The following are results of a literature review on Dynamic Wheelchair Seating. This term is used in multiple contexts. Some articles refer to dynamic seating but are addressing changes to the seated posture during manual wheelchair propulsion. Other articles refer to dynamic surfaces or cushions that “actively redistribute pressure on the body surfaces.” (i.e. Stephen Sprigle PhD, P. T. (2011). Assessing evidence supporting redistribution of pressure for pressure ulcer prevention: a review. Journal of rehabilitation research and development, 48(3), 203.). Some articles refer to a seat’s “dynamic stiffness” (i.e. Garcia-Mendez, Y., & Boninger, M. L. (2012). Dynamic stiffness and transmissibility of commercially available wheelchair cushions using a laboratory test method. Journal of rehabilitation research and development, 49(1), 7.).

This review explores literature in the context of dynamic wheelchair seating where a part of the wheelchair or wheelchair seating system moves in response to client movement. Literature that is specific to dynamic seating as a part of a mobility base is highlighted.

Peer Reviewed Publications (in chronological order):

   Includes dynamic seating.

   Designs challenges to match client dimensions and achieve responsive movement.


   “This paper reports a protocol to assess the feasibility and preliminary evidence for the efficacy of dynamic seating to improve functional outcomes for young children with dystonic cerebral palsy (DCP).”

   Includes dynamic seating.

People with cerebral palsy are much more likely to develop arthritis at a young age in comparison with the rest of the population. Possibly due to excessive forces at joints.

   Repeated impacts, even in the absence of concussion, can lead to brain injury.

   Sensory function has significant effects on voluntary functional movements. Sensory input plays a crucial role in motor function rehabilitation and the combined sensorimotor training modality is more effective than conventional motor-oriented approaches.
   Movement can increase vestibular and proprioceptive stimulation opportunities which can, in turn, promote balance, stability and spatial orientation.

   Use of the Head Pod resulted in improved head control.

    Spasticity increases with resistance, such as extension forces against a non-yielding surface.

    doi:10.1123/mc.2015-0089
    Study:
    Study to assess the efficacy of a vestibular stimulation training in improving motor functions in cerebral palsy.
    Results:
    A significant improvement was noted after a combination of neurodevelopmental treatment (NDT) and vestibular training.

    doi:10.1155/2017/7260130
    Self-directed movement increases brain derived neurotrophic factor (BDNF) which enhances brain recovery at the structural and chemical level and encourages dendrite and axon development.

    Enriched environments prolong the critical periods of neuroplasticity (experience dependent plasticity), stimulate dendritic growth, and improve neuronal response properties. Sensory stimulation, such as vestibular
input from movement, can increase plasticity windows. Sensory deprived environments postpone the onset of critical periods of neuroplasticity and maintain cortical neurons in an immature state.

This chapter includes clinical applications of Dynamic Seating.

Pilot study investigating and characterizing the use of the two adjustable seating functions on the Elevation ultralight dynamic wheelchair during community use.

Study of the effects of moderate changes in wheelchair position on orthostatic cardiovascular and cerebrovascular reflex control in persons with spinal cord injury using the Elevation ultralight dynamic wheelchair. Lowered seating (rear of seat lower than front) increased blood pressure in those with lesions to the autonomic pathways.

The study compared the effect of regular classroom chairs, therapy balls, and air cushions on classroom behavior of students with autism. Improved in-seat behavior (86.7%) and on-task behavior (53.3%) with use of therapy ball.

The authors reviewed literature on the use of classroom-based dynamic seating to improve attention. 5 studies were reviewed and the evidence supports improved attention.

http://eprints.whiterose.ac.uk/105176/3/Accepted%20Lyons%20et%20al.pdf  
“Positioning discomfort first presents itself as an unconscious desire to change body posture, which
diminishes when the individual is able to initiate a change of posture. The discomfort increases across time and may be associated with one or more factors such as instability, sliding, excessive heat buildup, stiffness, excessive localized soreness or pain, spasticity, or stretch.”

Study:
13 children with physical and intellectual disabilities, non-verbal using adaptive seating. Subjective. Results: These children rely on caregivers to note and intervene to relieve their discomfort. *Positioning discomfort diminishes when the wheelchair user can change their position.*

DOI: 10.1080/10400435.2016.1201873
Study:
First study to describe a cohort of individuals with CP GMFCS levels IV and V, prescribed a PWC.
CP is now considered a lifespan condition with associated health factors, e.g., musculoskeletal impairments, medical complications, speech impairments, pain, and fatigue (Kembhavi et al., 2011). It is unclear if these are part of the natural course of CP, a consequence of long-term disability, or unrelated comorbidity. Clinical features such as spasticity and problematic pain appeared less well managed in adults than in children.
Results:
Of 102 participants, 20 reported problematic pain (over half of those had spastic CP).
“We found nine features of CP, of which eight were reported by Novak et al., the most frequent being problematic pain (n = 20), hip problems (n = 18), and problematic spasticity (n = 15) (Table 3). Specified causes of problematic pain were spasticity (n = 7), (kypho)scoliosis (n = 6), back pain (n = 5), hip pain (n = 2), back pain, and spasticity (n = 2), no specified cause (n = 4), or more than one of the above. Nine users reported back pain thought to be treatable with standard approaches.” 18 required medical management for problematic pain.
*Providing movement may reduce pain.*

Study of office workers with and without low back pain found that those without low back pain had significantly more frequent postural shifts during prolonged sitting and sat more symmetrically.

Prolonged static sitting in a wheelchair increases risk of lower back pain. The study examined 7 dynamic sitting strategies: lumbar prominent, back reclined, femur upward, lumbar prominent with back reclined, lumbar prominent with femur upward, back reclined with femur upward, lumbar prominent with back reclined. The study analyzed the biomechanical effects of these strategies on lumbar-pelvic angles. Changes in position were made through inflation and deflation of air bags and a power recline. The most beneficial movements were lumbar prominent and lumbar prominent with femur upward in providing movement which may reduce back pain.


*Seating Dynamics* | p: 303-986-9300 | f: 303-986-9301 | sales@seatingdynamics.com
Static sitting can lead to lumbar pain, fatigue, and decreased function. Dynamic chair with seat that moves in 3 dimensions affects pelvic mobility. Lumbar fatigue was reduced, and function was increased.

Abstract from the European Academy of Childhood Disability 27th Annual Meeting. Design of dynamic seat with movement at ankles, hips, knees and back. Seat is instrumented to measure torque and angular displacement. The child demonstrated increased social engagement and function.

A literature review showed that only a small number of high quality research studies addressed adaptive seating systems for children with cerebral palsy. Data suggests that adaptive seating can improve activity and participation. More research is needed.

Measurement methods for distinction and quantification of hypertonia components. Definitions of pathophysiology of hypertonia and spasticity.

Research is needed to determine if new designs that require active sitter involvement fulfill the goals of dynamic seating. Authors suggest new definition of dynamic seating (within office furniture) “Sitting in which the action is provided by the sitter, while the dynamic mechanism of the chair accommodates that action.”

Adults with cerebral palsy are more likely to experience joint pain (43.6% vs. 28.0%) and arthritis (31.4% vs. 17.4%) than people without cerebral palsy.

53.7% children with cerebral palsy also demonstrated dystonia.

Seating and Wheeled Mobility clinical applications, including Dynamic Seating
An air cushion adapting to changes in position improved pressure relief and decreased tissue stress compared to a foam cushion.

https://doi.org/10.1016/j.ejpn.2012.07.007
Comfort is a high priority for families.

https://doi.org/10.1111/dmcn.12246
Of 64 discrete interventions, 24% have been proven to be effective. There is a gap between research and practice.

doi:10.1542/peds.2012-3985
A systematic review was conducted to appraise the effectiveness evidence about Enriched Environments improving the motor outcomes of infants at high risk of cerebral palsy. Enriched environments Enriched Environments looked promising for children with cerebral palsy.

https://doi.org/10.3389/fnhum.2013.00261
Experience-dependent functional and structural changes occur in the brain due to neuroplasticity, including psychological and behavior improvements.

doi:10.1542/peds.2013-0224
Study:
252 participants aged 3 to 19 years across all levels of severity of cerebral palsy.
Results:
54.8% of participants reported some pain, 24.4% of caregivers reported pain that affected level of activity, and 38.7% of physicians reported pain and identified hip dislocation/subluxation, dystonia, and constipation as the most frequent causes.
Pain is prevalent among children with cerebral palsy and is sometimes attributed to dystonia and constipation.

_Pain is more common in people with ID and health care professionals must be familiar with pain indicators._


_Study examined the effect of using FootFidgets and Standing Desks in a fourth grade classroom. Mean attention significantly increased when using both interventions in combination._


_Purpose:_ To explore the experience of pain and discomfort in users of electric-powered indoor/outdoor wheelchairs (EPIOCs) provided by a National Health Service.

_Study:_

EPIOC users receiving their chair between February and November 2002 (N = 74) were invited to participate in a telephone questionnaire/interview and 64 (aged 10–81 years) agreed. Both specific and open-ended questions examined the presence of pain/discomfort, its severity, minimizing and aggravating factors, particularly in relation to the EPIOC and its use. Results: Most EPIOC users described experiences of pain with 17% reporting severe pain. Over half felt their pain was influenced by the wheelchair and few (25%) considered their chair eased their symptoms. The most common strategy for pain relief was taking medication. Other self-help strategies included changing position, exercise and complementary therapies. Respondents emphasized the provision of backrests, armrests, footrests and cushions which might alleviate or exacerbate pain, highlighting the importance of appropriate assessment for this high dependency group.

_Results:_

Users related pain to their underlying medical condition, their wheelchair or a combination of the two. User feedback is essential to ensure that the EPIOC meets health needs with minimal pain. This becomes more important as the health condition of users changes over time.

_Implications for Rehabilitation:_

_Pain is frequently experienced by users of powered wheelchairs and may be severe._ Clinicians need to distinguish between wheelchair-related pain and pain due to an underlying health condition. Improved design and additional features to powered wheelchairs should reduce this pain and suffering but at a financial cost.

_Most power wheelchair users experienced pain and over half believed this pain was related to the wheelchair itself. One strategy that improved pain was changing position._


_Adults with spastic bilateral cerebral palsy were severely affected by chronic pain, fatigue, and depressive symptoms._
   Study:
   Systematic review with meta-analysis of 30 studies on CP, included users with pain requiring further investigation or management.
   Results:
   Among children with cerebral palsy, 3 in 4 were in pain.
   *Pain needs to be addressed during wheelchair seating interventions.*

   *Dynamic sitting was not found to be effective in reducing low back pain or low back discomfort as a stand-alone approach in a typical population using office chairs.*

   https://doi.org/10.1080/00140139.2012.721521
   *Sitting on a novel dynamic chair (Back App) resulted in less lumbar flexion and less back muscle activation than sitting on a standard backless office chair during a typing task among pain-free participants. Facilitating lordotic sitting with less muscle activation may reduce the fatigue and discomfort often associated with lordotic sitting postures. Increasing hip extension facilitated lordotic sitting with less muscle activation.*

   “The first article to discuss pain in adults with CP was published in 1999. (23) Since then, the number of articles with a focus on pain has increased. Between 2000 and 2010, 11 studies examined pain as an outcome in adults with CP. (7-9, 17-19, 22, 26, 30-32) Of the 12 studies published since 1999, however, seven have been based on data derived from two study samples (see Table S1). (18, 23) Engel et al. have published six of the 12 studies about pain since 1999. (7-9, 22, 23, 31) The three most common themes related to pain in the research literature are the prevalence of pain in adults with CP, (7-9, 17-19, 22, 23, 26, 30-32) the effect of pain on functional activities, (7, 9, 23, 31) and coping or intervention strategies for pain. (7-9, 22, 31) These themes mark a shift away from an impairment-based focus on pain to examining pain from the perspective of Activity and Participation, and contextual (Personal or Environmental) factors.”
   *In a literature review of 12 studies on pain in adults with cerebral palsy, the three most common themes are 1) prevalence of pain, 2) the effect of pain on functional activities, and 3) coping or intervention strategies for pain.*

“The focus of rehabilitation treatment has recently shifted to neurological rehabilitation in response to increasing evidence for neuroplasticity. This approach aims to improve development and function by capitalising on the innate capacity of the brain to change and adapt throughout the patient’s life.”

   The goal of this article is to develop an instrumented, dynamic seating system for people with extensor thrust using the Design Structure Matrix (DSM) tool.

   Common themes in plasticity that emerge across diverse CNS conditions include experience dependence, time sensitivity, motivation, and attention.

   Vestibular input (movement) can reduce maladaptive behaviors.

   Quantitative movement analysis was used to compare movement during an extensor thrust with a dynamic back and with a rigid back. Results: decreased extensor thrust, increased range of motion in anterior-posterior direction, decreased vertical trunk movement during extension and decreased upper extremity movement (reduced large UE movement).

   Most concussions deliver 95 g’s upon impact. The average football player receives 103 g’s when hit during a game.

   Full access version: http://www.r82.co.uk/media/417996/fumagalli_research_dynamic_v_rigid.pdf.
   Study:
This study was done by Fumagalli in Italy. Quantitative movement analysis using 3D kinematics and pressure distribution was used to compare movement during an extensor thrust with a dynamic back and with a rigid back in ten people with cerebral palsy and dystonia. An R82 x:panda seating system was used.

Results:

Participants experienced decreased extensor thrust forces, increased range of motion in the anterior-posterior direction (the client could move their trunk forward and back), decreased vertical trunk movement during extension (shear) and decreased upper extremity movement (reduced large UE movement and increased smoothness of movement). The authors concluded that this could lead to increased occupant comfort (decreased pain) and quality of postural stability.


Study:

The goal of this study was to determine the effects of a dynamic seating system (movement at hips and knees) as a therapeutic intervention in children with cerebral palsy. The study included twelve children: half received static seating and half received dynamic seating. Each child was evaluated in the areas of range of motion, muscle tone (Modified Ashworth Scale), motor function (Gross Motor Function Measure), and level of disability (Pediatric Evaluation of Disability Inventory) at initiation, 3 months and 6 months. A Kids Rock wheelchair was used.

Results:

Both groups improved in motor function (particularly in Sitting and Crawl/Kneel) and level of disability (self-care, mobility, social function). The authors concluded that a larger, more homogeneous group would likely show significant differences in muscle spasticity, gross motor function and disability. Trends showed a decrease in spasticity, an increase in range of motion and improvement on the GMFCS (Gross Motor Function Classification System) for crawling and walking. Repetitive, high impact extensor thrusting can critically damage wheelchair seating systems, including failure of the back canes and frame, footrest hangers, and headrest mounts.


Development of a simulator that allows independent adjustment of trunk, pelvis, and thighs to improve posture.


Experience directed activity (self-directed movement) enhances and activates changes in brain structure and function. Children with cerebral palsy should have the potential to respond to experience directed activity (self-directed movement) in a similar way to adults, with the additional potential of regulation of neuronal development in response to injury (neural plasticity).


A summary of epidemiology of CP throughout the lifespan, including functioning, ability, and quality of life of adults with CP.

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Prevalence of pain in adults with CP


Dynamic cushion demonstrated increased attention and alertness in response to movement.


Relationship of seat inclination and postural control.


Study:
The objective of this study was to examine the effectiveness of an experimental dynamic wheelchair seating system designed to relieve discomfort for long-duration wheelchair users. The study used the Tool for Assessing Wheelchair discomfort (TAWC). Two wheelchair users each tested an initial design and feedback guided the development of a second design.

Results:
The study found that dynamic seating reduced spasticity intensity and contact pressures, improved postural stability, increased comfort (decreased pain), improved function, prevented damage to the seating system, and increased vocal and/or breathing ability.


Children learn to move by moving.


Includes description of design project for a dynamic seating system for persons with extensor tone.


Study:

Seating Dynamics  |  p: 303-986-9300  |  f: 303-986-9301  |  sales@seatingdynamics.com
This Retrospective study of the Aktivline dynamic seat occurred in Germany.

Results:
The study found that children and adolescents could sit longer, felt less pain, and demonstrated improved posture, joint mobility, and digestion.

A goal of dynamic seating is to reduce repair costs and costs of change.


Design of a dynamic seating system that moves with respect to the wheelchair frame, allowing the seat to move with the user during an extensor thrust. “Dynamic configurations are very effective in reducing interaction forces at the seat back and improving comfort by reducing the peak pressures.” The dynamic seating system resulted in better contact between the cushion surface and the user. Dynamic Seating resulted in a 25% reduction of combined force over a static configuration. This would lead to less equipment breakage.


An analytical dynamic model of a human subject undergoing an extensor thrust on a rigid chair was created. A Dynamic-Hingeback Seating System was also developed. Desired motion of the system occupant during extensor thrust was verified.


Development of a system to determine human-generated motions and forces during unconstrained extensor thrusts. Effectiveness and reliability established.


Development of a system to determine human-generated motions and forces during unconstrained extensor thrusts. Effectiveness and reliability established. Similar to article above.


Study:
This Retrospective study of the Aktivline dynamic seat also occurred in Germany.

Results:
This study showed reduction of pain and improvement of movement control of the upper extremities, trunk, and head.
   A review of findings on the environmental modulators of pathogenesis and gene-environment interactions in CNS disorders. Enriched environments can delay the onset and progression of motor symptoms in Huntington’s Disease (mouse model), can enhance learning and memory in people with Alzheimer’s disease, and have a positive impact on experience dependent plasticity in people with Parkinson’s disease, ALS, fragile X, Down syndrome and various forms of brain injury.
   Enriched environments prolong critical periods of neuroplasticity (experience dependent plasticity).

   Study:
   Purpose was to establish the test-retest reliability, internal item consistency, and concurrent validity of a newly developed Wheelchair Seating Discomfort Assessment Tool (WcS-DAT).
   Results:
   The tool was shown to be reliable and stable for quantifying wheelchair seating discomfort.

   New understanding of adult plasticity of CNS and contributing factors.

   Study:
   This study was conducted in Italy.
   Results:
   Researchers observed that the use of a thoroughly designed dynamic seating system decreases intensity and duration of extension at the trunk and head, decreases hyperextension of the neck during spasms, decreases extension of the lower limbs, maintains body alignment with the components of the posture system during and after spasms, conserves energy consumption, and improves swallowing and, as a result, reduces drooling.

   Seating discomfort was identified as a core area of concern.

   Movement against resistance has been demonstrated to increase strength in people with increased muscle tone.
   *No longer available.*

   DOI: 10.1055/s-2002-33680
   MRI study of a 15 year old with subcortical lesion. Movement was associated with the unusual pattern of bilateral cortical activation. Early brain damage may induce alternative organization of cortical brain functions.

   *Included use of dynamic seating for discomfort relief.*

   Resistance training increases muscle strength without an increase in spasticity.

   https://psycnet.apa.org/doi/10.1037/0090-5550.43.2.152
   Constraint-induced movement therapy encourages movement of an affected extremity, improving motor control through neuroplasticity.

   https://doi.org/10.1177%2F153331759801300605
   Movement reduced depression, anxiety, and pain. Significant improvements in balance were noted.

   Development of an objective measure to quantify the degree of spasticity.

   A method of calculating the net forces and torques on human joints using inverse dynamics and an 11 segment model of the human body.
Non-Peer Reviewed Publications

https://www.convaid.com/the-new-XPanda-understanding-dynamic-seating-by-sally-mallory-PT-ATP-
education-manager-convaid-r82/
Children with involuntary extensor thrust exert very large forces against the back, headrest, and footrest which can lead to skin breakdown and difficulty maintaining the pelvic in neutral due to destabilization of the hip joint.

A case study of a young man with cerebral palsy and clinical benefits of dynamic seating.

https://mydigitalpublication.com/publication/?i=488749#{%22issue_id%22:488749,%22page%22:30}
Movement within a wheelchair seating system can enrich environments, leading to positive brain changes through neuroplasticity.

An overview of dynamic seating clinical indicators.

https://www.dauphin-france.com/partner_portal/downloads/dauphin/ergonomie/Ergonomie-
Broschuere_EN.pdf
The impact of static seating. Ergonomic furniture.

https://www.painscience.com/articles/microbreaking.php
Dynamic ergonomics concept. Microbreaks are regular, small, biologically meaningful breaks from a static position. Many small breaks are more effectively than fewer longer breaks.

https://www.painscience.com/articles/chair-trouble.php
Research has found that microbreaks and mobilizing are important in combating consequences of prolonged sitting.

https://mobilitymgmt.com/Articles/2017/02/01/Dynamic-Seating.aspx
The results of a survey on use of dynamic seating in the United States.
https://www.hermanmiller.com/research/categories/white-papers/innovations-in-supported-sitting/
Movement is human nature and moving between supported positions helps the muscular and skeletal systems. It also helps mental stamina and the ability to concentrate (Dr. Brock Walker, expert on musculoskeletal disorders).

https://www.bluetoad.com/publication/?m=3586&i=270359&p=52&pre=1
An overview of dynamic seating and a case study.

https://www.bluetoad.com/publication/?m=3586&i=270359&p=46&pre=1
An overview of dynamic seating and a case study.

https://network.aia.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=a0cff0a7-0b52-41ea-a4b0-8b54e7401179lumb
Inactive sitting places greater stress on the tissues and systems of the body, the person becomes uncomfortable, tired, and less productive. Dynamic seat (office chair) has been shown to increase attention and concentration. Moving the legs improves blood flow to the heart and brain.

Paper explores the effects arising from corporate wellness programs. Companies who want to improve employee well-being are using active design. Increases in small movements improve energy and function and decrease tension and depression.

Ergonomic interventions (including active seating) yield a positive return on investment in terms of decreased injury and productivity.

http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.605962.
This project shows that the development of a fully mobile data acquisition system is achievable and practical. Results obtained from twelve children during their community-based activity of daily living showed no significant differences in the mean and peak interface forces on the backrest between the rigid and dynamic systems. However, when using the dynamic backrest system, a significant decrease in force and bending moments were observed on the right footrest, the dominant side of most participants.
Prolonged static movement increases risk of heart disease; overproductive pancreas; colon, breast and endometrial cancer; muscle degeneration and tight hip flexors; poor circulation in legs; osteoporosis; decreased brain function; strained neck, sore shoulders and back; loss of spine flexibility and disk damage.

A general overview of the need for dynamic seating and a stable pelvis.

https://www.hermanmiller.com/research/categories/white-papers/supporting-the-spine-when-seated/
Civilian American and European Surface Anthropometry Resource (CAESAR) survey results, a large scale, three-dimensional anthropometric survey of civilians in the several countries. The pelvis dictates the curve of the spine in all seated postures. When the pelvis rotates rearward, pressure increases on the intervertebral discs and muscle activity increases. The can lead to muscle fatigue and discomfort. Seated people move their torso an average of 53 times an hour.

https://www.hermanmiller.com/research/categories/white-papers/the-art-and-science-of-pressure-distribution/
As the sitter changes posture from upright to recline, pressure-distribution changes.

https://www.rifton.com/adaptive-mobility-blog/blog-posts/2012/may/dynamic-seating-position
Definition and clinical indicators.

Ergonomic furniture with adjustments and movement to improve posture. Poor posture leads to muscle, spine, and joint pain.

Introduction to Dynamic Seating.

https://mobilitymgmt.com/Articles/2011/02/01/Keeping-Kids-in-Motion.aspx
Dynamic seating clinical indicators and product considerations.


A study on the impact of the three-dimensional office chair system ON® on cognitive skills and the subjective feeling of well-being. Half of 80 participants trialed the three-dimensional office chair for 12 weeks. Test results showed significant improvements in concentration. Participants indicated increased movement, more varied movement, physical feeling of well-being, better postural support, and increased comfort.


Dynamic seating coding and product considerations.


Addresses dynamic seating.


A chair should promote movement, move with the user, and make it easy to move. It should facilitate, support and enable effective performance. A chair needs to provide cognitive ergonomics to facilitate focus, attention and memory.


A case study of a client using dynamic seating and the clinical benefits.


A focus on the Kids Rock dynamic wheelchair.


Neuroplasticity.


Not moving is harmful, contributes to backpain and injury, contributes to leg edema, and causes discomfort/pain. Constrained sitting is uncomfortable and static postures contribute to arthritis, inflamed tendons and tendon sheaths, chronic joint degeneration, muscle pain, impaired circulation and tissue damage. Also, keeping the center of rotation of a moving back close to the client’s center of rotation at the pelvis reduces shear. The only effective way to maintain a seated posture for extended durations is to dynamically shift between a range of stable positions.
*General article on dynamic seating, definition, clinical indicators.*

*A seating system that accommodated to changes in position for a child with constant fluctuations with extension, flexion, and rotation. A Roho cushion was used to accommodate postural needs and provide a degree of movement.*

https://www.steelcase.com/research/articles/topics/wellbeing/leap-productivity-health-impact-study/
*In a year long study, people using the Leap chair (ergonomic dynamic office chair) achieved up to a 17.8% increase in productivity. Over 450 participants at two companies participated. Participants reported significantly lower pain and discomfort and overall musculoskeletal symptoms were lower.*

https://www.steelcase.com/research/articles/topics/ergonomics/movement-in-the-workplace/
*Sitting for long periods with little movement can impact health and function.*

https://www.steelcase.com/research/articles/topics/wellbeing/posture-support-changing-workplace/
*Reclining postures reduce the load measured in the intervertebral discs. Posture variability is detrimental to the body. Maintaining one position causes the muscles and ligaments supporting the back to become fatigued. Changing position pushes used fluids out of the vertebral discs and draws in fresh nutrients.*

**Presentations and Proceedings**


This session presented a current feasibility trial to guide and inform the design of a full scale trial to assess acceptability and efficacy of whole-body dynamic seating on activity, participation, and quality of life in preschool children with dystonic cerebral palsy, using mixed qualitative and quantitative methods.


   http://www.rstce.pitt.edu/RSTCE_Webinar/2017/RST_CE_0304_17.html


    https://numotion.sharefile.com/share/view/s525818a067741228

   Proceedings, pgs. 64-68.
   At the time of this presentation, this group was designing a seating system for children ages two to five years with whole body dystonia. They were also determining the feasibility of evaluating the impact of the seat with functional outcome measures suitable for use with this group, as preparation for a subsequent trial with a group of six children. Item #2 on this list presents their progress.

    Proceedings pgs. 48-51.


    https://www.homeceuconnection.com/course/dynamic-seating/


   This session presented research that was on-going and stated that long-term testing was underway. The study was testing whether the KiSS dynamic seating system impacted body motion or seat interface pressure.
   Results:
   Preliminary testing did not show a significant effect.

   Recording: https://www.youtube.com/watch?v=LO4y_VeHn8k&feature=youtu.be.


   This session describes the development of a novel dynamic seating system. Initial prototypes were evaluated by two children. The final prototype was then used in further studies (see items #2 and #14 above).
   Results:
   The following outcomes were noted: increased vocalization, increased movement, one child was able to access a switch in the dynamic seat (and unable to in their static seating), reduced spasm intensity, increased symmetry in posture, increased head control, and the onset of movement (of the dynamic seat) reduced the rate of increase of spasm. The client also expressed preference for the dynamic option.

   This session described an evaluation of the impact of a simulated dynamic foot support on an adult with Dystonic cerebral palsy who experiences whole body extensor spasms. This study was designed to optimize the mechanical design of the foot support to then use in a pilot study scheduled for February 2014. It is unknown if this study occurred.
   Results:
   Use of the simulated foot support increased head and arm control and the client reported that it was easier to drink and swallow. It should be noted that the simulated support was provided only by the clinician’s hands.


A mobile strain gauge data acquisition system was developed to capture the forces and moments in wheelchair components in a rigid and dynamic seating system. The research team determined the magnitude of the contact force on the backrest, footrests and center of pressure (COP) on the seat during ADLs (Activities of Daily Living). Footrest forces and moments varied, but back support interface forces remained the same for each system (static and dynamic). Average force on the backrest was 60-70% BW (Body Weight) and 20% BW on each footrest. Peak forces (during extension) were 200% BW on backrest and 600% BW on footrests.

Results:
Clients are able to exert up to 200% of their body weight against the backrest and 600% of their body weight against the footrests during extension. Dynamic seating can be used to diffuse these forces.


http://www.iss.pitt.edu/iss_pre/iss_pre_doc/iss_2011.pdf.


Describes the Elevation wheelchair which is an ultralight rigid manual wheelchair that allows the client to adjust the seat height (posterior portion raises) and backrest recline angle. The chair weighs less than 25lbs. It is operated by 2 gas springs under the seat and a lever.

The authors define dynamic seating as “the user’s ability to easily and quickly adjust their seating position independently.”


Addresses microstimulation in seating systems


A case study describing a seat designed with dynamic footrests and a dynamic back. The child showed reduced muscle tone and improved head and hand control.


Study reported a decrease in spasticity, an increase in range of motion and improvement on GMFCS, the positive effects of the dynamic posture system in subjects with children brain paralysis when in the seated position and during daily activities.


Shows that a dynamic seating system may positively affect the reduction of spasticity and the increase of certain functional activities.

Lack of dynamic seating options to respond to high tone, perhaps due to lack of evidence.


Measurement and analysis of distribution of interface contact force and area under vertical vibration, analyzing cushion design.

Study found changes in hip extension force and duration using a dynamic back.

Study found improvements in function, demeanor, and reduced repairs using a dynamic back.


A seating system to accommodate to changes in position for a child with constant fluctuations with extension, flexion, and rotation.

Design Articles


**Patents**


**About the Author, Michelle L. Lange, OTR/L, ABDA, ATP/SMS**

Michelle is an occupational therapist with 30 years of experience and has been in private practice, Access to Independence, for over 10 years. She is a well-respected lecturer, both nationally and internationally and has authored numerous texts, chapters, and articles. She is the co-editor of Seating and Wheeled Mobility: a clinical resource guide, editor of Fundamentals in Assistive Technology, 4th ed., NRRTS Continuing Education Curriculum Coordinator and Clinical Editor of Directions magazine. Michelle is on the teaching faculty of RESNA. Michelle is a member of the Clinician Task Force. Michelle is a certified ATP, certified SMS and is a Senior Disability Analyst of the ABDA.