Orthoses in the Management of Spasticity in the Lower Limb

Introduction

Lower limb spasticity is commonly seen in stroke, spinal cord injury, traumatic brain injury, multiple sclerosis and cerebral palsy. It commonly occurs with other neurological features such as muscle weakness, loss of muscle control and loss of sensation.

As in all other aspects of rehabilitation, there must be a multidisciplinary approach to its management. Adequate assessment of the specific impairments causing disability is necessary for appropriate interventions to be instituted.

The orthotist has a key role in advising about appropriate orthotic devices that can be used in a particular patient, prescription and manufacture of the orthosis as well as undertaking regular reviews to ensure that it continues to meet the patient's needs. In referring patients, the clinician must provide enough clinical detail and aim of referral to help the orthotist provide the most appropriate device.

Orthoses are generally used in conjunction with other interventions including physiotherapy, positioning, stretching, oral antispasticity medication and botulinum toxin injections.

Orthoses

Orthoses are external devices designed with the aim to affect body function and/or assist function.[1] They may be prescribed in patients with lower limb spasticity with the aims of:

- Decreasing muscle spasticity by increasing muscle length through providing a prolonged stretch and exerting an inhibitory effect through sensory stimulation.
- Breaking up mass patterns of movement
- Improving biomechanics and improving stability

Use of orthoses may create problems by serving as a resistance against which the patients' spasticity is exacerbated, causing immobilised muscles to atrophy or increasing spasticity in more proximal muscles.[2] Impaired sensation increases risk of pressure ulceration.

Specific Orthoses

Ankle contracture boots

These are useful for management of mild to moderate spasticty and contracture at the ankle especially in non-ambulating patients. They provide a stretch by means of a foot positioner, adjustable for various degrees of plantiflexion, straps to vary inversion and eversion and a cut-out in the lining foam to protect the heel and prevent pressure ulceration. Some versions incorporate an ambulation pad. A commercially available example is the Leeder Multi Use Boot (Medistox Ltd) (Figure 1).

Figure 1 as courtesy of Medistox Ltd

Ankle-Foot Orthoses (AFOs)

These are commonly prescribed for patients with lower limb spasticity to help substitute for inadequate muscle function during key stages of the gait cycle, optimise alignment and manage abnormal muscle tone.[3,4]

AFOs range from off-the-shelf to custom-made and are commonly made of carbon fibre (ToeOFF™ splint) (Figure 2) or plastic. They may be articulating to allow sagittal plane movement at the ankle. Various features may be incorporated in them to help manage specific problems which are identified during the assessment process. A description of the huge range of AFOs is beyond the scope of this article but some specific examples are mentioned below:

- A dynamic ankle-foot orthosis (DAFO) (Figure 3) is a very thin flexible supramalleolar orthosis with a custom contoured sole plate to include support and stabilisation of the dynamic arches of the foot.[5] DAFOs are commonly used in the paediatric population, especially in children with cerebral palsy.

- Some children with diplegic cerebral palsy have weakness in the quadriceps and ankle plantarflexors and walk with excessive knee flexion and ankle dorsiflexion (crouch gait). This may be corrected by use of a rear entry ground reaction AFO which creates an extending moment at the knee to help produce a more upright gait.

- The Thonnissen support (Röck Orthopädie) (Figure 4) is an articulating carbon fibre AFO with adjustable elasticated dorsiflexion assist straps which allows greater range of movement at the ankle than a standard ToeOFF™ splint.

- In comparing metallic and plastic AFOs, Gok et al[6]

Figure 2

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Figure 3

found that metallic AFOs were better at increasing ankle dorsiflexion angles. They concluded that these provided better stabilisation at the ankle, improving heel strike and push-off.

- Evidence of the efficacy of AFOs in children and adults is inconclusive. Most studies have used small numbers of patients with no long term follow up. Morris[7] in a review concluded that the efficacy of orthoses to help in overcoming functional limitations and preventing contractures (in cerebral palsy) remains to be established. Likewise Leung and Moseley[3] highlighted the lack of large well designed studies of their efficacy in hemiplegic adults.

Contracture Correction Devices

Contracture refers to shortening of muscle with reduced passive range of movement as a result of prolonged maintenance of muscle in a shortened position.[8] It frequently occurs as a result of inadequately treated spasticity.

Serial casting is frequently used in the management of contracture. In this a cast is applied over the affected joint and periodically changed to increase the stretch on the affected muscle, decreasing tone and leading to increase in range of movement.

Contracture correction devices have been developed as an alternative to serial casting. They essentially consist of a hinged orthosis which spans the affected joint to which a mechanism for applying a continuous but adjustable

Figure 4

level of stretch by means of a coil spring, gas spring or clockwork spring is attached.[9] The tension in the device can be set so that it can be overcome eg by a spasm. In one trial, knee contractures were reduced by an average of 10.7° in four weeks.[10]

One commercially available version is the Advance Knee Brace (Technology in Motion Ltd) (Figure 5). Advantages of this over casting include decreased staff time spent in recasting, ability to provide an accurate amount of stretch, ease of skin inspection to minimise risk of pressure ulceration and ease of fitting. Some devices may be refurbished for re-use potentially reducing costs in the long term.

Tone inhibiting insoles

In some patients hyper-extension of the hallux may lead to difficulty or discomfort in walking. For such patients a bar made of firm sponge rubber and on a flat insole base may be placed proximal to the metatarsal heads. This has the effect of offloading the metatarsal heads and encouraging plantar-flexion of the hallux, relieving pain and build up of callus under the head of the first metatarsal. This may be used in conjunction with Botulinum toxin injections to the extensor hallucis longus to reduce tone.

In the published literature Iwata et al[11] have described the use of an inhibitor bar placed distal to the metatarsal heads on an AFO. This has been shown to improve the walking ability of hemiplegic patients with tonic toe flexion reflex.

Conclusion

As in all other aspects of rehabilitation, a multidisciplinary approach is essential for the management of lower limb spasticity. There exists a huge range of orthotic appliances, including various types of AFOs for management of spastic equinus/equinovarus deformity at the ankle, contracture correction devices and tone inhibiting insoles. The input of an experienced orthotist is invaluable in assessment and selection of the appropriate orthosis, however adequate clinical information and aim of referral should be provided to facilitate this.

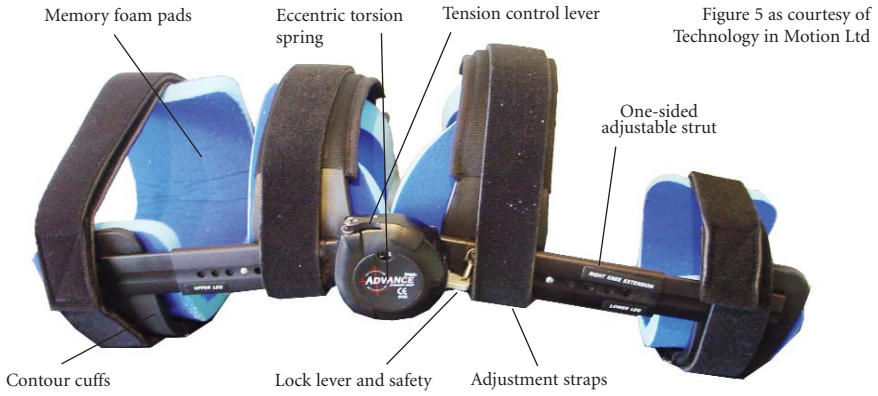

Figure 5 as courtesy of Technology in Motion Ltd

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Sources of Further Information

Books

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Websites

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British Association of Prosthetists and Orthotists.

www.recal.org.uk -
Bibliographic information about the literature of prosthetics, orthotics and related physical medicine and rehabilitation engineering.

www.strath.ac.uk/prosthetics -
National Centre for Training and Education in Prosthetics and Orthotics, University of Strathclyde.

Websites of Orthotic Companies:

www.technologyinmotion.co.uk - Technology in Motion Ltd
www.medistox24.com - Medistox Ltd
www.roeck.de - Röck Orthopädie