

Custom Orthoses

Custom Orthoses for the Child Athlete

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Children's sports used to mean Pop Warner, Little League, and high school athletics. The players were almost exclusively boys. Today more children than ever--boys and girls--are participating in a greater variety of sports. Sports-related injuries, unfortunately, have paralleled this rise in participation. Many are traumatic in nature, such as fractures, sprains, or contusions. But increasingly, practitioners are seeing injuries due to poor conditioning, overuse, poor mechanics, or abnormal foot structure.

Understanding the various etiologies leading to sports injuries in children is important not only in treating the injury but in preventing recurrence. Treatment of the acute injury usually involves rest, ice, stretching, and physical therapy. For non-acute injuries, orthoses may play a significant role in treating and preventing extrinsic factors such as overuse, or intrinsic factors such as abnormal foot structure.

Common Injuries

Acute traumatic injuries once dominated our Sports Medicine Clinic. Now, however, the number of overuse injuries are at least equal to traumatic injuries in this clinic population. Since many children get much of their exercise in an organized sports setting, conditions such as tendinitis or stress fractures often are related to extrinsic factors that can include training error, playing surface, or footwear. In some cases, however, conditions we often attribute to extrinsic overuse factors--training error, for example--actually may be brought about by intrinsic conditions such as poor mechanics or abnormal foot structure. Anterior tibial tendinitis is just one example of such an injury affected by foot mechanics and foot structure.

Anterior tibial tendinitis, one of the more common etiologies of "shin splints," is manifested by severe pain and inflammation along the anterior crest of the tibia. It is most commonly seen in athletes with an excessive foot pronation that produces two effects. In the first, the anterior tibial tendon, acting as a supinator of the foot, is forced to work harder to resist the excessive pronatory forces. This leads to fatigue of the muscle and potential strain. Secondly, the flattening of the foot leads to excessive stretching of the anterior tibial tendon, resulting in traction on its site of attachment to the periosteum of the tibia with resultant inflammation and pain.

Stress fractures of the foot are another overuse injury we see with increased frequency in the child athlete. Yet, once again, foot structure and biomechanics may play an important role in the etiology of this condition. Excessive force on a single metatarsal can result in a stress fracture. An abnormally long or short metatarsal may cause this excessive force. Also, hypermobility of the first ray can cause excessive loading of the second metatarsal, resulting in a stress fracture.

Orthoses

Orthotic devices can be effective in treating the conditions described above for a variety of pathologic entities, both as treatment and preventative care. They have proven effective for the treatment of symptomatic plantar fasciitis, shin splints, subtalar synovitis (sinus tarsi syndrome), and calcaneal apophysitis. They also are helpful in the management of stress fractures, sesamoid pain, metatarsalgia, Achilles tendinitis, and patellofemoral stress syndrome resulting from poor tracking of the patella secondary to excessive pronation or supination.

Rigid orthoses generally are prescribed when optimal functional control is desired, while soft orthoses are used when accommodation and cushioning are the primary goals. This is a valid concept. However, the lingering question is how much rigidity is necessary for the child athlete to achieve symptomatic relief? Rigid orthoses commonly are fabricated from hard plastic materials including polydur, polypropylene, or graphite, while soft orthoses most commonly are fabricated from various densities of Plastazote or similar material. Rigid orthoses have the advantage of providing excellent functional control and can be made thin enough to fit into a variety of different shoe styles. Many patients have difficulty, however, adjusting to the prolonged break-in period these devices typically require. Rigid orthoses also are more expensive.

We prefer to fabricate soft or semi-soft devices for our youthful athletes. We start by laminating a layer of Aliplast onto one of three densities of Plastazote. By choosing the medium to hard density of Plastazote, a relatively functional orthosis can be fabricated. Semirigid orthoses do not provide the optimal functional control of a rigid device. However, they often provide sufficient control of biomechanical deformities to provide symptomatic relief and allow continued participation in sports. The child athlete often adapts well to these devices with a short break-in period. Semisoft devices can be easily adjusted if necessary whereas rigid devices often must be returned to the lab for most adjustments. Semi-soft devices also are less expensive—not an insignificant consideration for the growing athlete who may go through three or four orthoses before reaching skeletal maturity.

Disadvantages to semi-soft devices include bulkiness, which can make shoe fitting more difficult. Semi-soft devices also are less durable than rigid devices, often "bottoming out" in 12 to 18 months. This is only a relative disadvantage, however, since children usually outgrow their orthoses before they actually wear them out.

Orthoses for the child athlete are best fabricated custom from a negative cast using the suspension casting technique holding the foot in a neutral position (i.e., subtalar joint neutral and midtarsal joint maximally pronated and locked). A positive cast is made and the orthosis is pressed to this cast. Corrections are then made to accommodate for varus or valgus deformities. The medial longitudinal arch can be reinforced with materials such as cork or Korex to provide additional rigidity and functional control. Additional adjustments may include medial or lateral flares to further prevent excessive pronation or lateral ankle instability, respectively. Or, a one-quarter inch heel lift of Poron-like material can be added to provide additional shock absorption at heel strike or accommodate a tight Achilles tendon, which otherwise promotes additional midstance pronation.

Children's participation in athletic events has increased significantly in the last 10 years and shows no signs of slowing down. Injuries in children have also increased proportionately. In particular, the growth of organized sports has led to increased numbers of overuse injuries related to repetitive sports training.

Custom orthotic therapy can play a valuable role in the management of these injuries as well as in prevention of further injuries, allowing children to continue their participation in sports at any level. The use of semi-soft orthoses in this age group can provide adequate functional control to allow for significant relief of the child athlete's symptoms. Advantages of semi-soft orthoses outweigh the disadvantages in this age group and are preferred over rigid orthoses.

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References

1. Outerbridge RA, Micheli LJ. Adolescent sports medicine: Changing patterns of injury in the young athlete. *Sports Medicine Arthroscopy Review* . 1996; 4(2):93-98.
2. Smith AD. Overuse injuries. In: Cantu RC and Micheli LJ (eds.) *ACSM'S Guidelines for the team physician* . Philadelphia: Lea & Febiger, 1991:297-306.
3. Micheli LJ, Ireland ML. Prevention and management of calcaneal apophysitis in children: an overuse syndrome. *Journal of Pediatric Orthopaedics* . 1987; 7:34-38.
4. Micheli LJ, Vorderer TW, Santopietro F, Sohn R. Chapter 27: Athletic footwear and modifications. In: Nicholas JA, Hershman EB, eds. *The Lower Extremity and Spine in Sports Medicine* , 2nd edition, Vol. 1. St. Louis: Mosby-Year Book, 1995:513-522.
5. Donovan J, et al. Sports orthotic device. *J Am. Podiatric Med. Assoc* . 1979, 69:571

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