



# USING DYNAMIC SEATING TO REDUCE CLIENT INJURY AND EQUIPMENT DAMAGE

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Daniel is a 22-year-old young man with the diagnoses of cerebral palsy and seizures. Daniel has high tone in his extremities and low tone in his trunk and neck. His tone is so extreme he has broken components of his wheelchair frame in the past and dislocated both of his elbows and ruptured both patellae. I have had the privilege of working with Daniel, his mother, Mary, and his complex rehab supplier, TD Schenck of Numotion, for many years.

## EXTENSION AND INJURY RISK

Over the years, Daniel has used many different types of seating systems and manual wheelchair bases. When he was 6 years old, he used a linear seating system with an antithrust seat, a semi-rigid pelvic positioner, lateral trunk supports, an H-style anterior trunk support, shoe holders with ankle straps, and a head support. In this system, he tended to 1) extend his hips, 2) push against the head support and hook under it, and 3) assume a posture of upper extremity adduction, extension and internal rotation in combination with scapular protraction to hold his head upright. He required additional support and stability within the seating system to reduce the need for this posturing. Prolonged posturing in this pattern had already led to a very narrow shoulder girdle, anterior shoulder subluxation and elbow hyperextension. We felt he was at risk for long term orthopedic consequences including distortion of the rib cage, shoulder dislocation, elbow dislocation, and permanent range of motion loss.

We recommended several modifications to his current seating system: a sub-ASIS bar to maintain the position of the pelvis and reduce overall extension (I know, we recommended this. It was 12 years ago, after all ...), a Y-strap across the shoulders to reduce scapular protraction (one strap crossed the clavicle and the other crossed the head of the humerus), and arm troughs with straps to maintain the upper extremities in a more neutral position (see Figure 1). As Daniel did not have functional use of his arms, we were comfortable blocking the head of the humerus.

Daniel tolerated the sub-ASIS bar well and this did reduce his overall extension by preventing extension at the hips. The Y-straps were not effective, and so we worked with Aspen Seating to fabricate custom shoulder pads that covered the head of the humerus, pulling his scapulae back into a more retracted position. His shoulder girth increased from 9–13", as a result. Daniel did not tolerate the arm



**FIGURE 1** Arm trough to maintain upper extremity flexion.

"They don't get any tougher to position than Daniel! I've had the pleasure of working with Daniel and his family for most of his young 22 years of life. Daniel's postural control is the challenge we all look for as a Rehabilitation Technology Supplier: years of comprehensive evaluations revolving around how we keep him in a functional position, prevent him from shearing off bolts, and provide proximal stability for distal function. Luckily, we have new technologies in the seating/positioning world to address the challenges associated with our clients' tone and orthopedic asymmetries. Dynamic seating components on Daniel's current chair, along with aggressive molded seating, has been a game changer. Daniel's functional positioning continues to be a work in progress, but on the right track — stay tuned!"

— TD Schenck, ATP/SMS  
Numotion, Aurora, Colorado

troughs but continued to extend against the arm straps. His doctor was worried he would break one of his arms (and we agreed), so use of the straps was discontinued.

## CLIENT INJURY

At age 10, Daniel was using a Stealth i2i head support to better manage his head position and prevent hooking. This was working well. Daniel had grown, and a new linear seating system was recommended. He was extending quite a bit within his current linear seating; however, he was scheduled to receive a Baclofen pump and we hoped this would reduce his overall muscle tone. As a result, we did not change much in the recommended seating.

Unfortunately, Daniel had serious complications with the pump, placement and his Baclofen dosage was greatly reduced, leading to an increase in tone (compared to his tone levels when previously taking oral Baclofen). After receiving his new linear seating system, Daniel experienced a hairline fracture of the lower right femur and had some tendon tearing bilaterally below and lateral to the knees. We believed these injuries were due to the extreme forces generated in his lower extremities from extension. His orthopedist diagnosed Daniel with Osgood-Schlatter disease and recommended Daniel be positioned in increased knee extension to reduce force through the knees. His parents began to place a large pillow under his lower legs, which increased the angle of the knee but also lifted his feet off the footplate – taking away his leverage during extension. We also had to replace the sub-ASIS bar, as this caused pressure over the Baclofen pump. Unfortunately, the pelvic positioning belt was not maintaining the position of his pelvis. We tried various style pelvic belts, angles of attachment, and a four-point attachment style without improvement. Daniel continued to extend, leading to loss of position of the pelvis (into a posterior pelvic tilt), though force was reduced through his knees and ankles as he was no longer contacting the footplates. He was not tolerating the seating system for long periods of time and was often in his alternative positioning system (positioning wedge system) on the floor.

In addition to these injuries, Daniel's extreme extension was also leading to loss of component alignment and damage of his seating system and wheelchair frame. This led to frequent adjustments and repairs. Depending on the extent of required repairs, Daniel could not use the wheelchair at all, instead remaining in bed or in his adaptive seating system and missing school.

## DYNAMIC SEATING

After continuing to try various seating modifications, we trialed the Kids Rock 2 manual wheelchair with Reaction Dynamic Seating when Daniel was 12 years old. We hoped to diffuse his muscle tone by allowing movement of the seating system in response to Daniel's movement at the hips and knees (see Figure 2). The seating on the loaner wheelchair did not provide the support he required; however, we determined the base would work well for him. He enjoyed the movement and when he returned to a starting position, his pelvis returned to neutral.

Daniel was still extending quite a bit, and when he relaxed, he tended to collapse due to low tone in his trunk and neck. Daniel continued to grow and was starting puberty, and we were concerned that spinal curvatures were likely to develop, as a result. We recommended an orthotic molded seating system (the Aspen Seating Orthosis/ASO) to provide better postural support of his low tone trunk and to minimize development of spinal asymmetries. This is typically a one-piece system; however, was modified to work with the Kids Rock, as the seat-to-back angle opened in response to Daniel's extension. A Stealth Products tone deflector was added to the i2i head support to absorb force behind the head, as well. As movement was now

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**FIGURE 2**

Daniel in the Kids Rock 2 and Aspen Seating Orthosis.



**FIGURE 3** Dynamic Rocker Back



**FIGURE 4** Dynamic Elevating Footrests

“If it weren’t for dynamic seating, my son’s knees would still be swollen & bruised, and he would still be breaking wheelchairs by shearing screws in half when he pushes with his high-muscle tone. The moving parts allow him to be comfortable for longer periods of time and alleviates his pressure points, along with more options for positioning adjustments.”

— Mary, Daniel’s mother

## USING DYNAMIC SEATING ... (CONTINUED FROM PAGE 41)

provided at the knees in response to extension, Daniel no longer required the pillow, and his feet could once more contact the footplates, better distributing his weight along his buttocks, posterior thighs and feet. Shoe holders were mounted on the Kids Rock’s single footboard.

Daniel eventually outgrew the Kids Rock 2 at age 14. He was so tall his hips and knees were no longer aligned with the pivot points of the dynamic components. A Kids Rock 3 was ordered; however, this system was so wide the family returned it. They were unable to get the chair in and out of their accessible van or the school bus (the Kids Rock wheelchairs were eventually discontinued). We were reluctant to put Daniel back into a static wheelchair frame. We chose instead to try the Seating Dynamics Dynamic Rocker Back Interface (DRBi) and Dynamic Footrests on a Quickie IRIS tilt manual wheelchair base. The dynamic back moved in response to Daniel’s extension, absorbing and diffusing his force (see Figure 3). The back also worked well with the articulated Aspen Seating Orthosis. The DRBi comes with four different elastomers, allowing us to determine the right amount of resistance. If the resistance was too “soft,” the back tended to activate or open in response to the frame being tilted. If the resistance was too “hard,” Daniel’s



**FIGURE 5** Using dynamic components has helped Daniel to better tolerate his seating system, to posture less and be more functional. He has not broken anything on his wheelchair frame for a long time either!

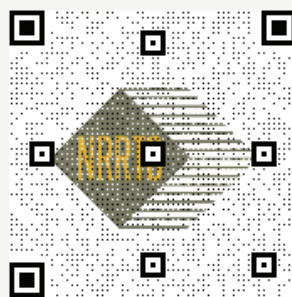
# OVERALL, DYNAMIC SEATING, IN COMBINATION WITH AN APPROPRIATE SEATING SYSTEM AND WHEELCHAIR BASE, HAS REDUCED DANIEL'S ACTIVE EXTENSION THROUGHOUT HIS BODY AND PREVENTED FURTHER INJURY OR EQUIPMENT BREAKAGE.

extension did not activate the dynamic movement, despite his strong extension. The Dynamic Footrests elevated and telescoped in reaction to Daniel's extension. These were mounted at a starting position of 60 degrees to match his current available knee range. The footplates were also mounted in a position of external rotation to accommodate his tibial torsion. Shoe holders were mounted on the footplates to maintain foot contact to activate the dynamic feature (see Figure 4).

## RESULTS

At age 15, Daniel had been using these new dynamic components for a year (see Figure 5). His knees were no longer red and swollen. Although he continued to extend at his hips and knees, he did so less frequently and with less force. It appeared just knowing movement was available was enough to reduce his active extension. If the dynamic back is locked out, he notices quickly and will begin to extend more frequently and with more force. The family has stated they will never go back to static seating again (scan the QR code at the end of the article).

Daniel's molded seating system has needed to be modified, and several new shape captures have been required over the years as his curvatures have continued to worsen. This seating has worked well, providing adequate postural support and distributing pressure to reduce pressure injury risk.



To watch video of Daniel, please scan the QR code.

Video 1: Daniel watching his favorite baseball team, the Colorado Rockies!

Overall, dynamic seating, in combination with an appropriate seating system and wheelchair base, has reduced Daniel's active extension throughout his body and prevented further injury or equipment breakage. This has been a successful intervention for Daniel and his family.

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