP

The Children's Hospital of Denver
Power Wheelchair Criteria - Indoor

The following are criteria developed by The Children's Hospital of Denver to help determine if a client is appropriate for a power wheelchair. If a client is able to demonstrate the following criteria during an initial assessment and/or during any other subsequent training sessions, a power wheelchair is deemed appropriate. If the client only meets some of these criteria, training guidelines will be provided to the family/caregivers to help develop these skills. The Children's Hospital may then follow-up by phone call or re-evaluation to determine if all criteria are met following training. Our intention is to provide as appropriate a recommendation as possible for the client.

__________ The client demonstrates Cause and Effect concepts in the power wheelchair. Demonstrated by: the client realizes that activating the access method (i.e. a switch) is causing movement of the power wheelchair. This may be communicated verbally or by expression.

__________ The client demonstrates Stop and Go concepts in the power wheelchair. Demonstrated by: the client realizes that activating the access method (i.e. a switch) is moving the power wheelchair and that releasing the access method stops that movement. This may be demonstrated verbally, by following directions to "Stop" and "Go", or stopping consistently for obstacles.

__________ The client demonstrates Directional concepts in the power wheelchair. Demonstrated by: the client realizes that the power wheelchair will move in different directions, depending on how the access method is used. For example, moving the joystick in another direction or activating different switches for different directions.

__________ The client demonstrates the ability to follow directions while driving the power wheelchair. Demonstrated by: the client will follow directions such as "Stop", "Go" and "Come Here".

__________ The client demonstrates adequate judgement for their age while driving the power wheelchair.

Demonstrated by: the client recognizes obstacles and attempts to avoid these, the client does not show signs of aggression with the power wheelchair and the client demonstrates caution.

__________ The client demonstrates adequate problem solving for their age while driving the power wheelchair. Demonstrated by: the client will maneuver the power wheelchair to a designated destination without verbal cues. I.e. drive to the stuffed animal.

__________ The client demonstrates adequate vision functionally to safely drive the power wheelchair. Demonstrated by: visual attention to the environment and the ability to recognize and avoid obstacles.

__________ The client is able to use an access method with adequate activation, sustained contact and release. Demonstrated by: the client is able to consistently and accurately activate access method (i.e. switch), sustain contact as needed and release to stop while driving the power wheelchair. The client demonstrates adequate endurance and consistency of motor control. Once a client has demonstrated competence in these areas, indoor driving is considered appropriate. Outside driving requires further skills. Please refer to the Power Wheelchair Criteria - Outdoors checklist for more information.

The Children's Hospital of Denver
Power Wheelchair Criteria - Outdoor

The following are criteria developed by The Children's Hospital of Denver to help determine if a client is appropriate for driving a power wheelchair outdoors. These criteria are assessed after a client has demonstrated competence driving indoors. Please refer to the Power Wheelchair Criteria – Indoor checklist. If a client is able to demonstrate the following criteria during an initial assessment and/or during any other subsequent training sessions, driving a power wheelchair outdoors is deemed appropriate. If the client only meets some of these criteria, training guidelines will be provided to the family/caregivers to help develop these skills. The Children's Hospital may then follow-up by phone call or re-evaluation to determine if all criteria are met following training. Our intention is to provide as appropriate a recommendation as possible for the client. Mark each item Independent (I), Needs Supervision (NS) or Dependent (D).

__________ The client demonstrates the ability to follow directions while driving the power wheelchair outdoors. Demonstrated by: the client will follow directions such as "Stop", "Go" and "Wait" in a variety of outdoor situations, including crossing a street.

__________ The client demonstrates adequate judgement for their age while driving the power wheelchair outdoors.
Demonstrated by: the client stops at all driveways and street crossings, accurately determines if crossing is safe and completes crossing. The client understands the meanings of crosswalk signs and traffic lights. The client does not attempt to drive up or off a curb unless the power wheelchair is designed for this task and the curb is within specified parameters.

__________ The client demonstrates adequate problem solving for their age while driving the power wheelchair outdoors. Demonstrated by: the client recognizes unsafe situations, such as the lack of a curb cut, and is able to problem solve a solution, such as going back to a driveway and driving in the gutter to until reaching the crossing.

__________ The client demonstrates adequate vision functionally to safely drive the power wheelchair outdoors. Demonstrated by: the client is able to discriminate boundaries of a sidewalk, curb edges and changes of terrain. The client is able to adequately see display, as necessary, in sunlight.

__________ The client is able to use an access method with adequate activation, sustained contact and release over varied terrain. Demonstrated by: the client is able to consistently and accurately activate access method (i.e. switch), sustain contact as needed and release to stop while driving the power wheelchair outdoors over varied terrain. The client demonstrates adequate endurance and consistency of motor control over varied terrain.

Optional:
___________ The client will be able to use access public transportation with the power wheelchair. Demonstrated by: the client will be able get to correct bus or light rail stop at the correct time. The client will be able to determine when correct bus or train has arrived at stop for boarding and for departure. The client will be able to enter and exit the bus or train.

Forms used thanks to: Michelle Lange, OTR, ABDA, ATP
Assistive Technology Partners
Carol Wells PT
Director Physical Therapy

The Children's Hospital
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Power Mobility Training Assessment
Joanne Bundonis, PT, PCS

NAME: DATE OF BIRTH:

DATE TRAINING INITIATED: ASSESSMENT DATE:
THERAPISTS:

POWER WHEELCHAIR:

POSITIONING AIDS:

ACCESS METHOD:

SCORING CRITERIA

0 **Not attempted**

1 **Maximal Assistance**
Attempts task but requires complete assistance in order to execute the task safely. Requires continual 50-100% hands on assist to control the wheelchair safely and continuous verbal cues.

2 **Minimal Assistance**
Requires intermitten 10-50% hands on assistance to redirect the wheelchair when it deviates and continuous verbal cues.

3 **Direct Stand-By**
Completes entire task but needs guarding for safety. Requiring assistance less than 10% of the time and occassional verbal cues greater than 50% of the time.

4 **Verbal Cues Only**
Independent in performing task without assistance, but requires frequent verbal cues greater than 25% of the time for safety and redirection.

5 **Age Appropriate Supervision**
Independent in task with visual supervision and infrequent verbal cues of less than 25% of the time.

6 **Age Appropriate Independence**
Independent in task greater than 75 percent of the time.

! To score add up the score from each section and divide by the number of criteria in that section to get an average.
! A score of 4 .5 or greater indicates functional power mobility skills, work on refinement
! A score between 3 and 4 is considered marginally functional, work on lacking skills
! A score below 3 indicates skills that are not functional, focus on regular training

BEGINNER/INDOOR SKILLS

	Able to maintain sitting position without activating access method when appropriate
	Sustains pressure forward for greater than 10 seconds
	Sustains left turn pressure for greater than 5 seconds
	Sustains right turn pressure for greater then 5 seconds
	Sustains reverse pressure greater than 5 seconds
	Release control when appropriate
	Does Circles
	Moving in the direction of a target for 10 feet
	Moving in direction of a target for 25 feet
	Moving in a straight path for 10 feet regardless of stops

	Moving in a straight path for 25 feet regardless of stops
	Stops after bumping into an obstacle
	Turns left toward a target
	Turns right toward a target
	Drives in reverse for 5 feet
	Slows and moves around an obstacle
	Moves through a double door
	Turns power wheelchair on and off
	Score = Sum/18
	INTERMEDIATE SKILLS
	Moves in a straight path for over 25 feet without stops
	Makes 2 plus turns toward a target
	Stops at an unexpected event
	Stops and parks within 2 feet of a target
	Drives outdoors on ashphalt over 25 feet
	Remains on one side of hallway recorrecting for stationary objects for 100 feet.
	Able to change drives or speeds
	Stops when others approach in tight environments to allow them to pass
	Identifies if the power wheelchair is malfunctioning
	Moves through a single doorway
	Score = Sum/ 10
	ADVANCED/COMMUNITY SKILLS
	Ascends a ramp
	Descends a ramp
	Navigates a sidewalk with a curb for over 25 feet
	Navigates a curb cut-out
	Navigates a busy hallway with varied, random and multiple obstacles
	Avoids irregularities in the ground
	Drives on and off van lift
	Enters and exits an elevator
	Able to cross a street or intersection
	Negotiates various doorways including opening of doors
	Drives on side of roadway when no sidewalk is present
	Score = Sum/11

What is different about wheelchairs with the transit option?

Douglas Hobson PhD
Larry Schneider PhD

Background

Over the past thirty years, there have been significant improvements in motor-vehicle transportation safety for able-bodied travelers. Much of this is due to federal motor vehicle safety standards (FMVSS) that require manufacturers of motor vehicles to comply with minimum crashworthiness design and performance requirements. However, there has also been a significant increase in consumer ratings testing, such as the National Highway Traffic Safety Administrations (NHTSAs) New Car Assessment Program (NCAP) and the Insurance Institute for Highway Safety's (IIHSs) tests and published ratings that impose higher test and performance requirements than federal safety standards. With the exception of a 1992 modification to FMVSS 222 School Bus Crashworthiness that requires bus manufacturers to install statically tested four-point strap-type tiedowns and 3-point belt restraint systems for use by forward-facing wheelchair occupants, these federal standards and consumer tests do not address occupant protection systems used by most wheelchair-seated travelers.

To fill this void and improve the transportation safety for wheelchair-seated travelers, the Adaptive Devices Subcommittee (ADSC) was established in the mid 1980s as a Society of Automotive Engineers Technical Subcommittee for the purpose of developing SAE Recommended Practices for after-market motor-vehicle adaptive equipment. Within this Subcommittee, the Restraint Systems Task Group was charged with the task of developing design and performance requirements for wheelchair tiedown and occupant restraint systems (WTORS). The result of more than ten years of effort, which involved significant coordination and harmonization with International Standards Organization (ISO) and Canadian Standards Association (CSA) efforts to development similar standards, is SAE J2249 Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles.

As SAE J2249 neared completion, members of the SAE Restraint Systems Task Group recognized that providing effective occupant protection in a crash is a systems problem and that the remaining "weak link" in the system was the wheelchair. Without effective securement of the vehicle seat, and without effective seat support, an occupant restraint cannot provide effective crash protection. Not only was an increasing variety of wheelchair makes and models, often with higher mass, greater numbers of adjustments and features, and lack of standard welded frames, making it more difficult to effectively secure wheelchairs in vehicles, but wheelchair manufacturers had begun to label their products as "not to be used in motor vehicles." This added considerable liability to wheelchair transporters as well as confusing wheelchair users about their safety.

As a result of these concerns, a new Working Group, called the Subcommittee on Wheelchairs and Transportation (SOWHAT), was formed within the ANSI/RESNA Wheelchair Standards Subcommittee, with the charge of developing a new ANSI/RESNA wheelchair standard that established design and performance requirements for wheelchairs relative to their foreseeable use as seats in motor vehicles. With the financial support of numerous private and public agencies, including school transportation groups and the NHTSA, the first transit wheelchair standard, officially known as Section 19 ANSI/RESNA WC/19 WC/Volume 1 Wheelchairs Used as Seats in Motor Vehicles, or simply WC/19, was developed in less than five years and became effective in May 2002. As with SAE J2249, comparable ISO and CSA standards (CSA Z604 Transportable Mobility Aids and ISO 7176/19 Mobility Devices for Use in Motor Vehicles) have also been developed with very similar requirements.

GOALS AND RATIONALE FOR THE NEW STANDARDS

One of the primary goals has been to establish requirements that are appropriate for the worst-case motor-vehicle crash environment, which, for both public and private transportation is the van or minivan. This principle was based on the assumption that WTORS manufacturers do not generally limit or control the types of vehicles where their products are installed and used, and that most wheelchair users will not limit their travel to one type of vehicle or transit mode. A second principle behind the initial standards has been to establish requirements that will offer wheelchair users the opportunity to use belt-type occupant restraints and seats that are comparable in frontal-crash performance to equipment available to able-bodied travelers that must comply with federal safety standards. A third objective has been to provide forward-facing wheelchair occupants with improved protection in frontal crashes, which account for more than half of all serious and fatal injuries to motor-vehicle occupants.

Although the provisions of these initial standards contain numerous design and performance requirements related to improving the ease and effectiveness of wheelchair securement and occupant restraint, the most significant requirement of these standards is that products (WTORS and wheelchairs) must perform successfully in a 30-mph, 20-g sled-generated frontal crash pulse, similar to that specified in FMVSS 213 for child restraint testing, and FMVSS 208 rigid-barrier testing of vehicles.

In addition, wheelchairs that comply with WC/19, or the related ISO and CSA standards, must provide four easily accessible hook-on type securement points and be dynamically tested when secured by a four-point strap-type tiedown system. The reason for this design requirement for transit wheelchairs is the due to the need for compatibility between the method of wheelchair securement provided on the wheelchair and the method of wheelchair securement provided in public vehicles. Although difficult to use correctly , four-point securement using strap assemblies is currently the most commonly used securement method in public and school transportation. This is because of its relatively low cost, its ability to be used with a wide range of wheelchair types, and its ability to comply with the 30-mph, 20-g test requirements. The four required securement points on transit wheelchair make the strap-type strap tiedowns much easier to use correctly. Transit wheelchairs may, of course, also be designed and crash tested for use with other methods of securement, such as auto-engage docking securement used by wheelchair-seated drivers.

This exhibit demonstration is intended to feature products that comply with the above transit wheelchair standards and thereby illustrate the features that improve the safety for wheel-seated vehicle occupants. Questions from participants will be most welcome.

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Contoured Seating Using Foam In Place Technology

Karen Hardwick, Ph.D., OTR, FAOTA

Types of Devices
- Full Body Positioning Devices
- Seats
- Backs
- Partial pours/Fills
- Limb Supports

Appropriate Fit/Design
- Physical Factors
  - Abnormal Muscle Tone
  - Primitive Reflexes
  - Complex Medical Conditions
  - Skeletal Deformities/ROM
  - Age
  - Size/Weight
  - Behavioral Factors

Appropriate Fit/Design
- Functional Concerns
  - Transfer Needs
  - Living/Work Environments
  - Need for Comfort/Rest
  - Need for Specific Positioning
  - Sanitary Concerns
  - Cosmetic Factors

When To Use FIP
- When the individual needs close contouring
- When the individual has extreme windswept deformity
- When the individual requires rotational support during fabricating
- when the individual cannot tolerate vibration or positioning on a simulator

When To Use FIP
- When you need small areas of contouring
- When you need to modify an existing system
- When you need a fast/immediate solution
- When you need a relatively inexpensive trial of contouring

Contraindications
- Hypertonicity/Excessive Movement
- Sensitivity to Heat
- Sensitivity to Fumes
- Resistance to Being Still
- Resistance to Materials
  - sound or feel of plastic bag

Pouring Process
- Formulate the Plan
- Prepare the Individual
- Prepare the Site
- Prepare the Staff
- Pour the Foam
- Reevaluate the Product
- Finish the Product

Preparing the Site
- Mat Table
- Wedge
- Pillows/Bolsters
- Foam Pieces
- Bags
- Cardboard/Plastic
- Markers
- Glue
- STAFF!!!

Preparing the Site
- Foam Knife
- SunMate Foam Kits
  - Various sizes depending on project
- Sheet Foam 2”
- Skin Protection
  - Sheets/clothing/stockinette
- STAFF!!!

Preparing the Staff
- Have sufficient staff available
- Explain the plan
- Apprise staff of critical factors
  - Client behaviors
  - Medical precautions
- Assign specific staff duties

Preparing the Individual
- Consider Physical Factors
- Consider Emotional/Behavioral Factors
- Communicate with individual
- Protect the Skin
- Re-evaluate During the Process

Positioning the Individual
- Sitting
- Reclined
- Supine
- Sidelying
- Limb Positions
- Inserting the bag
- Pouring the Foam

Pouring Process
- Position Individual
- Insert Bag
- Reposition Individual
- Pour Foam
- Trim
- Reposition Individual
- Reevaluate

Finishing
- Trim After Initial Pour
- Add Foam if needed
- Remove Foam if Needed
- Evaluate/Construct Supporting Structure

Common Problems
- Amorphous Shape/Poor Definition
- Poor Positioning in Final Product
- Hard Spots
- Wrinkles
- Waste

Common Problems
- Amorphous Shape/Poor Definition
- Poor Position/Support After Pouring
- Hard Spots
- Wrinkles
- Waste

Amorphous Shape/Poor Definition
- Poor bag technique
- Pour size too large
- Poor positioning of individual
- Misdirection of foam
- Gravity
- Poor coordination among staff

Poor Positioning/Support After Pouring
- Overcorrection of client
- Movement during pour
- Misdirection of foam
- Poor bag technique

Hard Spots
- Bunched Bag
- Old foam
- Improperly mixed foam
- Client movement
- Staff movement/touching foam

Wrinkles
- Poor bag technique
- Client's clothing/diaper
- Hand/finger prints

Waste
- Wrong Size of Pour
- Usually too large
- Poor bag technique
- Hard spots
- Preconstruction of Supporting Structure
- "Foam in Box"
- Poor Staff Coordination
- Poor Planning

Questions

Checking the Blindspot
A Case Study in Assistive Technology

Joan Padgitt, PT, ATP
Rich Salm, CRTS, ATS

Consider that the entire scope of knowledge that is possible in the world being represented as a circle or pie shape. From that pie cut a wedge that represents everything that you know. Whatever that percentage may be, you also know that there is certain amount or wedge of knowledge that you know you don't know. But it is also important to consider that there are also areas of knowledge that you don't know, you don't know.

Simply said:

1.) There are things that we 'know we know'
2.) Things that we 'know we don't know'
3.) Things that we 'don't know we don't know'

The things that "we don't know we don't know" can also be called "blindspots". Blindspots limit our performance as Assistive Technology Practitioners and Suppliers (ATP & ATS). This leads to the question...How do we identify blindspots and eliminate them from our practice of Assistive Technology (AT)?

There is an effort in our industry to develop competency levels in the practice of AT. We can look to other industries which have competency levels based on experience, knowledge, and performance such as Electricians who have three clearly defined levels of competency: Apprenticeship, Journeyman, and Master. This paper will have the reader consider 4 levels of AT competency; the Beginner, Practicing, Advanced, and Master practitioner.

Consider that the beginner level is where an understanding of the importance of AT is realized. The beginner has little or no AT experience to draw on and knows they possess many blindspots. This person will call in the more experienced practitioner, supplier, and manufacturer representative as needed to assist with the acquisition of AT for their client. The beginner participates, questions, and contributes to the process of AT determination.

At the practicing level of AT, an understanding and practice of "The AT Process" is achieved. The process generally has 5 basic steps:

1.) Information Gathering
2.) The Physical and Functional Assessment
3.) Simulation (Trial and Error Process)
4.) Delivery and Fitting
5.) Follow-Up

The practicing level AT practitioner acquires experience with many different types of clients where successful outcomes outweigh failures and blindspots are lessened. This is the practitioner who increases their level of knowledge through attendance of continuing education courses, conferences, and trade shows taking advantage of networking opportunities. This is the person who understands posture and the biomechanics of the seated position and their effect on function, skin integrity, and sitting tolerance.

The advanced practitioner and supplier often times takes the leadership role in "The Process" and continues to be proactive in seeking out team members to augment areas of weakness. This person recognizes the importance of the team and will bring in the expert when there is a breakdown in the process. This is the person who starts looking outside of the box and looks to create new technology & modifications to existing technology. This person also knows the difference between a symptom and a problem and addresses the problem not the symptom. The advanced practitioner identifies goals (outcomes) and educates the client, caregivers, and team as the process goes along. This person understands the need for and seeks credentialing/certification. Blindspots continue to decrease for the advanced practioner.

The master practitioner is the person who does not settle for status quo. There is an understanding that technology continues to evolve and this person continues to ask questions and seek innovation in product design, assessment, theory, and practice. This is the person who understands that being good at something is the enemy of being great and that passion can lead to greatness. The master practitioner is interested in and performs research and outcome studies, publishes and presents papers, and continues to seek out networking opportunities and continuing education from colleagues with a different client base and practice technique in order to continue reducing blindspots in their practice of AT.

A summary of strategies for eliminating blindspots from your AT practice will include:

- Attending continuing education courses and conferences such as RESNA (Rehab. Engineering Society of North America), ISS (International Seating Symposium), the Medtrade Show, as well as other independent and manufacturer sponsored educational programs.
- Clinical practice with a diverse clientele under the mentorship of persons with advanced AT expertise.
- Sitting for the AT certification/credentialing exam.
- Develop and perform a research/outcome study or survey.
- Submit a study or paper for presentation at a conference.
- Join/involve yourself in an AT organization.
- Networking at conference and websites such as www.rehab.com.
- Volunteer to assist with a conference.
- Continue your hands-on practice, practice, practice!

With a combined working knowledge of 35+ years experience, our team was presented with determining the AT needs of an 80 year old client presenting with hypotonic quadriplegia and dependence in all functional areas. The team's knowledge of posture, biomechanics, wheeled mobility bases, and seating components gave us ability to anticipate the client's seating, positioning, and mobility needs with frame modifications determined at the assessment and simulation stages. Through education of the client and their family through "The AT Process" AT parameters and components were agreed upon by the team which is inclusive of the client and family. The fitting and delivery of the appropriate AT for the client in their home was smooth with better than expected outcomes. The patient's goals were met within the environmental and financial constraints faced by the family.

In conclusion, since we now have a working definition of "blindspots" or areas of knowledge that we don't know, we don't know about in our practice of AT, it is key to continue to ask the questions...Is there technology that would benefit my clients that I don't know about? Is there something that I can create for this client that does not exist? Is there someone who has more expertise that can contribute to determination

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Geriatric Mobility: Strategies for Success

Michael Babinec, OTR/L, ATP, ABDA

Learning Objectives:

1. The participant will identify key factors of the aging process and the impact these have on the selection of Seating and Mobility Products.
2. The participant will identify key characteristics power and manual wheelchairs beneficial to geriatric mobility.
3. The participant will identify effective strategies to meet seating and positioning needs of the elderly.
4. The participant will identify strategies to teach success for independent power mobility in a small living environment.

I. Demographics of Our Aging Population

- A. Men v/s Women
- B. Increase since 1990
- C. Anticipated growth
- D. Independent v/s Assisted Living v/s Institutionalized Elderly

II. Overview of the Aging Process

- A. Orthopedic Issues & Related DME Product
  - Parameters
  - Osteoporosis
  - Arthritic Changes
  - Skeletal Collapse
  - Reduced Flexibility
  - Pelvic & Spinal Posture Changes
  - Pain / Stiffness
  - Bony Prominences
  - Reduced R.O.M.
  - Product Parameters

- B. Pressure Wound / Decubitus Ulcers & Related DME Product Parameters
  - Intrinsic Contributing Factors
  - Extrinsic Contributing Factors
  - Pressure Wound Concerns
  - Product Parameters

- C. Muscular Changes & Related DME Product Parameters
  - Reduced Strength
  - Atrophy
  - Reduced Endurance
  - Pain / Stiffness
  - Slower response / Reflex Action
  - Tight Ham Strings
  - Product Parameters

- D. Sensory Changes & Related DME Product Parameters
  - Visual Changes
  - Hearing Loss
  - Peripheral Neuropathies
  - Product Parameters

- E. Digestive System Changes & Related DME Product Parameters
  - Nutrition
  - Hydration
  - Reduced Mobility
  - Reduced Bladder size or Prostrate Changes (Incontinence)
  - Product Parameters

- F. Cardio-Pulmonary & Related DME Product Parameters
  - Endurance / Fatigue Issues
  - Dyspnia
  - Product Parameters

II. Overview of the Aging Process

- G. Cognitive Changes & Related DME Product Parameters
  - Memory Loss
  - Perceptual Deficits
  - Problem Solving Issues

- H. Benefits of Geriatric Independent Mobility
  - Independence
  - Improved Self Esteem
  - Comfort
  - Reduced Pain / Stiffness
  - Improved Cognition
  - Reduced Depression
  - Enhanced Family / Social / Community
  - Participation & Involvement

III. Aging Disabilities with Mobility Concerns

- A. CVA
- B. Fractured Hip
- C. Osteoporosis
- D. Arthritis
- E. COPD
- F. Parkinson's
- G. Dementia
- H. Alzheimer's
- I. Amputee

J. Generalized Deconditioning
K. Foot Disorders (up to 1/3 of this population)
L. Multiple Disorders

IV. Evaluation Components
A. Goals
B. Diagnosis
C. History
D. Mat/ Posture Evaluation
E. Functional Skills Evaluation
F. Cognitive / Perceptual Evaluation
G. Environmental Evaluation
H. Current Equipment
I. Resources

V. Goals for Seating and Mobility Systems
A. Comfort
B. Function
C. Independence
D. Mobility
E. Positioning
F. Prevention
G. Accommodation
H. Neurological Goals
I. Musculo-Skeletal Goals
J. Caregiver / Attendant Goals
K. Additional Considerations

VI. Mobility Considerations
A. Arm Propulsion
B. Foot Propulsion
C. One Arm Drive Propulsion
D. Powered Mobility
E. Transfers

VII. Assisted / Dependent Mobility Options
A. Manual v/s Power
- Pro's
- Con's

B. Configuration Issues
- Width & Depth
- Back Height & Back Angle
- Seat to Floor height
- Tilt orientation
- Center of Gravity
- Suspension?

C. Institutional Chairs
- Pro's
- Con's
- Characteristics Beneficial for Geriatric Users

D. Standard Manual Chairs
- Pro's
- Con's
- Characteristics Beneficial for Geriatric Users

E. Scripted Manual Chairs
- Pro's
- Con's
- Characteristics Beneficial for Geriatric Users

F. Positioning Chairs
- Pro's
- Con's
- Clinical / Functional Comparison of Tilt v/s Recline
- Characteristics Beneficial for Geriatric Users

G. Powered Mobility
- Personal Mobility Vehicles (Scooters)
- Frame Power Chairs
- Base Power Chairs
- Rear v/s Center v/s Front Wheel Drive Issues
- Electronics / Driver Control Issues
- Characteristics of Powered Systems useful for the Geriatric Population
- Teaching Strategies

VIII. Seating System Parameters
A. Durability
B. Maintenance
C. Comfort
D. Pressure Relief
E. Stability
F. Accommodation
G. Dissipating Capability (Heat & Moisture)
H. Modifiable
I. Incontinence Issues
J. Transfers to & From
K. Cost

IX. Summary

Medicare Reimbursement: The Client's Needs and the Equipment Have To Meet the Code!

Elizabeth Cole, MSPT
Amy Bjornson, PT, ATP

As more and more funding sources adapt Medicare codes for reimbursement of seating and mobility equipment, the need for a clear understanding of the criteria for these codes is critical for anyone prescribing or supplying this equipment. This session will describe coverage criteria for both the client and the piece of equipment as well as the necessary documentation for successful and timely reimbursement.

For any equipment item to be covered by Medicare, it must be a defined Medicare benefit category and determined to be reasonable and necessary to improve the functioning of a 'malformed body'. In order for Medicare to cover any type of wheelchair, the client must be determined to be bed or chair bound without it. This may be the result of lower extremity weakness, decreased range of motion, spasticity, poor endurance or balance. All of which prevent functional ambulation. In addition, the patient must require this manual wheelchair for mobility or functional seating and positioning in the home. Medicare requires that both the equipment and the needs of the client meet specific criteria in order to qualify for that code. A complete listing of manual wheelchair codes can be found at www.PalmettoGBA.com; This presentation will cover the most frequently requested types of manual wheelchairs and components. Bolded items represent key criteria for that particular code.

Wheelchair Codes
K0001 - Standard Wheelchair
Equipment Criteria

Weight:	***> 36 lbs without front riggings***	Seat Width:	16 or 18"
Seat Depth:	16"	Seat Height:	$\geq$ 19 and $\leq$ 21"
Back Height:	Non-adjustable 16 - 17"	Arm Style:	Fixed or detachable
Footrests:	Fixed or swingaway detachable	Footplate Ext	16 - 21"
Axle Plate:	Fixed		

There is no manufacturer warranty requirement.

Clinical Criteria
The patient is covered for a K001 wheelchair if the following criteria are met:
The patient is able to functionally propel a standard weight wheelchair or is dependent in mobility; it is not required that the patient self propel a K001 wheelchair. The patient does not require a specific seat to floor height for functional mobility or transfers or a specific back height. The patient does not require an adjustable axle plate for functional posture or mobility and the patient can perform an independent pressure relief or is in the wheelchair for very short time periods. The patient does not have significant spasticity, deformities or a progressive condition. This information is documented on the Certificate of Medical Necessity (CMN) form.

K0002 - Standard Hemi Wheelchair
Equipment Criteria

Weight:	> 36 lbs without front riggings	Seat Width:	16 or 18"
Seat Depth:	16"	***Seat Height:***	***17 - 18***
Back Height:	Non-adjustable, 16 - 17"	Arm Style:	Fixed or detachable
Footrests:	Fixed or swingaway detachable	***Footplate Ext:***	***14 - 17 1/2"***
Axle Plate:	Fixed		

There is no manufacturer warranty requirement. Products in this code frequently have seat widths of 20" available.

Clinical Criteria

The patient is covered for a K002 wheelchair if the following criteria are met:

The patient can functionally propel a standard weight wheelchair with a lower seat to floor height, but does not require an adjustable axle plate for seating, mobility or function, or the patient is able to transfer in and out of the wheelchair with a lower seat to floor height but not a standard height wheelchair. The patient is able to perform an independent pressure relief or is in the chair for very short time periods. The patient does not have significant spasticity, deformities or a progressive condition. This information is documented on the CMN form.

K0003 - Lightweight Wheelchair

Equipment Criteria

Weight:	***≤ 36 lbs without front riggings***	Seat Width:	16 or 18"
Seat Depth:	16"	Seat Height:	≥ 17 and ≤ 21"
Back Height:	Non-adjustable 16 - 17"	Arm Style:	Fixed height detachable
Footrests:	Fixed or swingaway detachable	Footplate Ext	16 - 21"
Axle Plate:	Fixed		

Products in this code frequently have seat widths of 20" and seat depths of 18" available. CMN is the only required documentation but be prepared for an audit.

Clinical Criteria

The patient is covered for a K003 wheelchair if the following criteria are met:

The patient is unable to propel in a standard weight wheelchair due to upper or lower extremity weakness, poor endurance, cardiopulmonary conditions, pain, fatigue, arthritis, spasticity or decreased range of motion but can and does propel in a lightweight wheelchair. The patient's body dimensions and weight are accommodated by the standard dimensions offered and does not require more specific seat to floor height for functional mobility or transfers. The patient is able to tolerate a standard back height, does not require an adjustable axle plate, can perform independent pressure reliefs or is in the wheelchair for very short time periods and does not have significant spasticity, deformities or a progressive condition..

K0004 - High Strength Lightweight Wheelchair

Equipment Criteria

Weight:	***< 34 lbs without front riggings***	Seat Width:	***14, 16, or 18"***
Seat Depth:	***14 or 16"***	Seat Height:	≥ 17 and ≤ 21"
Back Height:	***Sectional or adjustable (15 - 19")***	Arm Style:	Fixed or detachable
Footrests:	Fixed or swingaway detachable	Footrest Ext	16 - 21"
Axle Plate:	***Fixed/minimally adjustable***		

Lifetime warranty on the frame and crossbrace is required. Products in this code frequently have seat widths of 20" or seat depths of 18" available as well as even lower seat to floor heights.

Clinical Criteria
The patient is covered for a K004 wheelchair if the following criteria are met:
The patient is unable to propel in a standard or lightweight wheelchair due to weakness, poor endurance, cardiopulmonary conditions, pain, fatigue, arthritis, spasticity or decreased range of motion but can and does propel in a high strength, lightweight wheelchair. The patient must self propel, with either upper or lower extremities, while engaging in activities of daily living, is in the chair for longer than 2 hours per day and requires the wheelchair for greater than 3 months. The patient would also be eligible for a K004 wheelchair if they require seat width, depth or height that cannot be accommodated in a K001, K002 or K003 wheelchair. Additional coverage criteria include body dimensions that cannot be accommodated in a lightweight wheelchair but the patient's weight is under 250 pounds, a need for a specific back height due to poor balance, postural control, abnormal tone or orthopedic issues. Poor balance, posture, tone or orthopedic issues that require a minimally adjustable axle plate to provide changes in seat angles for functional seating and mobility would also qualify a patient for a K004 wheelchair..

K0005 - Ultralightweight Wheelchair
Equipment Criteria

Weight:	***< 30 lbs without front riggings***	Seat Width:	14, 16 or 18"
Seat Depth:	14 or 16"	Seat Height:	$\geq$ 17" and $\leq$ 21"
Back Height:	Not defined	Arm Style:	Fixed or detachable
Footrests:	Fixed or swingaway detachable	Footrest Ext:	16 - 21"
Axle Plate:	***Fully adjustable***		

Lifetime warranty on frame and crossbrace is required. A K005 wheelchair is no longer rented but is purchased. Products in this code frequently have multiple seat widths and depths available in 1" increments as well as lower seat to floor height options.

Clinical Criteria
The patient is covered for a K005 wheelchair if the following criteria are met:
The patient is unable to functionally propel a standard, lightweight or high strength lightweight wheelchair but can and does propel in an ultralightweight wheelchair. The activities of instrumental living performed in a K005 that cannot be performed in a K001-K004 wheelchair such as doctor's appointments, school and or job, must be documented. The patient's body dimensions cannot be accommodated in lesser coded wheelchairs or they need a specific back height for postural stability. Additionally, the patient must have a condition that requires maximum adjustment of rear wheel position or frame orientation in space to allow for activities of instrumental living.
Additional clinical criteria may assist with coverage of a K005 wheelchair:
The patient cannot safely propel a high strength wheelchair due to poor coordination or ataxia and has significant trunk instability in a fully upright position or there is evidence of repetitive strain injuries associated with propelling a K003 or K004 wheelchair. Documentation of other secondary medical conditions will also assist in qualifying a patient for a K005 wheelchair. A K005 can also serve as a less costly alternative to a power wheelchair.

K0006 – Heavy Duty Wheelchair
Equipment Criteria

Weight:	***Not specified***	Seat Width:	18"
Seat Depth:	16 or 17"	Seat Height:	> 19 and < 21"
Back Height:	Non-adjustable 16 - 17"	Arm Style:	Fixed height detachable
Footrests:	Fixed or swingaway detachable	Footplate Ext:	16 - 21"
Axle Plate:	Not specified	***Client Weight:***	***> 250 lbs***
Seat/Back Upholstery:	***Reinforced***		

Products in this code frequently have other seat widths/depths for larger patient body dimensions.

Clinical Criteria
The patient is covered for a K006 wheelchair if their body weight exceeds 250 pounds or they have severe spasticity..

K0007 – Extra Heavy Duty Wheelchair

Equipment Criteria

Weight:	Not specified	Seat Width:	18" *
Seat Depth:	16 or 17”	Seat Height:	> 19 and < 21"
Back Height:	Non-adjustable 16 - 17"	Arm Style:	Fixed height detachable
Footrests:	Fixed or swingaway detachable	Footplate Ext:	16 - 21"
Axle Plate:	Not specified	***Client Weight:***	***> 300 lbs***

Clinical Criteria
The patient is covered for a K007 wheelchair if their body weight exceeds 300 pounds or they have severe spasticity.
If the patient needs an extra wide wheelchair, but does not meet the weight requirement for a heavy-duty chair, use K0001 or K0002 for the base and K0108 for the extra width option. The submitted charge for the K0108 should be the difference in the charge for a heavy duty and a standard wheelchair.

K0009 - Otherwise Not Coded
Equipment Criteria
The wheelchair has a base that does not fit any other code. Generally, this code is used for Tilt in Space wheelchairs or other specialty frames.

Clinical Criteria
The patient is covered for a K009 wheelchair if the following criteria are met:
The patient is unable to perform independent weight shifts and is at risk for skin breakdown. If the patient has compromised respiratory function, swallowing or eating issues that require a dynamic change of position in space, they will quality for a K009 wheelchair. In addition, a patient with poor sitting tolerance, inability to maintain appropriate seated position requiring dynamic position changes will qualify. Seizures or spasticity also qualify patients for K009 wheelchairs. Initial claims for K0009 wheelchairs must include the brand name and model of the base and a statement documenting the medical necessity of this base. Include why another base (K0001–K0007) is not acceptable. It will be necessary to document why a reclining back does not meet the patient’s needs.

General Wheelchair Coverage Criteria
Medicare covers the least costly, medically acceptable alternative. Options or upgrades that are used for leisure activities are generally denied. Only one wheelchair is covered at a time with denial to backup wheelchairs. The reimbursement rate includes all labor charges for assembly, delivery and education as well as on-going service of the wheelchair. Medicare will cover one month of rental fees if a patient-owned wheelchair is being repaired.

For an item to be considered for coverage and payment by Medicare, the information submitted by the supplier must be corroborated by documentation in the patient’s medical records that Medicare coverage criteria have been met. This documentation must be available to the DMERC upon request and a CMN must be kept on file. The initial claim must include a copy of the CMN and any additional documentation. Manual wheelchairs described by codes K0005 and K0009 are also eligible for Advance Determination of Medicare Coverage.

Wheelchair Accessories
Common wheelchair accessories are a covered Medicare benefit if the patient has a wheelchair that meets coverage criteria and the accessory is necessary for function in the home or to perform instrumental activities of daily living. The medical necessity for all options and accessories must be documented in the patient’s medical record and be available to the DMERC on request. Each option to the wheelchair base should be billed on the same claim as the base itself. Miscellaneous options, accessories, or replacement parts for wheelchairs

that do not have a specific HCPCS code should be coded K0108 and must include a narrative description of the item, model name and a statement defining it's medical necessity. It is also helpful to reference the line item to the submitted charge. A list of common accessories and their medical justification follows:

K0016 - Height Adjustable Arms (Each)
Weakness, decreased ROM or balance require height adjustable arms for functional positioning, weight shifts or transfers. The patient cannot be accommodated by a standard height armrest and spends more that 2 hours per day in the wheelchair.

K0028 – Manual Fully Reclining Back Option
The patient spends at least 2 hours per day in the wheelchair and has quadriplegia, fixed hip or trunk angle, or lower extremity casts/braces that require the reclining back feature for positioning. Excessive extensor tone or the need to rest in a recumbent position two or more times during the day will also qualify a patient for a reclining back.

K0030 – Solid Seat Insert
The patient spends at least 2 hours per day in the wheelchair.

K0031 – Safety Belt/Pelvic Strap
The patient has weakness or upper body instability or tonal anomalies that require use of this item for functional positioning or performance of independent living activities.

K0040 - Angle Adjustable Footplate (Each)
Orthopedic or tonal anomalies prevent the patient from functional positioning with non-angle adjustable footplate.

K0048 and K0195 - Elevating Legrests
Orthopedic or tonal anomalies prevent the patient from functional lower extremity positioning with non-elevating legrests. The patient has a musculoskeletal condition or the presence of a cast or brace which prevents 90¡ flexion at the knee or is at risk for significant edema of the lower extremities. Meeting the criteria for a reclining backrest will also qualify the patient for elevating leg rests. Use K0048 for elevating legrests that are used with a wheelchair that is purchased or owned by the patient. This code is per legrest. Use K0195 for elevating legrests that are used with a capped rental wheelchair base. This code is per pair of legrests.

K0054 – K0058 - Non–Standard Seat Width, Depth, or Height
This is covered only if the ordered item is at least 2" less or greater than the standard option, and the patient's dimensions justify the need.

K0059 – Plastic coated hand rims (each)
Upper extremity weakness or tonal anomalies require the use of plastic coated handrims for propulsion.

K0062/K0063 - Projection Handrim (Each)
Upper extremity weakness or tonal anomalies require use of vertical projection handrim for propulsion.

K0107 Wheelchair tray
Upper extremity weakness or tonal anomalies require use of tray to perform independent living activities.

K0064 Airless inserts
Patient is unable to maintain air tires.

K0065 - Spoke Guards
Upper extremity weakness, tonal anomalies or vision/perception/sensation deficits require use of spoke guards for safe propulsion. These are generally not considered a medical necessity

K0079 - Wheel Lock Extensions (Pair)
Upper extremity weakness, range of motion or tonal anomalies, balance, vision/perception or body dimensions requires the use of wheel lock extensions for functional transfers or independent living activities.

K0101 - One Arm Drive Attachment
The patient propels the chair with only one hand and this need is expected to last at least 6 months.

K0106 - Arm Trough
The patient has quadriplegia, hemiplegia, or uncontrolled arm movements requiring upper extremity support.

K0551 – Residual Limb Support (Each)
The patient has a residual limb that requires support for functional mobility.

K0115, K0116 - Custom Fabricated Back Module for Seating

The patient has a significant spinal deformity or severe weakness of the trunk muscles, and the need for prolonged postural support to permit functional activities, or pressure reduction cannot be met adequately by a prefabricated seating system. The patient must be in the wheelchair at least 2 hours per day. Claims for codes K0115 and K0116 must include documentation of the patient's diagnosis, description of the deformity, detailed evaluation, description of each seating feature with medical justification and explanation of why a prefabricated system will not suffice. Also include the time the patient is expected to be up in the system. The Manufacturer's name and model must be included. A photograph of the device, a brief description of materials used, and an estimate of the fitting/ fabrication time will also assist with approval. Seating systems in which distinct back and seat cushion components are connected do not meet the definition of code K0116. If a custom, fabricated two-piece seating system is provided, the back component is coded K0115. The seat component is coded K0108.

Aging with Dignity & Grace - Striking a Balance Between Comfort and Function

Sharon Pratt, PT

It is evident that the prescription of better Assistive technology goes hand in hand with enhancing the quality of lives of elderly people in wheelchairs. Limited resources seem to be the single biggest reason why poorer Assistive technology is more common than rare in long-term care facilities. This workshop will look at some of the most common issues among the seated elderly as well as at some of the possible solutions with discussion on justification based on outcomes.

We will explore the effects of aging on the neuromusculoskeletal, cardiopulmonary, urinary, gastrointestinal, skin, and sensory systems as well as the functional consequences of these changes. The challenge these changes present when seating the elderly as well as the challenges specific to long term care facilities and institutionalization will be discussed and demonstrated with slides and case studies.

Case studies as well as interactive discussion will address possible solutions to these challenges, covering conceptual solutions as well as technological and educational solutions. The rewards of seating the elderly will be presented as successful outcomes that are measurable and useful for documentation for funding purposes. Keeping in mind that the philosophy of the nursing home is to provide residents with the opportunity to live the highest quality of life that they are able and that the philosophy of rehabilitation is restoration of function, there is tremendous potential to work together as a team with the goal of common, positive and measurable outcomes.

The Elderly Population

- 1983
    - 27 million elderly
    - 11.5% of the population

- 2010
    - 40 million elderly
    - 14% of the population (OTA 1985)

Elderly Framework

- Well Elderly
    - Assets heavily outweigh deficits
- Frail Elderly in Community
    - Assets & deficits in precarious balance
- Frail Institutionalized Elderly
    - Deficits outweigh assets
    - Can no longer maintain independence

(Rockwood et al, 1994)

Adverse Effects of Institutionalization

- Loss of physical function
- Harmful physiological effects due to bed rest or immobility
- Potential iatrogenic illness (drug reactions, harmful falls)
- Undernourishment
- Hostile physical environment (raised beds, shiny floors, cluttered hallways, restraints)

The Aging Process

- Aging
    - Neuromusculoskeletal
    - Cardiopulmonary changes
    - Urinary changes
    - Gastrointestinal changes
    - Skin changes
    - Vision changes
    - Hearing changes

Challenges...

- Multiple secondary diagnoses
- Pain
- Incontinence
- Tight hamstrings
- Foot propulsion
- Kyphotic postures
- Risk of aspiration
- Asymmetrical postures
- Increased risk of skin breakdown

Challenges Specific to Institutions
- Limited resources
- Equipment use & Standard chairs/Fixed height arms
- Maintenance
  - Misplaced parts
  - Misused parts
- Communication between multiple caregivers
- Recognition that benefit outweighs cost
  - Education

What's the same and what's different about assessing the elderly person?

Posture.
- Reducible - correct
- Reducible - not tolerable of correction - accommodate
- Fixed - Accommodate

Identify level of Risk for Skin Breakdown
- Low
- Moderate
- High

Function.
- Identify top 4 Priorities (for example)
  - Independent propelling
  - Independent transfers
  - Independent feeding
  - Moisture resistant

Equipment Use & Maintenance
- Low maintenance
- Few removable components
- Clear labeling
- In-service
- Pictures

Education
- Facility Administration
- Case Managers
- Physicians
- Funding Agents
- Family / Caregivers
- Client

Rewards of Seating the Elderly
- Improved function
- Less staff time for repositioning, feeding,
- More efficient transfers
- Increased interaction & socialization
- Increased safety
- Restraint reduction
- Increased sitting tolerance
  - Increased comfort
- Reduced incidence of decubitus ulcers
- Cost savings
- Increased resident dignity and choice
- Facility Marketing Tool

To Tilt or Not to Tilt

Allan Boyd, B.Eng.
Gloria Leibel, B.Sc.P.T.
Christel Meisinger, B.Kin.

New Technology is now available to provide dynamic orientations in space on a multitude of wheelchair frames. It is often confusing for clinicians to decide who would benefit from this technology and how to justify this to funding agencies. This presentation will provide some incite into the age-old questions; why, who and how, do we use dynamic tilt to enhance the comfort and function of our clients. Case studies will be used to illustrate the good, the bad and the ugly of using tilt. Positioning is not just an orthopedic alignment, but must also take into consideration muscle tone and mobility and function. Individuals with decrease postural control, which affects their ability to maintain an upright sitting position, and or limits their functional abilities, often require seating intervention. When do we integrate gravity into this equation? Using case studies as examples we will illustrate some of the technical considerations to be aware of when prescribing tilt.

Why do we use tilt?

The human body was built to move, not sit. When placed in a seated position for any length of time some form of support is needed to maintain good posture. The main point of weight bearing in the seated client is the ischial tuberosities. Because this is a two point system, it tends to be rather unstable. In order to find stability, people will shift their weight by either locking the pelvis in an anterior tilt, using their extremities as a base of support or roll back into a posterior tilt and shift the weight to the sacral area. These are all normal compensatory mechanisms, which allow for safe seated posture and protect the person from the development of pressure sores.

Once we understand seated posture and how our bodies compensate, we need to look at what happens to our clients. They may lack our functional repertoire of movements, due to abnormal muscle tone, non-functional reflexive activity, fixed bony deformities and or contractures. Who should consider using a tilt? Any client who is unable to weight shift independently for any reason should be considered for a tilt option.

Benefits of Tilt

1. Normalize tone
2. Facilitates aligned position
3. Provides gravity assistance for clients with poor head/trunk control
4. Improves/facilitates swallowing
5. Reduces risk of tissue trauma by distributing pressure
6. Increases sitting tolerance
7. Decreases pain
8. Independent repositioning
9. Assists caregivers for easier access when transferring
10. Allows for easier access in height restricted situations i.e. vans

Disadvantages of Tilt

1. May compromise the drainage of catheters
2. May limit upper extremity function
3. May increase pressure over the sacral area
4. Increases weight of wheelchair and makes it difficult to self-propel manual wheelchair
5. May make transfers more difficult i.e. seat to floor height

Most common diagnosis of clients using tilt

1. Cerebral Palsy
2. Duchenne’s Muscular Dystrophy
3. Multiple Sclerosis
4. Spinal Cord Injuries (mainly quadriplegia)
5. Amylotrophic Lateral Sclerosis
6. Severe Developmental Delay/ Seizure Disorder
7. Elderly (poor sitting tolerance)
8. Pediatrics

How do we achieve tilt?

1. Manual frame: single pivot i.e. Quickie TS, or, centre of gravity shifting tilt i.e. Solara
2. Power Base: rear wheel, front wheel, and midwheel drives

What are the considerations? (set-up)
1. Balance of w/c-base, frame length,
2. Stability
3. Seat to floor height
4. Access i.e. toggle switch, integrated through joystick, spec switch
5. Who is accessing the tilt?
6. Seating

Funding Issues
1. Costs- insurance, government agencies, service clubs, private funding
2. Justification- rationalization to funding agencies, families?
3. Retrofits
4. Time without chair –impact: time away from work, rental of equipment

Environmental Issues
1. Floor to seat pan heights
2. Is there a communication device
3. Community access –weight of frame

Functionality Issues
1. Growth
2. Modularity
3. Complexity of system

Design Criteria (Manufacturing Considerations)
1. Functionality (degrees of tilt, fixed pivot versus CG or weight shift, seat to floor height, adjustability, modularity)
2. Stability (safety)
3. Drive Characteristics (rear wheel drive, front wheel drive, mid-wheel drive, adult and pediatric power bases)
4. Durability, Reliability, and Servicing (static and dynamic testing, structural integrity, actuators, weight shift mechanism)
5. Electronics (specialty control devices, switch options, mercury cells versus micro switches, attendant controls)
6. Customization (the market talking to you, i.e. Development of the Super Low)
7. Pediatric and Bariatric tilts
8. Accessories (ventilators, power recline, extended shear reduction, power elevating leg rests-Pivot Plus, power elevating/articulating foot platform, power elevating seats)

The Good: Harry
Harry is a 12-year-old boy with a diagnosis of Cerebral Palsy. He presents with severe orthopaedic deformities, right side tighter than left, bilateral dislocated hips, severe hip flexion and adduction contractures, tight hamstrings, bilateral tibial torsion and inversion of both feet. He is attending an integrated program at a local public school. He is nonverbal and communicates with gestures, eye pointing and has a dynavox. He requires assistance for all transfers and activities of daily living. When seen at clinic his equipment consisted of a power base with a left sided joystick and modular seating. Harry was constantly complaining of pain, his sitting tolerance was poor and his position was compromised causing him to have difficulty accessing his joystick and his computer for school.

Solution:
Harry underwent a baclophen pump insertion. The family has decided not to pursue hip surgery at this time. A power base with modular seating and a centre of gravity shift dynamic power tilt was prescribed. Harry is still experiencing pain however he has returned to school. His sitting tolerance has increased dramatically as well as his ability to access his environment.

The Bad: Alissa
Alissa is a 22-year-old young lady with a diagnosis of Cerebral Palsy (spastic quadriplegia). She presents with severe orthopaedic deformities, a strong ATNR to the right, a scoliosis convex to the left fixed with luque rods, pelvic obliquity rotated to the right, restricted hip flexion approximately 30 degrees fixed abduction, external rotation, upper extremity limitations including shoulder, elbow and wrist restrictions. Alissa exhibits severe postural insecurity and a progressive visual disorder.
She is presently finished high school and living in a supported setting with some attendant care access. She spends the entire day in her wheelchair and as a result often does not have a diaper change all day. Alissa is extremely difficult to transfer in and out of her wheelchair. She experiences a great deal of back pain, and finds it difficult to maintain her position in her custom molded insert. The greater the seat to back angle of the insert, the greater the extensor tone exhibited. Because of her extreme tone Alissa has broken all the hardware in her headrest and stressed her wheelchair to the breaking point. The good news is that Alissa is verbal and can direct her own care. The bad news is we have been unable to find any consistent access for switches to allow Alissa any control over her environment.

Solution:
Remold her insert to as close to 90 degrees seat to back angle as possible (considering her limited hip flexion) and possibly change her orientation in space to an anterior tilt (to free her head from the extensor pattern). We will then set up a dynamic tilt with switch access in a manual tilt frame. In this way Alissa will have some control over her environment and will not be dependent on caregivers throughout the day.

The Ugly: Andrew
Andrew is a 24-year-old young man with a diagnosis of Cerebral Palsy (Athetoid). He presents with strong extensor tone and no fixed deformities and postural insecurity. His favorite sitting posture is a full posterior pelvic tilt, legs in full abduction and external rotation, weight bearing on his sacrum and his thoracic spine. He is presently attending school. He is non-verbal and uses eye pointing and a dynavox communication device. He drives a power base with a head array, however spends most of his time in a folding manual wheelchair with a custom seating insert that accommodates his favored position.

Solution:
This is a work in progress. Dynamic tilt has been discussed and trialed with Andrew and his family. Andrew has rejected all attempts to accept dynamic positioning in both his manual and his power wheelchair.

Conclusion:
People who spend extended periods of time in wheelchairs have an inherent need to weight shift. Fortunately the technology of dynamic tilt is now available for all types of wheelchair frames both manual and power "With a perfectly adjusted wheelchair, life can continue to be tempting. A wheelchair that feels more like a friend, a companion not a struggle or a label of disability makes it physically and mentally easier."(Engstrom 1993) Consider tilt!

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Do I really need all this information??

Adrienne Falk Bergen PT ATP/S

During the 30 years that I have been doing assessments for seating and wheeled mobility I have learned that a thorough assessment always results in a better result. Whenever a short cut is taken, and some critical information is missed, the result is usually less than satisfactory. This results in a need to "patch" the final product to make it work. Patching takes extra time, and since neither time, nor the materials needed to make the "patch" can be billed to a third party funder, everyone looses. The consumer must wait longer to get their equipment, and the equipment may be less than optimal. The clinician and supplier must spend added hours on fittings, delivery and followup. The supplier usually winds up supplying additional parts and/or equipment, or in the worst case taking the equipment back and paying a restocking fee to the manufacturer.

In an effort to standardize the assessment process and assist newer clinicians in gathering information, a series of forms were devised and posted on my web site, RehabCentral.com. Each of the forms guides the team along a path that will ensure a thorough assessment. The process begins with a good intake interview to gather pertinent information that may affect the intervention plan and/or the final outcome. This must include information about the entire environment where the equipment will be used. The environment includes the home, transport methods and comments about any other locales where the equipment will be utilized. Assessment of the client in his existing equipment and discussions about the equipment with the family and the consumer give the examiners valuable information about what has and has not worked in the past. It affords the team an opportunity to describe the user's posture and function in the equipment he already owns. A photograph is usually helpful in supporting the written word.

This initial intake should be followed by a complete mat evaluation in both supine (gravity eliminated) and sitting (gravity added, accommodation made for ROM limitations found in supine). This portion of the assessment will allow the examiners to see the underlying potential for good postural alignment without the influence of gravity. Once any interfering limitations are noted the client is brought to sitting with accommodation for the limitation. Support is given as needed to produce the best result possible, and the examiner notes how much support is required and whether or not the posture can be corrected. Simulation at this stage is very helpful, whether with the examiner's hands or a simulator. The simulator leaves the examiner's free to move around the supported client, make changes and observe over a long period of time.

This detailed assessment is recorded, along with complete measurements to provide a baseline from which intervention planning can begin. Once intervention planning and product trials are complete the complete recommendation can be written and justified using the forms included in the Justify section of the site. If questions come up during the funding process, or during the ordering phase, the complete assessment document can be used for further decision making, often without having to revisit with the client. Fittings and delivery should then go smoothly.

Custom Seating and Mobility for an Individual with Fibrodysplasia Ossificans Progressiva

Penny J. Powers, PT, MS
Jenny Robison, PT/ATP

An 18-year-old African American male, CM, was referred in October 2001 to the Seating Systems Clinic at Vanderbilt University Medical Center to obtain a wheelchair. CM's primary diagnosis is Fibrodysplasia Ossificans Progressiva (FOP). This disease is a rare inherited connective tissue disorders characterized by heterothrophic bone in ligaments, tendons and muscles. CM presented with severe musculoskeletal deformities and loss of joint range of motion in all peripheral joints and spine. He had no shoulder range of motion and severely limited elbow and wrist range. Severe limitations in hip, knee and ankle, neck and trunk range of motion were documented as well. CM was able to sit no lower than 30" seat to floor height given the loss of his hip range of motion and inability to forward flex his trunk. At home, he "perched" on the edge of a bar stool or rested against a wall. The family residence is a mobile home in a rural area of Tennessee. CM semi-reclined in their van in order to transport.

CM required assist for all activities of daily living including, feeding, dressing, and bathing. His leisure activities included talking on the telephone and playing video games. He could operate the joystick control of a well-known video game unit. This young man could ambulate short distances at a very slow pace through "rocking" forward. He lacked the ability for any trunk rotation. His most recent mobility device was a power wheelchair obtained in 1992.

Our team included personnel from Ed Medical, Inc. and Permobil, Inc. Ed Medical, Inc. is a local vendor that provides high end, custom mobility and other durable medical equipment in the Nashville area. Permobil, Inc. is a nationally renown private company that provides custom power mobility. Their headquarters are located in Lebanon, Tennessee; it is in close proximity to Nashville. This company has a reputation for customer service and quality product fabrication. It was imperative to work with a company that is capable of custom high-end production and advanced technological expertise. Vanderbilt, Ed Medical and Permobil embraced Permobil's motto, "nothing is impossible. Vanderbilt, Ed Medical, and Permobil personnel conducted a second evaluation to begin collaborative data gathering and goal setting. Permobil was able to do a mock up wheelchair for trial purposes in November 2001. CM was able to demonstrate independent transfers and independent mobility with a hand-held joystick. We obtained the necessary letter of medical necessity and received approval for funding in late 2001.

The wheelchair that was requested was a Permobil modified Chairman 2K Stander.
Technical specifications include 26" turning radius, and maximum speed of 5mph. We requested a tall Freedom foam in place back, custom one-piece foot plate and pole mount for the handheld joystick. The wheelchair was modified for anterior tilt and hip angle so that CM could "back into the chair" and lower enough to be able to drive the chair. Funding was obtained without any constraints and the order was placed in early Spring 2002.

Permobil completed the wheelchair in late summer, 2002. ED Medical, Inc. had difficulty reaching CM's mother over the course of weeks. Their van was determined to be irreparable and Ms M indicated that it would be a hardship to come to Vanderbilt for the final fit. It was agreed that the final fit could be done at home and an appointment was made. Ed Medical, Inc. personnel transported the chair and materials to pour foam in place back in the home. The fitting process was initiated and just prior to initiating the Foam in Place Back, CM refused to participate further. He verbalized the wheelchair was a bad "omen". CM's mother indicated that his functional status had declined and his "depression" had worsened. She verbalized her own concerns for her son's prognosis and quality of life.

It took several weeks and some compromise to accomplish the final fit. The back was finished via the addition of medium and soft Sunmate foam. The back was modified such that in place of the standard bolts, locking pins were added so that Ms. M could remove the back and would facilitate transport of the chair in their present vehicle. Ed Medical, Inc. donated a pair of portable ramps to assist the patient and family in their mobility and access needs. The family accepted the wheelchair in December 2002.

We believe that providing optimum patient care including mobility devices is a complex process and highly variable. We present this case study as an opportunity to partner with providers and engage in problem solving, design and implementation to achieve the best outcomes for patients. This outcome could not have been achieved without the professional expertise and creativity of all involved parties.

A RCT to Compare the Effectiveness of Occupational Therapy Seating Intervention with Conventional Seating Intervention in Postural Control for Elderly with Sitting Problem

Anna Wu, MS

Occupational therapist in Hong Kong has been providing seating services to their clients for more than 20 years. Many studies have been carried out in different hospitals, aged homes, non-government organizations and community services. Most of these studies showed significant improvements in terms of seating posture, decrease in seating interface pressure and decrease in frequency of sliding out etc. However, very few of these works have a control group in their study designs that weaken their power of studies and thus the effect of generalization.

In this research, the effectiveness of Occupational Therapy seating intervention will be compared with the conventional seating treatment. Interventional/ experimental study of single blinded randomized controlled trial design is used. The intervention under investigation in this study is "Occupational therapy seating intervention". Occupational Therapy seating intervention was defined as a protocol of Occupational Therapy assessment, prescription of tailor made special seat and provision of adaptations. And conventional seating intervention referred to the provision of either a 16" or 18" seat width standard wheelchair equipped with removable arm and leg rest. This is a single center study using convenient sampling. Geriatric rehabilitation in-patient is chosen and study carried out in Caritas Medical Centre's rehabilitation wards. The inclusion criteria were: In-patient of geriatric rehabilitation ward who are medically stable and chair bounded cases having sitting problem and unable to sit independently but emotionally stable. While those who are independent sitter, mentally confused and exhibit disturbing and violent behavior will be excluded from the study. Randomized Controlled Trial design with patient randomized into 2 groups based on ward distribution. Patient was then positioned in assigned seat with the standard upright sitting position. Peak seating interface pressure and distance of sliding forward were measured after 15 minutes. In order to monitor the quality of service provision, Occupational Therapists of at least two years special seating experience are involved in treatment provision thus treatment quality can be standardized. On the other hand, only one final assessor, who was blinded from the patient's status of treatment group, would be involved in measuring outcome, so consistency of assessment can be assured. The blinded final assessor is a non-medical profession who has no knowledge on special seating and undergone 4 weeks basic training in taking outcome measures.

There were altogether 20 cases recruited and four of them refuse to sign the consent so leaving all together 16 cases. There are 8 cases in the tested and control group respectively. Using independent sample t-test reviewed that there was significant difference in peak pressure ($t = 2.707$, $p = 0.011$) and forward displacement ($t = 2.605$, $p = 0.014$) in post intervention assessment between the control and experimental group. Characteristics for both the experimental group and the control group are analyzed and no statistical significant detected reviewing they are truly comparable.

Result of this study supported that Occupational Therapy Seating intervention was effective in reduction of "Peak seating interface pressure" and decrease in "sliding forward" phenomenon. Major limitation of this study was the small sample size and single center design that weaken the power of the outcome.

The Spinalis Model: Using a Network of Medical Specialists and Consultants During the Assessment of Seating Problems for Individuals with SCI

Marie Alm, RPT, MSc

The Spinalis model is the approach to seating issues in spinal cord injury at the Spinalis Clinic, Rehab station Stockholm, using a specialized seating team and including medical expertise when necessary. Seating assessment, adjustments and the choice of wheelchair properties requires that the physio- and occupational therapists in the seating team have to take many things into consideration due to the complexity of seating, for example to consider the home environment, physical and medical conditions, psychological and cognitive issues. The medical problems are many, and six issues such as deformities, pressure sores, urological disorders, pain, weight problems, psychological illness and cognitive deficits are found to be common ones that may require medical expertise for a second opinion or a further medical assessment. As well as the accessibility to the medical staff at the Spinalis clinic, different consultants, such as an orthopaedic surgeon, a plastic surgeon, an urologist, a dietician, a psychiatrist, a neurospychologist, are connected to the clinic. The unique accessibility to different medical consultants at the Spinalis Clinic is invaluable to the seating team and the seating clinic in order to obtain a sufficient knowledge base for optimal adjustment and for the choice of the most suitable wheelchair properties. Medical problems can often be an obstacle to independent life style, health and quality of life. Therefore the use of a medical network and detecting different essential problems interfering with seating and providing an accurate program for prevention or intervention is necessary. By using more medical resources during the assessment before further planning for the choice of wheelchair equipment, or making adjustments, the final results become much more optimal and specific and the work effort much more satisfactory and less time consuming in the long term.

To Describe Seating in Individuals with Complete Thoracic SCI by Using a Combination of Clinical Methods

Marie Alm, RPT, MSc

Objectives
To describe seating in individuals with complete thoracic spinal cord injury (SCI) by using a combination of clinical methods.

Setting
SCI unit, Stockholm, Sweden

Methods
Wheelchair properties were documented. Measurements of posture from photographs in 30 male subjects with complete thoracic SCI, sitting in a relaxed and an upright position on a standardized surface and in a wheelchair, were calculated. A comparison was made between positions and seating surfaces. An examiner's classification of lower trunk position in the wheelchair was compared to subjects« evaluations. SCI subjects reported sitting support, satisfaction, and wishes for improvement.

Results
Most SCI subjects used similar wheelchair properties. None of the backrests were custom designed. Relatively small differences were found between the relaxed and upright position in the wheelchair regarding measurements of posture and according to the examiner's classification of the lower trunk position. Only 13/30 SCI subjects were sitting with the lower trunk centered relative to the backrest in the upright position. The examiner's classification and the subjects« evaluation of asymmetric sitting were not always in agreement. Only 12/30 SCI subjects were satisfied with their way of sitting.

Conclusion
Current wheelchair properties and adjustments seem to inhibit a postural correction towards upright sitting and fail to provide sufficient lateral support. Findings indicate an inability for SCI subjects to vary their sitting position in a wheelchair to a large extent. Both an examiner's classification and subjects« evaluation of asymmetric sitting is necessary to obtain a sufficient knowledge base for subsequent adjustment. By using methods regarding different aspects of seating a more comprehensive view of seating was achieved. The combination of clinical methods seems to be useful in order to describe seating in individuals with complete thoracic SCI.

Cost and Quality Outcome of a Power Wheelchair Leasing Program for Persons with Terminal Disease

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The current service delivery process in the United States for procuring a person with a wheelchair is very time consuming due to archaic regulations and reluctance by third party payers to fund expensive equipment. Individual conditions also change from the time of initial evaluation to delivery of the device resulting in further modifications, requests for funding, and delays in service. In many instances people with terminal diseases such as Amyotrophic Lateral Sclerosis (ALS) die before delivery of the system or soon after. The equipment technically remains the property of the intended user and therefore not returned to the supplier or funding source to be recycled.

UPMC Health System (with its own internal clinicians, health insurance plan, and rehabilitation technology supplier) recognized that traditional methods of procuring custom power wheelchairs to people with terminal disorders was costly and inefficient. A power wheelchair leasing/recycling program was developed for Health Plan beneficiaries using the Swedish designed Permobil power wheelchair due to its adjustability and versatility.

Inclusion into the program required that the beneficiary have a life expectancy of less than 24 months and be assessed at the Center for Assistive Technology (CAT). A rental fee of $750 per month was established based on a $20,045 average retail cost of the devices. The monthly rental fee is paid for 15 months after which a one-month rental allowable will be paid every six months for maintenance similar to the Medicare rental program. The monthly rental cost includes all necessary maintenance, repair, or replacement to the equipment as well as any necessary upgrades for alternative controls or other features including a vent tray.

A review of files noted 19 individuals with terminal illnesses had been evaluated for power wheelchairs at the CAT over an 18-month period. Of these 12 either expired prior to receiving their wheelchair or their conditions advanced to the point where they could not use them. The average wait time for delivery of the 7 remaining people was 6 months (+ 1.0SD) due to negotiating bureaucracies.

Over the immediate last 18 months, 6 Health Plan beneficiaries met the criterion for the program. Three have cycled through the program to death and 3 are currently using their devices. The wheelchairs were delivered to the 6 beneficiaries in an average of 1.4 months thus reducing delivery time by 75%.

The three cases who cycled through the program used the device for an average of 4.8 months at a cost of $10,725 to the Health Plan. Purchase of the devices would have otherwise cost the Health Plan $61,350 thus showing a savings of $50,625 ($16,875 per case) or 83%. The three active cases have been using these power wheelchairs for an average of 9 months as of December 2002. The reason for the increased in length of usage may be due to earlier referral to the program following its announcement to key referral sources.

Two power wheelchairs were purchased by the supplier for the program. The rest were either recycled or existing demonstration equipment therefore reducing cost burdens to the supplier. A 5 or more year life cycle for these power wheelchairs is expected therefore they will be used multiple times by different beneficiaries.

We conclude that although this is a preliminary analysis of a very small sample, this program has the potential to provide people with equipment in a timelier manner thus improving their quality of life by giving them much needed comfort, postural support, and independent mobility. Equipment was also delivered at a significant savings to the Health System as a whole. As the program continues a larger sample of data will provide better analysis of outcome.

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Whole-Body Vibration Analysis of Four Different Wheelchair Cushions

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Introduction

Wheelchairs provide mobility for millions of people with disabilities. Poor wheelchair design and bad road conditions can lead to secondary injuries. The effects of whole-body vibration (WBV) exposure have been found to be detrimental to the health of humans. The effects of whole-body vibration on the individual are due to physiological, psychophysical or physical factors, as well as the frequency, direction, magnitude and duration of the vibration [1-3]. Cushions can be used as to decrease the WBV during manual wheelchair propulsion. Different kind of cushion has different transmissibility. Better quality cushion can decrease the risk of secondary injuries for wheelchair user. In this study, we selected four different cushions for test. The nine obstacles made up the simulated activities of daily living obstacle course. Total thirty-two subjects were included in the study. Each subject traversed the course at a self-selected speed and was asked to do three trials for each cushion. Welch's averaged power spectral density method was used to analyzing the data. Different direction transmissibility, transfer function between seat and head vibration were analyzed in this paper.

Methods

Thirty-two full time wheelchair users, twenty-two males and ten females were included in the study. The characteristics of the participants are listed in Table I. The participants gave written informed consent prior to the initiation of any procedures.

Table I. Average Characteristics of the Participants

Age (yrs.)	Weight (kg)	Height (in)
41±9.2	81.4±16	68.5±5.5

Four different cushions Pin-dot Comfortmate (PDCM, Contoured Foam), Varilite Solo (VS, Air bladder with foam base), Jay Active (JA., Viscoelastic material with foam base), Roho Low-profile (RLP, Air) and four back supports Sling Back, PAX back, Jay Active Back and Varilite Fast Back, an Invacare wheelchair (lightweight folding wheelchair with pneumatic tires) were used. The wheelchair was selected based on the results from a previous study [4]. The cushions and back supports were selected to represent typical seating systems currently available. The order of testing for the cushions within each back support was randomized. A data logger based on a Motorola microcontroller with two accelerometers, one was mounted to the wheelchair frame, another was mounted to a Bite-Bar, were used to record accelerations present at the base of the wheelchair seat, and at the subjects' head. The data sample rate was 200 Hz. Each subject was asked to traverse over the simulated activities of daily living obstacles three times for each cushion. Each trial data were divided into eight segments and Welch's averaged power spectral density method was used to analyze the data. The Welch and transfer function equations are given:

$$x_n(k) = \sum_{k=1}^{N/8} x(n!\frac{N}{8} + k) \qquad n = 0..8 \qquad (1)$$

Find power spectral density PSD_1 for $x_0(n)$, PSD_2 for $x_2(n)$ … and PSD_7 for $x_7(n)$,
We use the average power spectral density equation

$$PSD = \frac{1}{8}!\sum_{k=0}^{7} PSD_k \qquad (2)$$

and transfer function $$Transfer_{Bite-Bar}(w) = \frac{PSD_{Bite-Bar}(w)}{PSD_{Seat}(w)} \qquad (3)$$

Results

Figure 1 is the average vibration power spectral density for the four different cushions in z direction for the wheelchair seat, and x, y and z direction transfer function from seat to the Bite-bar.
For seat vibration in the z direction, from 4Hz to 12Hz, cushion JA attenuation is –8.5db to -11db, RLP is –10.5db –12db and PDCM, VS are –12db to

-14.6db. From 20Hz to 100Hz cushion JA has the largest attenuation from –15db to –41db and VS has smallest attenuation from –12.5db to –27db. There are no differences in the z direction transfer functions among the four cushions. From 4Hz to 12Hz the attenuation in z direction for four cushions is 10db to –2db. From 20Hz to 100Hz the attenuation is –17.6db to -66.3db. In the y direction, there are no differences among cushion PDCM, JA and RLP. But cushion VS has bigger attenuation from 4Hz to 20Hz. In the x direction, there are no differences for attenuation among four cushions.

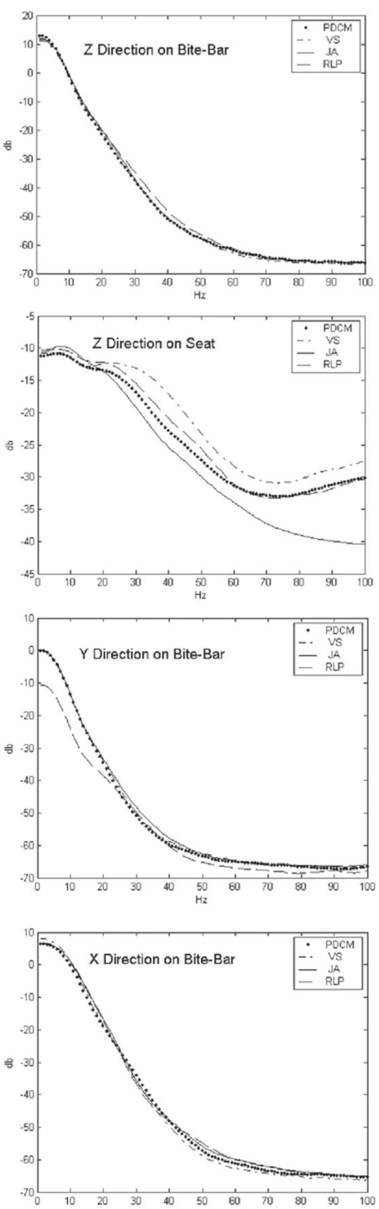

Figure 1. Average Vibration Power spectral density on seat and Transfer function from Wheelchair Seat to Bite-Bar

Discussions

In this study, we selected four different cushions for test. The vibration in the z direction on the wheelchair seat, within frequencies from 4Hz to 12HZ, there were no significant differences for attenuation among the four cushions. Frequency from 20Hz to 100Hz cushion JA has the largest attenuation from –15db to –41db. For transfer function, there was the largest attenuation in the y direction, the smallest attenuation in the z direction. Because there is no difference in the transfer functions in same direction among the four cushions, it shows that subjects dominate the vibrations at their heads.

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The Comparison of Cushion Coverings in Custom Molded Seating

Jill Sparacio, OTR/L, ATP, ABDA

Introduction

The concept of custom molding for seating systems is based on principles of total contact. Through the molding process, total contact is provided to the client, offering customized support. With this, the pressure is distributed over greater area, decreasing the user's potential for pressure issues. Although lengthy discussion has taken place regarding this concept, very little has addressed how the cushion covering can impact pressure distribution. Many manufacturers of custom molded seating offer a variety of surface coverings. Clinical supposition has evolved to identify the benefits and drawbacks to these coverings. This study, a simple two subject project, was specifically designed to address these questions. In an attempt to provide objective data to demonstrate differences, it is hoped that greater clarification of uses can be established. This data is hoped to be helpful in securing funding for coverings that are considered an additional charge.

Methods

Selection of Subjects: Two clients were selected to participate in this study. Criteria for inclusion was as follows:

1. Physical deformities/asymmetries that result in a need for custom molded seating. More specifically, commercially available seating components cannot meet the client's positioning needs.
2. Availability of two mobility bases to allow ease of use of two seating systems. The use of both systems needed to be previously incorporated into their daily routine.
3. Ability of both seating systems to be set up in an identical manner, insuring that the planes and orientation of the surfaces were consistent.

Equipment: During the molding process, KISS simulators, manufactured by Pindot, were utilized. Plaster casting was used to capture the shapes. The cushions, a set of vinyl covered and a set of "naked", were manufactured by Invacare's Pindot Contour-U. Both sets were manufactured at the same time to insure consistency in foam qualities and contour. The cushions were visually inspected to insure similarity. The X-Sensor pressure mapping system with multi-port electronics unit and dual pads was used to record the data on pressure distribution. Measurements were recorded in mmHg at a range of 0mmHg to 150mmHg.

Protocol: Two subjects were tested in their seating systems for a duration of 20 minutes. Measurements were recorded after 10 and 20 minutes. Following testing in the first set of cushions, testing continued with the second set. Care was taken to stay within the client's documented seating tolerance.

Findings

Increased contact, documented in the number of active sensors, was noted in the naked style cushions. These differences resulted in low percentages, ranging from 5% to 15%. Peak pressures varied on the different surfaces without demonstrating a consistent pattern. Average pressures were consistently lower on the naked cushions.

Discussion

It appears that custom molded cushions that do not have vinyl covering allow for greater distribution of pressure. This study showed that although peak pressures varied, the increased contact received from what appeared to be greater immersion into the foam surface was valuable to decrease average pressures. The increased contact received from the naked cushion translated into greater pressure distribution.

It is important to keep in mind that pressure distribution in custom molded seating is dependent on accuracy in molding as well as proper positioning of the client in the seating system. Many internal and external factors can impact positioning while seated, having either a negative or positive effect on the fit of the seating system.

This study answers basic questions related to the differences between custom molded seating systems with and without vinyl covering. More studies are needed to address other types of surface coverings with comparisons made between pressure management and the provision of optimal support.

Classical Thermodynamics of Wheelchair Cushions and Otto Bock ComforT Temperature Intervention

E. Call
R. Jones
B. Levy
B. Oberg

Background: Of all the risk factors associated with pressure ulcers, temperature and humidity remain among the most difficult to address. Temperature and humidity profiles collected through the course of normal activities allow the detection of conditions that may raise concerns for tissue viability. Further, an effort at temperature intervention is documented utilizing a temperature moderating cushion now commercially available.

The length and severity of high temperature episodes are documented using Dickson miniature temperature and humidity probes, allowing the identification of activities that may place tissue at increased risk. Temperature histories representing cushion thermodynamics can then be used to identify environments and activities that may place heat stress on the tissue.

This work is based on the hypothesis that heat trapping in a wheelchair cushion increases the risk to the tissue by increasing metabolic rates and total metabolic requirements while at the same time the supply of metabolic substrates has been reduced or eliminated due to the compressive loads of sitting[1]. The temperature at which stress to the skin can become a concern is believed to be the point where the skin surface temperature exceeds the skin resting state temperature in air. This temperature is identified as the point where insensible moisture loss is no longer adequate to maintain normal skin/body temperature. The range where this is observed in volunteers is 28-31˚C[2]. The concept of heat stress in the skin is predicted by the Arrhenius equation and generally relates a 1˚ C temperature increase with a 10% increase in metabolic reaction rates, see Figure 1[3]. Heat trapping in a wheelchair cushion is thus responsible for approximately 50% increase in skin cell metabolism. This creates an increased need amidst a decreased supply that leads to additional cellular stress.

The introduction of a Phase Change Material (PCM) cushion by Otto Bock provides an opportunity to moderate temperature to a point near or below that identified as the resting state temperature for skin. The ability to moderate temperature is related to the PCM's ability to melt and absorb heat at one temperature (28.5˚C), then re-crystallize at a lower temperature (19.1˚C). The resulting temperature change also provides a reduction in relative humidity (RH). The magnitude of both the temperature and humidity responses is dependant upon the individual but falls in the range of 3-10˚C and 1-20% RH.

Figure 1. Arrhenius Plot. Effect of Temperature on Metabolic Reaction Rate (top of next column).

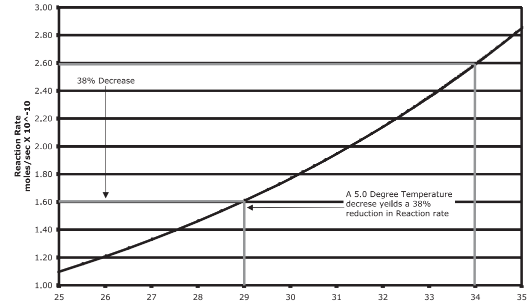
Thermodynamic Resistance Model

Node	Layer	Thickness (inch)	Thermal Conduct	Thickness/ deg K	Temp C
Core Temp					37
	Muscle	2	0.237	0.703	
Blood-tissue					33.8
	Fat	0.5	.116	.359	
Tissue- Skin					32.1
	Skin	0.25	0.214	0.097	
Skin-Underwear					31.7

Tests: A one-dimensional, steady state conduction model of the human buttock seated in a wheelchair yields a realistic temperature profile showing the trapping of heat at the cushion buttock interface. This model begins at the body core and takes into account all layers and interfaces to the exterior of the cushion. This allows the insertion of specific data related to atrophy, gender, typical clothing, ambient temperatures, cushion characteristics, etc.

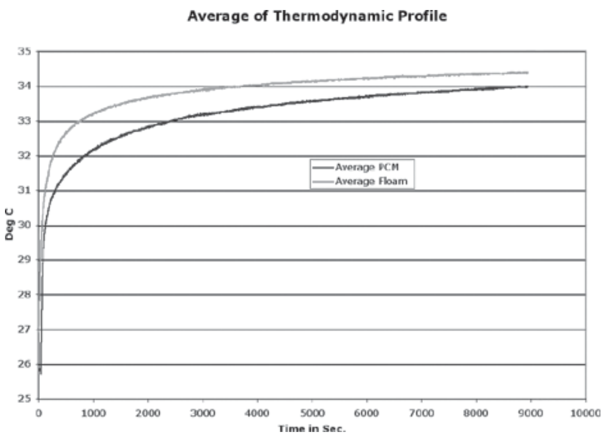
Figure 2. A Portion of the Temperature Profile Model

Thermodynamic Resistance Model



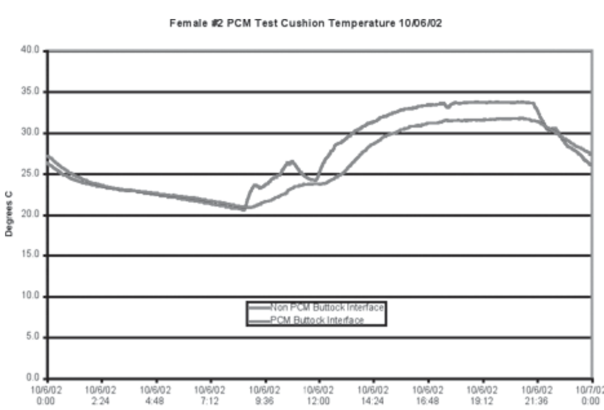
Laboratory modeling using a hot water heated indenter validated as providing the same heat transfer to the cushion as the human buttock demonstrates the thermodynamic profile of a PCM verses a non-PCM cushion. Note the temperature shift generated by the PCM contained within the cushion. The average of multiple sensors is presented for legibility in this small space.

Figure 3. Thermodynamic Profile of Cushion With and Without PCM

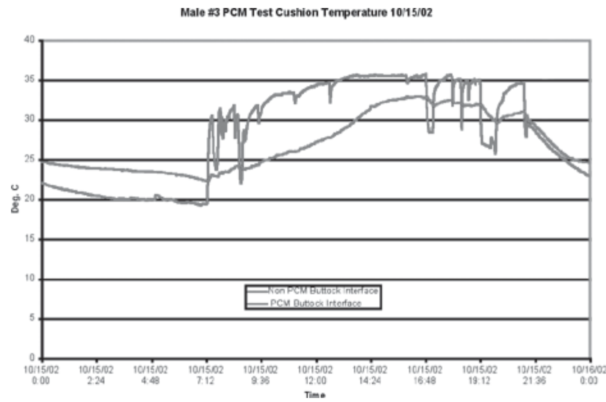


Tests with Volunteers: Cushions fitted with miniature programmable temperature and humidity data acquisition sensors were placed under paraplegic volunteers and data collected during their normal daily activities for periods up to 1 week. Cushion were divided into half PCM, half non-PCM on a random basis to provide as close to identical test and control environments as possible.

Figure 4. Female Paraplegic, 24 Hour Data Sample



5. Male Paraplegic, 24 Hour Data Sample



Note that there is both a reduction in buttock/ cushion interface temperature and a moderating or leveling out of the temperature. This is due to the nature of the PCM, which will give off heat if the PCM is in an environment where re-crystallization or solidification can occur. The first portion of each of the above graphs shows a negative slope and a convergence of the PCM and non-PCM temperatures. This is due to the re-crystallization of the paraffin over night while the cushion is exposed to room- air temperatures.

The difference between the PCM and non-PCM temperatures at any given point provides the temperature reduction that can be applied to the Arrhenius plot to estimate the reduction in metabolic rate and thus the reduction in potential cellular stress. In a typical day the difference may range from 3-10˚C.

Reduction in humidity also occurs with temperature reduction. Measured values fall in the range of 8-20% reduction in RH. Data plots with RH and degrees F compounded on the Y axis demonstrate that humidity follows temperature. This is likely due to increased moisture capacity of air and increased sudor.

Discussion: It should be noted that force applied to tissue creates concern for tissue viability, which is then compounded by the presence of heat. However, in the absence of pressure, heat induces a capillary dilation that results in increased delivery of the required substrates of cellular metabolism via the increased blood flow. Thus a healing effect is generated by increased blood flow due to application of heat. However, in the presence of vessel constricting forces, cooling becomes desirable to reduce cellular metabolic rates and prolong the time to exhaustion of cellular reserves, thus reducing the cell's susceptibility to force related injury (pressure sores).

While gel cushions have been found to draw heat away from the buttock, they can create a heat deficit and vasoconstriction[4]. Significant heat loss due to the nature of a gel cushion can even result in cold related tissue damage[5]. This is not true with PCM, which maintains a window of temperature difference determined by the range between melting and freezing points of the PCM, along with a lower specific heat that provides a greater margin of safety for the buttock tissue.

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Design and Provision of Custom Cushions to Help Prevent Recurrence of Pressure Ulcers in People with SCI and History of Chronic Pressure Ulceration

Gilbert Logan PhD

Background:
The Spinal Outreach Team (SPOT), as part of the public funded Queensland Spinal Cord Injuries Service (QSCIS), is a multi-disciplinary team of health professionals, providing health services to people with spinal cord injury (SCI) in Queensland and northern New South Wales. SPOT is an advisory and consultancy service supporting people with SCI, their significant others and local service providers, after the acute rehabilitation phase and along the life-long continuum. During its seven-year existence SPOT has identified and provided assistance to a number of clients with skin breakdown, a common complication of SCI. In particular SPOT has focussed on clients who can only sit for a short time only before experiencing skin issues. Some clients have repeated incidents of skin breakdown and can spend extensive time confined to bed or hospitalised to heal these areas. This has a marked impact on their quality of life including financial, psycho-social and physiological areas.

The Rehabilitation Engineering Centre (REC) at Royal Brisbane Hospital, also funded by the Queensland State Government, has joined with SPOT staff to investigate the issues that appear to be relevant to recurrence of skin breakdown in these clients, and develop appropriate interventions to address issues. Referrals to the collaborative service come after most other avenues of intervention are exhausted. These are usually complex cases that are unable to be solved using commercial options. While community service professionals or hospital staff are involved in the initially problem solving, it is generally the SPOT physiotherapists who initiate the referral to and involvement of the REC.

Aims:
As a collaborative client focussed service, we aim to:

- Maintain / improve tissue integrity long-term (breaking the cycle: skin breakdown – bedrest – graduated return to sitting – skin breakdown) and hopefully reducing the number of episodes of hospitalisation for skin breakdown.
- Provide a service that increases sitting time to meet client life-style and functional requirements.
- Educate the client, their significant others and service providers on their role in helping to the solve the skin breakdown problem.

Our interventions have identified characteristics that appear to indicate an individual may be more at risk and in need of our services:

- Often long-duration post SCI, with history of recurring skin breakdown.
- Have extensive areas of scar tissue from surgery for wound closure or from primary healing.
- Weight issues.
- Lack of regular skin checking routine.
- Often have abnormal posture eg pelvic and/or abnormal vertebral column-pelvis alignment.
- Have local moisture related problems.
- Emaciated pelvis with absent muscle and fat bulk to distribute the load (particularly clients with lower motor neuron lesions).
- Male clients may experience perineal pressure that restricts bladder voiding in sitting.
- Commercial cushions have been exhaustively trialed and found to be ineffective.

Service Provision:
The client, significant others, local service providers, rehabilitation engineer and physiotherapist work together as a team. Clients can be seen at home, by videoconference, or at a REC Pressure Ulcer Clinic. We have found the home visit to be a very important part of the assessment, to evaluate the client's environment including the type, condition and use of equipment such as the bed, hoist and slings and shower chair, and daily activities such as computer use. Special attention is given to the effectiveness of previous seating and mobility equipment. Service provision includes assessment, design, provision and evaluation. Particularly important to the process are:

- Determination of the history, exacerbating i ncidents, client's life-style and daily activity, impact of the skin breakdown on the client and carers/family members.

- Detailed examination of mobility issues, transfer skills, posture, clothing.
- Review of seating in wheelchair, shower commode and other sitting situations, e.g. car, work.
- Pressure mapping of the client on their current cushion and other trialed cushions, examining the influence of posture including lower limb positioning and determining the client's weight-relieving potential.
- Consideration of options for new seating with the aim to unload areas susceptible to pressure and maximize load-bearing surface area.
- Problem-solve / determine a possible seating solution for that client and their requirements.
- Evaluation.

Cushion design:
Load re-distributing cushions are developed from (1) clinical assessment (2) pressure mapping information and (3) anatomical mapping of the client on a transparent surface determining bony points, scar tissue and blanching, areas of skin breakdown, thigh position, scrotum, etc. These landmarks are transferred to a composite polyurethane cushion blank and a well to relieve load-sensitive tissue is developed and cut out. Greater trochanter shelves of the cushion can be built up to achieve a level pelvis. During trial fits of the cushion, fine tuning of the well and surface features is performed to ensure load-sensitive tissues are unloaded, the client does not bottom-out and the chair is set up to provide the correct support eg foot plate contact. Materials such as Supracore and Action Pilot Gel Pads can be effective in decreasing concentrated loads on the cushion surface, e.g. under greater trochanters.

Observations:
- Progress with this client group can be slow.
- Gains can be negated in a single incident and the process must start from scratch with re-application of a graduated return-to-sitting program.
- Client expectations can often be unrealistic as age and length of time post injury can have a marked effect on skin vascularisation, limiting sitting time. Previous sitting performance is not always a realistic determination of future aims and may require education of the client by various members of the team.
- Pressure mapping can be effective in educating clients in correct sitting posture, weight relieving, and the cause of current skin breakdown, but hasn't been able to identify the possible reasons for ongoing limited sitting time eg ischaemia related to scar adhesions.
- A previous brand or type of commercial cushions may not provide necessary pressure redistribution/relief as the client ages. Ongoing evaluation of cushion performance and suitability is recommended. Re-evaluation of the cushion when the client acquires a new wheelchair is essential.
- A back-up cushion is low-cost insurance against tissue insult if the main cushion becomes unserviceable.
- Custom fabricated foam cushions have a limited life, often less than 12 months with active users and affected by environmental factors such as heat and humidity.
- If custom cushion provision is contemplated, the service need is a recurrent one.

The Use of Heart Rate to Measure Wheeling Efficiency

B.J. Sawatzky
W.C. Miller
I. Denison

Oxygen analysis is a sophisticated method of determining the efficiency of mobility. This technique is popular in studies of gait analysis but has been used to a lesser extent in determining wheeling efficiency of individuals who use a manual wheelchair. Wheeling efficiency can be assessed by measuring oxygen uptake (ml) and then normalized for body weight (kg) and distance wheeled (m) (ml/kg/m). Unfortunately the use of oxygen analysis is cumbersome, time consuming and expensive. Heart rate is a potentially useful and affordable clinical alternative to assess wheeling efficiency associated with wheelchair set up.

The use of heart rate to predict energy expenditure, however, has been a hot topic in the literature. Luke et al (1997) reported a relationship of heart rate to oxygen cost with a r = 0.90 in ten able-bodied individuals running on a treadmill at a sub-maximal effort. However, Ijzerman et al (1999) showed in 10 patients who have a thoracic SCI during crutch walking that the reliability of heart rate was ICCC=0.99 but the correlation between heart rate and oxygen cost was ICC=0.79. In the paediatric population, heart rate has been shown to be a reliable predictor of energy expenditure (Butler et al, 1984; Nene et al, 1993; Rose et al, 1990) with correlations reported between 0.86 and 0.89. However, Boyd et al (1999) found too much within subject variability for heart rate to be a reliable measure in predicting energy expenditure. To date there have been no studies examining the relationship between energy cost and heart rate during wheelchair propulsion at a self-selected wheeling pace.

An understanding of the energy cost of manual wheeling may assist in selecting the appropriate; wheelchair model, set up and seating devices earlier in the wheelchair prescription process. This avoids potential frustration and exhaustion that may occur from selecting the wrong system. An objective measure of energy expenditure will enhance wheelchair prescription by the therapist and provide an earlier return to daily life for the client. We hypothesised that there would be a positive linear relationship between heart rate and oxygen consumption among paraplegic wheelchair users while wheeling over a flat hard surface.

Methodology

A total of 20 individuals who use a manual wheelchair as their primary form of mobility were recruited. Individuals were included in the study if they: i) had a diagnosis of paraplegia due to a spinal cord lesion, (traumatic or congenital) at the T4 level or lower; ii) were between the age of 20 and 55 years of age; iii) have been using a wheelchair for at least six months and their current chair for at least two months.

Prior to testing, the subjects were familiarized with the study environment and weighed for calibration of the O_2 analsyer. The testing equipment (Polar heart rate monitor and Cosmed K4 O_2 system) was fitted, and a 10-minute adjustment period was provided. Baseline data for heart rate and oxygen consumption was measured over final five-minute rest period prior to exercise.

Data from four trials were collected. Normally, incremental workloads are applied to wheelchair user on an wheelchair ergometer. Since ergometer wheeling does not completely simulate wheeling freely on a level tiled/linoleum floor, we used a change of tire pressure (100, 75, 50, 25 psi) as a change of workload and allowed the subject to wheel at his/her own selected speed Wouldn't include this in order to save space.

To ensure a standard of tire quality and type along with standardized axle bearings the subjects had our standard PrImo V-trak tires mounted to their chairs. The subjects were blinded to the tire pressure. The starting and subsequent tire inflation pressures were determined using block randomization and set just prior to the first trial. A total of four trials were completed with a full 10-minute rest break between trials. During each trial the subject was instructed to maintain constant self-selected wheeling velocity for 5 minutes. The variables collected during each trial included: i) oxygen consumption; ii) heart rate; iii) distance travelled.

Results

Of 20 subjects only 14 subjects were used for analysis. Three patients were excluded due to inability to complete the protocol. One subject was functioning at a T2 level with some upper extremity spasticity. Two subjects had significant pulmonary function deficit due to scoliosis that lead to technical difficulties with the heart rate data collection due to their chest contours not allowing for adequate contact with Polar Heart rate monitor chest-strap.

There were four females and ten males in the analysis. The mean age for the whole group was 34.5 yrs The mean correlation between heart rate and oxygen consumption was 0.73 for all subjects, however several subjects had much lower correlation. Sub analysis revealed there was a trend for individuals with higher lesions to have a lower correlation. When the subjects were separated to a group with above T6 and a group with T6 and below lesions the correlations were 0.58 and 0.80 respectively (Table 1).

Table 1. Correlation of heart rate to oxygen consumption in subjects wheeling at self selected speeds.

Subject #	Age	Sex	Lesion level	Correlation (r)
02	51	m	T6	0.89
04	27	f	T7	0.84
06	37	m	L1	0.75
07	36	m	T12	0.94
08	45	m	T8	0.79
10	51	f	T6	0.76
11	26	m	T12	0.77
12	23	m	T12	0.80
18	45	f	T6	0.84
19	20	f	T12	0.60
T6 & above (mean)	36.1			0.80
05	32	m	T4	0.76
13	45	m	T5	0.44
15	27	m	T4	0.58
16	18	m	T5	0.54
Below T6 (mean)	30.5			0.58

Discussion

Wheeling efficiency of manual wheelchair propulsion can be very useful to assess whether a particular set up or wheelchair design is better for an individual from an energy expenditure perspective. This study provides data that suggests that heart rate is a potentially good method of estimating wheeling efficiency in individuals with spinal cord lesions below T6.

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Clinical Application of Power Tilt and Recline Systems How to Determine Client Need and Ensure Proper Funding

Amy Bjornson, PT, ATP

Powered dynamic seat functions are necessary for certain populations to provide position change, pressure relief and improvement of physiologic functioning. This session will look at the importance of utilizing power tilt, power recline and power tilt/recline combination systems to maximize client quality of life. The assessment process necessary for appropriate, need-based prescription will be outlined as well as the necessary documentation for successful and timely reimbursement.

Coverage criteria for any dynamic seating system
For any powered dynamic seat function to be covered, the following criteria must be met:
The client cannot independently change their position: These clients have no means to shift their weight and redistribute pressure putting them at high risk for skin breakdown. They are unable to tolerate sitting and therefore would be bed bound without a powered dynamic seat function. Tilting or reclining provides a means for independent weight shifts and position changes decreasing risk of pressure sores, reducing need for care giver assistance and increasing sitting tolerance.

The client cannot maintain their pelvic, trunk or head position and/or balance against gravity for prolonged periods of time: Due to muscle weakness, these clients are unable to maintain a symmetric, stable position in gravity. They therefore move into poor postures including posterior pelvic tilt and thoracic kyphosis in efforts of gaining stability. These postures present increased risk of pressure sores as well as compromise to physiological functioning as described below. Provision of dynamic tilt or recline will allow movement out of the stream of gravity, promoting upright postures and symmetric weight bearing.

Client is at risk for respiratory complications: Without adequate trunk strength, the client falls into postural collapse as above while in the upright position. The respiratory system is compromised due to decreased ability for the diaphragm to move posteriorly which impedes lung expansion. This can result in atelectasis or positional pneumonia because secretions are not mobilized in the lower lung fields. Provision of dynamic tilt or recline can prevent postural collapse, promote thoracic extension and reduce these respiratory risks.

Client is at risk for digestive complications: In the upright position, the client falls into postural collapse as above. Digestive system is compromised because food is unable to pass down the gastrointestinal tract – this can result in gastritis, gastric reflux, esophagitis as well as bowel impaction. In addition, head and neck position are poor putting the client at risk for aspiration or promoting gag reflex. Dynamic tilt or recline can be used to facilitate postures that reduce the risk of gastrointestinal complications.

Client is at risk for postural hypotension: In the fully upright position, some clients are unable to maintain high enough blood pressure due to muscle inactivity. These clients are at risk for dizziness or loss of consciousness. Dynamic tilt or recline allows client to be re-positioned with head in a lower position in order to raise blood pressure.

Client is at risk for autonomic dysreflexia: A condition in which the blood pressure increases due to an event or condition that the body interprets as "noxious"**.** The blood pressure can rise high enough to be life threatening, leading to stroke. Dynamic tilt or recline allows the client to be brought into the most upright position possible to quickly lower the blood pressure.

Dynamic Tilt in Space vs. Recline
Dynamic Tilt in space systems maintain the same seat to back angle while providing change of position. This system is more appropriate for clients with hip joint contractures, clients with extensor spasticity and those who must maintain specific seated position due to multiple secondary supports or contoured seating. Studies have shown 30 degrees of posterior tilt offers adequate postural control while 45 degrees offers an effective weight shift.

Dynamic recline systems change a client's position by opening up the seat to back angle. This allows for pressure to be distributed over the client' back and buttocks, substantially increasing the area of pressure distribution and decreasing peak pressures. Recline, by opening up the hip angle, also allows access to the perineal area for bladder care while in the wheelchair. It provides improved sitting tolerance for clients with sensation because recline offers varying hip positions.

There are several clinical concerns regarding dynamic tilt in space systems. Although tilt systems move pressure distribution from the clients buttocks to their back; it does not substantially increase the *area* of distribution allowing for high peak pressures. In addition, tilt systems do not alter the seated position; patients with sensation may require changed angles in space in addition to orientation in space.

Difficulties arise with recline systems due to the introduction of shear forces. Shearing, by definition, is one surface sliding or moving on another stationary surface. Shear forces apply a tangential pull to the blood vessels causing occlusion. Prolonged narrowing and occlusion will lead to tissue necrosis and skin breakdown. Shearing occurs with recline systems because the arc of movement of the client and the wheelchair are not the same. The movement arc is different because the pivot point of the client (hip joint) is superior and anterior to the pivot point of the recline system. Studies have shown that pressure at which blood vessel occlusion occurs is half of normal when shear forces are present. (Bennett) The shearing or sliding that occurs with recline and return also moves clients out of proper position and into a kyphotic, rotated position. Recline can also elicit extensor spasms. During therecline cycle, extensor musculature is placed in a slack position which can generate activity in these muscles. Dynamic recline is also inappropriate for individuals with hip and knee range of motion limitations.

Research Studies regarding Pressure and Shear Forces

Studies have been performed looking at pressures and shearing forces in varying positions. Hobson et al found in 1992 that the maximum reduction of peak pressure occurred with the backrest reclined to 120°. However, surface shear forces were increased 25% with the backrest reclined to120°. He also found that although average pressures were similar between normals and SCI patients, shearing forces and peak pressures were 1.5-2.5 times higher in the spinal cord injured population. Guttman, in 1976, found shear stress cuts off even larger areas from vascular supply than pressure alone. Aissaoui found the most pressure relief at 45 degrees of tilt (12%), but that a combination of tilt and recline decreased maximum pressure more than each individually (40%). In addition, Aissaoui found that tilt was an effective manner of decreasing sliding forces. Based on these studies, it is appropriate to use both tilt and recline when tilt is needed for maintaining position and managing tone during weight shifts, but recline is needed for bladder and/or bowel management or gastrointestinal feedings. Dual Systems are also appropriate when tilt alone is not sufficient for pressure relief, but contractures or positioning makes recline alone inappropriate.

The above studies also detail that shear forces present position challenges as well as risk for skin breakdown. Consequently, it is imperative that these shear forces be controlled to maximize both performance and function of any dynamic seating system.

New Technology

The Smart Seat technology represents a breakthrough in tilt and recline technology. It offers the benefits of both tilt in space and recline systems while preserving posture and skin integrity by providing 3 mechanisms for shear control.

The first mechanism of controlling shear occurs by aligning the pivot point of the recline system to the end users greater trochanter. The Smart Seat pivot point is adjustable in the superior/inferior dimension – std., 1.5, 2.25 inches above the seat pan.

Second, the Smart Seat has a programmable shear program that moves the back panel downward as the system reclines – thereby matching the movement of the client. This back panel movement is programmed by a clinician or supplier and is digitally stored in the controller of the Smart Seat.

Lastly, the Smart Seat has innovative, new technology using gravity to assist in control of shear forces. This *Enhanced Recline* feature adds a posterior tilt component as the client returns from recline. The client reclines for weight shift – the seating system "opens up"as in normal recline systems. However, when return to upright is initiated, the seating system is "closed up": the *seat* comes up to a 90 degree seat to back angle. The client is now in a tilted position, in optimal posture, before being returned upright. The Enhanced

Recline feature provides the pressure relieving advantages of recline while preventing the resulting shear forces and loss of optimal posture.

The Smart Seat technology offers a comprehensive system through digital technology. It is easily customized to meet the positioning and mobility needs of highly involved clients – including safety features and complete programmability. The result is a system that redefines positioning systems and assists in restoring quality of life.

Chris Bar Research Forum sponsored by ROHO Inc.

Chair:

Geoff Bardsley, PhD

The 2003 Chris Bar Research Forum is a British Parliamentary style debate focusing on the need for comfort in wheelchair seating.

Audience participation is essential in this debate, with a vote for and against the motion being taken before and after presentations from two teams of proposers and seconders.

The audience is encouraged to challenge to speakers during and after their presentations.

The motion to be debated is as follows:

This House believes that comfort is irrelevant in the practice of wheelchair seating and that discomfort is simply a pain in the butt!

Nineteenth International Seating Symposium

Saturday, March 1, 2003

An Update of the Research and Management of Care for Persons with SCI (Spinal Cord Injuries)

Moderator: David Cooper, MSc, RT

Participants: Peter Axelson, MSME
Michael L. Boninger, MD
Mary Ellen Buning, PhD
Rory Cooper, PhD
Susan Johnson-Taylor, OTR/L
David Kreutz, PT

Spinal cord injury is a devastating disability. However, recent advances in medical, therapeutic and social management, have enabled persons to have lifestyles that were at one time thought to be impossible. This session will provide the audience with an update on advances in research and rehabilitation for persons who have had a spinal cord injury.

Dr. Michael Boninger will address recent advances in medical research and management. David Kreutz will present approaches in rehabilitation therapy. Susan Johnson-Taylor will provide information about aging with a spinal cord injury. Peter Axelson will review programs in recreation that are available including a National Parks accessibility program. Rory Cooper will review both current technology and future technological trends. Finally, Mary Ellen Buning will review resources both electron and non that can be used by persons with disabilities and discuss which they find most useful.

Join us for this very updated review of what is current and even in the future for persons with a spinal cord injury.

Palm Devices – Toys or Tools ?

Doug Gayton ATP
Ian Denison PT, ATP

"...interesting to note that although giving up a paper schedule book has been nearly as hard as giving up cigarettes...when I did PUT AWAY the paper book the Palm becomes a wonderful, comfortable assistant."

A Grandmother in Spokane

The Palm has long been considered a tool to replace the ubiquitous day-timer. However the product straight out of the box requires one to bend to the whims of the designers of the product.

Add-on software, input methods, cases, memory, and syncing methods all contribute to enable these devices to serve you better.

Figure 1 - Screen shot of an add-on address book which allows the user to tie a photo-graph to the address information. This is a crucial memory aid for ABI/TBI users.

Figure 1 illustrates a simple product permitting the attachment of digital images to an address book. Not long ago we considered adding photographs to large button telephones to be revolutionary !

A plethora of software is available. The palm world has truly brought four types of software together: freeware, shareware, charware, and commercial products.

And a clever group of copy protection and registration schemes are in vogue. Figure 22 is representative of a programme which permits one to use registered products on a one time basis for evaluation and comparison. Just one of a series of indispensable tools, clinicians must have a portfolio of tools in the palm tool-box.

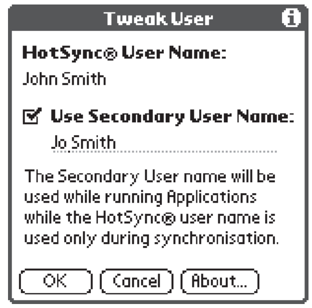

Figure 2 - Screen shot of 'Tweak User' allowing a secondary name to be entered for a device.

The 'Year in Review' of Palm OS products is truly exciting with Palm bringing forward Version 5.0 of their Operating System. Interestingly Palm products grew in such a fashion as to require a spin off of software products - all the while the 'big guys' amalgated...and witness the further damage to be inflicted upon the Pocket PC cabal with the introduction of Dell products upon the marketplace.

The Dana by AlphaSmart3 is an intriguing device operating in the Palm OS environment, lasting some thirty (30) hours, and allowing full screen width word-processing.

The Palm Version 5 Operating System is permitting great flexibility, especially in terms of greater storage, wireless capabilities, and BlueTooth networking.

Figure 3 - The DANA by AlphaSmart - front showing screen and keyboard layout.

Capture of digital images has been long important with Palm devices. Kodak produced a solid camera for the III series of handheld devices; and then seriously dropped the ball with their ill-fated effort for the Palm 'm' series. Fortunately Sony rose to the occasion with some offerings in their new product line...a line which also features Version 5 of the OS.

Voice capture is just one of the exciting input methods available now in these products. Some fifty different keyboards are available, many alternative graffiti methods, and a distinct lack of consensus about input strategies abounds.

Cellular products have matured since the Kyrocera which first embedded the Palm IIIxe (OS Version 3.5.1) into them.

Software for clinicians and clients, educators and students, and household members is exciting, practical, prompts accomplishment, and in the case of many of our patients, releives anxiety:

"I had my first good nights sleep after borrowing the Palm IIIc - for the first time in eight months I didn't worry if I had fed the dog, made lunch for tomorrow, or arranged for the repair to the truck."

1 http://www.palmgear.com/software/showsoftware.cfm?sid=72298820021012082918&prodID=8569
2 http://www.palmgear.com/software/showsoftware.cfm?sid=72298820021012082918&prodID=11492
3 Review available at: http://www.brighthand.com/articles/print.php?urlName=Dana_Review

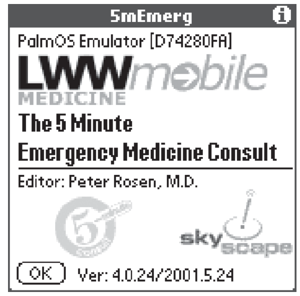

Figure 4 - Screen shot of Emergency Medical software package - title page.

Figure 5 - Picture of the Palm Tungsten Palm OS powered device.

Figure 6 - Picture of Sony PEGNX70V device with camera, rotating screen, and small keyboard.

Special Seating Issues in Bariatrics

Stephanie Tanguay, OTR, ATP/S, CRTS
Jean Minkel, MA, PT
Barbara Crane, MA, PT, ATP

Bariatrics is a branch of health care focusing on the treatment of obesity. Obesity is the most common metabolic disease in the United States with greater than 30% of the population meeting the criteria (1). Incidence is more prevalent in women (35%) than in men (31%) and becomes more common between the ages of 20 and 55. Occurrence doubles in populations of lower socioeconomic status.

Obese individuals have an increased risk for chronic diseases such as diabetes mellitus, hypertension and some types of cancer. Orthopedic and degenerative changes to joints and ligaments are increased, particularly osteoarthritis of the knees (2).

A sedentary lifestyle can have a dramatic influence that can promote incidence of bariatric condition. Under normal metabolic function, food intake increases as energy expenditure increases. However, food intake does not necessarily decrease proportionately when physical activity falls below a minimum level. Consumers with a propensity for adiposis (abnormal accumulation of fat in the body) could be further compromised by medical conditions leading to a more sedentary lifestyle.

It is becoming more common to see consumers with medical complications secondary to their bariatric status, which require mobility devices for household and community access. Increased demands on the pulmonary and cardiovascular systems from obesity result in hypertension and heart disease as well degenerative joint conditions as mentioned above. These complications can confine bariatric consumers to bed.

It is also increasingly common to see rehabilitation clients with spinal cord injuries, multiple sclerosis, traumatic head injury, muscular dystrophy, and cerebral vascular accidents with obesity as a secondary diagnosis. Most funding agencies recognize the necessity for specialty equipment to meet the needs of the bariatric population. Including manufacturer's published weight limitations in justification letters will help secure funding approvals for appropriate equipment.

Many manufacturers offer products to address the unique needs of the bariatric consumer. There are manual wheelchairs available for weight limits from 350 lbs. to 650 lbs. and above with options for seat to floor heights and adjustable rear wheel positions, in addition to seat widths in excess of 28" and various depth options.

Seat surface cushions have been available in sizes up to 20", 22" or 24" wide for many years. However, the weight limitations for some of these products remained at 250 lbs. More options are now commercially available to accommodate wider (in some cases 32" and more) chairs and for consumer weights from 350 lbs. to 650 lbs.

Powered mobility options for the bariatric population are in higher demand with the common use of direct drive power bases with the seat mounted above the base. Belt driven power wheelchairs with cross braces where wider seats equate to a wider frame are not as desirable for the bariatric population, although they are still available from some manufacturers.

Definitions / Terms for Bariatrics
(reference Taber's Medical Dictionary)

Abdominal obesity:	a condition in which excessive adipose tissue is prevalent in the abdominal area.
Adiposis Cerebralis:	obesity due to intracranial disease, esp. of the pituitary.
Adult-onset obesity:	obesity first appearing in the adult years.
Endogenous obesity:	obesity associated with some metabolic or endocrine abnormality within the body.
Exogenous obesity:	obesity due to an excessive intake of food.

Gluteal-femoral obesity: obesity in which fat deposits are located primarily below the waist in the hips and thighs.

Hypothalamic obesity: obesity resulting from dysfunction of the hypothalamus.

Juvenile obesity: obesity that occurs before adulthood.

Morbid obesity: obesity of such degree as to interfere with normal activities, including respiration.

(1) The Merck Manual, 17th edition, 1999. p 58.
(2) Wheelchair Users & Postural Seating – A Clinical Approach. R. Ham, P. Aldersen, D. Porter. p 202.

Special Measurement Techniques for Bariatric Clients
Presented by Jean Minkel, MA, PT

Anatomical Measurements

Mat Assessment Form		
1. Hip width	_________	
2. Back of buttocks to back of knee	Left _________	Right _________
3. Back of knee to heel	Left _________	Right _________
4. Seat Surface to elbows	Left _________	Right _________
5. Hip Flexion angle	Left _________	Right _________
6. Knee Extension angle	Left _________	Right _________
7. Foot length	_________	

Ask the person to sit up over the edge of the mat. Use the hip and knee range measurements from above to position the person within his/her available hip flexion and knee extension. If needed, ask an assistant to sit behind the person to provide support while you take the following measurements. Clipboards (2) to be used as straight edges (a caliper serves the same purpose if available) and a metal tape measure are helpful tools for measuring body dimensions.

- Hip width (Measurement from greater trochanter to greater trochanter).
  Position each clipboard to the side of the person at his/her greater trochanter. Be sure the boards are parallel with each other and perpendicular to the front edge of the mat. Use the tape measure to measure the distance between the clipboards.

- Back of buttock to back of knee.
  Position the clipboard behind the person and in line with his/her pelvis. Slide the board slightly to the side you are measuring to create a straight edge parallel to the front edge of the mat. Use the tape measure to measure the distance from the clipboard to the front edge of the mat (directly behind the person's knee).

  The clipboard being used behind the pelvis, simulates the back support. For persons with a fixed posterior tilt of the pelvis, the clipboard will be angled, liked a reclining back support, measure from the bottom edge of the clipboard forward to the front edge of mat. For persons with a fixed pelvic rotation, keep clipboard in line with "back" buttock and measure forward (right and left leg measurements will be different- leg length discrepancy) Repeat procedure on the opposite side.

- Back of knee to heel.
  Use the tape measure to measure from back of the knee to the bottom of the heel (supporting foot in neutral dorsiflexion). Repeat on the opposite side.

- Seat surface to elbow.
  Ask the person to bend his/her elbow to 90^0, as pictured in the diagram. Use the tape measure to measure from the bottom of elbow to top of mat surface. Repeat on the opposite side.

- Length of foot with shoes
  While the person is sitting over the edge of the mat, feet on floor, shoes on; line up one clipboard behind the person's heel and the other in front of the toes. Measure the distance between the clipboards.

Note: Measurements #5 and 6 and the angular measurements taken during the supine assessment for Hip Flexion and Knee Extension.

Bariatric Resources

Bariatric Equipment Manufacturers

Product Design Group (PDG)	http://www.prodgroup.com/
Gendron Inc.	http://www.gendroninc.com
Wheelchairs of Kansas	http://www.wheelchairsofkansas.com/
21st Century – Bounder Wheelchair	http://www.wheelchairs.com/
Brownstone	http://el.net/brownstone/
Convaquip	http://www.convaquip.com/home.shtml
SizeRIGHT	http://www.sizeright.com/index.html
Tuffcare	http://www.tuffcare.com/
Sunrise Medical	http://www.sunrisemedical.com/index.jsp

(type in bariatric under search section and all bariatric products will come up)

Invacare	http://www.invacare.com/cgi-bin/imhqprd/index.jsp

(product catalog lists bariatric products – click on this listing for products)

EPVA Tech Guide

– Bariatric wheelchairs and products	http://www.epvatech.org techguide.php?vmode=1&catid=108

General Bariatric Internet Sites:

Association for Morbid Obesity Support	http://www.obesityhelp.com
Calorie Control Council	http://www.caloriecontrol.org
Everything you want to know about obesity	http://www.obesite.chaire.ulaval.ca/websites.html
Shape up America!	http://www.shapeup.org
Weight control information network	http://www.niddk.nih.gov/
Obesity meds and research news	http://www.obesity-news.com
Obesity online	http://www.obesity-online.com

Associations:

American Dietetic Association	http://www.eatright.org/
American Obesity Association	http://www.obesity.org/
American Society of Bariatric Physicians	http://www.asbp.org/
North American Association for the Study of Obesity	http://www.naaso.org/

Books:

- Compulsive Overeater: The Basic Text for Compulsive Overeaters. Bill B. and Bill B. Compcare, 1988.
- Diets Don't Work. 3rd edition. Bob Schwartz. Breakthru Publications, 1996
- Emotional Eating: What You Need to Know Before Starting Another Diet. Edward Abramson. Jossey-Bass, 1998.
- Fat is a Feminist Issue: A Self-Help Guide for Compulsive Eaters. Susie Orbach. Berkeley Publishing Group, 1991.
- The Fat of the Land: Our Health Crisis and How Overweight Americans Can Help Themselves. Michael Fumento and JoAnn E. Manson. Penguin Books, 1998.
- Fat No More: The Answer for the Dangerously Overweight. Norman B. Ackerman. Prometheus Books, 1999.
- Losing Your Pounds of Pain: Breaking the Link Between Abuse, Stress, and Overeating. Doreen Virtue. Hay House, 1994.

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October 27, 1999, Volume 282, No. 16
http://jama.ama-assn.org/issues/v282n16/toc.html

Configuring Powered Mobility Systems for Children

Karen M. Kangas OTR/L

The Times have changed.

- Today we have equipment with accompanying assistive technology which was never before available. This equipment on powered chair bases includes:
  1). programmable
  2). alternative switch access especially, electronic zero-pressure switches, and
  3). flexible, customized seating.
- This equipment, is often under-utilized or not applied adequately to support independent control of powered mobility for children with complex needs.

The Configuration of the Chair and the Training has not changed.

With the times changing, and completely different equipment available, it is important to note that how training for powered mobility occurs, has not changed. Training continues to consist of teaching driving skills as would be developed and utilized by adults who have acquired disabilities and who have already been ambulatory, mobile, bicyclists, skaters, runners, jumpers, climbers, and automobile drivers.

Using new equipment which will allow children who have never been mobile in any way, (and certainly not ambulatory), in short, who are very inexperienced with mobility, require completely different training strategies to be successful.

We must teach mobility first, encouraging independent control, before "driving skills" can be taught. We must work within familiar environments for initial mobility, not large parking lots and gymnasiums, or wide hallways, which are completely unfamiliar to the child. We must program and set up the equipment to allow the child to safely explore and learn the use of the equipment in direct control of the environments within which they live and learn.

Instead, we create a "driving environment" as if we were teaching children to drive an automobile, we overly control the situation, constantly demanding the child to listen and obey our commands. This method of learning may be helpful when a machine like a car is being taught to be responsibly managed, but it is certainly not helpful when attempting to teach a child to "walk" and for children with complex needs, "walking" and "mobility" is what they need to learn, not driving.

The Physical Configuration of the Chair needed.

In order to support learning mobility, not driving, the physical configuration of the chair must support independent control and mobility. The configuration must suit and be planned to work for both the child and the trainer.

For the Trainer:

The visual display needs to be mounted in the rear stably, and within an easy viewing of the trainer. The trainer must know the programmability of the chair, and its current "modes." The child will not and should not be expected to manage a chair before she has even experienced making it go where she wants. The switch controller interface must also be mounted initially in a convenient spot for the trainer's access. The trainer must turn on the chair, and the switches, so that the child can experience immediately control of moving the chair.

The chair's On/off switch is initially controlled by the trainer. Even the reverse switch of the chair may need to be initially controlled by the trainer. Why? The child must experience movement, and control of the chair within a familiar environment. From that experience, the child will develop increased desire, attention, and competence to extend her learning to include management of the chair and the activity.

The child must first experience successful mobility, and independent control of it, before the child can be expected to be interested in learning responsible use of the machine parts of the chair. If mobility is encouraged, and supported, the child will naturally develop increased abilities, and interests. The chair, due to its programmability, and the equipment's flexibility can be adjusted and change with the child. The child's own learning can be supported by this programmability, and competence and use of the chair can expand as experience increases.

The Programming of the Chair required.

Standby and standby modes should not be programmed or used when a child is first learning mobility. These modes are not needed, and constantly interfere with the child's understanding of the consistency of actions of the chair.

No seat functions should be programmed, nor should re-set be programmed. The chair should simply drive, drive slowly, and stop. There should be no menu to follow, no waiting to occur, except for the turning on/off and set up by the trainer.

The speeds needs to be set very slowly, imitating the speed of an initial stepping toddler. However, the chair still needs to perform, so torque or the power level needs to be adjusted to allow the chair to move efficiently over carpeting, or door sills.

Speed and turning deceleration and acceleration must be adequately programmed. Most of the time the switch's actions should be immediately responsive, with no delays. Acceleration and deceleration are only needed when the child can manage increased speeds and multiple environments.

The Physical Configuration needed for the child to experience mobility.

Seating for task performance is the the foundation for independent control of the chair. This is seating which does not control tone, nor is it the seating needed for safe, passive transport. This is seating which allows the child to manage her own body, use tone, and allows for pelvic stability and mobility. This seating is often radically different than the seating needed by the child for the child to be managed. Now, the child is to manage herself.

This may often require the armrests to be removed, the legrests to be removed, the chest supports to be removed, and the seat and back angles may need to be radically altered to support a more upright, yet forward posture. Positions of task performance are critical in independent control. These are positions of pelvic weight bearing, and support. Using seating which has controlled the child, is not going to support the child in controlling herself.

The training session must be short, and as the child's own patterns of independent control are observed, the seating can be increasingly supportive of independent control.

Digital control of the chair, particularly with head switches can be considered a starting point, instead of proportional control with a hand. Most children who are considered to have complex needs, have difficulty with tone management or motor coordination. A joystick can make a chair move, but controlling it is another completely different scenario. Managing both speed and direction can confuse a young child, or a child who has never experienced mobility. Using digital control, a switch always and only performs one task, and it is always consistent and reliable. This allows a child to quickly and automatically expect the switch to perform a particular way, allowing the child to develop a natural expectation of the activity.

Switch placement must allow immediate success and control. Zero pressure switches can be extremely helpful here, as the child must only control his range of motion, and not have to coordinate that range with strength. Managing range and strength (or coordination) is already difficult, and can be eliminated with initial training strategies. Success and control, especially control of stop, happens naturally with children when real independence is available. This allows the foundation of safe management of the chair as competence increases with experience.

Attendant control should never be used to manage a chair while a child is learning. Attendant control is for management of the chair when the child is not in the chair. When the child is either headed for trouble, or the adult is anxious about the chair and child's location, the adult trainer needs to turn the chair off, and disengage the chair, move the chair, explain to the child why this activity was stopped. Then, the trainer can start the chair up again, giving the child an experience of time and understanding as to how the difficulty arose. Crashes should not be experienced, the trainer is there to prevent them. Safety is the responsibility of the adult trainer, as the child is learning to "walk." We certainly do not allow toddlers to run out in the street, and we do not expect them to not run out after we tell them once. We remain with toddlers all the time, expecting them to not know rules, to learn to manage their bodies as they learn and experience activity. This same method of support and supervision must occur for powered mobility training.

How the child will learn.

All children (and adults) learn motor control and postural control through the development of routines. All learning has sensory motor components, and so far, we have paid far too much attention to the motor components, ignoring the sensory integration required to act, and repeat an act. All human beings, not just children, learn by process. This process becomes a routine which is an activity which can be anticipated. The anticipation is the ability to know what will be required to perform the activity, and the knowledge of the beginning, the middle, and the end of the activity. To develop routines, practice which is moderately novel must occur.

Increasing the frequency of the activity, rather than the duration, is how routines develop. Allow the activity to not be managed by an arbitrary longer length of time expecting endurance, but rather allow the activity to be repeated, ended, and eventually expanded.

React to the child's actions, rather than directing the child. If we directed all toddlers as they began to move, they would stop moving. Instead, we naturally support them emotionally. If they stop moving, we presume they intended to stop. So, also, must we support children who are developing experience with powered mobility. React to them, keep them safe, presume every action was intentional. When the chair and its programming and configuration are set up adequately, these actions of the child will be obvious, and under her control. Independence will be evident, although at first, fragile, in that it is not of a long duration, nor always able to be reproduced. However, if the child's actions are not obvious, and appear to be confused, or erratic or inconsistent, then, the chair is inadequately programmed, or the seating has been inadequately conceived.

When will real success and real independence be achieved.

It is surprising how children with complex needs must meet expectations higher than ever expected of children with simple needs. Can any child's skills be predicted or anticipated? Can any adult's? No. Only an environment of support and curiosity can be provided to allow a child to demonstrate interest, and competence. Will every child who is in a powered chair be able to manage every unfamiliar environment efficiently? No, but then no child of any age, nor any adult of any age can manage every unfamiliar environment efficiently. However, all of us are able to demonstrate adequate and functional independent control as our personalities and experience and desire allow. Children with complex needs are no different. Some will learn quickly, and learn a lot, some will learn quickly, but only perform in some situations. All will demonstrate independent actions, and control in some environments. We can both tell you that, because it happens with the children we work with, every day, in all situations.

Incidence of Motor Vehicle Accidents in Individuals who use Wheelchairs

Shirley G. Fitzgerald, PhD
Thomas Songer, PhD

With the implementation of the Americans with Disabilities Act (ADA) and related legislation, wheelchair users have increased opportunities to interact with society. Therefore, it is likely that an increase in usage of motor vehicle transportation by these individuals has occurred. Due to this trend and the thought that it is expected to continue; it is necessary to outline the characteristics of these individuals in terms of the wheelchairs and transportation use.

Information on the injury risk to wheelchair riders in transportation situations, though, is very limited. Most of the data available focuses on incidents occurring while the vehicle is stationary. For example, the National Highway Traffic Safety Administration [NHTSA 1997a] reported recently on the findings from a study of non-crash related activities associated with motor vehicles. Related activities included exposures to lifts, transfers, and wheelchair securement in the vehicle. The study estimated that 1500 injury events (requiring ED care) were related to motor vehicles. Injuries related to improper securement occurred most frequently; 35% of the injuries identified. Injuries from lift malfunctions (19%) and collisions between the wheelchair and the vehicle (26%) were also common. Transfers accounted for 15% of the events. Vans were involved in 48% of the incidents, passenger cars (30%) and buses (12%).

Studies investigating injuries to wheelchair users occurring while the vehicle is in motion are few in number and incomplete. Case reports [Shaw 2000, ECRI 1995, Richardson 1991] note fatalities and injuries to wheelchair users in transport. Two reviews have also examined accident information from the National Electronic Injury Surveillance System (NEISS). Richardson [1991] estimated that there were about 2200 injuries among wheelchair users in motor vehicles from 1986-1990. Most of the injuries were attributed to improper securement in vans and buses during sudden stops or sharp turns. Shaw [2000] reported basically the same results looking at incidents from 1988-1996, thought the estimated number of injury events was lower (n=1320).

These two reports and a third review [ECRI 1995] suggest that the injury risk to a wheelchair user during motor vehicle transport is likely to be small. However, these reports also noted several problems in adequately characterizing risk based upon existing databases. Foremost, existing accident databases do not adequately or appropriately identify wheelchair users or the characteristics of crashes they are involved in. In addition, it is also difficult to distinguish vehicles, whether they are in motion, drivers, passengers, type of transportation (private or public), and seating (wheelchair or vehicle seat). Preliminary reports note that injury risk may be related to type of vehicle, seating, and wheelchair securement [Shaw 2000, Bertocci 1999].

Given the limitations that currently exist, we argue that an important study design to use in studies of motor vehicle injury risk in wheelchair occupants is one based upon surveys or personal interviews of the population using wheelchairs. This design allows an investigator to identify exposure to various forms of transportation, typical configurations regarding wheelchairs and securement, and previous experience pertaining to crashes and injuries. A pilot survey study was conducted to 1) examine the occurrence of accidents and injuries to wheelchair users while using motor vehicle transportation and 2) gather pilot data that would enable a larger a project to be conducted.

Methods: Subjects (N=49) were recruited from a variety of sources including the National Veteran's Wheelchair Games held in New York City, New York, July of 2001. Subjects were asked to complete a short questionnaire that encompassed usage of motor vehicles and resultant accidents. Questions were directed at how often subjects rode as passengers and drivers, miles ridden, whether subjects transferred or not when in a vehicle, and the occurrence of accidents that may have occurred in the past two years. All subjects signed informed consent prior to participating in the study. Descriptive statistics (mean, standard deviations, frequencies) were used to analyze the data.

Results: Forty-nine predominantly male (72%) subjects participated with a mean age of 50.7+12.7 years. The average age since injury was 23.8 + 19.5 years, with 64% of the subjects having a spinal cord injury. The remaining subjects were diagnosed with multiple sclerosis (14%), cerebral palsy (8%), spina bifida (4%), and other disabilities (amputee, post polio (6%)). Sixty-one percent used a manual wheelchair as their primary means of mobility.
Most subjects (75%) reported traveling as a passenger at least once a week, with only 26% reporting they traveled as passengers at least once a day. Fifty-five percent indicated they transfer to a vehicle seat when riding as a passenger. The average distance traveled was 51 miles per week. Two subjects reported three accidents. One person reported being in two accidents as a passenger. For the individual who had two accidents, both times it occurred in a private vehicle. The person was traveling in a vehicle seat and was not injured. For the other incident, the person was traveling in a public vehicle, in their wheelchair, which was tied down. No resultant injury occurred.
For the subjects that drove (n=36), an average distance of 233 miles were driven per week and only three used their wheelchair to drive from. Five subjects reported having a least one motor vehicle accident in the past two years, with one subject having two accidents. Of these five subjects, all transferred to a vehicle seat to drive. Two of the five subjects were injured as a result of their crashes. Five of the six accidents involved a single vehicle and impact varied from left side to rolling the car over.

Discussion: This is the first study to document transportation habits and occurrence of injury of individuals with disabilities. Although our sample size is small, the majority (72%) of our subjects drove, with seven subjects identified who had motor vehicle accidents in the past two years. Results, at this time are preliminary, and may reflect only one segment of the population who uses wheelchairs. Studies with larger populations identified from diverse sources are needed to adequately characterize crash and injury events. The sampling methodology was biased; our population was relatively active as many of the subjects were recruited at the National Veteran's Wheelchair Games. It is likely, that individuals who use wheelchairs who do not participate in the games, may be less likely to drive and transfer to their automobiles car seat. This work has also shown that a survey is acceptable to a population who uses wheelchairs and enables a researcher to identify accidents. Future work should encompass a more in-depth questionnaire as well as longitudinal methodology to enable more accurate incidence accident rates.

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Wheelchair Transportation Safety: Occupant Restraint Preferences From Adult And Pediatric Wheelchair Users

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ABSTRACT
Wheelchair occupant restraint systems (WORS) that are fixed to the vehicle are commonly used to protect wheelchair users during frontal impact when traveling in motor vehicles. This study investigates user preference of occupant restraints that are integrated in wheelchairs. A survey was developed and distributed among pediatric and adult wheelchair users. Preliminary results show that a wheelchair integrated restraint system (WIRS) is preferred by pediatric wheelchair users and adult individuals with a higher level of disability using power wheelchairs. Occupant protection was rated higher than occupant restraint comfort and fit. Factors that may affect WIRS acceptance are added wheelchair weight and backrest height.

BACKGROUND
Individuals with limited mobility that require assistance during transfers, often use wheelchairs as motor vehicle seats during transit in motor vehicles. Belt and docking type wheelchair securement systems fasten wheelchairs to the vehicle floor during transport. The voluntary ANSI/RESNA WC-19 standard requires wheelchair seat integrated pelvic restraints [1]. However, current practice for occupant protection during frontal vehicle impact consists of WORS attached to a fixed location on the vehicle structure. Studies have shown that vehicle mounted WORS, can result in poor belt-fit and decreased occupant protection when used with various types of wheelchairs and occupant populations (children, adults) [2-4].
Previous studies show feasibility of seat integrated occupant restraint systems on motor vehicle seats and wheelchairs; upper toarso and pelvic restraints are independent of the vehicle, easy for wheelchair-seated occupants to operate, safe and comfortable [5, 6]. Since a WIRS may add weight to the wheelchair and height to the wheelchair seat back, user input is essential to evaluate the benefits of a WIRS for adults and children using various types of wheelchairs.

OBJECTIVES
The objective of this study was to obtain input from adult and pediatric wheelchair users on the factors related to WIRS acceptance and to determine an appropriate user group for the WIRS.

RESEARCH METHOD
Wheelchair users were contacted through wheelchair manufacturers, consumer organizations, educational settings and transit organizations. A 'closed-ended question' survey was developed addressing issues such as user characteristics (age, gender, functional level), wheelchair type (manual, powered), vehicle type (para-transit, mass transit, private vehicle) and asked for user input on wheelchair integrated upper torso and pelvic restraints. Relationships between age, wheelchair type and occupant restraint preference was documented and evaluated.

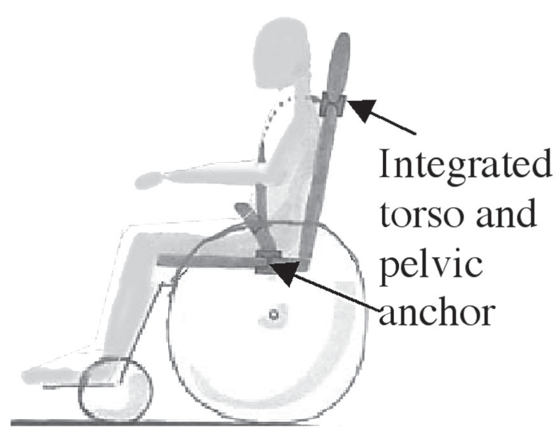

Figure 1: Wheelchair Integrated Occupant Restraint System (WIRS)

SURVEY RESULTS

So far, 36 respondents have completed the survey. Those surveyed represented a wide range of individuals with physical disabilities. The group was almost evenly split between children and adults and consisted of 61% male respondents.

Highlights of the survey were the following:

- 93% of children used a manual wheelchair
- 67% of children used a tilt-in-space or reclining wheelchair
- 52% of adults used a power wheelchair
- 60% of the children traveled in a small school bus and 26% in a small family van
- 32% of the adults traveled in large city buses and 47% in para-transit vans
- on average, respondents traveled 93 miles and 7.2 hours per week
- 64% used some type of wheelchair securement system (4-point tiedown or docking type system)
- 72% traveled in motor vehicles that offered wheelchair occupant restraint systems
- 77% of respondents used an occupant restraint part or all of the time
- 89% traveled forward facing
- respondents were confused about the difference between (pelvic) postural supports and safety restraints
- 61% said that the occupant restraint increases their feeling of security
- 89% did not know if their wheelchairs were WC/19 compliant and/or crashworthy
- 19% reported motor vehicle incidents due to wheelchair tiedown or occupant restraint shortcomings or misuse
- 72% ranked occupant protection as the most important feature of occupant restraints, whereas only 11% said that belt comfort and fit was a more important occupant restraint feature
- 44% ranked a crashworthy wheelchair frame as the most important feature of a wheelchair, whereas 17% ranked wheelchair comfort as the most important wheelchair feature

Questions specifically related to WIRS revealed the following answers from the respondents:

- only 7% of pediatric wheelchair users said they do not prefer a WIRS
- 33% of adult wheelchair users said they do not prefer a WIRS
- 67% of pediatric users would not mind having a higher backrest to accommodate a WIRS
- 80% of pediatric users would accept a heavier wheelchair with a WIRS
- 43% of adult users felt that added wheelchair weight was a concern
- 33% of adult users felt that added backrest height was a concern
- 67% of respondents had their wheelchair seatback start at or above their shoulders

CONCLUSIONS

Wheelchair users surveyed value the importance of WTORS. More adults who use manual wheelchairs, 56%, would prefer a vehicle-mounted restraint system, as opposed to only 33% of power chair users. Concerns regarding a WIRS are related to crash safety, and the annoyance of added weight and increased backrest height. The majority of respondents have wheelchair seatback heights that start at or above shoulder height, indicating that there is potential for safely anchoring a WIRS to a wheelchair seatback without increasing seatback height significantly. Our findings suggest that WIRSs may not be appropriate for all wheelchair users in all environments. However, the survey results indicate that a substantial portion of pediatric and adult wheelchair users are interested in using wheelchair integrated restraint technology, even if it means increasing wheelchair weight and backrest height.

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Seniors' Perceptions Of Their Safety While UsingA Private Vehicle

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"The inability to drive was more than a retreat from mobility, for it was one more step away from spontaneity and the free exercise of will. Whereas I could once act on whim and fancy, I now had to exercise planning and foresight."

(Murphy, 1990)

INTRODUCTION

Access to use of a private vehicle, either as a driver or a passenger, affords considerable independence for seniors in completing their daily activities. There is substantial research that investigates the influence of declining skills and function of seniors on the ability to drive a vehicle safely. However, very little research has considered the fit between the abilities of the senior and the design of private vehicles and how the vehicle design might influence the ability to operate a vehicle safely.

The project reported here is the first in a research program investigating issues of seniors as passengers and drivers and, in particular, the congruity between vehicle design and seniors' abilities and needs. It is part of a larger program of automotive research investigating safe transportation for vulnerable populations. It is anticipated that outcomes of this research program will include vehicle design more suitable for seniors, educational programs to enable purchase of vehicles that meet the needs of this group, and influence of relevant public policy.

The purpose of the project presented here was to explore vehicle safety issues of seniors over the age of 60. The specific issues that were explored included seniors' knowledge and use of vehicle safety features, their means of managing their own safety and that of passengers, and issues of ingress and egress.

METHOD

A semi-structured telephone interview was conducted with 59 seniors. Participants were recruited through several means including an international conference on seniors and technology, through various seniors groups and organizations, and using snowball techniques. The semi-structured interview asked about utility of vehicle safety features, transportation of others, including other seniors and children, ingress and egress, management of their own safety and that of other vehicle occupants, additional safety features they would recommend to vehicle designers, and additional information desired related to vehicle safety features.

The interviews were transcribed and an initial content review was conducted on the transcripts by both researchers. Codes were identified and defined following this review. Coded data were entered into the NVivo software program. Information coded in similar means was reviewed to identify themes and relationships between themes.

RESULTS

Fifty-nine participants were recruited for this project including 19 men and 40 women. The age range was 60-93 years with the range of years of driving experience reported as 12-80 years. We recruited 24 participants in the 60-69 age category, 22 in the 70-79 age category and 13 in the over 80 year category. Despite extensive efforts we were not able to recruit additional participants in the over 80 category. A reluctance to talk about difficulties experienced with driving for fear of losing their license was hypothesized as one reason for the recruitment problems in the older age group.

Overall, there was an interaction between the abilities of the person and the environment, which included both the vehicle and aspects of the external environment such as weather and traffic congestion. This interaction influenced the choices, beliefs and abilities related to their safety as either a driver or passenger in a private vehicle. This paper will focus on the aspects of the vehicle design that influenced safe transportation and the utility of certain vehicle features.

Not surprisingly, ingress and egress were difficult for most of the participants. Issues relating to the height of the seat, size of the door aperture, need for a device to assist ingress and egress, and assisting others were raised repeatedly. The use of seatbelts was another issue that was raised frequently. Participants felt that there was too much variation in the design of seatbelt coupling units. People were not always able to fasten or unfasten the seatbelt. It was difficult to locate the seatbelt attachment or to see it to fasten. Seatbelts were generally uncomfortable to use and many people indicated that they used them only because they were required to do so by law.

Control features such as turn signal indicator, radio controls, and windshield wiper controls that were in familiar locations or within easy reach were most useful. Some seniors reported a reluctance to remove their hands from the steering wheel or take their eyes off the road in order to make adjustments to these control features. Aspects of visual scanning and information processing related to the instrument panel were also raised.

CONCLUSIONS

This preliminary work identifies a number of aspects of vehicle design that are not congruent with the abilities of seniors and may be contributing factors to safety concerns for their transportation. Our findings of difficulties with ingress and egress and use of seatbelts are similar to those found by Steinford, Torrita, Mann, & DeGlopper (1999). A larger population based survey is planned to provide more evidence for these issues. With this information, concepts of universal design can be applied to the vehicle design process to make vehicles safer for seniors.

This project was funded by Industry Canada and NSERC through AUTO21—The Automobile of the 21st Century, a Network of Centres of Excellence

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The Clinical Approach to Pediatric Seating, Positioning,& Mobility: “Objective, Not Subjective, Assessment”

John R. Stull, L/PTA, ATP

Acknowledgements
This presentation is dedicated to the memory of William J. Meeker, RTS, custom seating & mobility specialist, who for over 20 years provided the highest level of custom products & services to pediatric and adult clients thru out New Jersey and the tri-state area. Bill left behind a legacy of un-matched professionalism and an unforgettable personal dedication to improving the lives of the people he served.
Acknowledgements:
Clayton Adaptive Rehab Equipment, NJ
Voorhees Pediatric Health System, NJ

Biography
I have spent the past 10 years employed by Voorhees Pediatric Health System. I recently resigned from my position as Coordinator of Seating, Mobility, and Assistive Technology Clinic that services the needs of children who are medically fragile and technology dependent, ages premature to 21 years of age, as well as being an AT consultant for the inpatient & outpatient rehab, medical day, day hospital and school based programs at VPHS.

Currently I’m employed with Clayton Adaptive Rehab Equipment as pediatric specialist/ATP where I’m privileged to be able to assist a great number of children & adults thru-out the tri-state area of NJ,PA and DE.

The field of pediatric assistive technology service provision presents many variable therapeutic challenges that make working with children a very unique and rewarding experience. Ultimately as clinicians, we search for AT that will enhance and improve the overall function and independence of the children we serve.

Newton’s 3rd Law states that for every action there is an equal and opposite reaction.
Our clinical statements and actions cause a reaction that could positively or negatively impact that child/family’s life.
We should always keep this law in mind when we find ourselves or other clinicians making subjective statements that are not supported with objective findings. The following are subjective phrase’s that we should be cautious with saying to a child and family.
“I think he can or can’t do it.”
“I like the way he/she looks in or with that.”
“I don’t like the way he/she looks in that w/c or with that technology.”
If we get a new w/c or technology he/she will look better.
The same w/c or technology worked well for the last person I saw with the same Dx.
I give every one with that Dx. the same custom w/c or assistive technology.

All of those previous statements are purely subjective, unless we have solid objective tests and measures to support our theories, assumptions or opinions. As therapeutic clinicians and technology providers we are very holistic professionals by nature, but we can’t forget that our entire practice is based on science with objective findings that support our theories and actions.

The team approach must be utilized in order to properly and objectively assess a child for an appropriate AT device. The number one player on the team must always be that child and his family.

The team should also include all or some of these related medical, therapy, and technology professionals.

- Specialty Physician or PCP
- ATP, OT/COTA, PT/PTA, ST, Recreation
- Rehab Engineer, Rehab Equip. Tech.
- ATS, RTS/Technology Provider (pediatric)
- Nursing, Respiratory Therapist, Dietician
- Special Educator
- Caregiver, one-on-one aid/assistant
- Case manager, Social Worker

The team may be large or small, in various settings such as:
- Inpatient Rehab Hospitals
- Outpatient Seating, Mobility, & AT Clinics
- Pediatric Specialty Sub-acute/LTC Facility

- Outpatient Pediatric Therapy Clinics
- Specialized School based Clinics
- Home Care & Early Intervention Programs
- Specialized Clinics (i.e. MDA, CP clinics)

Whichever the setting, large scale or smaller team, each person's input is invaluable when assessing a child for AT. Team members will be responsible for providing valuable objective information that will help determine the appropriate AT devices and services.

Team members must collect data in the following area's through Q&A, simple to complex tests and measures, environmental assessments, and trial of devices.

- COGNITION: Dx: CHI, Anoxic Encepholapathy, CP, DD, MR, etc.
    - Simple cause and effect exercises (switch operated toys, joystick)

Video games

Object recognition, remembering things in their environment

Example: If the child can physically move a w/c via self propulsion or power mobility: Can they control it? Do they understand that they are moving themselves through space?

VISION:
- Low vision
- Field cuts
- Visual tracking
- Light sensitivity Corrective Eyewear?
- Hand/eye coordination, Visual Perception

If these area's are questionable, recommend a formal visual assessment be performed by a specialist. (I.e. Neuroptometrist.)

NEUROMUSCULAR:
- Dx: MD, SMA, CP, Spina Bifida, SCI, TBI
- Prognosis; short/long term
- Nerve, MS, bone, organ impairments
- ROM, tone abnormalities, contractures
- Increased MS spasms, increased seizure activity

Secondary medical issues, associated with Dx such as Cardiopulmonary, GI, Bowel/Bladder dysfunction/incontinence

Are medical and/or surgical interventions probable?
- Orthotics, splints, braces
- Botox, Baclofen pumps
- Orthopedic surgeries/neuromuscular surgeries
- Gastostomy/feeding tube, catheterization colostomy
- Seizure meds, pain meds, BP meds, etc.
- Tracheotomy, oxygen/ vent dependency

Environment:
- access to physical
- surroundings such as:
    - Home, School, Work, Recreation
      Community/public access
      Rural or Urban areas, or both
      Accessibility of transportation

Child's Cultural Factors:
- Self perception
- Motivation
- Socioeconomics
- Beliefs about disability
- Knowledge of disabilities and related support services
- Sources and extent of social/family support
- Current/future role(s) in the family
- Coping strategies (constructive/destructive)

All of these areas can provide the type of information needed to help an Assistive Technology Team in the decision/selection process with that client in order to match an appropriate technology with that person.
- Consider what it is that the client/family wants the technology to do for them?
- Is it possible for the technology to accomplish these goals? How will it impact their lives, both positively and negatively?
- It is up to the Team to answer these questions based on all of the objective findings obtained.

The team needs to be honest and present its findings with reasons to support their decisions to the child and family.

The Team may need to steer the child/family in a more practical direction if the goals of the client/family appear unattainable.

Last, but not least consider Funding! Or should funding be considered first? From a clinical stand point, we want to give these children anything and everything they would need to improve their lives. All too often funding can be the greatest challenge of all. For that reason, we must review funding resources while assessing for AT, simultaneously. If we find that there are funding issues, we must inform the family and team, and search for alternative funding, such as government programs charitable organizations and fund raising.
What is the priority now and in the future?

Conclusion
Finding AT solutions for the Pediatric population presents a uniquely challenging task, that involves a great deal of dedication, creativity, and objectivity. This usually involves a long term commitment by the team, in order to help that child /family overcome the obstacles and changing needs that they will experience in the future.

Clinically assistive technology professionals must be committed to on going continuing education, knowledge of new & improved AT products and services, and must continue to have open mind attitudes towards new concepts and ideas.

CASE STUDY 1
Desmond is a 20 y.o. male. Admitted 1992 to Voorhees Pediatric Facility/ LTC.
Dx: Anoxic Encephalopathy, MR, CP, RAD, Fundoplication, Gastrostomy.
PMH: Experienced respiratory arrest at 6 months of age (x2 in 1 week) secondary to severe bronchitis. Resulting in ventilator dependency and neurological impairments.

Desmond was 10 y.o. (1992), he presented with fetal/kyphotic positioning at all times.
Slightly retracted shoulders
No measurable scoliosis
Obliteration of lumbar lordosis (passively in prone he could achieve a 15-20 degree lordosis).
Hip contractures (35-130 degrees)
Knee contractures (20-120 degrees)

1993 x-ray lateral view of Desmond’s spine

10 years later Desmond now presents with an extremely kyphotic thoracolumbar spine
Upper extremity contractures t/o
Significant scoliotic deformities:
45 degree left thoracic curve (T5-T11)
30 degree right thoracolumbar curve (T12-L5)
Hip contratures (60-90 degrees)
Knee contractures (90-110 degrees)
Ankle Dorsiflexion contractures (20 degree)
2002 Desmond in left side lying position

2002 Full body view of Desmond’s contractures

Side view of Desi’s old w/c which could no longer accommodate his kyphosis and hip angle causing him pain & discomfort.
Frontal view of Desi in his old w/c, showing his poor lateral trunk support.

Desi’s old foam-in-place back support. No longer supporting his spine

Frontal view of Desi’s new custom FIP back support.
Full lateral view of Desi’s New seating system.

Full lateral view of Desi positioned properly in his new seating system.

Frontal view of Desi with adequate lateral support & accommodation of his trunk
CASE STUDY 2 Molly is a 14 y.o. female.
Admitted to Voohees Pediatric Facility/LTC 1990.
Dx: GenSymp Pyrexia of unknown origin, Skeletal dysplasia, larygomalacia, ventilator dependency, bilateral hip & knee dislocations, multiple significant contractures PMH: Respiratory distress, multiple fractures

Molly spent her life from age 2 to 10 in bed or supine in padded wooden cart that had a shelf that would accommodate her ventilator.
The cart’s size and weight made maneuvering, and access to other environments very difficult. Trips out side the facility were impossible.
Due to her supine position and the height of the cart, she could not interact with therapeutic activities or other children.

Molly old mobility base. Now in storage.

In 1998, Molly was cleared by her medical team, to begin assessing for a custom seating & mobility system. This system needed to be:
Lightweight, compact, and maneuverable
Provide change of positions for comfort, pressure relief, postural drainage and increased pulmonary function.

Seating must support and accommodate her postural deformities. Decrease risk of Fx
Provide proper orientations to interact with environment and peers.

1999 Molly's first new tilt-n-space w/c.
Custom FIP back & seat
Custom contracture foot/leg supports
Vent base

Molly in w/c
Forward tilt is locked out to decrease respiratory distress.

2002 Molly's FIP seating needed growth adjustments
Molly Smiling!

Since receiving her new w/c in 1999, Molly attends a specialized school, participates in recreation therapy sessions, attends many community outings, and can simply leave her room and interact with more of the world.

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The Fit Function Relationship

Marty Ball
Tina Roesler MS, PT, ABDA

In recent years, the impact of long-term manual wheelchair use has become an important consideration when providing new equipment to first-time users or replacing existing equipment for clients with years of manual wheelchair experience. Regardless of the client's experience level, proper fit can have a dramatic effect on functional abilities, now and in the future. The way a chair fits can effect the ability to propel efficiently, the risk for upper extremity injury such as acute and chronic overuse syndromes of the shoulder complex and the wrist and hand, the risk for secondary complications such as spinal deformities and pressure ulcers, and functional activities such as transfers and activities of daily living (ADL).

From a clinical standpoint, we must first recognize the limitations of the mobility system. We will not prevent overuse injuries or secondary complications, but we can minimize the impact by providing properly fitted equipment from the onset. We must consider functional ability and potential, identify and educate the client regarding risk factors for secondary complications, consider lifestyle choices, and identify upper extremity pathology; both past and present. For example, a client with new spinal cord injury (SCI) may have preexisting shoulder dysfunction that may impact our system selection and setup. This will impact long term function and independence.

After clinical evaluation, we need to take a careful look at equipment selection. Recognize the impact that size and weight have on functional ability. Size is a critical factor. We cannot be afraid to "fit" the chair to the client; "leaving room" can create postural and functional problems that the client will have to face in the future. Proper size will help facilitate mobility, maximize accessibility, allow the shoulders to be positioned correctly over the axles, and help to minimize long term postural dysfunction and risk for skin breakdown. Size can also affect the ability to transport the chair to different locations. Weight of the chair may also be critical. We should consider the weight of the entire system as well as its component parts. Lighter weight wheels, for example, increase the client's ability to initiate propulsion and continue rolling efficiently. While weight of the frame and other components may not be as important for propulsion (assuming proper set-up), it will impact the client's ability to perform everyday tasks such as loading the chair in and out of a vehicle. It may reduce upper extremity strain during such activities and foster greater independence.

Perhaps most important is the set-up or configuration of the mobility base and all of the components. We can select appropriate pieces of equipment, but we must also be able to put them together to maximize performance and function. Often, clinicians and suppliers may take an "out of the box" approach. They unpack the wheelchair, assemble the necessary components and seat the client in the system making minor adjustments to back angles and tightening wheel locks. Often, little attention is given to the position of the wheels in relationship to the shoulder joint, the seat to floor height differentiation, or anatomical angles as compared to actual angles of the chair and seating system. Wheel position, for example, can impact upper extremity biomechanics and the ability to propel efficiently. We need to set up the chair to protect upper extremity function, minimize energy consumption, and facilitate mobility in a variety of settings.

It is important to involve the client in all aspects of the selection process. Without the client's input, it is impossible to anticipate all of their functional needs. Also, it is an opportunity for the clinician to educate the new user about equipment choices and risk for secondary injury and discuss lifestyle choices that may impact selection. With long-term users, we need to be sure we consider all aspects of function; for example, if a client is able to transfer independently, what good is that if they are unable to independently load the wheelchair into their vehicle? Functional activities cover a wide variety of everyday tasks that go beyond propelling the chair and getting in and out of the chair. It is necessary to know where the client will be using the chair (work, school, recreation), how it will be transported, and if there are special accessibility issues that need to be considered. All of these tasks, as much as possible, must be discussed during equipment selection.

While it is often difficult to know all of these answers with new users, we must be able to anticipate activity and participation to ensure the best fit and maximize function. A properly fitting chair and seating system will enhance the users' ability to negotiate in his or her community and help to ensure a positive experience for first time users and their families.

While it is apparent that size, weight, and wheelchair configuration all play a role in proper fit and function, we must look beyond the initial prescription and anticipate long term requirements. We know that overuse injuries occur and that we will see changes in function and participation. Additionally, we must consider the global impact these changes will have on our clients. By taking the time to assess the equipment, the client and the relationship between the two, we will be more successful at making the client happy while maximizing functional ability and minimizing the impact of long term complications. We should use assessment as an opportunity to educate and remind ourselves and our clients about the importance of the fit-function relationship.

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Wheelchair Seat Cushion Coding: Issues and Answers

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Introduction and Purpose
In December 2001, the DMERCs released a draft LMRP of Wheelchair seating and requested comments. Thirty-four comments were received from manufacturers, vendors, industry organizations, healthcare professionals and facilities, and professional organizations. In addition to the general call for comments, five advocacy organizations were twice contacted seeking comments. No responses were received.

All 34 responses commented on coverage policy, and many, but not all commented on coding definitions. This session will introduce the definitions offered in the draft, discuss, in part, issues raised about these definitions, and relate some testing methodology to the test methods within the ISO wheelchair cushion standards process.

CATEGORIES of Seat Cushions:

Kxxx1 General use wheelchair seat cushion
Kxxx2 Skin protection wheelchair seat cushion
Kxxx3 Positioning wheelchair seat cushion
Kxxx4 Skin protection and positioning wheelchair seat cushion
Kxxx5 Custom fabricated wheelchair seat cushion
Kxxx6 Powered wheelchair seat cushion

SKIN PROTECTION CRITERIA
Requirements included the following:
1) It has the following minimum performance characteristics:
   a) Simulation tests demonstrate a loaded contour depth of at least 40mm with an overload deflection of at least 5 mm, or
   b) Human subject tests demonstrate peak interface pressures that are less than 90% of those of the standard reference cushion at each of the three following anatomical locations – right and left ischial tuberosities and sacrum/coccyx

POSITIONING CRITERIA
Requirements included the following:
1) It has two or more of the following structural features:
   a) A pre-ischial bar or ridge which is placed anterior to the ischial tuberosities and prevents forward migration of the pelvis,
   b) Two lateral pelvic supports which are placed posterior to the trochanters and provide lateral stability to the pelvis,
   c) A medial thigh support which is placed anterior to the trochanters and provides medial stability to the lower extremities,
   d) Two lateral thigh supports which are placed anterior to the trochanters and provide lateral stability to the lower extremities.

The feature must be at least 25 mm in height in the pre-loaded state, from the lowest point of contact of the targeted body part to the highest point of contact;

COMBINATION SKIN PROTECTION & POSITIONING CRITERIA

Added requirement of adjustability:
2) It has materials or components which may be added or removed to help address orthopedic deformities or postural asymmetries;

CUSTOM FABRICATED CUSHION DEFINITION
A custom fabricated seat cushion (Kxxx5) or custom fabricated back cushion (Kxxx9) is a static cushion that is individually made for a specific patient starting with basic materials including: a) liquid foam or a block of foam and b) sheets of fabric or liquid coating material. The complete cushion must be fabricated using molded-to-patient-model technique, direct molded-to-patient technique, CAD-CAM technology, or detailed measurements of the patient used to create a carved foam cushion. The cushion must have a removable vapor permeable or waterproof cover or it must have a waterproof surface.

SUMMARY:
Requirement for ‘general’ cushion: minimum of 25mm loaded contour depth

Requirement for ‘skin protection’: either a bench test (40 mm loaded contour depth) or human subject interface pressure testing must be done. Interface pressure tests compare the ‘test’ cushion with flat foam.

Requirement for ‘positioning’: defined features with minimum dimensions
Added requirement for combination cushions: adjustability

ISO Test Methods Relating To Coding Definitions

Loaded Contour Depth: A means to measure the ability to contour, taking into account the initial contour and contouring produced by the loading

Interface Pressure: An interface pressure sensor array is used to characterize the magnitude and distribution of forces when loaded with a SKELI (standardized indentor).

Variables reported: Peak Pressure Index, Dispersion Index, Contact Area
Positioning: none

Fatigue/Lifespan
Repetitive Load Testing: 200,000 cycles after which changes in thickness over the surface are measured.
Stability of properties with use: 200,000 loading cycles are used after which tests are repeated to identify changes in cushion performance (interface pressure, force-deflection, etc.).

• Martin Fergusen-Pell, PhD
The development of international standards for wheelchair seating offers practical benefits in matching technical characteristics to user needs. However the application of information provided through such tests must be treated with caution, especially in the development of funding policy and product classification. This paper will review the process of wheelchair seating selection and funding and also provides data demonstrating that the clustering of technical characteristics is not a viable way to establish product funding codes.

Damned If We Do, Damned If We Don't
Whose Job Is The Paperwork, Anyway?

Moderator: Adrienne Falk Bergen PT, ATP/S

Participants: Laura Cohen PT, ATP
James Fiss, CRTS
Susan Johnson-Taylor OTR/L
Kathleen Riley PT ATS,CRTS
Mark E. Smith, MA

Prior to obtaining an assistive device, most consumers follow a specific path:

- someone (the user, a caregiver, a clinician or a counselor) identifies that there is a need for a piece of equipment to help with a task;
- the consumer then meets with someone for an evaluation (a physician, therapist, supplier, engineer, vocational counselor);
- device are tried out to see what will work the best
- a report is prepared which includes the results of the assessment and the trials, and a statement to the payer as to why the device(s) should be funded
- the funder may pend the request and ask for additional information prior to approval
- the funder approves the device for purchase and supply
- the device is supplied to the consumer

When durable medical equipment such as wheelchairs and seating systems are being supplied, most insurance carriers (public and private) require that a document indicating the medical necessity for the device accompany any request for prior approval. When Medicare is the funding source the CMN acts as this document but the supplier is still expected to have a letter of medical necessity on file supporting the need for the device and any special features.

There has always been controversy about who should be preparing the documentation needed for funding approval. Medicare specifies who is allowed to complete the CMN. In most cases there is no regulation specifying who is supposed to write the letter of medical necessity. Since it is a statement of "medical" necessity must it be written by a physician, therapist or nurse? What if the professional involved with the consumer is not familiar with wheelchairs and seating systems? What if the professional has no time to prepare additional reports? This panel will address some of the issues involved in this controversy, and then open the floor to a discussion.

• Susan Johnson –Taylor OTR

The letter of medical necessity for seating and mobility equipment is the culmination of a thorough evaluation. Each component of the evaluation is a piece of the puzzle. If pieces are left out, the puzzle remains incomplete. Therapists are trained to identify a problem through a number of evaluation techniques, assemble goals based on the evaluation information, and then come up with a treatment plan based on the goals. Treatment is "fine-tuned", depending on the client's responses. A seating and mobility evaluation is not very different. After the evaluation information is collected, goals for the client relative to equipment are set. Equipment is tried to determine what will work vs. what the team thinks will work, thus "fine-tuning" the "treatment". The end results are final equipment goals, which are then matched to pieces of equipment to meet those goals, after which the letter of medical necessity is written.

• Kathleen Riley PT, ATP, CRTS

I strongly believe that a letter of medical necessity should be prepared by a medical professional. As the supplier I should provide the therapist or physician with detailed information on the features of the equipment that has been selected, so that they can tie it to the client's medical condition and functional limitation when justifying the need for the equipment. If the funder asks for additional information we will provide whatever we have in the original packet, and will add additional technical information as requested. If more medical information is needed or if a change in product is requested we direct the questions to the therapist or physician.

Despite my professional background and license as a PT my function on the team is as the supplier. I make it clear that I am not the proper person to do the letter and my therapists are pretty compliant with providing it. Let's face it; if you are a busy clinician and someone else is willing to do your paperwork, then wouldn't you let them? But, if the supplier is only willing to provide you with product information that is specific to function then you have to do the letter. Providing our information via email in a word document or on a floppy disk allows the clinician to cut and paste the equipment/product information into their document.

• James Fiss CRTS

It is a real frustration in good business sense and ethical practice when faced with who should prepare the letter of medical necessity for a piece of equipment. On the one hand we all know deep down that it is the therapists job to write the justification, although we run into those who don't really understand what their part is in the process and those who are just too lazy. Then we have had physicians who say that if we, the supplier, don't write the letter, they know our competitor will. It has become a necessary evil, writing a justification for a product that I am selling. It just doesn't seem right. The majority of the time when I do write one, I forward it to the therapist to approve or rewrite in the form of a 3 Ω" floppy set up in Word. I have found that the best therapists that I work with write the best letters. Best, meaning those who understand seating and the process.

The situation around writing justifications has become a can of worms. For example, how many ways can you justify a flat free tire, a pelvic strap, adjustable height armrests, a basic headrest, etc. Unfortunately, we may need a "cookbook" plan for justifications. Our state has finally passed on the whining about justifications sounding like many others. Some parts of a justification are pretty much the same for any wheelchair. We have computers to help form the letters if we plug in the answers that can save some time. Everyone cannot write a great letter, so we may have to compromise.

• Mark E. Smith, M.A.

With a doctor, therapist, and supplier involved in the acquisition of one's mobility, the only constant is the consumer, and as the center, he or she should take an active role in the medical justification and documentation. Too often, the professionals are individually only familiar with a portion of the consumer's needs. The doctor may only know of the consumer's physical condition, as relating to general health; the therapist may only know of the physiological condition, as relating to positioning; and the supplier may only know of the mechanical technology, as relating to wheelchairs. Yet, all of these critical aspects must go into the justification. It is, then, most meaningful if the consumer ensures that these three aspects thoroughly merge in the justification, confirming that his or her entire need for mobility is demonstrated.

• Laura Cohen PT, ATP

I do second level reviews for payer sources. From that prospective I note that there clearly is a continuum in the quality of medical documentation submitted for seating and mobility claims. Access to knowledgeable, skilled providers is an issue that certainly varies region to region. There are predominantly three levels of providers 1) knowledgeable, skilled providers, 2) inexperienced and under trained professionals or unethical providers, and 3) unknowledgeable and unskilled providers. In reality, what is frequently happening in the field is the suppliers are composing the letters of medial necessity for seating and wheeled mobility requests. Commonly, there is no therapist involved in the process. Suppliers seem caught between a rock and a hard place when recommending equipment. They want the customer to be satisfied and happy so they sometimes write a recommendation for a piece of equipment that might be above and beyond what the person requires, yet they also have the customer satisfaction of the third party payer in mind and want to recommend the most appropriate level of equipment often leading to a conflict.

The second level review process consists of communication with providers to identify additional information. Due to funding restrictions and site for delivery of care, suppliers are frequently the best source of information specific to the home environment, accessibility, transportation, terrain, anticipated usage, etc. Discussion will include information that is valuable to expedite the review process and facilitate approvals of seating and wheeled mobility claims.