
Lower Extremity Telescopic Orthosis for Immediate Fitting in Paraplegia

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ABSTRACT: For initial gait training with the paraplegic patient, a lower extremity telescoping orthosis has been developed. This brace eliminates the time-consuming fabrication, considerable weight, and cumbersome use of conventional knee-ankle-toe orthoses and is easily adjustable to a wide range of patients. Particularly during the early phase of rehabilitation, this brace offers significant advantages to the patient with lower extremity disabilities.

Introduction

Pokora, Ober, and Milewski introduced the lower extremity telescopic orthosis (LETOR) at the Fourth World Congress of the International Society for Prosthetics and Orthotics, Imperial College, London, September 6, 1983. Designed to be a functional, inexpensive brace for immediate fitting in paraplegia, the LETOR eliminated the disadvantages of conventional double upright appliances: time-consuming fabrication, considerable weight, and cumbersome use. After extensive testing in Poland, the LETOR was released to the Dallas Rehabilitation Institute in 1986 for clinical testing. An improved version of the LETOR is currently available (3D

Orthopedic Inc. Dallas, TX). This article describes the construction of the LETOR, the indications and contraindications for its use, and the authors' experience with this orthosis in 14 cases.

Design

The LETOR consists of three stabilizing units which, when linked together, constitute a stabilizing column attached to the posterior aspect of the leg (Figs. 1-2). The foot stabilizing assembly consists of an aluminum stirrup with a rubber heel which fastens over the patient's shoe and is held in place by a foot strap. A rubber, wedge-shaped insert is used to control heel position. The entire assembly is attached to a telescoping tube at the back of the stirrup. The knee stabilizing assembly is a three-part, under-the-knee cuff which is mounted to the telescoping tube using a bow and clip mechanism.

This allows the cuff to rotate in a frontal plane and permits adjustment of the height of the cuff for each individual. The thigh stabilizing assembly consists of an aluminum thigh support with a padded insert and strap. This is attached to the telescoping rod through a hinge subassembly. A second above-knee strap may be added if additional stability is needed. All fastenings in the brace utilize Velcro closures to facilitate ease in application and removal of the brace. The total weight of a single, adult size LETOR is approximately 1 kg.

Operation

The LETOR is applied over the patient's own shoes (Fig.1). The knee and thigh support assemblies are adjusted to provide maximal stability in stance. The telescoping nature of the brace allows the thigh support mechanism to be positioned under the but-

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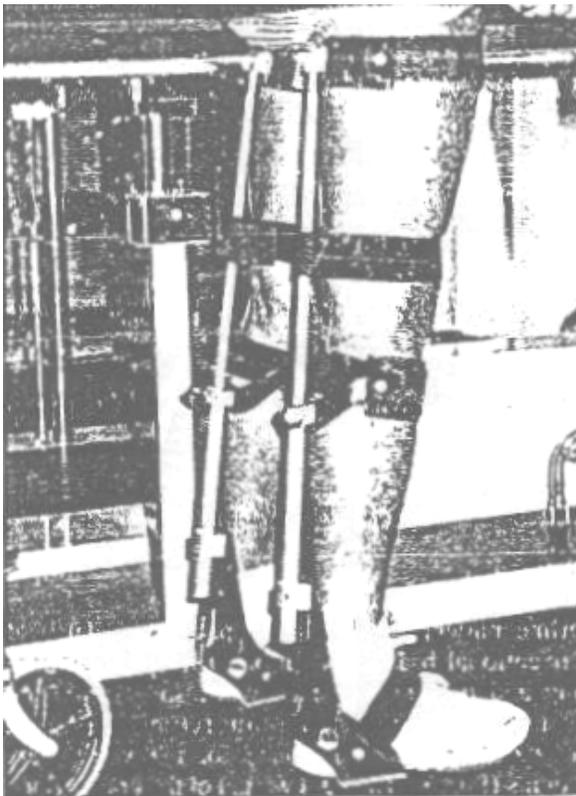


Fig. 1: Paraplegic patient standing in LETOR. Note the position of the knee and thigh supports.

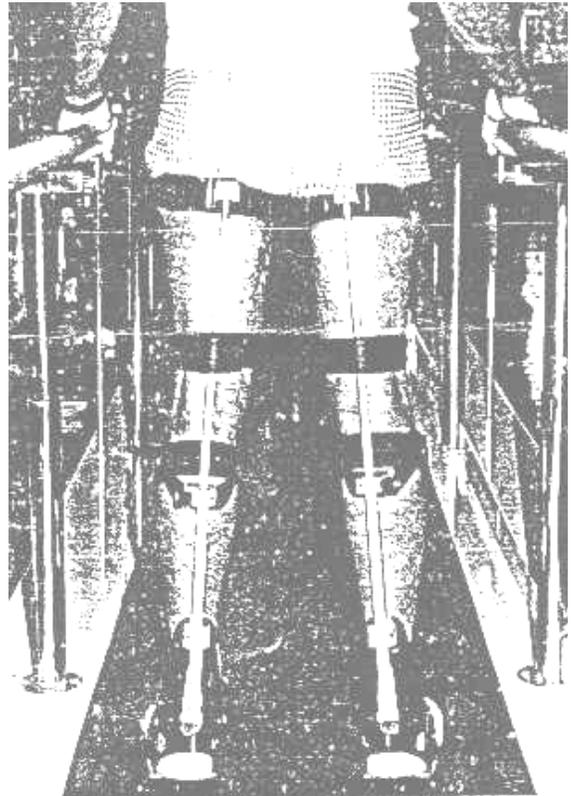


Fig. 2: Posterior view of patient standing in LETOR, illustrating alignment and construction of brace.

tock, if necessary, and facilitates adjustment across a wide range of patients. By shortening the telescopic set and placing the thigh support assembly at the knee (Fig 3), the patient can sit comfortably without removing the entire orthosis. The adjustable nature of the brace also provides the possibility of gait training with a reduced stabilizing efficiency of the orthosis. By partially lowering the thigh stabilizing assembly, a controlled range of free motion in the knee joint can be obtained, if desired (Fig. 4).

Clinical Experience

Over the past 12 months, the LETOR has been used by eight physical therapists at the authors' institution for initial gait training in 14 patients. Diagnoses ranged from T4 to L1 spinal cord injuries, both complete and incomplete lesions. The patient

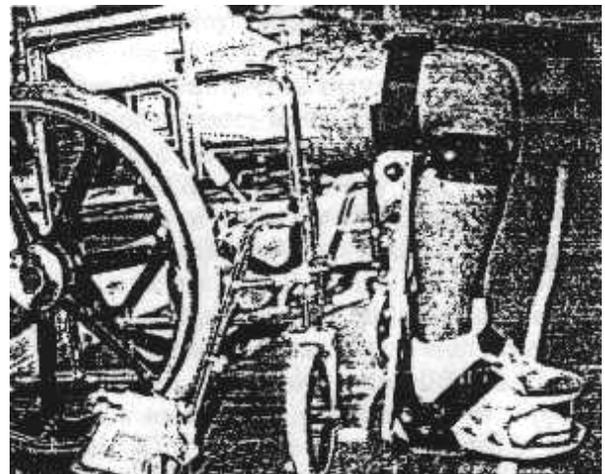


Fig. 3: Sitting in LETOR. By lowering the thigh assembly, a patient may sit without removing the brace.

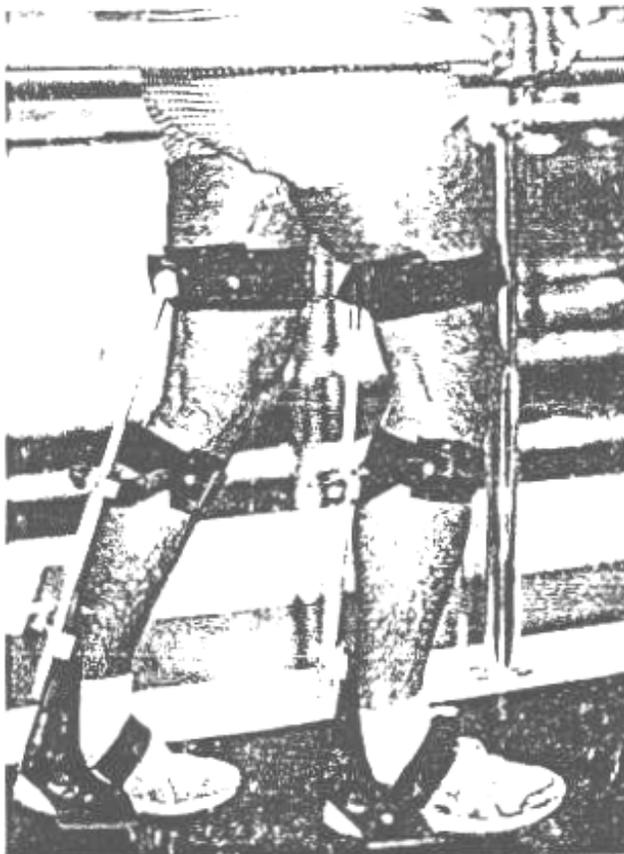


Fig. 4: Controlled knee flexion. Lowering the thigh cuff allows restricted, yet independent, knee motion.

population included five subjects under 20 years, three between 20 and 30, and six over 30 years. Five of the subjects were potential community ambulators, seven were household ambulators, and two were unsuccessful with gait training and returned to a wheelchair as their only means of mobility after six to eight gait training sessions.

The LETOR was evaluated using the following criteria: ease of adjustability; speed of donning/doffing; patient independence with donning/doffing; ease of sitting/assuming stance; standing balance; rotational stability; roll over during gait; weight of brace; durability; and cosmesis.

When compared with conventional double upright knee-ankle-foot-orthoses (KAFOs) currently used for gait training, the LETOR appeared to have several advantages. The primary advantage from the therapist's standpoint was the ease of adjustability, which made the LETOR especially appealing for training a large variety of patients. In addition, to

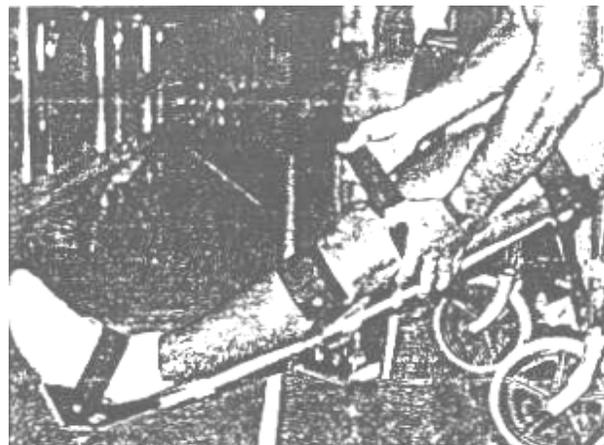


Fig. 5: LETOR application may be performed easily by the patient.

allowing a single brace to be used by multiple patients, it permitted a trial of brace-use in a borderline patient without the expense and delay of conventional brace fabrication. The speed of donning and doffing the brace was also a significant advantage in the rehabilitation setting where the same orthosis is being used for many different patients (Fig. 5). The light weight of the brace, when compared to other conventional KAFOs, was also a significant advantage in the marginal ambulator.

Despite the less rigid structure of the LETOR when compared to double upright KAFOs, the LETOR compared favorably with conventional braces when evaluating gait parameters. In the patients evaluated, there appeared to be no difficulty with standing balance, rotational stability, or roll over during gait. In addition, there appeared to be very little difference between the LETOR and conventional braces in the ease of donning and doffing the brace independently.

The major disadvantage of the LETOR in this study was the relatively low durability of this brace when compared with conventional KAFOs. After approximately 1 year of moderate to heavy use, the thigh rod began slipping, the Velcro straps required replacement, and the vinyl heels began to wear. Once significant heel wear developed, it became more difficult to move from stance to a sitting position due to slipping of the heels. This problem was accentuated by the absence of knee flexion in the braces which was also considered a disadvantage in several cases. While not a

significant consideration in a temporary or training orthosis, cosmesis was a negative consideration in the use of this brace as a permanent appliance in that the LETOR must be worn outside rather than under clothing.

Discussion

The LETOR brace meets several important requirements for immediate functional bracing of lower extremity disabilities. Its adjustability permits the fitting of a majority of adult patients whose trouser inseam measurement does not exceed 34 inches. The posterior telescoping bar should not be used to support the knee of any patient weighing in excess of 200 lb. The LETOR is adjustable through a wide range of patients, it is easily applied and removed, and it is accepted well by both patients and therapists. The durability issue concerning the original design has been addressed in the paraplegic telescoping orthosis currently being marketed.

The LETOR is best suited for those patients lacking voluntary control of the knee and ankle. The orthosis permits only slight knee flexion and simulates ambulation with a fully extended rigid knee. It can be used as soon as upright ambulation is desired. The LETOR is a tool for evaluation of ambulatory potential or skill.

The LETOR may be used as a temporary method of bracing the functional/community ambulator. The decision to prescribe definitive KAFOs is generally based on the demonstration that community ambulation is a reasonable expectation. The LETOR may be used as a training device while the definitive KAFOs are being fabricated. The LETOR can also be used as

a definite brace system for that patient who is an institution/household ambulator. That patient who will only use orthoses on a very limited basis may choose to use a system that he or she can easily apply over clothing, stand and move about, and then quickly remove prior to returning to normal wheel-chair activity. The LETOR is an economical system for the household ambulator to use regarding cost and energy expenditure.

Although the LETOR is applicable to a wide range of patients, there are some contraindications to its use which must be considered when evaluating a patient for bracing. Both lack of motor control at the hip joints and severe spasticity preclude the use of any KAFO, and the LETOR is no exception. Due to the rigid design of the LETOR, contractures of the knee over 20° create considerable pressure under the thigh support and may also limit the use of this orthosis. Medial and lateral knee instability are also relative contraindications to the use of the LETOR. The authors have also found that the single support structure does not provide sufficient lower extremity stability in the extremely obese patient.

While the authors have been extremely pleased with the LETOR in a wide majority of patients, a thorough evaluation of the patient's ambulatory status is required to predict successful use of the brace. In order to obtain a highly adjustable and lightweight brace, stability in this orthosis has been decreased over conventional bracing. The authors believe, however, that during the early stages of the rehabilitation process, a significant portion of patients with lower extremity disabilities may benefit from this advance in bracing.