CHAPTER 39

SIMPLE BRACING TECHNIQUES

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Braces have been utilized for years to improve ambulatory function for patients with many types of conditions. Patients with paralysis were prime candidates for bracing in an era where polio was prevalent. Prior to the advent of more modern surgical developments, bracing may have been the only means by which an individual with substantial deformity or muscle imbalance could expect to function to any meaningful degree. Although clinicians may not frequently encounter conditions such as polio, bracing techniques may still be of benefit for a number of patients today. The purpose of this paper is to introduce the concept of bracing, review a few simple means of bracing, and to demonstrate its effectiveness.

ANKLE FOOT ORTHOSIS

The Ankle Foot Orthosis (AFO) is probably the most commonly employed form of bracing used today. It consists of a lightweight synthetic material that is fabricated from a mold of the patient's foot and leg. This device fits underneath the foot and across the posterior ankle and leg, being anchored at the upper leg by a leather/velcro strap(s). There are several advantages to this type of device. Typically it is very light and inconspicuous, fitting under the pants leg quite easily. The AFO usually works well in oxford and most laced casual shoes, in many instances obviating the need for a prescription shoe. Because of these features, it is typically well accepted by patients.

When prescribing an AFO there are several factors to be considered. Generally, the author leaves the selection of the actual material to the prosthetist, as this may vary depending upon the desired attributes of the brace. Polypropylene is used in many instances, especially when some degree of flexibility is desired in the brace. Graphite may be used for more rigid devices. However, the prescribing doctor should indicate the type of control that is needed, i.e., rigid or semi-flexible.

The primary indication for an AFO is a drop-foot deformity. In situations where the anterior muscle group is weak, but still capable of some function, a semi-flexible device may be adequate to hold the foot in a neutral position, yet allow some flexibility to enhance gait. However, greater overall stability may be obtained with a rigid device, especially in a patient where there is some other deformity, or with absence of anterior muscle function. An AFO may also be useful in controlling a patient with ankle instability who is not a surgical candidate or who prefers conservative options.

Prefabricated AFO devices are also available through medical supply houses in a variety of sizes. These may be of some limited benefit in a few circumstances. The author most commonly employs this type of device in patients with nerve problems involving the dorsal foot and/or ankle, and has found this simple modality to make a significant difference in a number of individuals. In patients with nerve injury or neuropraxia, traction on the tissues will exacerbate symptoms, possibly precluding resolution of the complaints. This is particularly problematic when the patient is asleep. An AFO will splint the foot in a more rectus position, alleviating plantarflexion and traction on the nerve. At night, this can be maintained in position on the leg with an ace wrap. The prefabricated splints will usually require some modification to fit comfortably. The author has found the most common complaint to be irritation at the malleolar level where the device tends to extend too far anteriorly. This problem is easily remedied by grinding this portion of the AFO down to a less prominent level. It can also be padded with synthetic viscolastic gel material for improved comfort.

An AFO may not be the best option for a patient where there is considerable deformity within the foot. In the author's experience, although the device is molded, there is a limited ability to adequately provide the protection that may be required over an osseous prominence, especially in a patient with neuropathy. While padding the AFO itself may be beneficial, the ultimate effect is typically less than that seen with

a good custom orthotic device. Furthermore, it would appear that one would also have a more difficult time accommodating a patient with a significant equinus deformity, which may at times accompany the loss of anterior muscle function.

UPRIGHT BRACE

The upright brace is a more traditional means of providing support and stability to a limb, but in many instances may prove to be a superior modality to the AFO. This device consists of two metal bands that fit along the medial and lateral sides of the foot, ankle and leg (double upright brace), or a single band that fits on either side (single lateral or single medial upright) (Fig. 1). The brace is articulated at the ankle and a variable amount of motion can be provided, depending upon the needs of the patient. The device anchors to the proximal leg via a leather/velcro strap in the same fashion as the AFO. This is more conspicuous than the AFO and requires a special shoe or at least some shoe modifications. In particular, metal slots will need to be incorporated into the heel of the shoe to receive the stirrup for the brace at the foot level. A rigid shank is usually preferable to prevent excess bending stress from being transferred from the brace to the mid or rearfoot area. Alternatively, a synthetic sole may be employed. This is typically a wedge design as opposed to being a separate heel.

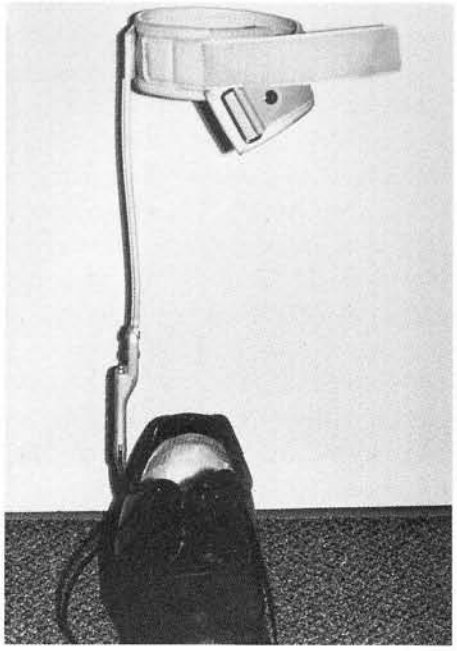

Figure 1. Single lateral upright brace.

One of the primary criteria for choosing between an AFO and a more traditional brace will be the degree of deformity and accommodation required for the foot. More significant problems can usually best be protected via a depth oxford with an accommodative orthotic or else a molded shoe. This will work better in conjunction with a brace.

Depending on the rigidity of the device, all braces will alleviate bending force at the ankle to some extent. The clinician will need to specify how much motion is desired in the articulation of the brace. It is the author's belief that the bending forces placed upon the foot during gait are the greatest potential source of disruptive forces. For most patients, direct vertical loading stress is of secondary importance. Therefore, in most cases where there is significant deformity or risk to the foot, the ankle of the brace will be locked at neutral so that much of the stress during propulsion is transferred to the brace as opposed to the foot. One may alternatively allow some degree of plantarflexion in the brace, but then limit the dorsiflexion to neutral (90°). This will allow the patient to maintain some motion at the ankle, which may be helpful in daily activities such as driving.

A rocker sole is another useful addition that one may consider if the ankle is to be locked. This will allow greater ease of adjusting to the rigid nature of the brace, and further reduce bending forces acting upon the foot. The author will instruct the pedorthotist to provide a rocker sole of a certain height (i.e., 1/4 inch), with instructions as to how the sole is to be shaped. Generally, the sole is left full thickness at the heel with the bevel beginning just proximal to the metatarsophalangeal joint level. If the rocker is to be used on one side, consider having the pedorthotist/ prosthetist build up the contralateral sole an equivalent amount to balance the two limbs.

The presence of an ankle equinus deformity will have a significant impact upon the bending force exerted upon the foot. Alleviation of this problem can be accomplished via tendo Achillis lengthening or with an appropriate heel elevation in the shoe. With a brace, one can also add an appropriate heel raise to the shoe to balance an ankle equinus deformity. It would appear that an AFO would be more limited in this capacity.

While a single lateral upright brace is a good means of providing stability, a double upright

brace will more effectively neutralize bending forces, especially when combined with an appropriate heel raise for the equinus deformity. Providing support and protection when both limbs are at risk is more difficult. Generally, if a double upright brace is used bilaterally, the patient will have difficulty ambulating without the two medial portions of the uprights hitting. When bilateral control is required, the author prescribes a double upright brace for the limb considered most at risk, and a single lateral upright brace for the contralateral extremity (Fig. 2).

Figure 2. A patient who requires additional protection on both extremities. In this case, a double upright brace is prescribed for the limb at greatest risk. A single upright is used on the contralateral side. Using a double upright on each extremity would make weight bearing difficult as the two medial uprights would tend to hit together with ambulation.

An additional modification that may benefit some patients is a T-strap. This is a padded leather strap that fits around the medial or lateral aspect of the ankle on one side, and around the upright of the brace of the opposite side. This is helpful in attempting to control any excess pronatory or supinatory stress within the foot or ankle. This may be of benefit in patients who otherwise may not be surgical candidates. Examples include patients with equinovarus deformity following a cerebral vascular accident, or a tibialis posterior rupture with a collapsed pes valgus deformity. In the latter circumstance, a medial T-strap would be employed to wrap around the medial ankle with the adjustable leather strap anchored to the lateral upright of the brace. By tightening the strap one may help to support the ankle in a more rectus position.

PATELLAR TENDON BRACE

The patellar tendon brace is essentially a double upright device with a molded socket to fit around the knee (Figs. 3A, 3B). This brace will not only eliminate bending forces, but will reduce vertical load, although primarily at the rearfoot and ankle levels. It is best used in patients with significant ankle problems such as a Charcot joint with instability, or in individuals with problems about the calcaneus. This brace is much more cumbersome to apply and is not as easily accepted by patients. However, it does provide an extra measure of protection and may be considered when a double upright brace or AFO have proven ineffective.

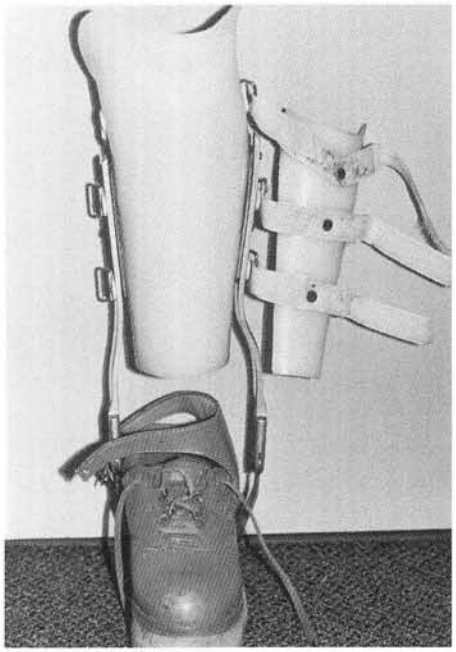

Figure 3A. A patellar tendon brace. Note the contouring for the knee to accept weight from the leg.

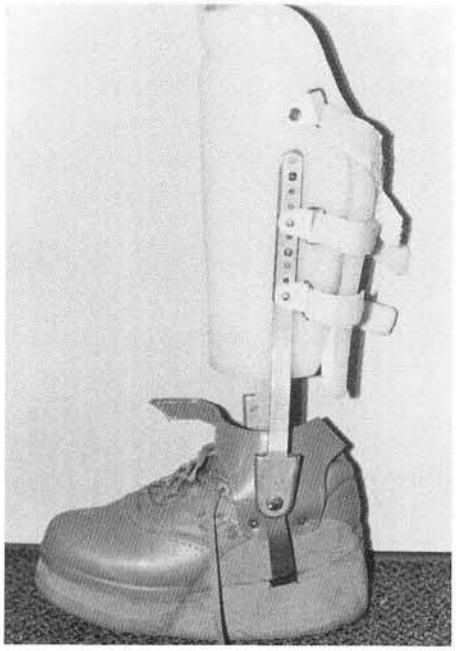

Figure 3B. Note the rocker sole on the shoe to assist weight transfer.

BIBLIOGRAPHY

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