Callipers

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The word calliper is often used interchangeably with braces or orthoses to describe external supportive devices for the leg. Generally, the term orthosis (derived from orthos meaning to straighten) should be used to describe a device applied to the external surface of the body to improve function. Leg orthoses can be divided into (a) foot orthoses such as insoles and heel wedges; (b) ankle-foot orthoses, which extend above the ankle; (c) knee-ankle-foot orthoses; and (d) hip-knee-ankle-foot orthoses. Although leg orthoses have popularly been referred to as callipers (probably based on the similarity of the construction of early callipers to the measuring instrument of the same name), the term "brace" (more commonly used in the United States) is perhaps now more appropriate and is becoming more widely used.

Ankle-foot orthoses

Ankle-foot orthoses are the most commonly prescribed and illustrate well the construction and functions of leg orthoses in general. There are two types: conventional orthoses of leather and metal construction and contemporary orthoses made from thermoplastics (most commonly ortholene and polypropylene).

Conventional ankle-foot orthoses consist of one or two metal uprights connected proximally by a leather calf band and distally to a mechanical ankle joint. The calf band should rest 4 cm below the tibial condyle and not impinge on the peroneal nerve below the fibular head. There should be room to insert a finger between the calf band and the leg, and the metal uprights should not press against the leg. The orthoses may be attached to the shoe by a rounded socket in the heel (which then acts as a mechanical joint, fig 1) or by a square socket which then requires a proximal mechanical ankle joint (fig 2). Both types of orthoses restrict movement in the sagittal plane. Movement can be helped, limited, or

Functions of leg orthoses

- to provide stability for weakened, paralysed, or unstable legs
- to relieve weight bearing
- to relieve pain
- to control deformity
- to restrict movement of the joint

prevented by incorporating springs or stops at the joint. Stops can be preset to allow any predetermined degree of movement. Movement at the ankle joint may be helped or restricted by using springs or elastic straps across the joint (fig 3).

Contemporary orthoses—Orthotic design changed dramatically with the introduction of thermoplastics. The thermoplastic is shaped by applying a heated softened form to a plaster mould of the leg. They have the advantage of being light and having a more acceptable cosmetic appearance. Generally, plastic ankle-foot orthoses do not have mechanical joints. Movement at the ankle is achieved by flexing the orthosis, the shape of the orthosis around the lower calf determining the flexibility. By leaving more material anteriorly a fairly fixed orthosis can be obtained, while progressive trimming will produce a more flexible splint (fig 4). As they are in close contact with the skin their use is not advised if there is a tendency to ulceration or the legs are oedematous and prone to a change in size.

Common indications for orthoses

Flaccid foot drop—The commonest cause of foot drop is peroneal nerve palsy, usually from pressure at the neck of the fibula. It may also be a consequence of peripheral neuropathy, nerve root lesions (sciatica), and muscular dystrophies. Whatever its cause it results in the toes dragging on the floor during walking. This may be corrected by using a thermoplastic orthosis of the required structural strength and compliance to produce sufficient dorsiflexion assistance. Alternatively a conventional orthosis with a single medial upright could be used. This could incorporate either a compression spring behind the ankle joint (producing a dorsiflexion force) or a stop, which will prevent plantar flexion.

Spastic foot drop is most commonly seen after a stroke. A spastic foot tends to adopt a position of plantar flexion with a degree of inversion and external rotation. Early physiotherapy aims to reduce spasticity and seems to prevent, minimise, or retard the degree of hypertonicity. As a result few stroke victims require mechanical support of their ankle. If patients do not respond to manual therapy physical supports may have to be considered. Boots may be all that is required to enable safe and comfortable ambulation, or when there is only mild spasticity a thermoplastic orthosis may be enough to overcome the foot drop. If further mechanical support is required the appliance should be designed to keep the foot in as functional position as possible. As muscle spasm will overcome a spring of

FIG 1—Round calliper

FIG 2—Square calliper with mechanical ankle joint

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FIG 3—Springs at mechanical ankle joint to help or restrict movement

any strength that could be tolerated by the patient their use should be avoided. Here a double bar calliper fitted with plantar flexion stops should be used together with strong well fastened shoes to prevent the heel rising out of the shoe. To help overcome inversion a T (or Y) shaped strap attached to the outside of the shoe (fig 5), covering the lateral malleolus and looped around the medial upright can be added. This pulls the lateral malleolus medially, correcting the varus position. If there is a tendency towards eversion the valgus position can be corrected with a medial strap. Inspection of the heel of the shoe for uneven wear will indicate whether sufficient support is being provided. For the patient with stroke with a knee that is so weak that bracing seems necessary, providing an above knee orthosis is unlikely to be successful. Weakness of the hip muscles together with the weight of the orthosis will prevent any considerable improvement in gait.

Patients with paraplegia resulting from a lower cord lesion—for example, lesions of the cauda equina—generally benefit from mobilisation with a leg orthoses.

FIG 4—Thermoplastic splints, the left being the less flexible

The higher the lesion (particularly above T10) the less likely that orthoses are to be successful. Most patients will require a metal knee-ankle-foot orthosis, though some will manage with a plastic orthosis. The usual metal orthosis consists of two metal uprights from the upper thigh to the ankle connected by rigid posterior calf and thigh bands that keep the uprights in their correct position and are closed in the front by soft fastenings. Knee locks allow flexion of the orthosis when sitting but lock to provide stability when walking. A variety of locks is available, the most common being a drop lock (ring lock) or a bail lock (Swiss lock). Stops at the ankle joint are required to prevent both plantar and dorsiflexion.

Ankle deformity—Valgus or varus deformity of the ankle (as in rheumatoid arthritis) may be corrected simply by providing appropriate footwear. If more support is required a standard single or double upright orthosis attached to a firm shoe usually provides enough ankle stability.

Pain relief—Pain in the ankle from conditions such

FIG 5—T strap for correcting varus deformity

Checkpoints when examining a patient with an ankle-foot orthosis

Conventional orthosis

- calf band does not impinge on peroneal nerve
- a finger can be inserted between calf band and leg
- metal uprights are not pressing against the leg

Contemporary orthosis

- legs are not oedematous and prone to fluctuation in size
- legs are not prone to ulceration

General

- patient able to put on orthosis
- patient finds orthosis acceptable to wear
- wear and tear—for example, worn leather, cracked plastic
- uneven wear of shoe indicating inadequate support of ankle

as rheumatoid arthritis and osteoarthritis may be exacerbated by walking because of lateral deforming forces and the direct effect of weight bearing. The tendency to valgus deformity may be overcome by appropriate footwear. Alternatively an ankle-foot orthosis may have to be provided. A single or double upright orthoses with free movement at the ankle (no springs or stops being required as there is no muscle weakness) may provide enough support at the ankle to prevent painful lateral forces on the ankle. Relief of weight bearing pain at the knee may be provided by either a knee orthosis or a knee-ankle-foot orthosis.

Prescription of orthoses

Orthoses are available only on prescription from hospital specialists. The supply of orthoses to the NHS is contracted out to the private companies who tender the most competitive prices. They will send an orthotist to attend hospital clinics, who, with the consultant and physiotherapist, will assess the patient. Consideration should be paid to (a) what the orthosis is to achieve; (b) combining function with acceptable cosmetic appearance; (c) ensuring that the patient (and carers) know how to and are able to fit the orthosis; and (d) avoiding complications such as pressure sores. After fitting the orthosis the patient should be reviewed by the prescribing specialist, who can then "stabilise" the prescription for up to five years. During this period the orthosis can be repaired or replaced by the orthotist without specialist consultation. After this time, however, a new prescription has to be issued by the specialist after referral by the general practitioner. Provision and repair of leg orthoses are carried out free of charge to the patient.

Appendix

USEFUL READING

- McHugh B, Campbell J. Below knee orthoses. *Physiotherapy* 1987;73:380-5.
- Redford JB, ed. *Orthotics etcetera*. Baltimore: Williams and Wilkins, 1980.
- Goodwill J. Orthotics (callipers and appliances). In: Goodwill CJ, Chamberlain MA, eds. *Rehabilitation of the physically disabled adult*. New York: Croom Helm, 1988:741.