A New Design For the Management of the Cerebral Palsy Hip

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BACKGROUND

Traditional hip orthoses implemented to stretch the adductor group of tendons have evolved over the years as static positioning orthoses with the goal being an abducted position of the hip. Majestro and Frost pointed out that structural or bony deformities arise from abnormal muscle forces and that correcting these abnormal forces early in life could prevent or alter these structural deformities while the child is growing (1). Petri casts are used in postoperative situations and in some cases as a serial casting method of increasing the adductor length, typically post-Botox injections. Orthoses are more prevalent due to ease of removal for bathing and exercising. Beals pointed out that preambulatory orthoses may be beneficial to acetabular development (2). Other studies concur with this ability of the acetabulum to develop a more stable socket for the femur if the head is well positioned (3, 4). Scrutton took a retrospective look at the literature and found a common conclusion to be that these hips in cerebral palsy patients are normal at birth (5). Kalen and Bleck emphasize the importance of preventing hip deformities in the CP patient due to resultant pain, postural difficulty, interference with ambulation, and problems with perineal hygiene (4). Knapp and Cortes pointed out that it is the adductor tightness that prevents this perineal care (6).

Two problems with this patient population are compliancy from parents and caretakers due to difficulty in donning the orthosis on a child with spasticity and/or contracture in these abducted positions, and internal rotation resulting from strain or tension when abducting the legs. In their review, Aminian et al. recognized that internal rotation, among other factors, could come from over-activity of the internal rotators of the hip, medial hamstrings, and the adductors (7).

The design that we sought was one that would allow the patient’s parents or caretakers to do the orthosis with the child’s legs in the abducted position and then click a release that would position the legs in abduction. The idea was to implement a design that would greatly improve the caretaker’s ease in donning the orthosis, eliminating the need to abduct the legs manually. Our goals remained unchanged from current A-Frames being to prevent or delay surgery, to decrease scissoring in gait by stretching the adductors and internal rotators, and to attempt to seat the head of the femur in the acetabulum of the hip.

METHOD

An orthosis was fabricated in much the same manner as an A-Frame in which custom-molded knee orthoses were fabricated. The orthosis ran from just proximal to the ankle up to just distal to the perineum medially and just distal to the trochanter laterally. The knee was secured with a padded cage over the knee to give a third point of pressure to keep the orthosis in position. At the initial fitting, a second and third strap were added to the thigh and lower calf to help keep the orthosis from migrating. The abduction joint was added along with a strap between the legs at the most proximal end to connect the two knee orthoses and to create a pivot to enhance abduction (Figure 1). Dynamic joints were also used at the knee to increase range of motion to the hamstrings. The dynamic abduction and extension joints were fabricated by Ultraflex Systems Inc., Downingtown, Pennsylvania, and further adaptations were developed by the author in conjunction with Ultraflex Systems.

RESULT

Our patient tolerated the orthosis well and his father was pleased with the ease of donning. Clinically, the picture was similar to the A-Frame, except for greater donning/doffing ease and the ability of the patient to adduct against tension with a reflex and then abduct when relaxed. The scenario gave us the first dynamic hip abduction orthosis for stretching and met our goals. It was evident, however, as it is in casting as well as the A-Frame, that the legs were internally rotating. We changed the knee orthosis to knee ankle foot orthosis (KAFO) to be able to grab the ankle and foot and help control this internal rotation (Figure 2). Later an adaptation was added that allowed for adjustability in the transverse plane to increase or decrease this rotation angle (Figure 3). To the author’s knowledge, this is the first component used specifically to statically allow the practitioner varying degrees of rotational control in the transverse plane.

The patient was instructed to wear the orthosis every night to bed and if possible for an hour during the day. In consideration of the proximal hamstring stretching, another adaptation was added that allowed the parent to quickly disconnect the KAFOs from the entire abduction mechanism to allow the patient to do a proper stretch of the proximal hamstrings (Figure 4).

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To get this stretch without the orthosis on, a caretaker must hold the contralateral leg down while at the same time flexing the hip and extending the knee on the ipsilateral. The majority of patients feel overwhelmed, like they need a third hand. With this new adaptation, all a caretaker has to do is disconnect the mechanism and hold one leg down while lifting the other (Figure 5). The KAFO keeps the knee extended, serving as a third hand.

Our patient has been wearing the orthosis for approximately six months and has gone from an abduction range of approximately 20 degrees bilaterally from the mid-sagittal line to 40 degrees bilaterally. Clinically, the patient now ambulates with a decreased amount of scissoring, which has greatly improved the cadence in his gait pattern. Wearing time, initially every night and one hour during the day, has fallen to every other night and one to two hours every day. The author emphasizes the nighttime wear, but in situations where that is unachievable, then one or two hours of wear during the day becomes more crucial. Caretakers are pleased with the ease of donning and the ability to adduct against the joints has created a more comfortable method for stretching.

**DISCUSSION**

Our initial goal of creating an orthosis that achieves the abduction position and limitation of internal rotation that current A-Frames accomplish and to make it drastically easier for parents to don the orthosis has been met. The purpose of this design was not to change current thought, but rather to design a system that would allow the caretaker to don the orthosis with the patient’s legs in the adducted position and allow the dynamic joints to do the abduction. The extra adaptations of rotation control and the quick disconnect feature have enabled us to take treatment a step further functionally for hip position and practically by allowing the orthosis to be used as an assistant when doing proximal hamstring stretching.

Our question now becomes, “Can we ultimately change the natural history of hip adductor tightness and resultant structural changes in the cerebral palsy population by abducting the legs and preventing internal rotation while doing so?” And second, “Can it be effective in changing a patient’s gait pattern to allow for a more efficient stance and swing position of the legs in relation to each other?” The author has fit 12 additional patients with this new design and is seeking to investigate these questions. We also hope to determine if improvement upon the static position of A-Frames has indeed been met with a dynamic system, and if there has been orthopedic improvement to the anatomy of the hip in the cerebral palsy patient. The author proposes to look at radiographs in and out of the orthosis to determine efficacy, as well as in different positions of internal and external rotation to determine the role of the orthosis in hip stability.

**REFERENCES**