Clinical Prosthetics & Orthotics

Vol. 7, No. 1 1983 Winter (Issued Quarterly)

Ankle Foot Orthoses—Metal vs. Plastic

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Since the late 1960's, when Yates (1) and Lehneis (2,3) wrote the first articles pertaining to the use of plastics in orthotics, the debate has continued comparing conventional metal to thermoformed orthoses. But debate is no longer necessary as the well-informed clinic team finds that plastic orthotic systems have come of age and should be prescribed on a routine basis.

The advantages of thermoformed orthoses are numerous, extending far beyond the obvious factors of improved cosmetic and weight considerations. These, however, have significant merit in themselves. American society is appearance-conscious and highly competitive, an atmosphere in which individuals with disabilities are finding their rightful place among the non-disabled. The influence that the appearance of a device has on the effective interrelationships at home and in the workplace cannot be ignored. Thermoplastic devices are form-fitting, fleshtone, hygienic, and noise-free, unlike the metal devices of yesterday, and assist the individual in breaking the stereotypes of disability set by society. Of particular importance to the patient is the ability to interchange shoes, as long as the heel height remains consistent.

The devices' light weight means a decrease in energy expenditure and, in many cases, makes a marked difference in the patient's ability to perform hip and knee flexion adequate for a full day's activities. This also allows the patient to life the involved extremity for climbing stairs, getting into an automobile and other actions requiring flexibility. A recent study by Smith, Quigley, and Waters (4) concluded that the "lighter" polypropylene Ankle Foot Orthosis promotes more efficient advancement of the involved limb, allowing a greater percentage of the gait cycle to be devoted to the stance phase of gait." This accounted for the "more normal pattern of foot-floor contact at initial contact and at terminal stance" (4, p. 54).

Hygienic concerns are easily met with plastic orthoses that may be cleaned daily with soap and water, rubbing alcohol, or chemicals such as acetone. To incontinent children and adults this means an increased life for the orthosis, as well as cleanliness and an improved self-image.

In the same manner that prosthetic practice was revolutionized by the concept of total contact, so too has orthotics experienced a renaissance. With the total contact features of thermoformed orthoses, increased force may be applied to the skeleton without discomfort and skin breakdown as the area receiving the force is multiplied. Prevention and correction of deformity is greatly enhanced as compared to the metal bands of conventional double upright orthoses with their small surface areas.

The force-distributing properties of plastic orthoses are of particular benefit in the case of insensitive feet where decubitus ulcers must be aggressively prevented. The use of well-formed total contact orthoses may preclude the need for expensive custom shoes in these cases and allow healthy feet in affordable and attractive footwear.

Although cosmesis, weight, hygiene, and total contact features are important assets of thermoformed orthotic systems, versatility is the major advantage to the prescribing physician and clinic team. Design potentials are unlimited and allow the customizing of the orthosis to the exact biomechanical needs of the patient, without excess bulk or "over-bracing." As von Werssowet stated ". . . a brace should be selected with the most simple design that will accomplish the purpose and mission" (5, p.364).

At the knee and ankle joints, free motion and some degrees of limited motion are easily obtained with a total plastic orthotic system. When a specialized assist or stop is required, a hybrid system (6) utilizing metal

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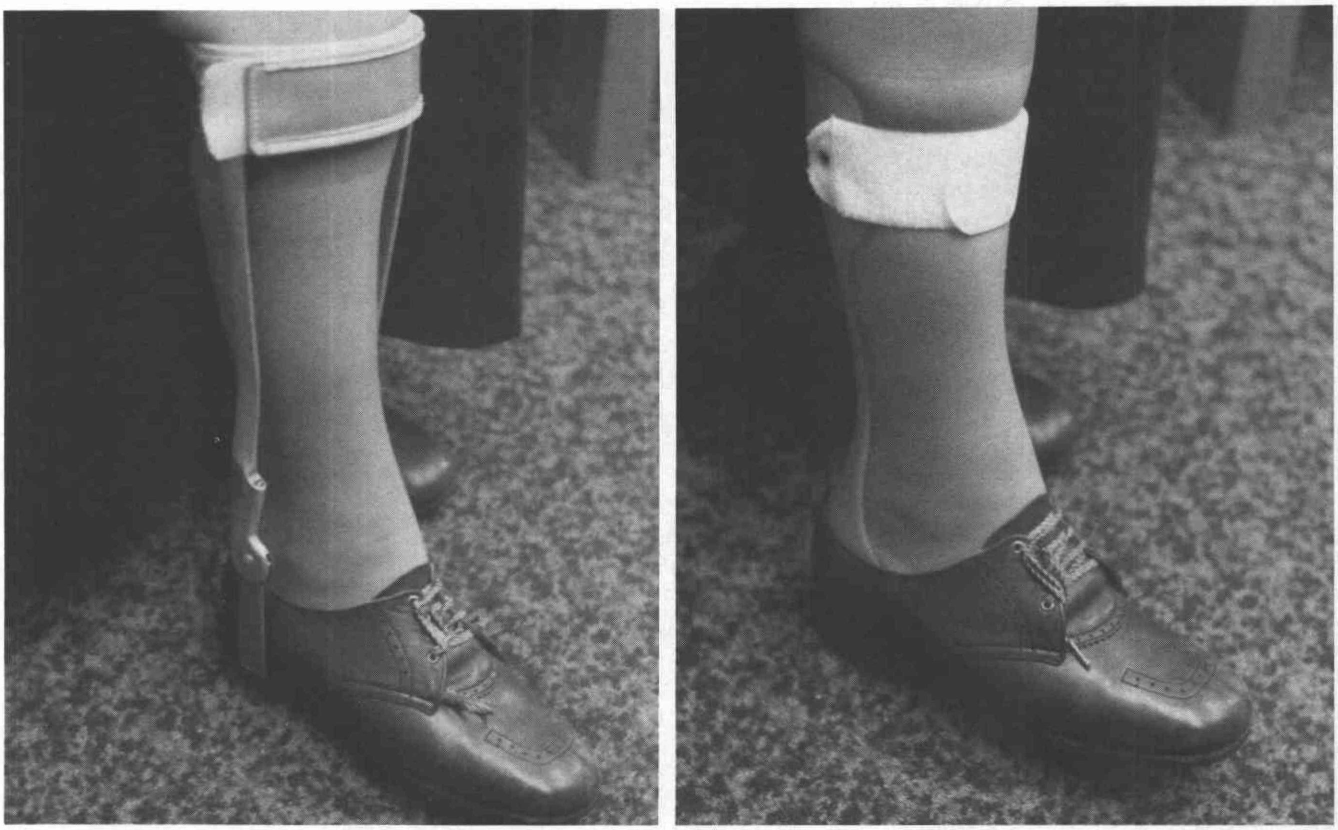

The controvery illistrated—metal double upright ankle-foot orthosis vs. plastic ankle foot orthosis.

joints within the plastic design may be more satisfactory in meeting the patient's needs. Where total immobilization is indicated, plastic orthoses may be fabricated with corrugations or carbon composite inserts (7) that afford rigidity. Ankle position may be altered to provide a stabilizing effect to the knee joint at midstance or to prevent recurvatum when posterior structures are compromised.

A striking advantage of plastic orthotic systems is their superior control at the ankle in the frontal plane. A result of both the total contact nature of the device, as well as the individuality of possible designs, this provides excellent control in cases presenting equinovarus (hemiplegia secondary to CVA), clubfoot deformities, and other mediolateral instabilities. Varying the thickness of the plastic and the configuration of the trimlines creates an appropriate three point pressure system that will not require force application over boney prominences, as the ankle strap of a conventional double upright orthosis requires over the lateral malleolus.

Plastic orthoses are beginning to play a role in work regarding inhibitive casting and the effect upon spasticity. Eberle, Jeffries, and Zachazewski (8) recently reported success with an inhibitive AFO, a concept that was not feasible with metal orthotics. Their report stated that "the technique of fabrication used for construction of a molded polypropylene AFO allows for all of the tone-inhibiting characteristics of casting . . . to be built into the AFO . . . (including) hyperextension of the toes, pressure under the metatarsal heads, a stable ankle position, and deep tendon pressure along the tendo calcaneus" (8, p.454). The molded footplate offers excellent control as compared to conventional metal orthoses where "modification must be made to the shank of the shoe in cases of severe spasticity, lest it break at the anterior edge of the tongue and thus allow the foot to adopt a position of equinus" (9, p.1).

Prepared by the American Academy of Orthotists and Prosthetists, 717 Pendleton St., Alexandria, VA 22314. Second class postage paid at Alexandria, VA and additional mailing offices. Subscriptions: Domestic: $12 per year. Foreign: $13 per year.

The hydrostatic features of plastic fracture orthoses have, in many regions, radically changed the orthopaedic approach to fracture management. Their effective application has been well documented by Sarmiento (10) and others. Their light weight (6–10 oz.), excellent hygiene, and wear with street shoes (11), allows the patient a safe and speedy return to a near-normal lifestyle that often includes employment, even in cases of delayed healing.

Hybrid and total plastic systems are easily adjusted for volume change and progressive positional correction through the use of heat forming techniques. Longitudinal growth in children can be predicted and the appropriate length adjustability feature can be an integral part of the orthotic design.

Some unique and exceptionally biomechanical designs have been made possible through the use of thermoplastics. The spiral and hemispiral AFO designs (3) employ the physical characteristics of the coiled configuration of plastic to store energy and serve as a functional assist to weakened dorsi- and plantar-flexor musculature, with little effect on knee stability.

The prescription and use of thermoplastic orthotic systems is no longer confined to regions with specialized clinic teams. Although their use originated in the research of large medical centers in major cities, the private practice sector nationwide now has ten years experience in these management concepts. The professional literature of the prosthetic and orthotic profession abounds with information on all aspects of design rationale and fabrication techniques utilizing today's total plastic and hybrid systems.

I challenge each of you to break through the stereotypes of your conventional metal orthotic prescription and management practices. The potentials of current thermoformed based orthotic design are limitless, and will provide the patient with an immeasurably improved functional outlook and self-image.

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