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Evidence Note

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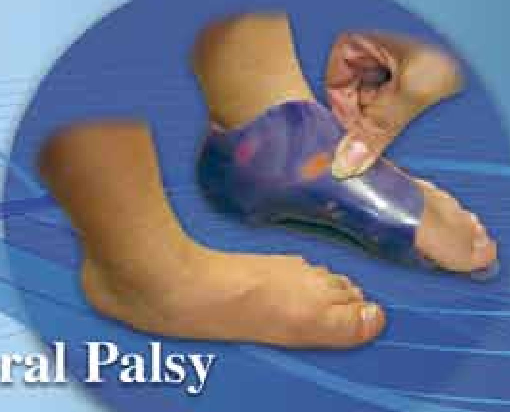

Feature

Qualitative Understandings of the Lower Limb in Children with Bilateral Cerebral Palsy

Sponsor's Editorial

Adjustable Dynamic Orthoses for the Child with Spastic Cerebral Palsy

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Adjustable Dynamic Orthoses for the Child with Spastic Cerebral Palsy

Exciting New Tools for Our Treatment Armamentarium

■ Keith M. Smith CO, LO, FAAOP
Mark DeHarde

Comprehensive treatment of the child with cerebral palsy (CP) includes selective use of surgery (orthopedic and neurological); pharmacology (systemic and focal); physical and occupational therapy (traditional and fitness training programs); and orthotic management (functional and therapeutic) practiced in a multidisciplinary team approach.[1] Due to the growing evidence of brain plasticity in the developing child with CP, releasing the full potential of each child can be pursued with more vigor and hope than ever before in order to raise the long-term trajectory of function and quality of life.

Times are equally exciting for orthotists and research and development (R&D) efforts supporting these teams because new tools such as adjustable dynamic orthoses can play a vital role in leveraging emerging science.

What are the four ***basic*** goals of ***conventional orthoses*** for the child with spastic CP?

1. To correct alignment of rearfoot, midfoot, and forefoot flexible deformities to protect the foot.
2. To provide a solid base of support with maximum contact area for improved stability.
3. To position the foot-ankle complex for swing clearance.
4. To help maintain current ankle range of motion (ROM).

What are the three ***additional*** goals of these children implied by the emerging science that are driving R&D efforts for ***adjustable dynamic approaches?***

5. To increase muscle length, strength, and balance as the child grows.
6. To improve proper biomechanical alignment of the trunk and lower limb without restricting motion.
7. To improve sensory-motor and proprioceptive feedback to the brain to learn motor control and function.

Basic Goals #1–4

Basic Goal #1 can be achieved with proper casting, mold modification, and fabrication of the AFO design. ***Basic Goal #2*** is often difficult if ROM is inadequate or if the design overly restricts ankle motion. ***Basic Goal #3*** can often be achieved assuming the hip and knee do not restrict terminal swing. ***Basic Goal #4 i***s doubtful at best and lacks any evidence to the authors' knowledge.

Current designs routinely prescribed for goals 1–4 are an articulated AFO with plantarflexion (PF) stop or a DAFO®-style AFO to address equinus or crouch without heel contact. If the patient is cast and corrected to a neutral (90°) ankle position but has a dynamic or static limitation of the posterior muscles (gastrocnemius-soleus, or GS), the GS may actually be tensioned by donning the AFO, as shown, for instance, if the heel is trying to pop out. This contributes to GS adverse firing during initial contact, when the tibalis anterior (TA) muscles should actually be firing eccentrically for shock absorption and controlled tibial progression. Without plantarflexion, the first and third rockers of walking are lost. These limitations have led the quest to more fully address the basic goals of conventional AFOs and additional patient needs (goals 5–7) demanded by patient brain plasticity and functional potential.

Each child's needs for ongoing comprehensive orthotic management are nearly constant throughout childhood, particularly during the child's growth periods, before the age of eight, and again during adolescence. Throughout these times, rapid changes in body mass and long-bone length may degrade the child's ability to walk. Therefore, his or her Gross Motor

Function Classification System for Cerebral Palsy (GMFCS) level may change. GMFCS is the system by which levels of motor function are determined based on self-initiated movement (the scale uses Levels I–V, with Level V being the most involved).[2] The functional level attained by puberty will likely be the peak function achieved and a key predictor of morbidity and mortality.

By replacing older static approaches with adjustable dynamic approaches, orthotists have a conservative and potentially longer-lasting intervention, thereby increasing the opportunity to make a difference in each child's potential.

Summary Comparison of Adjustable Dynamic versus Older Static Approaches

Goal #5: Muscle/Strength Length

Static: Solid daytime AFOs block some or all of the eccentric muscle work at the ankle. Static "night braces" are intended only to accommodate current ROM.

Adjustable dynamic: Adjustable Dynamic Response™ (ADR™) AFOs augment muscle function, assist eccentric muscle work, and lengthen muscle with each step.[3,4] The three rockers of walking are allowed rather than sacrificed. ADR AFOs also have been shown to improve average daily activity level by 47 percent over a traditional AFO in a single-patient case study.[5] Ultraflex therapeutic orthoses worn at rest and/or at night lengthen muscle and improve range, making daytime ADR™ AFOs more effective.

Goal #6: Biomechanical Alignment

Static: Solid daytime PF-stop AFOs restrict ankle motion, dynamic balance, and stability.

Adjustable dynamic: ADR AFOs position the foot for swing clearance and weight acceptance to the extent of available range, allow for potentially greater dynamic balance and stability, and allow for the ability to also fine-tune first (heel), second (ankle), and third (toe) rocker to the extent feasible. (Dynamic and static limitations to ankle range can be addressed with dynamic therapeutic orthoses at rest or at night.) Heel lifts/post are also used within the ADR AFO during daytime walking to maximize ankle motion and eccentric muscle action of the TA in early stance and GS in mid to late stance without contributing to adverse firing patterns that the 90° or PF-stop AFO may exacerbate.

Goal #7: Feedback to the Brain

Static: Solid and PF-stop AFOs restrict motion and therefore limit sensory motor and proprioceptive feedback necessary to improve motor function and dynamic stability and balance.

Adjustable dynamic: ADR AFOs seek to maximize motion with stability and to fine-tune first, second, and third rocker to the extent feasible so the gait pattern learned by the brain is potentially more optimal. This potential is exciting and demands further research.

The following patient summary demonstrates adjustable dynamic principles.

Our patient is an eight-year-old boy born with GMFCS Level III. He presents with significant spasticity in his lower limbs causing ROM deficits, gross weakness of the lower limbs, and significant crouch during gait. He began with a -35° popliteal angle and resultant crouch. Past orthotic management consisted of primarily ground-reaction AFOs, either solid-ankle designs set at 90° or hinged designs allowing the angle to be locked or set in a fixed position to accommodate his hamstring tightness. Problems with ambulation began when our patient began losing ROM in the sagittal plane to the hamstrings. We quickly implemented a program of therapeutic night-stretching Ultraflex knee orthoses to increase ROM and also incorporated Ultraflex ADR functional orthoses during the day for ambulation. ROM increased to -20° with the use of the night orthoses.

The key for ambulation with the ADR for our patient is that we are not stopping motion anymore but rather resisting it. The AFOs allow our patient to have full tibial progression through PF and dorsiflexion (DF). The focus of the AFOs is now on resistance of tibia DF or resultant crouch gait pattern. We are no longer stopping motion but utilizing the gains in ROM achieved with Ultraflex therapeutic orthoses and allowing controlled motion with the ADR resistance settings.

Many exciting research studies involving comparison effectiveness of static versus adjustable dynamic approaches are now under way, but more need to be initiated. Interested researchers are invited to contact the authors.

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JACOB'S PATIENT INSPIRED SOLUTION

Ultraflex addresses the multiple treatment goals involved with crouch. Jacob wears an Ultraflex dynamic assist stretching KO (at rest/nighttime) to maintain and increase ROM. Ultraflex Adjustable Dynamic Response™ (ADR™) AFOs (daytime) are worn bilaterally to control dorsiflexion, provide normal range, increase stability, and improve balance. The Ultraflex stretching KO worn at night/at rest is easily connected/disconnected to and from the ADR™ AFO with the Ultraflex UltraQuick Release™. The stretching KO/AFO ADR™ combination is billable as one brace. The family reports that Jacob is getting the stretching he needs, has improved balance and stability, and is more upright—all of which give Jacob greater function.

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Thank you to Keith Smith, CO, LO, FAAOP of O&P Labs, St. Louis, MO and Courtney Dunn, PT, DPT, of St. Louis Children's Hospital for their clinical contributions. A special thanks to Jacob and his family.