

Protecting Hips at Risk

THE ROLE OF A VARIABLE HIP ABDUCTION ORTHOSIS TO IMPROVE POSTURE AND FUNCTION

BY JAN F.A. SMITS, C.P.O.

In the U.S., there are over a half million adults and children with symptoms of cerebral palsy. The overall prevalence of cerebral palsy was 3.6 per 1,000 in 1996 and 3.1 per 1,000 in 2000 (Bhasin et al). Cerebral palsy is a challenging condition in which patients have to fight “high muscle tone” most of the time and in which coordinated movement is difficult to achieve. This large group of patients is in constant need for our devoted attention.

It is common sense to bring these children to an upright position as early as possible, not only to improve kidney and bladder function, but also to prevent damage at the hip joints. Most commonly, posterior dislocation results from inadequate opposition of adduction and internal rotation of the femur. Spasticity, abnormal muscle coordination, and abnormal synergies compounded by delayed or absent weight bearing result in abnormal development of the acetabulum and the femoral head, and stretching of the joint ligaments. Approximately 60% of children who were not walking by five years of age were likely to develop subluxation of the hip, with the greatest risk in those with severe neurological involvement (Gordon, Simkiss 2006). This statistic strongly supports starting treatment as young as possible; sometimes even before the child can stand or walk.

Traditional hip bracing may cause negative effects, such as a lack of movement and weight bearing; motor functions may be lost in that process. A more appropriate brace would enable the child to have a normal range of motion while maintaining the hip in good alignment to help prevent subluxation or dislocation. If a brace can accomplish these tasks successfully, it may be possible to delay or even prevent surgical intervention.

Such a brace must be able to create a “new balance,” even when performing independent flexion or extension. During flexion or sitting, a maximal abduction is required,

while during walking a minimal adduction is needed—just enough to prevent scissoring. An “ideal” brace would self-adjust to permit this change from one extreme into the other without having to make manual adjustments.

This “ideal” brace could also be beneficial post-surgically. Post-surgical complications, such as deterioration of the non-operated hip, avascular necrosis of the femoral head, osteoporotic hip fractures, and nerve palsies have been reported following adductor tenotomy. It is proposed these results could be improved with post-operative bracing

Orthoses like the Atlanta or Newington brace were designed to achieve a 90° abduction angulation of the femur and are used primarily for treatment of Perthes disease. The Scottish Rite orthosis allows free flexion and extension, a functional advantage for management of Perthes, but the abduction degree is fixed during both hip flexion and hip extension. This fixed angle is beneficial for Perthes, but restricts normal anatomical movement of the hip, a risk for the patients with cerebral palsy not inclusive of Perthes disease. Perthes is normally treated at the age of six or seven,

Fig. 1

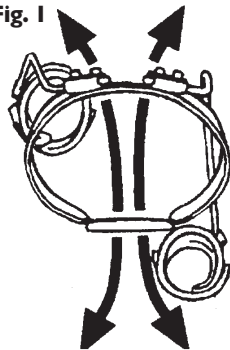


Fig. 2



Fig. 3



that would appropriately position the femoral head in the acetabular socket while still allowing function.

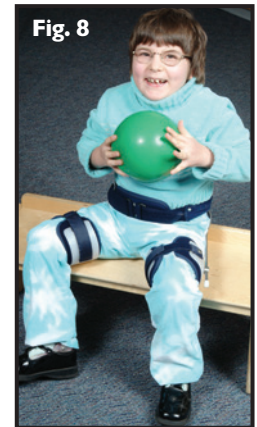
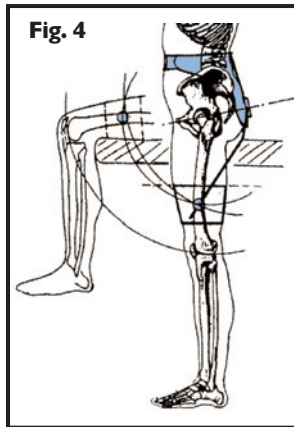
Such a device is available. Called SWASH, an acronym for “Sitting, Walking and Standing Hip Orthosis,” it is generically referred to as a Variable Abduction Hip Orthosis (VAHO). SWASH offers independent hip flexion, maximal abduction during hip flexion, minimum abduction during hip extension and weight-bearing, and continuous variation of abduction between these extremes. As simple as it looks, the SWASH hip orthosis has comprehensive biomechanical functions. It prevents adduction while standing and walking, and only gets into abduction during sitting mode, thus reducing contractures and creating a stable sitting base.

while patients with CP benefit most when we can help them manage the adductor tone, ideally from a very early stage and on.

The indications for a VAHO are subluxation, scissoring gait, and unstable sitting. Scissoring can often be observed during the resting period. In that case the brace is also indicated during the night. The users can be children with spastic diplegic or spastic quadriplegic, even children with spina bifida with their hips at risk may benefit from this VAHO. Optimum results are best realized when the child can be fitted at the youngest age possible, ideally one to four years of age. In these children, this VAHO may help to manage dystonia, hip migration, scissoring gait interfering with ambulation, and hip adduction, which limits independent sitting.

Dislocated hips and hip flexion contractures of more than *(continued on page 22)*

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20° are contraindications for the use of a VAHO. Excessive tibial torsion might cause problems for “normal” walking. Tibial torsion cannot be solved by this brace. Internal rotation of the leg can normally be influenced in a positive way.

Although the hip joints of the orthosis are placed dorsally to the natural joints, the mechanics of the joints are designed to compensate for this mal-placement. Moving the hip joint from extension into flexion will not cause any migration or chafing of the thigh cuffs or the pelvic band.

The axes of the hip joints are oblique angled and although they describe a circle in space, the projection of this circle on the floor shows an oval, which results in the typical movement of the thigh cuffs, hardly any abduction when standing and walking, and a maximum abduction when going into flexion. If we look from cranial, the joint housings are under a 20° angulation, which places the neutral balance within reach of the gravity line.

For normal walking and standing, a virtual straight path is used, while the cuffs reach their neutral point at the gravity line of the body. Adductor tone and movement fixes the pelvic band in an extended position, thus stabilizing the trunk. When moving from standing into sitting the cuffs reach the narrow end of the oval, resulting in maximum abduction, thus creating a wide base for stable sitting and prevention of contractures. (Fig. 1 & Fig. 2)

The hip joint assemblies will allow for two different adjustments: the degree of abduction

and the width of the uprights. For these adjustments, the axis finds its bearing in a nylon housing, which is fixed on the pelvic band. The nylon housing can be rotated to influence the amount of abduction. The appropriate width over the greater trochanters can be adjusted by sliding the axis in or out. (Fig. 3)

The thigh cuffs will guide the legs throughout the whole range of motion. The pathways of motion of the thigh cuffs mimic the pathways of motion of the femurs. (Fig. 4) The pressure on the inside of the leg can be high, so a long leverage will decrease the amount of pressure. The control and the effect are best when the cuffs are close to the condyles as long as they don't prohibit normal sitting, kneeling or squatting.

The thigh cuffs can also be rotated around the upright for achieving the proper location of the retaining rings, which should be free from the sitting surface. This adjustment may be done when wearing the brace.

Every adjustment must be verified for symmetry, which is of the utmost importance for proper function and appropriate result. The forces are passing 21 joints and angulations when we follow the route from the right inside leg to the left inside leg. Some of the angulations can be critical for the right balance created by this brace. Differences in leverage or angulation will also create imbalance in muscle function, because the brace is the counter force for all muscle activity around the hips and legs. For this reason, it is important that the orthotist continually check to assure symmetry with all adjustments.

CASE STUDY #1

In Fig. 5 we see a seven-year-old boy with severe scissoring. He is very persistent in his attempts to walk, but after only three or four steps his feet tangle up and he has to start all over again. Notice the improvement (Fig. 6) in his posture and the position of the feet when fitted with the VAHO. A little fine-tuning by the orthotist accommodated for the varus position and the inner rotation of especially the left leg. Normally the cuffs are kept just free from each other. In this particular case a little more abduction was needed, because of the varus position of the legs, to make sure that the feet can pass.

The weaning time for the SWASH brace can be four or five days, depending on the child. A wearing time of approximately six hours during daytime is normally enough to keep contractures under control. If scissoring occurs during the night, it is advisable to use the brace also during the night.

CASE STUDY #2

Fig. 7 shows a child who demonstrates the sitting instability frequently seen in children with C.P. They always keep one or even two hands on the chair to protect themselves from falling down. Fig. 8 shows the wide base created by the SWASH offers a solid base for sitting. When the child experiences this, he will lift his arms higher and higher. The child will gradually discover his hands are no longer needed at the chair for safety reasons and he will be freer to use his hands for other tasks—to sit at table to play, for example. Having a (continued on page 23)

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SWASH user confident enough in the brace to perform more advanced task means also that you added quality of life.

CASE STUDY #3

The eight-year old in Fig. 9 has spastic diplegia and has already had dislocated hip surgery. She demonstrates the hard task of walking with just her walker. Her face shows the effort she must make for each step. After being fitted with SWASH (Fig. 10), she was able to walk more relaxed, could coordinate her feet very well and could walk longer distances.

CASE STUDY #4

Fig. 11 shows a young lady who readily demonstrates how adductor tone can put the hips at risk for subluxation or dislocation. In Fig. 12, with the orthosis fitted, you can readily see the improved posture and reduced stress on the hips.

CASE STUDY #5

High adductor tone is one of the most common and obvious symptoms of spastic cerebral palsy. This tone affects posture of the entire body. It drives the feet into pronation, internally rotates the lower limbs, and has a flexion influence on both the knees and hips. This lower extremity posture influences the trunk into a slouched posture as demonstrated in this 14 year old in Fig. 13. The VAHO shown in Fig. 14 exerts an external rotary influence on the lower limbs (without twister cables), the knees and hips are influ-

enced more towards extension, and the trunk stands more erect. The biomechanical effect of the tone is thereby reversed. It exerts an external rotary influence on the lower limbs (without twister cables), the knees and hips are influenced more towards extension, and the trunk stands more erect.

CASE STUDY #6

Fig. 15 shows a 2½-year old with neuronomigrational defect and tethered spinal cord release. With any attempt at sitting, she would fling herself backwards. With SWASH, shown in Fig. 16, she was able to find a good position of balance so she was able to sit for long periods of time.

In the “ideal” world, the therapist and orthotist jointly review the biomechanical function. The following is an assessment form that we encourage therapists to complete before and after fitting. Unfortunately, I don’t think it is often used. Most prescriptions from physicians are written based on recommendation from the ther-

apist. However, there certainly are incidences where a physician will write a prescription and the patient goes directly to the orthotist. The latter is very unfortunate because the therapist is key to helping the wearer achieve maximum benefits from the orthosis. ■

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REFERENCES

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SWASH®
Initial Fitting Assessment

Patient ID# _____

Dx _____ Age: _____

WITHOUT SWASH

WEARING SWASH

SITTING

Hip adduction		
Sitting height from sitting surface		
Time no touch sitting		
General stability and posture		
Sit to stand functional performance		

STANDING

Femoral alignment		
Foot position and alignment		
Distance between feet		
Overall stance height		
General Posture		

WALKING

Neuromuscular control (jerky? fluid? balance issues?)		
Incidence of scissoring		
Transverse plane alignment both sides (one limb rotated more than the other?)		
Stride Length		
Heel to toe utilization during gait		
Speed		

Primary Goal: _____

Secondary Goal: _____

Waist: _____ Waist to Knee _____ Thigh _____ Walking Aid? _____

FITTED WITH: CLASSIC LP SIZE: Pelvic _____ Cuffs _____ Uprights _____