Orthotic Design from the New England Regional Spinal Cord Injury Center

Suggestion from the Field

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Long-leg bracing affords ambulatory potential and helps reduce the incidence of deformity in patients with paralysis or weakness caused by lesions of the spinal cord. The conventional long-leg brace or knee-ankle orthosis (KAO) consists of double metal uprights, drop locks or bail locks at the knee, double action ankle joints with anterior and posterior pin stops, metal stirrup, and steel shank extending to the metatarsal heads. Uprights are fastened to the leg with various combinations of thigh and shank bands.

In the Craig-Scott Orthosis (CSO), Scott refined this design by minimizing the number of leg bands so that three-point knee stabilization comes from a rigid anterior closure below the knee coupled with a thigh band superiorly and a heel counter inferiorly. In addition, the knee joints are displaced 0.75 to 0.73 in* posterior to the transverse axis of the knee and behind the weight-bearing line. This position creates an extension moment that enhances stability while easing pressure on the locking mechanism and on the skin under the pretilial restraint.

In 1981, we at the New England Regional Spinal Cord Injury Center (NERSCIC) sought to develop a KAO that incorporated the superior features of the CSO but eliminated the need for heavy, custom-made shoes and mechanical ankle joints. Our intent was to devise a durable, light-weight orthosis that would be cosmetically acceptable to the wearer and would cost less than currently available KAOs. To this end, we combined double metal uprights with a molded plastic ankle-foot orthosis (MAFO) (Fig. 1).

The components of the NERSCIC orthosis consist of ankle-foot support from a MAFO .25-in thick, stress-relieved polypropylene, vacuum molded to a positive cast. The ankle can be fixed in a prescribed degree of plantar flexion or dorsiflexion; however, we have found the neutral to 5 degrees of dorsiflexion position quite satisfactory for ambulation. Medial and lateral aluminum uprights (0.73 x 0.25 in) are triple riveted to the MAFO. To increase knee stability, stainless steel drop lock knee joints are offset 0.75 in posteriorly. The medial upright ends 1.5 to 2 in below the greater trochanteric terminus of the lateral post. A proximal thigh band slants medially to avoid contact with the ischium. The band includes a padded solid aluminum posterior segment and a leather anterior thigh cuff with Velcro closure belt. An aluminum cuff across the tibial flare completes the three-point support system. Tibial pressure relief is provided by .50-in high density, foam padding. Laterally, two Jewett back brace snaps hold the cuff in place (Fig. 2).

Depending on leg length, the completed orthosis weighs between 3 to 4 lb.† Overall weight with shoe can also be kept to a minimum because the individual can select from a variety of

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Fig. 1. Front view of NERSCIC orthosis.

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* 1 in = 2.54 cm.

† 1 lb = 0.45 kg.
lightweight footwear. Athletic shoes with nylon uppers and Velcro closure straps are frequently chosen for appearance and convenience. Shoes one-half size larger than regular usually accommodate the molded ankle-foot orthosis inserts. Because no custom shoe needs to be fabricated, cost is reduced. Moreover, when bracing is indicated, the use of plastics can shorten the interval from casting and construction to initial fitting to approximately 10 days.

In cases of spinal cord injury, ambulatory training with orthosis usually begins about eight weeks after injury. Once ambulatory training has begun, changes in leg volume because of resolving edema and alteration in muscle bulk may warrant brace adjustment. By six months after injury, however, leg size generally stabilizes, and further modification is unnecessary for most orthosis wearers.

An individual with an incomplete spinal cord lesion may require KAOs for early ambulation. As strength improves, uprights can be detached leaving only the MAFO component. This modular aspect adds flexibility and underscores the cost-effectiveness of this orthotic system.

Over the past three years, 22 bilateral and 6 unilateral NERSCIC braces have been fabricated. A limited number have also been fitted outside our facility. We have not seen any instances of breakage or received reports of malfunction from former patients who still use the orthoses for functional or exercise ambulation. A formal follow-up usage survey has a projected completion date of spring 1985.

In conclusion, the indications for using this orthosis include
1. Individuals with complete injuries below T6 or individuals with incomplete injuries who are functionally capable of standing.
2. Static circumferential measurements (not greater than 1 cm/day change).
3. Full hip range of motion.

All current information indicates that this is a lightweight, sturdy alternative to the conventional, long-leg orthosis.

REFERENCES