SWASH™

Clinical Manual

CAMP SCANDINAVIA

SWASH™ *Clinical Manual*

SWASH™, the
Standing
Walking
And
Sitting
Hip orthosis

US patent #4901710. Foreign patents issued.

Acknowledgements

To Dr. Paul Meyer of Cambridge, England who took the time and the effort to design a way to help his daughter Rebecca, and children everywhere, with cerebral palsy.

To Bertil Allard, President and CEO of Camp Scandinavia AB, who's vision, commitment and perseverance have made the SWASH available around the world.

To Jan Smits, CPO, of The Netherlands, along with Prim SA of Spain, whose combined engineering and manufacturing skills have made the complex simple, and the simple simply work.

And especially to the children with cerebral palsy who's love, enthusiasm and enduring spirit are an inspiration to all of us.

SWASH™ Clinical Manual

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Chapter One

Introduction

With a history and tradition of fixed abduction bracing for children with cerebral palsy, could you imagine a "variable abduction orthosis"? Its description might read: "a brace in which a child could pursue a normal range of activities without danger of hip dislocation, would further enhance acetabular modeling and tightening of the joint ligaments, and provide not only an adjunct, but an alternative to surgery".

"A device to achieve this must offer:

- Independent hip flexion
- Maximal abduction during hip flexion
- Minimum abduction compatible with the prevention of scissoring during hip extension and weight-bearing
- Continuous variation of abduction between these extremes."

In 1984, a four-year old girl with dystonic cerebral palsy developed subluxation of her left hip. She had been able to sit, stand and walk with support (albeit with scissoring). A fixed abduction brace was recommended to stabilize her hip, but it also prevented all these functional activities.

Her father, a medical practitioner, therefore designed a brace using the rotation of leg bars around an inclined pivot to achieve abduction which was continuously variable according to the degree of hip flexion. The result of this effort is the SWASH™ (Standing, Walking And Sitting Hip) Orthosis.

The first commercial use of the SWASH™ occurred in 1992. Since then, thousands of SWASH™ have been used worldwide.

The SWASH™ appears to be a relatively simple device. Looks, however, can be deceiving. There are a combination of fifteen (15) joints and angles in the SWASH™. Changing one angle usually affects the function of the other fourteen.

There are also two (2) different sets of uprights that can be used. These uprights differ significantly in their biomechanical effect on different types and classifications of children with cerebral palsy. Understanding how these different uprights and the joints and angles inter-relate with each other is key to the successful use of the SWASH™.

There are also ancillary factors that can have a significant impact on the functional outcome of a child wearing the SWASH™. Both AFO design and walker height can add to or detract from the child's functional level. Because of the integration of these issues and the need for appropriate fittings and adjustments, the SWASH™ is sold only through certified orthotic facilities. These orthotists are required to attend and pass a certification course conducted by CAMP Healthcare. A "team approach" including the Physician, therapists, orthotist and caregiver is strongly encouraged in the process of enhancing a child's ability to function with the help of the SWASH™.

SWASH™ major components are as follows in Fig. 1-1. The nomenclature will be consistently used throughout the manual.

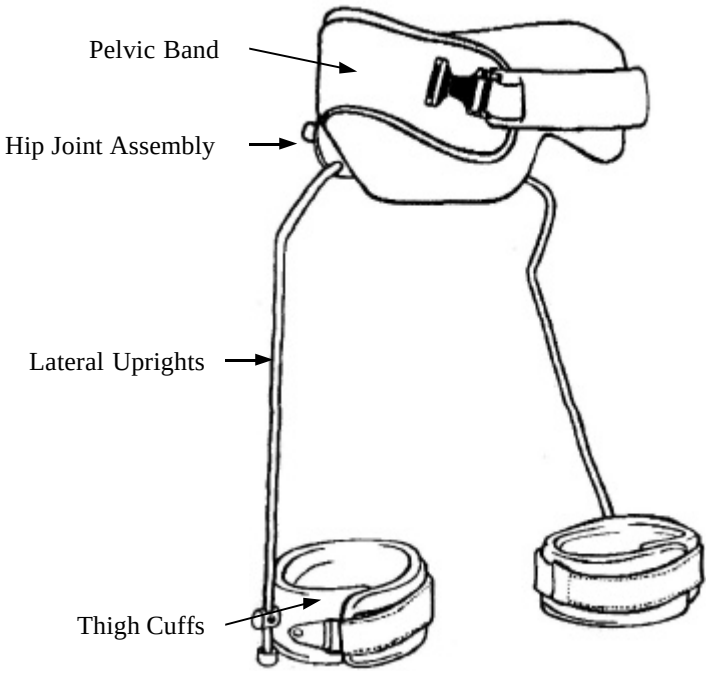


Fig. 1-1

As you become more familiar with the SWASH™, you will all the more appreciate the benefits this ***variable abduction orthosis*** offers to children with cerebral palsy.

Chapter Two

Cerebral Palsy Overview

Cerebral palsy is not a disease. It is a condition that has been defined as "an umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development". [1]

Cerebral palsy is classified using a combination of two (2) standards. One is based on anatomical distribution and the other deals with the physiological aspects of the condition.

Distribution	Description
Hemiplegia	"Windswept" - Arm and leg on same side involved, usually arm more than leg
Diplegia	Both sides of body involved, legs more than arms
Quadriplegia	Both sides of body, both arms and legs. [2]

Physiological classifications of cerebral palsy include:

Spastic cerebral palsy:

This is the most common form of cerebral palsy, and is categorized by the distribution of limbs involved with spasticity. This spasticity is usually intensified during periods of attempted activity and less severe during periods of rest.

Of the types of classifications listed above, some 70%-80% of all cases are spastic cerebral palsy. Spastic quadriplegia accounts for 40%-45% of this population while another 35%-40% have spastic hemiplegia, and approximately 25%-30% have spastic diplegia.

Dyskinetic cerebral palsy:

This classification of cerebral palsy is characterized by tonal abnormalities that involve the whole body. Muscle activity changes from hour to hour and day to day. Muscles can alter between demonstrating very rigid tone during activity to unusually flaccid tone during sleep. Athetoid cerebral palsy, demonstrating rapid jerky motions and slow writhing motions, is a subcategory of dyskinetic cerebral palsy.

This category accounts for 10%-15% of all cases of cerebral palsy.

Ataxic cerebral palsy:

This form of cerebral palsy is characterized by a lack of voluntary control over movement and balance muscle patterns. These children usually demonstrate low muscle tone.

Ataxic cerebral palsy accounts for less than 5% of all cases of cerebral palsy.

Mixed cerebral palsy:

This term is used when one type of motor pattern does not clearly dominate over another.

Epidemiology

The prevalence of cerebral palsy is approximately 2.6 out of 1000 live births. The cause of cerebral palsy is not always known. There may be prenatal, perinatal and postnatal causes. . Premature birth and very low birth weight are recognized as common associations of cerebral palsy. About .5 out of 1000 live births can be traced to known acquired causes of cerebral palsy. [3]

The signs and symptoms of cerebral palsy are often not fully apparent until the child is 2 to 3 years old. Early indications that hips that are at risk can occasionally be seen as early as age 9 months.

In children with cerebral palsy who are ambulatory, there is a 28% incidence of hip subluxations requiring medical intervention.[4] That rate goes up to 60% in children with cerebral palsy who are non-ambulatory.

Chapter Three

Biomechanical Design Considerations

Anatomical vs. Orthotic Pathways of Motion

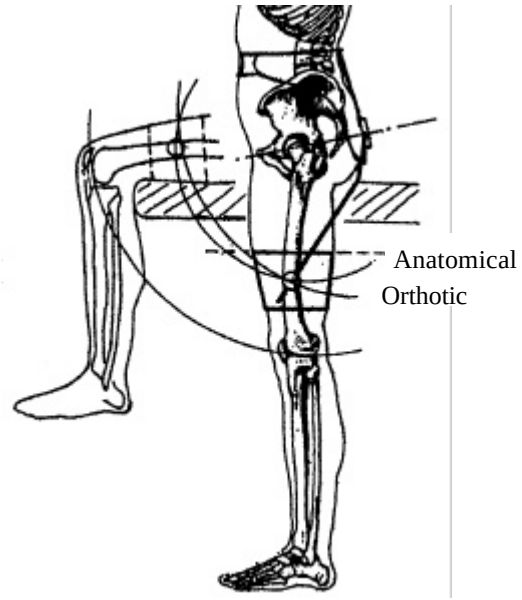


Fig. 3-1

At first glance, it appears that the orthosis should cause significant “pistoning” of the thigh cuffs on the thighs. The orthotic hip joints do not approximate the location of the anatomical hip joints. The orthotic joints are actually positioned closer to the sacroiliac joints than they are to the hip joints.

But in fact, the pathways of motion of the SWASH™ thigh cuffs do mimic the pathways of motion of the femurs (Fig. 3-1). This is designed into the orthosis through a combination of the angle of the pelvic band in the sagital plane, and the angle of the hip joint assemblies in the transverse plane. Also contributing are the angles of the uprights through the hip joints and the planes on which the angles on the uprights themselves are shaped.

The result of this tri-plane engineering is that “pistoning” of the cuff on the thigh is minimized. There have been no cases of red marks on the skin reported to date as a result of abrasion due to pistoning

Center of Gravity

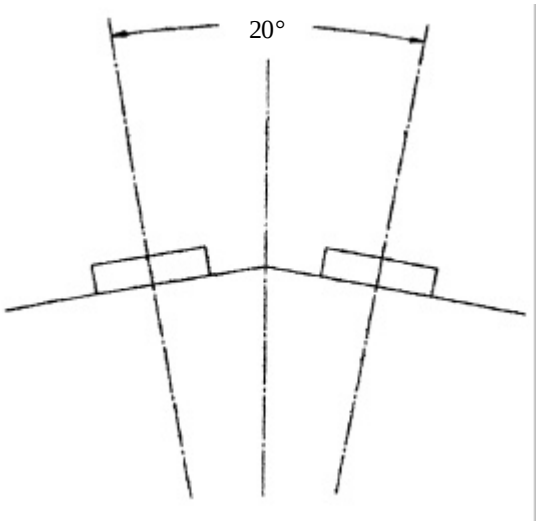


Fig. 3-2

Upon seeing the SWASH™ orthosis, one would expect that the center of gravity would be posterior to the trunk. The joints are posterior, leading to the expectation that the center of gravity would also be posterior.

In fact, however, the tri-plane engineering again utilizes all the angles described previously to bring the center of gravity just anterior to L2, through the center of the trunk. Of most significance is the 20° angle in the transverse plane (Fig. 3-2) designed into the posterior section of the pelvic band. This angle moves the center of gravity from posterior to mid-trunk alignment.

Chapter Four

Biomechanical Function of the Orthosis

Proximal Transfer of Adductor Tone

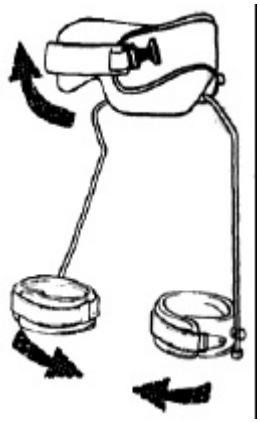


Fig. 4-1

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 the hips. This lower extremity posture influences the trunk into a slouched posture that is typical of children with cerebral palsy.

The SWASH™ actually takes advantage of high adductor tone and transfers that tone proximally (Fig. 4-1) to enhance trunk posture. As the SWASH™ overcomes adductor tone, two things happen. First, the biomechanical effect of the tone is reversed. It exerts an external rotatory influence on the lower limbs (without twister cables), the knees and hips are influenced more towards extension, and the trunk stands more erect. Second, as the SWASH™ reaches its "point zero", or its limit to adduction, it transfers adductor force proximally to help posteriorly rotate the pelvis which helps achieve a more erect postural position.

As a result of overcoming adductor tone and its biomechanical consequences, children with cerebral palsy may need their walkers raised to accommodate the more erect posture they now have.

The SWASH™ is not a cure-all for all postural problems. New postural motor control patterns will have to be learned and gained. The SWASH™ is seen as a device to facilitate these gains.

Even with the SWASH™ in use, there may be residual internal rotation of the lower extremities. Very often, unless there are internal tibial torsion or metatarsus adductus issues, the medial hamstrings have been seen to exert this internal rotatory influence. An aggressive walking program along with specific medial hamstring stretching has been seen to minimize this residual internal rotation.

Gait Dynamics

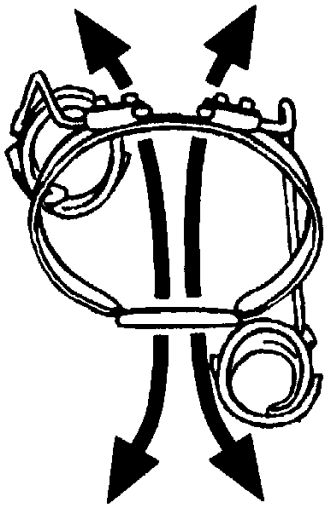


Fig. 4-2

This benefit of the SWASH™ is perhaps the easiest to see in immediate "before and after" analysis of children with cerebral palsy who scissor during gait due to high adductor tone. Properly adjusted, the SWASH™ will prevent scissoring (Fig. 4-2).

In clinical observation, there are three main benefits in this area of function for children with cerebral palsy. The first is that they can ambulate with greater independence. Many children who have never taken more than a few steps without someone having to untangle their feet can now walk to the limits of their endurance without scissoring.

Secondly, the SWASH™ seems to help conserve energy. Without the energy consumed in attempting to stabilize the trunk and untangle scissoring feet, the child is able to walk more fluidly for greater distances using the same energy.

Finally, as the child is better able to walk, the more they will want to walk, and the better they get at walking. Walking now becomes a means of getting from here to there instead of an exercise to be endured during supervised therapy sessions. With better gait biomechanics and greater gait capacity, muscle tone in the hamstrings and calf group are generally reduced while muscle length is increased.

Sitting Dynamics

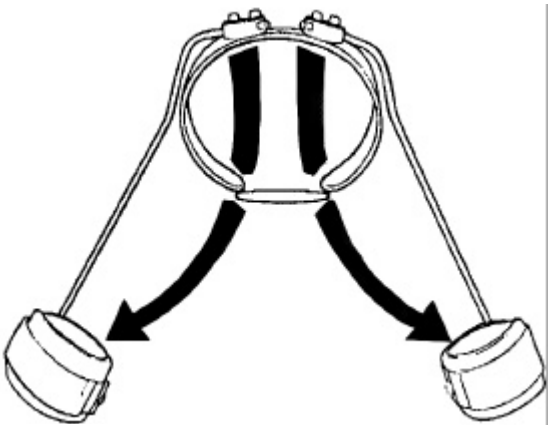


Fig. 4-3

Many children with cerebral palsy are very unstable during sitting. This is demonstrated by a typical slouched posture during sitting, cervical hyperextension to gain trunk stability, and the need for the child to use upper extremities for "touch balance". While it is common to refer to a child's "envelope of function", many children with cerebral palsy sit in a "cocoon" of function. Their hands are functionally tied down to the sitting surface by their lack of stability.

The SWASH™ is classified as a "Variable Abduction Orthosis". During standing and gait it provides just enough abduction to be compatible with the prevention of scissoring and internal femoral rotation. As the hips are flexed to assume the sitting position (Fig. 4-3), the SWASH™ further abducts the hips to create a tripod base for sitting stability.

Results of this stable base for sitting are demonstrated by a more erect posture during sitting and by the new-found discovery that hands can be used to interact with the environment around them. This can be a new and exciting discovery. Enhanced upper extremity function is also seen to improve trunk strength and control.

123° vs. 115° considerations

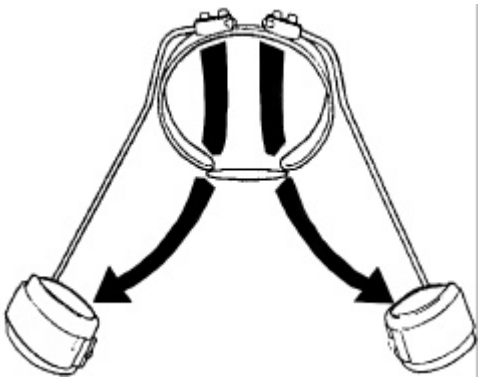


Fig. 4-4 123° Uprights

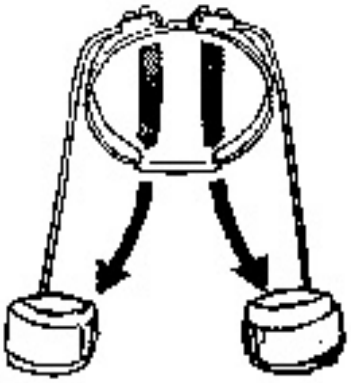


Fig. 4-5 115° Uprights

The SWASH™ is offered with two different sets of uprights. Selection of the correct uprights will have a significant effect on the functional outcome as a result of the orthosis.

The 123° Uprights (Fig. 4-4) offer a wider sitting base and should be used when:

- The greatest amount of adductor muscle lengthening in the sitting position is desired
- Influencing the trunk towards enhanced spinal extension is desired
- Exaggerated abduction for greater stance or gait width would be beneficial

The 115° Uprights (Fig. 4-5) with narrower sitting base uprights should be considered when:

- The child is primarily chair mobile and the 123° uprights would be too wide in the sitting position for the child to fit in the chair
- Adductors are too tight and the amount of abduction in the 123° uprights would be impossible or painful
- Adductors are too tight in the sitting position, which would cause the 123° SWASH™ to induce too much of a flexion force on the trunk during sitting
- The child has spastic quadriplegia and would benefit from reduced spinal hyperextension during gait. Setting the hip joint assemblies for greater abduction will increase the flexion influence of the orthosis on the trunk. To increase abduction without this flexion influence, externally rotate the thigh cuffs on the uprights (see fig. 4-6).

Thigh Cuff Rotation on Lateral Uprights

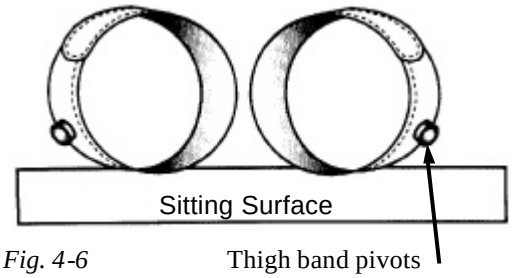


Fig. 4-6

The standard position of the thigh cuffs on the uprights is about 10° posterior to lateral (Fig. 4-6). To achieve additional abduction without rotating the uprights in the hip joint assemblies, the thigh cuffs can be externally rotated, moving the uprights more posteriorly to create additional abduction. The point at which the thigh band pivots would contact the sitting surface limits the amount of rotation on the uprights.

Hip Stabilization

Fig. 4-7

The most visible benefits of the SWASH™ are readily apparent by improvements in gait, in sitting, and in standing posture and stability. The benefits can be immediate and are often dramatic. Continued improvements are usually seen after the child has become acclimated to the orthosis.

Given the visible benefits, perhaps the most important benefit the SWASH™ offers is its influence on the hips. The very nature of high adductor tone places dislocating forces on the hips (Fig. 4-7). The internal rotation and adduction forces leave hips at risk.

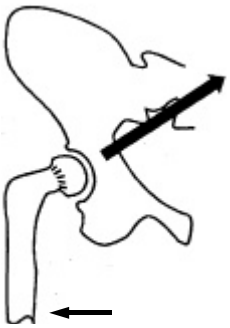


Fig. 4-8

In the ambulatory group of children with cerebral palsy, there is a 30% incidence of hip subluxations requiring medical intervention. That rate goes up to 60% in the non-ambulatory group of children with cerebral palsy.

In children with cerebral palsy, excessive adduction with internal rotation cause a posterior dislocating force, which is opposed by the SWASH™ variable abduction brace (Fig. 4-8). Although this may be expected to reduce the risk of hip dislocation, ongoing studies to document this benefit have not yet been completed.

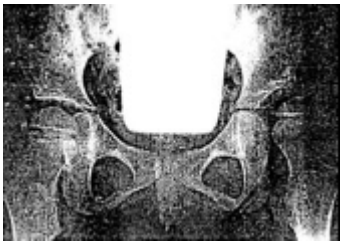
The following x-rays were taken immediately before fitting the SWASH, and again at one, two and three years post-fitting. They offer some insight into the results of using SWASH over an extended period of time.

In this before fitting x-ray, pelvic obliquity and (R) hip subluxation are readily evident. The acetabulum is shallow and does not cover the femoral head.

Fig. 4-9

One year post fitting shows improvement in pelvic angle and hip subluxation. Approximately 50% of the femoral head is now covered.

Fig. 4-10



At year two post fitting shows further improvement of the femoral head within the acetabulum.

Fig. 4-11

Three years post fitting shows normal pelvic angles and near normal hip development.

Fig. 4-12

Chapter Five

Indications and Contraindications

Indications

The following indications for SWASH™ include children between the ages of nine months and five years old with:

Spastic diplegia – the easiest to fit and to appreciate the benefits of the SWASH™. It is recommended to fit two or three spastic diplegic children first with the SWASH™ before attempting more challenging cases.

Spastic quadriplegic – also a primary indication but a little more challenging to fit. Use of the 115° uprights is usually more appropriate to minimize trunk hyperextension during gait (see fig. 4-5).

Risk of hip dysfunction – any child who is at risk of hip subluxation. Many children (and small adults) who are non-ambulatory are still appropriate for use with the SWASH™ as a device to provide sitting stability and to stabilize hips in a more biomechanically appropriate position.

Spina Bifida – children whose hips are at risk may benefit from the SWASH™. The SWASH™ can be built into custom molded body jackets for a combined trunk/hip stabilizing orthosis.

Night Splint – this application can be especially useful if the child spends the first two or three hours of the day overcoming muscle shortening that occurred during sleep.

Post-botox / baclafin pump – children can benefit from the enhanced stability and proprioceptive feedback the SWASH offers. Studies are underway to validate the theory that SWASH use will extend the duration of benefits of Botox and Baclafin treatments.

Post-operative – for stabilization when fixed amounts of abduction are not necessary.

Age Related Issues:

Between the ages of 9 months and 5 years, children with cerebral palsy will generally adapt to the SWASH very quickly. They tend to accept quite readily the correction if offers and adapt to new and more normal gait patterns. They usually accept the sitting stability it offers and quite freely start using their upper extremities for function instead of for sitting balance.

SWASH™ has been and can be successfully used for children older than age 5. However by the time a child reaches 9 or 10 there may be muscle length issues, muscle strength issues, and neuromotor patterns that can be very difficult to overcome. Older children tend to adapt more slowly to the orthosis than younger children.

Size ranges up to a 28” waist are available so children who are started early with SWASH can continue with the orthosis well into their teenage years.

SWASH has been used successfully with small adults with low adductor tone to manage scissoring gait.

Contraindications

Dislocated hips

Hip Flexion Contractures greater than 20° (Dynamic or fixed)

Adductors too strong for the SWASH™ to handle (usually over 9 years old)

Adductor length too short to allow SWASH™ use in the sitting position

Dyskinetic cerebral palsy except as a hip prophylactic orthotic management device

Waist or thigh sizes above those accommodated by the largest SWASH™

Limitations

If patients cannot walk without the SWASH™, it is highly unlikely they will be able to walk with the SWASH™. The SWASH™ cannot activate non-functioning muscles or nerves, or serve as a replacement for them.

SWASH™ does not eliminate the need for AFOs. Articulated AFOs (as opposed to solid ankle AFOs) are generally preferred to enhance the biomechanics of gait and provide an easier and more fluid gait pattern.

SWASH™ does not replace rehabilitation or the therapist. It does help overcome some of the major consequences of high adductor tone and therefore allows more specific and functional rehabilitation.

It may be unlikely that SWASH™ will provide sufficient force to overcome the very high adductor tone that may develop in adolescents. If SWASH™ is started earlier in the progression when it can overcome the force, continued use into the early teens through adulthood is appropriate.

Precautions

In patients with severe shortening of hamstrings, psoas, adductors, or heel cords, great care should be taken when planning the orthotic and therapy program.

Patients with spinal deformity may be unable to wear the SWASH™, or may require that the orthosis be incorporated into a custom body jacket.

With time, the orthosis may lessen the spasticity of the adductors. It is important on a regular basis to review the amount of abduction correction needed to maximize functional performance.

Hamstring tightness should also be monitored on a regular basis. Any signs of increased tightness should be specifically addressed.

Chapter Six

Pre-fitting Assessment

A pre-fitting assessment should be done and documented with a team consisting of at least a physical therapist and the orthotist. It is also desirable to have the primary caregiver present during this assessment. Each person brings to the evaluation their own areas of expertise and observational skills. Don't be surprised if the primary caregiver sees more that the rest of the medical team! Their observations and comments can be surprisingly insightful.

The assessments should be oriented toward overall function as opposed to individual components of function. Individual joint ROM is less important than overall standing height, for example. Be aware of and document asymmetries found during the evaluation.

Some facilities are using videotape as one of the ways to document the before and after effects of the SWASH™.

Clinically proven assessment methods such as Gross Motor Function Measure (GMFM) [6], or the Peabody Developmental Motor Scales (PDMS) [7], among other tests will add validity and proven repeatability to the assessment process.

Areas of observation and documentation may include but are not limited to:

Standing: Done in conjunction with the child's normal ambulatory aid.

- Overall stance height
- Foot posture and alignment
- Reliance on extrinsic devices for stability during stance
- Reaching capacity with and without extrinsic support
- Stand to squat functional performance
- General posture

Fig. 6-1

Walking: With normal ambulatory aid and with their normal AFOs (if used).

- Lower extremity transverse plane alignment – both sides.
- Stride length
- Stride base width
- Heel-Toe utilization during gait
- Speed & neuromuscular control
- Distance capacity
- Incidence of scissoring

Fig. 6-2

Sitting: On a firm surface with feet supported to allow a lower extremity 90/90 position.

Fig. 6-3

Overall sitting height from sitting surface

Reliance on “touch balance” for sitting stability

Reaching capacity distance with one and with both hands

Timed “no touch” sitting

Ball catch capacity

Sit to stand functional performance

General posture

Other functional testing: With and without AFOs

AFO design considerations can play an important part of functional capacity during gait. Significant differences can be seen during gait with AFOs compared to without AFOs. Observing and documenting gait with and without AFOs can provide important insights into the type of AFO design that will most benefit the functional outcome of the SWASH™ during gait.

Design considerations of the AFO are also very important. If the foot of the child is still intact, every effort should be made to use a limited ROM articulated AFO to help normalize gait. If mid-foot destruction has already occurred, a decision will have to be made between solid ankle and ROM limited articulated ankle AFOs. Answers to the following questions can lead to finding the most acceptable solution:

Will a solid ankle AFO help the foot regain its intrinsic stability or stop the progression of the mid-foot instability? And if it will, what is the cost of that foot stability in terms of gait function in both the short term and the long term?

Will a limited ROM articulated ankle AFO enhance gait function? If so, what will the cost be in terms of probable continued hypermobility or increased hypermobility of the mid-foot in both the short and long term?

A team consensus to the answers to these questions should lead to the most acceptable solution for the child’s best interest.

Chapter Seven

Orthosis Assembly

The lateral uprights with thigh cuffs attached are shipped detached from the pelvic band. The uprights are labeled “Right” and “Left” to correspond to the extremity on which they are fit.

To assemble the uprights to the pelvic band:

Unwrap the packing material from the uprights

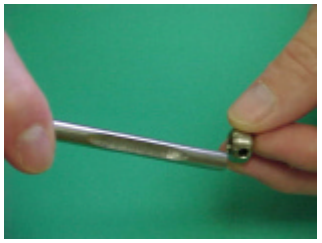


Fig. 7-1

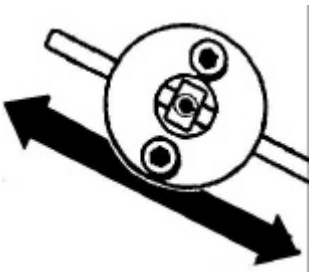
Loosen and detach the retainer rings from the uprights (fig 7-1)

Fig. 7-2

Insert the retainer rings (fig 7-2) into the hip joint boss with the hex- screw pointing up

Fig. 7-3

Insert the uprights into the hip joint assembly and through the retainer ring (Fig. 7-3). Make certain the groove in the upright is aligned with the set screw in the retaining ring.

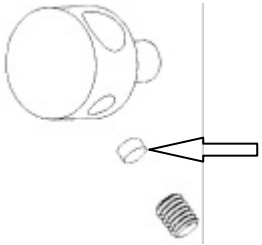


Position and tighten the retainer ring on the upright in the hip joint assembly so the screw engages the grooved area of the upright. Both uprights should be inserted an equal distance through the joint assembly (fig 7-4) so they are symmetrical.

Fig. 7-4

To change thigh cuffs on the uprights:

Loosen thigh cuff hex screw ½ turn



Rotate the cuff on the upright if necessary to insure that the hex screw head is facing down.

IMPORTANT! There is a brass bushing (fig 7-5) at the tip of the screw that acts as an interface between the tip of the screw and the upright. Keeping the head facing down will keep the bushing in place during removal of the thigh cuff from the upright.

Fig. 7-5

Remove the thigh cuff from the upright, keeping the hex screw head pointed down. Reinstall it on another upright or install a new thigh cuff.

Rotate and adjust height of thigh cuff as desired and retighten hex screw.

Chapter Eight

Fitting Procedure

Size selection

Take a circumference measurement at the waist just superior to the anterior superior iliac spine (ASIS) (fig 8-1), and at the distal thigh, just proximal to the condyles. If possible, determination should be made before fitting if the orthosis is to be worn over or under clothing. As a rough rule of thumb, the orthosis is generally worn over clothing if children are not managing their own toilet, and is worn under clothing if children are managing their own toilet.

Fig. 8-1

Select the correct size from the sizing chart (Fig. 8-1).

Size	Waist Circumference	Thigh Circumference	Upright Diameter	Upright Length
1	15 3/4 - 18 1/4” 40 - 46 cm	9 3/4 - 12 3/4” 25 - 32 cm	6mm	12” 31 cm
2	18 - 21 1/2” 46 - 55 cm	11 1/2 - 14 3/4” 29 - 37 cm	7mm	14.5” 37.5 cm
3	21 1/4 - 24 3/4 54 - 63 cm	13 - 16 3/4” 33 - 42 cm	7mm	17” 44 cm
4	24 1/2 - 28 1/4” 62 - 72 cm	14 1/2 - 19 1/4” 37 - 49 cm	7mm	19” 48 cm

Fig. 8-2

Note: size 1 uses 6mm diameter lateral uprights and sizes 2, 3, and 4 use 7mm lateral uprights. Level of function and tone (not just the size chart) should be evaluated when selecting the properly sized SWASH. For example, if the child is ambulatory, a size 2 should be considered even if the child measures a size 1. All components on sizes 2, 3, and 4 units are modular and interchangeable.

A size 1 thigh cuff is available to fit size 2 uprights. See parts list at back of the manual.

Fully assemble the SWASH™ prior to fitting (see chapter 7). Open the waist closure and both thigh cuffs.

Apply the SWASH™ to the child in the supine position for marking sizing changes. Provide both thoracic and head support for the child during the fitting procedure to insure the child’s comfort.

Initial Application

To achieve the proper position of the orthosis on the child:

Fig. 8-3

The pelvic band should be positioned immediately superior to the Anterior Superior Iliac Spine (ASIS) (fig 8-3).

Ensure that the child is not rotated in the orthosis. Check the ASIS relative to the posterior section of pelvic band on both sides to ensure symmetry in pelvic height and rotation in the orthosis.

To properly size the orthosis to the child:

Fig. 8-4

Mark appropriate holes for both truss studs in the waistband (fig 8-4). The studs should fit in the center of the slots in the overlap tab. The dual stud design provides intrinsic stability to the pelvic band.

Fig. 8-5

Slide the fingers of one hand between the padding and the child's abdomen with hips alternately flexed and extended to ensure a snug yet comfortable fit. (fig 8-5)

Fig. 8-6

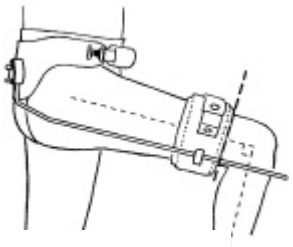
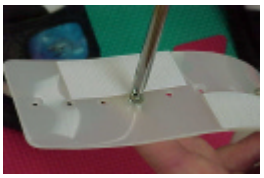


Fig. 8-7

Mark height of one thigh cuff on the upright (fig 8-6) so that thigh cuff height is as distal as possible on the thigh but proximal to the popliteus and the gastrocnemius (Fig 8-7).

Adjustments

Remove the orthosis from the child. Make all necessary changes to the orthosis while it is off the child.



Move waistband truss studs to marked holes. Tighten with Philips screwdriver (fig 8-8).

Fig. 8-8

Move thigh cuff to the marked position on upright and tighten. Move other thigh cuff to the same height and tighten (fig 8-9).

Set rotation of thigh cuffs to about 10° posterior from mid-line (see fig 4-6).

Fig. 8-9

Center the distance that the upright passes through the hip joint assembly (fig 8-10). This setting may need to be changed after the orthosis is tested on the child.

Fig. 8-10

Set amount of desired abduction at the hip joint assemblies (Fig 8-11). This setting will be your "best guess" of the amount of abduction needed to prevent scissoring during stance and gait. Adjustments for more or less abduction can be made after initial functional testing.

Fig. 8-11

More (fig 8-12) or less (fig 8-13) abduction may be needed depending on the child's functional performance during gait.

Fig. 8-12 *Fig. 8-13*

Note: "Lock Tite" or other adhesives are not generally necessary to maintain secure settings on the SWASH™.

Note: The orthosis should be set up to be symmetrical in every aspect. Most children with cerebral palsy present with both postural and functional asymmetries. The SWASH™ should be set up and used symmetrically for at least four weeks in an attempt to help the child become more symmetrical. Serial correction of severe asymmetries may be possible with the SWASH™ when necessary.

Fitting the orthosis

Open all closures on the orthosis. Reapply the orthosis to the child.

Check for correct pelvic band height and rotation (fig 8-14).

Fig. 8-14

Secure the pelvic band truss studs into their slots (fig 8-15) and snap the circumference strap closed.

Fig. 8-15

Secure the thigh cuffs (fig 8-16). Adjust the hook and pile closure and check for a snug but comfortable fit.

Fig. 8-16

Teach the caregiver how to apply, remove, and care for the orthosis (Chapter 11). Provide instruction about when and how long the orthosis is to be worn. Schedule a follow-up appointment to check the orthosis within one week. Subsequent follow-up appointments should be made every three months.

Checking the orthosis

Check the height and rotation of the orthosis on the child (fig 8-17). Make sure that the height is immediately above the ASIS and that the child is not rotated in the orthosis.

Fig. 8-17

Insert the fingers of one hand between the padding and the abdomen (fig 8-18) to assure a comfortably snug fit and the child's comfort.

Fig. 8-18

Flex the hips to 90° to check the position of the lateral uprights relative to the greater trochanters (Fig. 8-19). The uprights should be as close as possible to the greater trochanters without impinging on them with the hips flexed. If there is impingement or if the distance is too great, *remove the orthosis* and adjust the distance of the uprights through the hip joint assemblies. Recheck the amount of abduction at the hip joint assemblies. Then reapply the orthosis.

Fig. 8-19

Check both limbs with the knees at 90° that there is no impingement on the popliteus or the gastrocnemius (Fig. 8-20). If the thigh cuffs are too high or if they are too low and causing impingement on the popliteus or the gastroc, mark a more appropriate height on the upright, *remove the orthosis*, and adjust the cuffs to the new position.

Also check the rotational symmetry of the cuffs on the uprights.

Fig. 8-20

Chapter Nine

Post-fitting Functional Evaluations

During this process, simply repeat the evaluations accomplished in the pre-fitting evaluation. Note any changes in functional capacity that are measured or observed.

Note: Younger children typically adapt to the orthosis and show more immediate improvements more quickly than older children. A three-year-old generally adapts more readily to the orthosis than a seven-year-old.

Note: While some differences are usually apparent immediately after fitting, many more changes will become apparent after days, weeks, or months in the SWASH™. It may take some time for the child to acclimate to and to "trust" the orthosis.

Fig. 9-1

Standing: Many children will demonstrate a more erect and stable standing posture. It may take some time to become acclimated to their new posture and elevation. Cervical hyperextension and spinal rotation should diminish as pelvic stability increases. Improvements in standing balance and stability may be demonstrated after a few hours or days.

Be certain that the height of the walker is evaluated with the child wearing the SWASH™. Walker height will often need to be raised to accommodate to the new stance height of the child.

Fig. 9-2

Walking: In initially setting up the orthosis, it is difficult to judge the amount of abduction required to eliminate scissoring during gait. If scissoring is still hindering gait, *remove the orthosis* and increase the amount of abduction (Fig 8-10). For minor increases in abduction, the thigh cuffs may be externally rotated (fig 4-6). In some cases of higher adductor tone, it may be appropriate to exaggerate the amount of abduction to provide a wider base during gait just for the first week or two.

One side is often more involved than the other in children with cerebral palsy. It is typical to see one side show more residual internal rotation than the other side. Some facilities have reported success with working on stretching the medial hamstring on that more involved side to help overcome residual internal rotation.

Many children with cerebral palsy may lack endurance during gait. Energy consumption is seen to be very high in the effort to walk while overcoming scissoring. Because scissoring is now eliminated and gait is a much more achievable and fluid, if not enjoyable experience for the child, gait endurance and capacity typically show a significant increase over the first few weeks and months.

Fig. 9-3

Sitting: Stability during sitting is usually a fairly immediate improvement with the SWASH™. It takes about 15 minutes of "diversion therapy" to acclimate the child to an appreciation that now they do not have to touch balance to sit comfortably. More time will allow them the opportunity to increase reaching and other upper extremity functional capacities.

Gains in trunk strength and control are seen as secondary benefits to increased upper extremity capacity.

Refer to Fig 4-5 if the orthosis is influencing the child into too much spinal flexion (sacral sitting) during sitting.

Other functional testing: Once the orthosis has been tested, final adjustments may be made. The lateral uprights may need to be shortened so they do not stick out beyond the distal margin of the thigh cuffs. Round off the end of the upright after the cut to prevent sharp edges from being exposed in case the rubber cap comes loose. Double check the tightness of all screws.

Once the uprights are properly trimmed, additional functional testing such as sit to stand and stand to squat can take place.

Chapter Ten

Follow-up Management and Maintenance

Follow-up Management

One week check

It is recommended that the orthotist see a child within one week after initial fitting to check settings (especially the hip abduction angle) and to check the integrity of the orthosis. By this time the caregiver will know how it is fitting over (or under) clothing and may have other questions.

Three-month check

Fit of the orthosis

After the initial follow-up, three month follow-up evaluations are critical to maintain the orthosis in good condition and to make sure it's properly adjusted to meet the changing needs of the child. Confirm with the caregiver that any red marks are transient. The relationship between the lateral uprights and the greater trochanters may alter particularly rapidly during growth spurts or changes in stature.

Abduction angle adjustment

As adduction tone is reduced, the abduction that the child can achieve may also increase. As a result, the abduction angle of the orthosis and/or the wearing time may need to be decreased.

Hamstring length

Particular attention should be paid to hamstring length as the child progresses with the SWASH™. Reduced adductor contractions in other treatment programs may result in hamstring shortening. This reaction can be mitigated in the SWASH™ with improved gait biomechanics at the foot and ankle, and by enhanced gait capacity. If shortening does occur, a modification in the rehabilitation program may be indicated to specifically stretch the hamstrings.

All components of sizes 2, 3 and 4 are interchangeable. Should a child experience a growth spurt in length but keep the same waist measurements, longer uprights are available so the orthosis can keep up with the child without having to buy a whole new orthosis.

Maintenance

The condition of the orthosis should be checked every three months:

Friction in lateral uprights in joint assemblies

Ensure that the lateral uprights are free to rotate within the hip joint assemblies. Friction is usually caused by accumulated dust. To clean, loosen the retaining ring in the center of the joint assembly, remove the upright and clean it with fresh water. Use a dry pipe cleaner to clean the bearing surfaces in the joint assembly.

Play in lateral uprights in joint assemblies

Play of the lateral uprights within the joint assemblies should be minimal. If it should appear to be excessive, contact CAMP Healthcare.

Thigh cuff pivots

Check that the play of the thigh cuffs on their pivots is not excessive. This may increase over time but should never interfere with the ability of the thigh cuffs to control the legs. It the amount of play appears excessive, contact CAMP Healthcare.

Liners

Liners should be clean and offer the protection the child needs for comfort. If they are excessively worn or soiled, replacement liner sets are available from CAMP Healthcare. One set can be worn while the second set is being laundered. Laundering instructions are included with the caregiver protocols in chapter 11.

Chapter Eleven

Caregiver Protocols

Wearing time

The number of hours the orthosis is to be worn should be determined by the physician. This time will vary depending on the degree of involvement of the pathology, the goals of the rehabilitation program, and the tolerance of the child. While 24 hour use may be indicated, the recommended wearing time is at least six hours per day, usually during periods of highest activity. The SWASH™ may also be prescribed to be worn at night to control nighttime scissoring.

Fitting over / under clothing

If the child is not managing their own toilet, the caregiver typically applies the orthosis over clothing. If the child is managing their own toilet, the SWASH™ can be fit under clothing at the caregiver's discretion.

Liner care instructions

The liner in the orthosis is attached with hook and pile. It may be removed, hand washed in cool water with mild laundry detergent, and flat dried. Replacement liners are available through your orthotist.

Skin care

Red marks that appear as a result of wearing the orthosis should disappear within 30 minutes of removing the orthosis. The most persistent red marks are usually on the inside part of the thigh under the thigh cuff. Consult your orthotist if the red marks do not disappear within 30 minutes after removing the orthosis.

Follow-up with your orthotist

A one week post-fitting check-up is usually recommended to assure the integrity of the orthosis. Subsequent three month check-ups are recommended to assure the proper fit and function of the orthosis.

Chapter Twelve

SWASH™ Benefits and Outcomes

Benefits

- Limits or controls adduction when standing and walking to prevent scissoring
- Provides additional abduction for muscle lengthening and sitting stability
- Provides support throughout the day
- Limits adduction during the night
- May prevent hip dislocation caused by strong adductors
- Controls hip position post-operatively
- Can prolong effects of other treatment modalities
- Maintains muscle length
- May delay, serve as an alternative to, or prevent surgery

Outcomes

- Improved ambulation when wearing the orthosis. "Gait scores showed improved pelvic symmetry, better knee clearance, and progression in functional walking scales in most cases" [8]
- Longer walking distances using less energy is reported by some parents
- Vertical positions and dynamic walking is associated with improved bladder and kidney functions
- Improved trunk control facilitates upper body function for enhanced stretching and other exercises to improve muscle control and coordination skills
- Often helps the child overcome pathological movement patterns
- Improved sitting balance means the possibility of using both hands to perform tasks such as eating, playing, manipulating objects, and interacting with others instead of holding the sitting surface for touch balance
- Early mobilization may also reduce subluxation and dislocation of the hips
- Neutralizing the dislocating forces secondary to high adductor tone may arrest or reverse hip subluxation

Appendix I

Frequently Asked Questions about SWASH™

Is the SWASH™ usually worn over or under clothing?

Generally if the children are managing their own toilet the SWASH™ is fit under clothing. if the children are not managing their own toilet, the SWASH™ is fit over clothing.

Doesn't the SWASH™ actually strengthen adductors?

The opposite is true. The SWASH™ seems to enhance neuromuscular control, possibly because of enhanced proprioception due to the external pressure it applies to the distal thigh and the pelvic girdle. It also directs the pathways of motion for the lower limbs thereby reducing the need for muscle activity to overcome adduction. The result is that there is actually less spasticity during gait with the SWASH™ than without it. The adductors generally lose some tone with continued use of the SWASH™.

When will patients progress to not needing the SWASH™?

The SWASH™ helps manage the consequences of high adductor tone. While there is some carryover in lessened adductor tone after use of the SWASH™, that tone will generally return if SWASH™ use is totally discontinued.

Will AFOs still be necessary?

The SWASH™ does not significantly alter the need for AFOs. It may, however, change the design criteria for some patients. Because the SWASH™ has a significant influence over transverse plane rotation of the lower extremities, AFOs will generally need to be set up in relatively neutral position relative to rotation. If possible, they should also be designed with articulating ankles with ROM control to maximize the potential of closed chain stretch to the heel cord and ham strings during gait.

How long should the patient wear the SWASH™ each day?

The SWASH™ is generally worn about six hours each day. It is worn during periods of greatest activity. It can also be very appropriate for use as a night splint.

Are there any side effects to using the SWASH™?

Pressure marks may be evident on inside thigh where the SWASH™ overcomes the forces of abnormal adductor tone. These marks should disappear within 30 minutes of removing the SWASH™.

The child still seems to sit in too much spinal flexion. Can anything be done about that?

First, make sure the child is in 115° uprights (fig 4-5). If it is still a problem, teach the child to exaggerate forward bending as soon as they sit down and then sit up. This spreads the thighs and allows a more erect posture while sitting.

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SWASH™ Parts List

Model / Size	Description
	LATERAL UPRIGHTS SET: Includes one left an one right pre-shaped upright, two retaining rings and two set-screws
02700-01	6mm Lateral upright set, 123°
02700-02	7mm Lateral upright set, 123°
02700-03	7mm Lateral upright set, 123°
02700-04	7mm Lateral upright set, 123°
02701-01	6mm Lateral upright set, 115°
02701-02	7mm Lateral upright set, 115°
02701-03	7mm Lateral upright set, 115°
02701-04	7mm Lateral upright set, 115°
	JOINT ASSEMBLY: Includes one each slotted base plate, nylon bushing and washer: two each Allen screws, plastic covers
02702-01	Joint Assembly for size 01
02702-02	Joint Assembly for sizes 02, 03 & 04
	PLASTIC COVER FOR JOINT ASSEMBLY: Includes two plastic covers only
02703-01	Plastic cover for joint assembly size 01
02703-02	Plastic cover for joint assembly sizes 02, 03 & 04
	RETAINING RING SET FOR UPRIGHTS: Includes two each retaining rings and set screws
02704-01	Retaining ring set for size 01 uprights
02704-02	Retaining ring set for size 02, 03 & 04 uprights
	REPLACEMENT SCREW/BUSHING SET: Includes four Allen screws, two large set screws, two small set screws, two brass bushings
02705-01	Replacement screw/bushing set for size 01
02705-02	Replacement screw/bushing set for sizes 02, 03 & 04
	RUBBER TIPS for LATERAL UPRIGHT: Includes two rubber tips
02706-01	Rubber tip for size 01 lateral uprights
02706-02	Rubber tip for size 02, 03 && 04 lateral uprights
	ALLEN KEY SET: Includes three sizes Allen wrenches
02707-01	Allen key wrenches
	PADDING SET: Includes front and back waistband set, two thigh cuff pads
02710-01	Padding set for size 01
02710-02	Padding set for size 02
02710-03	Padding set for size 03
02710-04	Padding set for size 04
	THIGH CUFF SET: Includes one left and one right plastic cuff with removable padding, one retaining ring assembly including two retaining rings, two set screws and two brass bushings
02716	Size 01 Thigh Cuff set for 7mm uprights
02717-01	Size 01 Thigh Cuff set for 6mm uprights
02717-02	Size 02 Thigh Cuff set for 7mm uprights
02717-03	Size 03 Thigh Cuff set for 7mm uprights
02717-04	Size 04 Thigh Cuff set for 7mm uprights
	TRUSS STUD SET: Includes two studs, screws and lock washers
02711	Truss Stud Set (for abdominal belt closure)
	THIGH CUFF SNAP CLOSURE: Snap closure with D ring
02712-02	Snap closure for sizes 01 & 02
02712-04	Snap closure for sizes 03 & 04

SWASH™ *Clinical Manual*

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