The Hip-Abduction, Knee-Extension Orthosis (HA, KE) is designed to aid in preventing or correcting deformities in spastic hip abductor and hamstring muscles when stretching and exercise do not suffice. Spasticity in this group of muscles is not uncommon in paraplegia or in other selected diseases of the central nervous system—for example, in multiple sclerosis.

The orthosis consists of bilateral knee extension splints separated by three dowels progressing in length distally (Figures 1 and 2). The major objective in the design of this orthosis, unlike commercially available splints that stretch only the hip abductor muscles, is to stretch both the hip abductor and knee flexor muscles.

Muscle relaxation can result from the activity of the golgi tendon organ, which resides in the tendon of the muscle. Physiologist Guyton states, “When tension on a muscle and therefore on the tendon becomes extreme, the inhibitory effect of the golgi tendon organ can be so great that it causes sudden relaxation of the entire muscle.” *(1, p 165)*

Another objective for the orthosis is to provide a device that can be managed independently by the patient. The relative compactness and lightness of the orthosis make this possible.

**Materials and Construction**

Exact quantities are not listed because they will vary with the patient’s size and condition.

**Materials.** Orthoplast; 2.5-cm (1-inch) diameter dowel; 1.25-cm (½-inch) foam padding with adhesive backing; 0.3-cm (⅛-inch) foam padding with adhesive backing; 3.8-cm (1½-inch) Velcro; 3.8-cm (1½-inch) canvas webbing; moleskin lining; and pre-bond glue.

**Construction.** The following are instructions for fabricating a single knee extension splint. Paddings, which are made thicker in the medial aspect to prevent pressure areas, are measured and fitted to the patient before the splint is fabricated.

Medial padding: Determine length of medial padding by measuring the distance between 6.35 cm (2½ inches) above to 6.35 cm (2½ inches) below proximal and distal margins of medial curve of femoral condyle (FC). B. Determine width of medial padding by measuring distance from medial margin of patella (P) around to 2.54 cm (1 inch) posterior to medial curve of the FC.

---

*Paula Spector, OTR, is Supervisor of Clinical Affiliations, Hempstead Medical Center, Hempstead, New York, and consultant, Orthopedic and Rehabilitation Institute, Queens, New York.

*June Davis, OTR, is Chief Occupational Therapist, Hempstead Medical Center, Hempstead, New York.*
condyle (see Figure 3). Determine width of medial padding pattern by measuring distance from medial margin of patella around to 2.5 cm (1 inch) posterior to medial curve of femoral condyle (see Figure 3). Use pattern and cut three pieces of 1.27-cm (5/8-inch) foam padding. Apply padding in three layers against medial aspect of femoral condyle. Secure in place with self-adhesive plastic wrap.

Overlay padding: Length of overlay padding is the same as the length of the medial padding. Determine the width of the overlay padding pattern by encircling the posterior aspect of femoral condyle with the pattern and by bringing ends around to terminate at medial and lateral edges of patella (leaving patella free) (see Figure 4). Use pattern and cut one piece of .3-cm (1/8-inch) foam padding. Apply this over medial padding, in the position described above, and secure with self-adhesive plastic wrap. Cover overlay padding with stockinettes.

Splint: Cut pattern for each splint 1.27 cm (5/8 inch) less in length and width than measured for overlay padding. Cut Orthoplast to pattern size. Mold Orthoplast over padding and stockinettes, lightly flaring edges to avoid pressure. Remove both splint and padding. Put aside padding.

Dowel separators: Cut three lengths of dowels (exact lengths to be determined by degrees of abduction desired). Cut three pieces of Orthoplast to cover dowels. Each piece will measure 8.9-cm (3-1/2 inches) wide and 3.8-cm (1-1/5 inches) longer than associated dowel, extending 1.9-cm (5/8-inch) beyond each dowel end. Cut each 1.9-cm (5/8-inch) extension lengthwise in four places. Apply glue to inside surface of these four tabs and to medial aspect of splint at site for attachment of dowel. Press tabs to splint. Repeat procedure for remaining dowel attachments. Dowels should be attached first to same splint and then to second splint. Points of attachment are located on medial aspects above, center, and below medial curves of femoral condyles. To reinforce dowel attachments to splints, cut from edge to the center six 7.6-cm (3-inch) Orthoplast circles. Prepare circle for attachment and wrap around dowel and splint at attachment site (Figures 1 and 2).

Knee straps: Cut two lengths of canvas webbing. Using rivets, attach webbing to medial and lateral aspects of splint (Figure 1). Cross straps diagonally over patella. Secure with Velcro closures on medial and lateral aspects of splint.

Padding and lining splint: Cut pattern for outer moleskin lining 1.27-cm (5/8-inch) greater in length and width than measured for overlay padding. Apply medial padding-three layers of 1.27-cm (5/8-inch) foam padding—to medial aspect of splint. Apply overlay padding over medial padding and secure inside of splint. Cover overlay padding with moleskin lining and adhere to Orthoplast (Figures 1 and 2).

Discussion
Recommended Method of Application. Patient sits on the bed (back supported by headboard), lifts one knee at a time as he or she slides splint under knees, places knees into respective splints, applies downward pressure to each patella (in turn) as the knee straps are applied. To remove orthosis the patient releases the knee straps, presses hook end of dressing stick against proximal dowel separator, and pushes splint distally, until heels are free. If significant spasticity is present in the distal aspects of the lower extremities, the orthosis can be made longer to include foot splints; or separate foot splints can be applied.

Determination of how long and when to wear the orthosis depends on the individual's degree of spasticity and personal needs. It can be worn as a night splint or intermittently during the day, or both. In the clinical situation spasticity may be substantially reduced by applying the splint for a period of time before practicing ADL tasks such as lower extremity dressing and transfers.

The HA-KE orthosis has been effective in accomplishing its intent to prevent or correct deformities in hip abductor and hamstring muscles. We have observed a reduction in spasticity of both muscles in nine cases treated and no increase in spasticity in six other cases.

Acknowledgments
The authors express special thanks to Dr. Arminius Cassvan, Medical Director of Rehabilitation Medicine; Dr. Rudolfo Cane, Consultant to Rehabilitation Medicine; Rosalyn Davidson, Administration Director, Rehabilitation Medicine, Hempstead General Medical Center, Hempstead, New York; and Dr. Donald D. Goldberg, Executive Medical Director, Orthopedic and Rehabilitation Institute, Queens, New York.

REFERENCE

RELATED READINGS
Kaplan L, et al: Spinal Cord Dysfunction, New York Institute of Rehabilitation Medicine, New York University Medical Center, 1966