LET 'EM FLY – MINIMALIST SEATING FOR MAXIMUM FUNCTION II

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Is the ability to move in a wheelchair seat important? Why do people need to move? What happens to people seating for long periods of time who are unable to move? While there is little research on the long term effects of static sitting for wheelchair users, the effects of constrained and static seating postures have been the subject of a considerable body of research in the field of office seating ergonomics.

- In 1997, The National Institute for Occupational Health and Safety summarized the relationship between awkward and constrained postures, and musculoskeletal disorders (NIOSH, 1997).
- Aaras noted that constrained postures increase discomfort and health risks. (s.f. review by Aaras et al, 1997).
- Static seating postures cause discomfort (Graf et al 1993, 1995). It is difficult to tolerate unsupported and static seated positions for more than a short while (Reinecke, et, al 1985).
- When allowed to move freely, people are usually in constant motion. (Branton et al, 1967).

Static Postures have been found to contribute to a broad range of chronic disorders…such as arthritis, joint degeneration, tissue damage, and the interruption of blood flow (Grandjean, 1987). Static postures cause the sitter to move into postures that are harmful (Bhatnager et al, 1985), and are hazardous due to the lack of variety of postures (Bendix et al, 1994). If constrained and static seating postures are harmful to the able-bodied population, the effects are more pronounced in the wheelchair bound population that is generally less capable of independent movement. In her Egonomics Review, Ergonomist Rani Lueder noted that most people slump when they can't sit upright (Rani Lueder, 2005). This forward "slumping" in upright sitting reverses the lumbar curve, and shifts the load to ligaments which deform, (Kumar 2004) increasing the risk of disk rupture (Adams et al, 1994)

As far back as 1981, Nachmson found that the thigh to torso angle must be a minimum of 110 degrees to keep the natural curve of the lumbar spine (Nachemson, 1981). Sitting at less than110 degrees flattens the lumbar spine, and rotates the pelvis posterior. (e.g. Bendix and Biering-Sorensen, 1983). Sitting upright at angles of less than 110 degrees does not allow thigh-torso angles large enough to reinstate the natural curve of the lumbar spine. (s.f. Nachemson, 1981). In his book Ergomonic Seating (1993), Physical Therapist Bengt Engstrom noted that "when the pelvis has a forward-rotated position underneath the spine it is relatively easy to keep the spine correctly s-shaped and preserve a natural upright position", promoting thoracic extension. Thoracic extension, therefore, is made possible by 'forward pelvic rotation' that can only be achieved with open thigh-torso angles in a reclined seat. Tilt alone cannot give the same results as the pelvis rotates in relation to gravity, but not in relation to the spine. Wheelchair users mention that they find breathing to be much easier in open back angle positions due to the resultant thoracic extension. It is noteworthy that these studies were performed on able-bodied individuals without any noted incidence of range of motion limitations caused by orthopedic problems or muscle tightness, and yet the study population still required on open back angle for natural spinal alignment. The wheelchair bound population typically lacks the same ability to flex at the hips, and requires at least the same open back angles for spinal alignment.

Andersson found that recline (open back angle) reduces loads on the spine, and muscle work (or postural collapse in the absence of muscle tone) (Andersson et al, 1974), and Lueder noted that recline also stabilizes posture by supporting the torso against gravity (review by Rani Lueder, 2005). Engstrom notes that trunk stability is achieved if the backrest's angle makes the body's center of mass fall against the backrest (Engstrom 1993). (Engstrom also notes that tipping a tilt-in-space only seat with a static back angle causes increased thoracic flexion [kyphosis] instead of extension).

However, open or reclined back angles require increased reach to activities, increasing the load on shoulders and arms (review by Rani Lueder, 2005), and also cause an increased load on the neck as the sitter adjusts visual field (Grandjean et al, 1983). Therefore, an *adjustable back angle* as found on a powered reclining back is necessary to adjust the back position for different activities and function.

In summary, the problem is static positioning; reclined or upright. “The only way truly effective way to maintain a seated posture for extended durations is to continuously cycle through a range of natural, centered, and healthful positions.” (review by Rani Lueder, 2005). For a wheelchair user who is not able to independently 'cycle through a range of ...positions', the solution to maintain spinal health and posture is to move by the use of dynamic powered seating: the combination of tilt, recline, and powered elevating legs. Some 25 years ago the ergonomics researchers came to a universal agreement that 90-90-90 positioning (or a “Cubist” posture) is not a healthy posture, and not one to be promoted. In the wheelchair seating world, there has been a slow but gradual shift away from rigid positioning. However, the majority of children and adults with Developmental Delay are still seated on planar seating with seat to back angles that cannot be tolerated and still allow for proper spinal alignment or function.

For those who attended last years presentation, this year will *not* be the same presentation. More time will be focused on seating theory, ergonomic seating research and application to wheelchair seating, along with some case studies and outcome follow up.

The Following is a Reprise of Last Year’s Paper

When are you able to do your best work? When you’re strapped down, tied up, blocked in and squeezed? Or when you’re free to move? The answer is obvious! The same holds true of our wheelchair bound clients, even those with the most complex involvement. So unbuckle the shoe holders, loosen the wrist straps, drop the pommel, swing out the laterals, pop the chest harness, and *Let ‘em Fly*! You’ll be amazed at the increased function you can help your clients find when they are able to manage their own posture, instead of having it controlled for them. The key is to find the seating configuration that allows your client to use their relation with gravity to control the pelvis, torso, head, and upper extremities. Every client’s level of function and positioning needs are different, but this theory works to improve function on all levels of clients with tonal abnormalities, and is just as effective with adults as early intervention.

In a commendable effort to position our clients with abnormal tone in a nice symmetrical posture, we’ve often taken away the one ability that all humans require to be able to function independently: the ability to bear weight. High tone, low tone, wheelchair bound or not, it is our relationship to gravity and weight bearing that makes it possible to perform activities. All function based activities are accomplished by our body’s rotation and movement in and out of symmetry. Movement in an out of symmetry from a seated position requires that we are weight bearing in our pelvis and lower extremities. Once the pelvis is weight bearing, it is then possible for clients to use their lower extremities to gain significantly more management of their own posture, and improve control of both the upper and lower extremities. For the most severely involved, it can result in improved head control that can allows for effective use of specialty motorized wheelchair drive controls and independent mobility. For a person with abnormal tonal patterns and the inability to control and modulate tone, an attempt to use their head or upper extremities to perform an activity often results in an extensor pattern that pushes the hips forward, head backward, and arms and legs into extension as the person attempts to ground themselves through their lower extremities to develop the power necessary for movement.

All the well known positioning aids, the posterior dumped anti-thrust seat, the 4-point seat belt, the oversized pommel, the high top ankle huggers with shoe holders, the curved laterals, the chest harness, the lumbar roll, the jumbo sized headrest (maybe with a forehead strap)…all serve to prevent weight bearing in the pelvis, and the client can often be found precariously perched on their

toes and the top of the backrest. These are the clients with such ‘uncontrollable tone’ that they break footrests, rip shoe holder straps, bend or break headrest mounts, or are sliding out and under every ingenious restraint devised. The seating must position the client such that they are weight bearing on their own; a client cannot be pushed, strapped or wedged into a weight bearing position. Much of the extreme tone that is demonstrated is not unlike what any of us would look like trying to perform an activity from a similar seated position. Seating for function must provide a stable base, but also allow a range of movement such that the client can manage his/her own posture internally, as opposed to having posture controlled externally.

There is no cookie cutter approach to a seating configuration for the client with abnormal tone. Many diseases and conditions produce fairly consistent results that make seating configurations simple to design. Especially at onset, Spinal Cord Injuries, many Neuromuscular conditions such as ALS, MS etc are relatively consistent and a successful seating configuration can often be reproduced successfully for multiple clients. However, no two clients with abnormal tone present with exactly the same seating needs. The only way to determine how and where the client can bear weight is a personal evaluation with minimal external supports. Most clients with CP respond positively to a seat slope with some anterior tilt that places the knees below the hips, a position we all naturally use to perform tasks. When lateral support is required, a broad area of support such as a contoured back support works well without triggering a collapse onto the laterals. Pelvic position can be well maintained for most with a simple pelvic strap mounted across the proximal thighs at an angle of 80 to 90 degrees perpendicular to the seat base. Seat belts mounted at farther back toward the joint between the seat frame and back cane tend to pull the pelvis into a posterior tilt, and increase the risk of the client sliding under the belt. An anterior tilt seat base position places the client where they are able to use their tone to manage their own posture. It requires some work by the client, and is not a position anyone can sustain all day. It is imperative that the client have the ability to come in and out of the task performance position. For high functioning clients, it may be done by self-transfer to other seat surfaces. For more involved clients, it means that they must have power seat functions, and the ability to change position independently.

There will be several case studies of various complexity showing positioning and function in previous systems, and in task performance seating with minimal restraints and external supports. This strategy is a work in progress, and your comments are invited.

Speaker Bio

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