

This Information Sheet has been written by Chris Drake, Dip OTC, M.B.A.P.O. (Orthotist) Chris is a fully qualified Orthotist registered with the Health Professions Council (HPC). He has been in full practice since he qualified in 1983. This Sheet aims to answer your questions about ankle and foot orthoses – what they are, what they do and what the differences are between them. The sheet was written with children in mind, but is equally relevant to adults, and quotes some adult users on their orthoses.

What are AFOs?

Ankle and Foot Orthoses (AFOs), or splints, are external devices which are used to:

- correct or prevent a physical deformity
- stabilise a joint or joints
- reduce pain
- improve mobility or performance
- reduce the risk of injury

They have been used for many years to help manage the walking pattern (gait) of children with hemiplegia. They are used in preventing unwanted and uncontrolled movements associated with muscle imbalances, weakness or increased tone (tightness) in the lower leg and the foot and ankle.

Posture problems in children with hemiplegia

Abnormal movement in children with hemiplegia usually means a tip-toe walking pattern (**Equinus** or **Plantarflexed Gait**) with the added complication of the ankle becoming twisted outwards (**Varus ankle**) or collapsing inwards (**Valgus ankle**).

The adoption of a toe-walking gait also leads to secondary problems:

- the knee cases tends to snap backwards further than it would normally (hyperextension or back kneeling)
- hyperextension of the knee in turn has a harmful effect on hip position, pelvic stability and symmetry, and this can affect the child's balance and general posture
- the arm on the affected side will also react as the child fights to maintain his/her balance when walking.

I am aware that when I walk, my arm comes up, it is almost a balance thing, and it has got worse as my walking got worse if that makes any sense...It's not as bad when I have a splint on my leg doing its job properly

I am sure many parents will be familiar with this type of walking, which not only affects the child's posture, but also increases the potential risk of the development of contractures (shortening) of tendons and muscles, leading to permanent stiffening of the ankle and knee in later life.

How ankle and foot orthoses can help?

One way to help prevent this type of walking is to fit a below-knee ankle/foot orthosis (AFO) which can help control any abnormal movement of the foot and ankle during walking, play or rest.

- A well made and close fitting AFO will help stabilise the foot and ankle to bring about ankle stability and improve balance, posture and confidence.
- Controlling the foot and ankle will also influence hip and knee position in a positive manner and in turn lead to potential improvements in the child's gait, balance and posture.
- The foot plate of the AFO can be flat or contoured depending on the child's requirements. Insoles can be incorporated into the AFO to help maintain a good foot posture.
- Modifications can also be made to the outside of the AFO or even the child's footwear after fitting to "fine tune" the AFO. Small post-supply adjustments can also increase the effectiveness of the AFO; this is most commonly carried out to adjust heel height, which changes the angle of the lower leg in relation to the ground when walking (tibial shaft angle).

An AFO should never be uncomfortable for a child to wear and he or she should be able to wear it happily for most of their active day.

The history of orthoses

- AFOs used to be made of traditional metal and leather and then fitted to a supportive orthopaedic boot or other type of footwear. These tended to be heavy, unsightly and ineffective in maintaining the correct position of foot and ankle. Over a period of time what control they did offer would slowly reduce, as the footwear and leather straps softened and became misshapen.
- The advent of mouldable plastics meant that lightweight total contact AFOs could be made from a cast taken of the child's lower leg in a corrected position. The close fit of the thermoplastic AFO gives improved control and greater effectiveness.
- A modern AFO should be able to fit into the child's own footwear (not always problem free but usually possible), which means he or she will be more willing to wear it.
- AFOs can be made with a solid ankle complex which holds the foot and ankle at 90° to the lower leg (**neutral plantargrade position**). This prevents the foot and ankle from being pushed down (**plantarflexion**) and prevents the development of a toe-walking gait.
- AFOs can also have a certain amount of ankle movement built into them. This can be done by incorporating a mechanical ankle joint into the design of the AFO. Ankle joints allow movement at the ankle to be controlled and limited to a specific range of movement.

What is Dorsiflexion and why is it important?

Unfortunately a solid ankle AFO means that it is not just incorrect movement that is restricted: all movement of the foot and ankle is lost. The loss of this movement (**dorsiflexion**) is undesirable in some children with hemiplegia.

- Dorsiflexion allows many functions to be achieved easily without overstressing other joints.
- Without dorsiflexion, gait tends to be jerky and stick-like, as it is difficult for the body and leg to pass over the affected foot and ankle.

- Without dorsiflexion the energy needed to walk increases.
- Dorsiflexion also occurs in many other daily activities such as standing from sitting, sitting from standing.

Next time you are walking uphill, going up or down stairs, getting up from a chair or bending down to tie your shoelaces, concentrate for a moment on your foot and ankle position. You will notice the importance of dorsiflexion in all these activities.

Solid Ankle AFO

The fitting of a solid (fixed) AFO can be very effective at preventing a toe-walking gait as well as sideways movements of the ankle (Valgus & Varus movements) but it can hold back the child's development by not allowing Dorsiflexion to occur.

- Solid AFOs can be used very effectively in providing stability and encouraging a good base of support in young children with hemiplegia.
- Typically you may find that when a child starts to pull to stand and cruise around furniture a fixed AFO is the best option. It will provide support and give confidence when a child needs it most.
- Solid AFOs are also used where an existing contracture (muscle or tendon shortening) already exists and that the child may not have any ankle movement present. crouching, going up and down stairs, walking up hill and, let us not forget, walking backwards.

Articulated or Hinged AFO

The hinged AFO is in many ways very similar to the fixed ankle type. During the manufacture of the hinged AFO a simple mechanical joint is fitted at the level of the ankle axis and incorporated into the moulding. A backstop is also fitted behind the ankle to prevent plantarflexion (toe walking).

- A hinged AFO allows the required amount of dorsiflexion to occur while preventing all plantarflexion past 90 degrees (Plantigrade 90 degrees).
- A hinged AFO provides the same medial and lateral stability of the ankle as a solid ankle AFO and therefore prevents valgus or varus positioning.
- A hinged AFO can allow for a more natural, fluent gait, while allowing the foot and ankle to dorsiflex during other daily activities such as standing from sitting, sitting from standing, crouching, going up and down stairs, walking up hill and walking backwards.

Do all children with hemiplegia need an AFO?

Not all children need an AFO. But those who do not have the problems of a toe walking gait may still have general weakness or some instability of the ankle joint complex. This can lead to problems of balance, such as a very wide base during walking and general loss of confidence.

- The ankle may tend to collapse into a varus or valgus position.
- When the back foot is held in a valgus position (collapsing inwards), the arch of the foot tends to flatten along with it (overpronation).
- A varus back foot position (twisting outwards) tends to create a high arched foot (supination).

In cases like this, the fitting of **foot orthoses** can be helpful in reducing unwanted foot and ankle positions and consequently improve balance and posture.

Different types of foot orthoses

The orthoses which can help with the problems of ankle and foot instability range from simple supportive footwear to footwear with adaptations to complex multi-material biomechanical and functional foot orthoses.

Footwear alone has little effect over severe foot instability, but is useful in offering improved stability of an unstable ankle when the child starts to walk. The special footwear has a wide, flat, good-gripping sole with increased stiffening around the ankle and this can help give the child a greater sense of balance. But be aware that the foot itself may still roll around inside the boot unseen and therefore careful fitting of this type of footwear is essential.

I was upset when H was given her first pair of Piedros, she was so dainty and was going to have to wear great big clumpy boots, but she loved them, and we made them pretty with frilly ankle socks. She only took them off for bed, they were her 'special boots'

- Adaptations to footwear, such as wedges to the inside (Medial) or outside (Lateral) of the boot, can help increase the control over unstable ankles.
- Foot orthoses can be incorporated into the footwear to improve foot stability and these usually come in the form of insoles with arch support and heel cups which are extended up around the heel but finish below the ankle.
- Both these types of foot orthoses may have special wedging (posting) fitted, either to the outside (extrinsic) or built into the orthoses (intrinsic) when manufactured. The posting or wedging is fitted to produce a correcting force on the heel when the child is weight-bearing or walking.
- These foot orthoses are usually made of lightweight thermoplastics and made from a cast of the child's foot in a corrected position.

I currently am using a specially made insole which has had fantastic results. Before getting it I was told I would have to have an operation as that was the only option left. Though since getting it my foot has dramatically improved as before my ankle was rolling outwards and my foot was turning in, now the ankle is completely central and as I have been religiously wearing the insole my foot is now starting to self correct itself. Due to this I now don't need an operation for a while.

It is important to note that the un-affected foot must also be examined and will probably need to have an orthosis fitted too. This may not be the same as the opposite leg and may only be a levelling insole but it will encourage symmetry and improve balance.

Supramalleolar Orthoses (SMOs) and Dynamic Ankle Foot Orthoses (DAFOs):

Supramalleolar Orthoses **SMOs** (orthoses which finish just above the ankle) or Dynamic Ankle Foot Orthoses (**DAFOs**) come in a variety of designs. They are very useful in improving medial and lateral stability around the ankle.

- They offer little control over increased high tone (muscle tightness), excessive dorsiflexion or plantarflexion. They are therefore ineffective at correcting a medium to severe toe-walking gait pattern. They do not provide a great deal of control of the foot and ankle during the swing phase of gait or when non-weight bearing.
- They do however promote good weight bearing and this in turn can lead to reduced toe walking and also a reduction in the tightness of the muscles.

- SMOs and DAFOs stabilise the mid and hind foot when the child is standing or when the affected leg is in a weight-bearing position during walking (stance phase of gait). This must be taken into consideration when the child is assessed. They are often used when a child is developing skills and their gait is developing so their need for an orthosis gradually decreases.
- SMOs or DAFOs tend to have a fully contoured footplate. This is designed to maintain a good basic foot posture and reduce muscle tone and also such problems as toe clawing. These are known as **Neurological Modifications/Footplates** Separate neurological insoles can be fitted inside the orthosis rather than the actual footplate of the orthosis itself being altered.

Design Criteria

Whatever types of orthoses are recommended or fitted, they share many common design points and try to provide some or all of the elements below:

- hind foot stability (close moulding around heel)
- mid-forefoot stability (medial & lateral extensions, good arch support)
- control of unwanted exaggerated and abnormal movements
- reduction of the effects of increased tone (spasticity)
- promotion of a stable base
- encouragement of good standing position with equal weight bearing on both feet.
- toe and Metatarsal support (tone management)
- contoured sole plates to assist in foot stabilisation (tone reduction)
- construction from semi flexible or rigid materials (polypropylene, polythene etc)

Conclusion

Orthoses are never an answer in themselves but in many cases they are an extension of the therapist's arm while away from hands-on active treatment. The goal of orthotic management should be to provide the least amount of orthotic hardware possible to encourage and promote the child's own abilities in achieving a normal gait pattern.

It is important that a full assessment is carried out in a relaxed environment to ensure that the correct orthotic prescription is made. A quick 10-15 minute consultation in a busy clinic to make the decision on orthotic provision and design will most probably not lead to the best outcome. Once fitted with an orthosis, the child needs to have regular reviews to ensure the continued effectiveness of the orthosis as the child develops and grows.

At the time when a child grows out of his/her orthosis always ask yourself the question: **Does my child still need this type of orthosis?** Therefore a full assessment must be carried out again to review the type of orthotic management the child needs.

*You can find information on shoes suitable for wearing with an orthosis on **HemiHelp's Shoes** sheet. HemiHelp also sells '**Hands Up for Andie**', a children's book about a little girl who wears a splint.*

HemiHelp has a range of information sheets for both families where there is a child with hemiplegia and adults with the condition, as well as a Useful Names and Addresses List to help you contact other organisations.

***Hemiplegia** is a neurological condition that weakens one side of the body and affects one child in a thousand. It is sometimes described as a form of cerebral palsy and the effects are similar to those of a stroke. **HemiHelp** is a membership organisation offering information and support to children and adults affected by hemiplegia and their families.*

HemiHelp is happy for you to make photocopies of any part of this document.

Helpline: 0845 123 2372 (Mon-Fri 10am-1pm)

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Email: support@hemihelp.org.uk • Web: www.hemihelp.org.uk

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