

Figure 26-88 Full-length reinforced insole can be used for protection of the athlete with a previous midfoot sprain.

to full weight bearing in a fracture boot by 12 weeks. It is recommended to leave the screws in place for a minimum of 16 weeks. Often they are removed electively at this point. Allowing the screws to remain, however, does not preclude activity. The athlete is then ready to gradually resume training with the protection of a stiff-soled athletic shoe with a molded semirigid insole.

There is currently no consensus on the best treatment for athletes with untreated stage II injuries more than four months old. Some favor the open treatment described earlier. Experts recommend a formal anatomic reconstruction with tendon graft. Most investigators agree that late treatment is accompanied by a guarded prognosis for unrestricted return to sport. Therefore, it is crucial that the index of suspicion remain high to prevent disabling sequelae.

Summary

Soft tissue injuries to the midfoot, including the tarsometatarsal joint and the transverse tarsal joint, are

seen in sports but often go unrecognized initially. The degree of injury may be masked, and proper diagnosis requires a thorough understanding of the anatomy of the area coupled with knowledge of the mechanism of injury. When this is applied along with a detailed physical examination and radiographic evaluation, the physician can avoid the difficulties that can arise from chronic unrecognized injury to this region. Early aggressive treatment, including open reduction and internal fixation for displacement, produces the best results in these patients.

FOREFOOT SPRAINS

The athletic foot injury that has received the greatest notoriety since the 1980s is the extension sprain of the first metatarsophalangeal (MTP) joint, commonly called "turf toe" (Fig. 26-90 and Table 26-5).^{1140,1150} This has apparently resulted from the importance that society places on collegiate and professional sports and the publicity that these athletes receive when they miss a game because of injury. Another factor is the controversy over the role of artificial playing surfaces in the production of injuries in sports.¹¹⁵⁹ Other forefoot sprains certainly occur; however, these are not nearly as common as turf toe. These additional sprains include the flexion sprain of the hallux MTP joint ("sand toe") and sprains of the lesser MTP joints. These injuries are not nearly as common as turf toe and this section therefore primarily focuses on extension sprains of the great toe.

Historical Perspective

Although sprains in the forefoot occurred in sports before the introduction of artificial grass in 1966, the injury was so inconsequential that it was not reported. In 1975, during a round table discussion on the pros and cons of artificial turf, Garrick first mentioned the relationship between sprains of the first MTP joint and artificial grass playing surfaces.¹¹⁵⁴ The term "turf toe" was coined in the literature by Bowers and Martin¹¹⁴⁰ in 1976 when they attributed the injury to the combination of the hard artificial playing surface and the use of flexible shoes. The prevalence of this condition and its increasing recognition in college football was reported by Coker et al¹¹⁴⁴ from the University of Arkansas in 1978. They surveyed athletic trainers at 94 colleges and universities and found this sprain of the first MTP joint to be increasingly more common and a significant source of missed playing time. The prevalence and consequences of this injury resulted in an article in *Sports Illustrated* on turf toe in 1988.

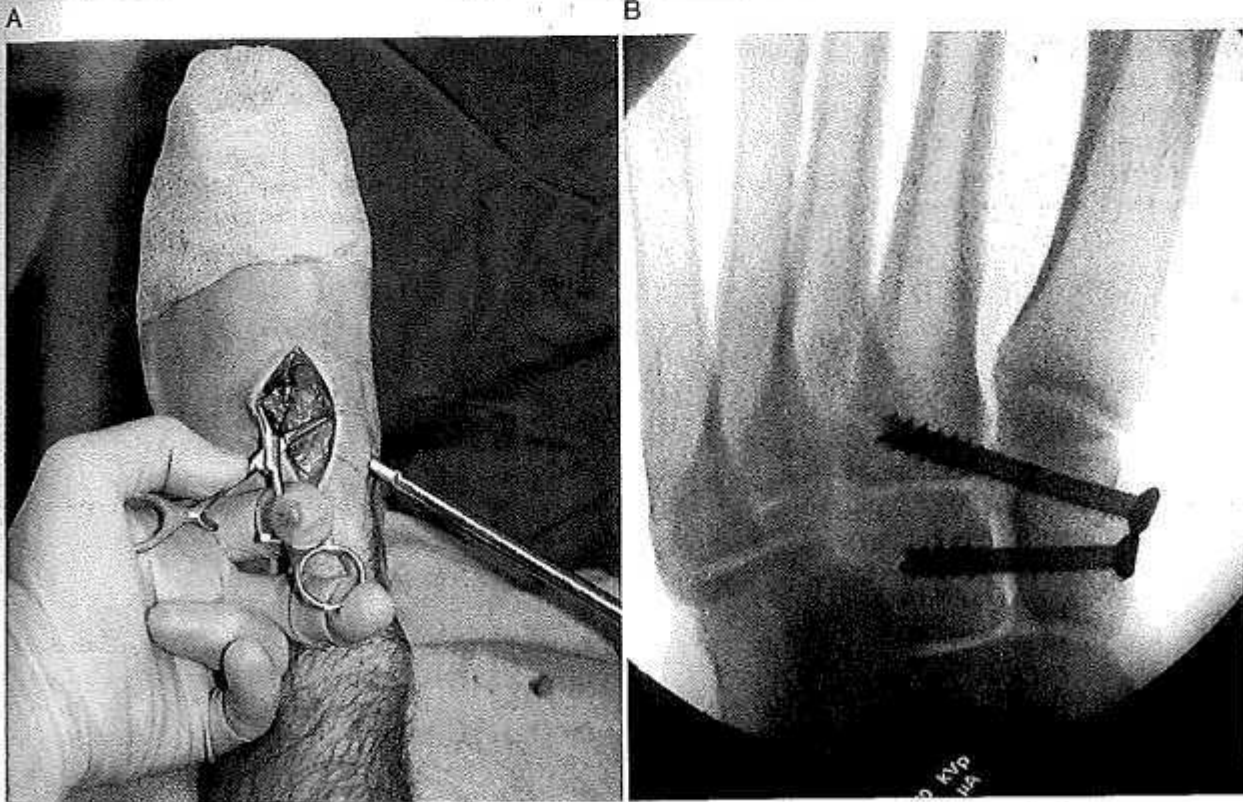
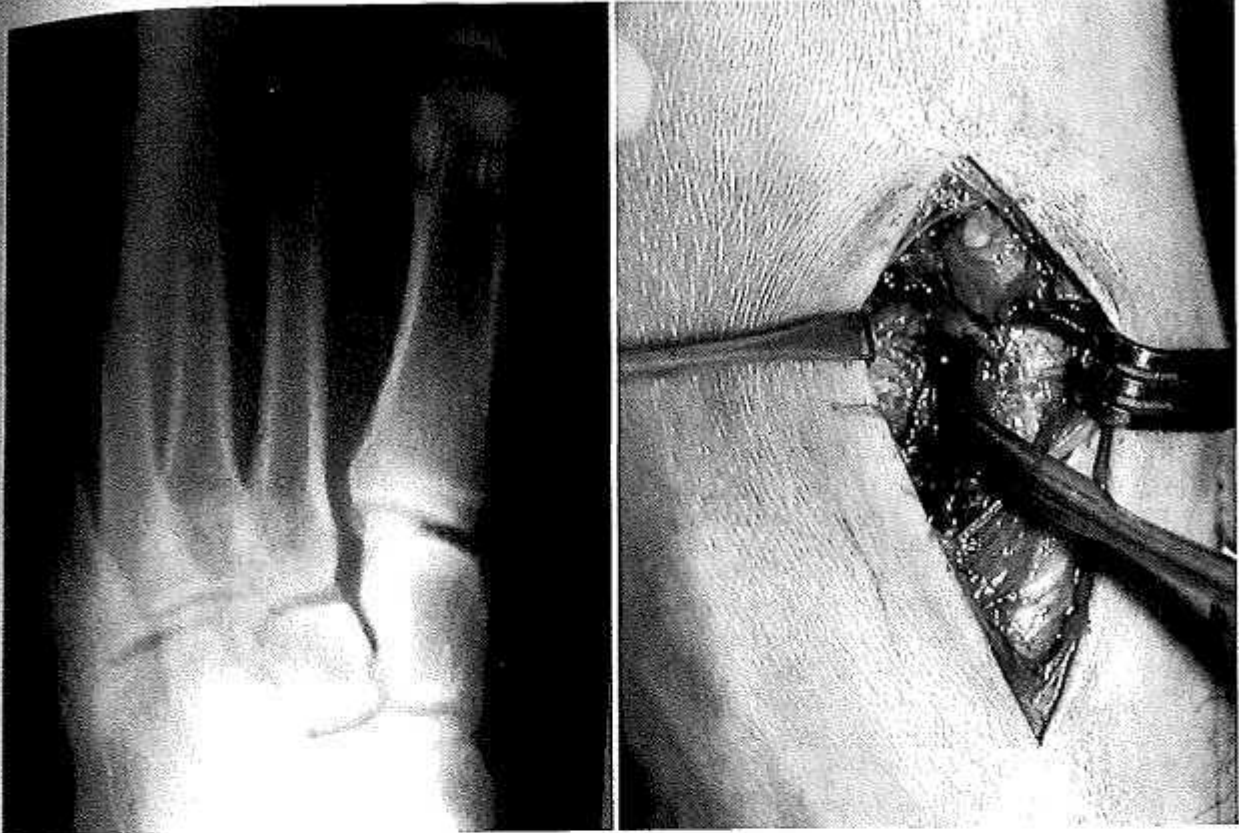


Figure 26-89 Unstable tarsometatarsal joint injury with diastasis or joint displacement requires anatomic reduction and rigid fixation. A, Radiograph demonstrating subtle diastasis. B, Torn ligaments and joint instability demonstrated intraoperatively with a Freer elevator. C, Reduction clamp is in place while the Lisfranc screw is inserted. D, Postoperative radiograph.

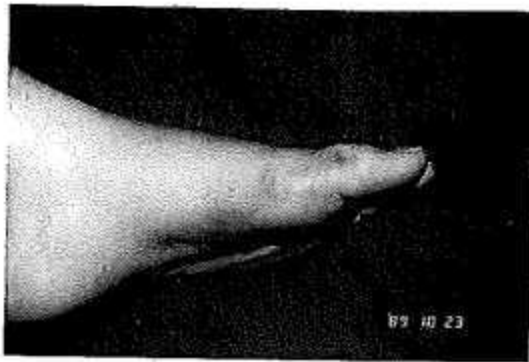


Figure 26-90 Turf toe injury can be a disabling problem for athletes.

Epidemiology

The true incidence of forefoot sprains in sports has never been accurately defined. At West Virginia University, 27 first MTP joint sprains were reported in a five-season period, or 5.4 injuries per season in a population of approximately 500 players.⁴⁰ Eighteen forefoot injuries occurred over three seasons among University of Arkansas football players, or six injuries per season.⁴⁴ During a 14-year period at Rice University, 63 MTP joint injuries in 53 athletes were reported.⁴¹ This review included all sports, and the average was 4.5 such injuries per year. Each year of the study had at least one injury, with a maximum of nine reported injuries to the MTP joints in 1 year. A study of 80 active professional football players found that 45% had sustained a turf toe injury.⁵² Only the Rice University study documents injury to the lesser MTP joints, with 13 injuries in seven athletes.⁴⁴

Severity of Injury

Turf toe injuries can result in significant functional disability. Push-off is greatly impaired, compromising forward drive and running.⁴² Players often miss practice after this injury and miss games when the injury is more severe. Comparing first MTP joint sprains with the more familiar lateral ankle sprain, ankle sprains are four times more common but account for less than double the number of missed practices.⁴⁴ The Arkansas study found more missed games from great toe injuries (seven) than from ankle sprains (six). In the study from Rice University, players with great toe injuries missed an average 6 days of athletic participation.⁴¹ It has even been implied that chronic pain from this entity has led to the retirement of certain professional football players.⁵⁹

Mechanisms of Injury

Since the original description of the problem, hyperextension of the great toe MTP joint has been the typical mechanism of injury for turf toe problems. This mechanism occurs in football linemen driving off the foot from their stance.⁵⁴ It is this situation that is most responsible for the chronic sore joint, resulting from overstress in nonprotective shoes. In the acute circumstance, the foot is typically in a dorsiflexed position with the forefoot fixed on the ground and the heel raised. Then an external force drives the first MTP joint into further dorsiflexion and ultimately into exaggerated dorsiflexion. The joint capsule tears on the plantar aspect. This can be distal to the sesamoids, through the sesamoids as a fracture or as a diastasis of a bipartite

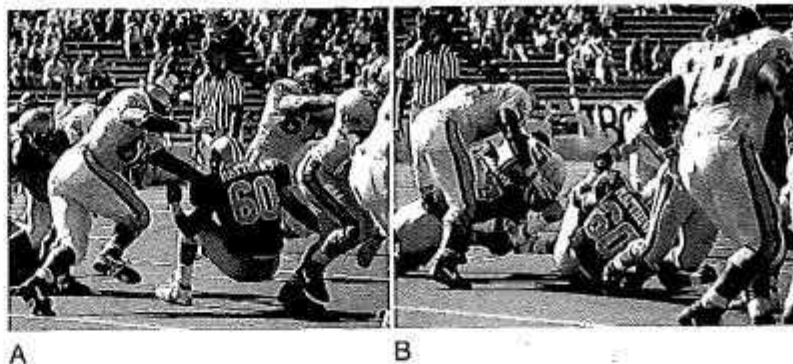
TABLE 26-5

Classification system for Turf Toe injury

Grade	Objective Findings	Activity Level	Pathology	Treatment
1	Localized plantar or medial tenderness Minimal swelling No ecchymosis	Continued athletic participation	Stretching of capsuloligamentous complex	Symptomatic
2	More diffuse and intense tenderness Mild to moderate swelling Mild to moderate ecchymosis Painful and restricted range of motion	Loss of playing time for 3-14 days	Partial tear of capsuloligamentous complex No articular injury	Walking boot and crutches as needed
3	Severe and diffuse tenderness Marked swelling Moderate to severe ecchymosis Range of motion very painful and limited	Loss of playing time for 2-6 weeks	Tear of capsuloligamentous complex	Long-term immobilization in boot or cast vs. surgical repair

Modified from Clanton TO, Butler JE, Eggert A: *Foot Ankle* 7:162-176, 1986; Coughlin ME, In DeLee JC, Drez D Jr (eds): *Orthopaedic Sports Medicine*. Philadelphia, WB Saunders, 1994, p 1862; Rodeo SA, Warren RF, O'Brien SJ, et al: *Foot Ankle* 14:425-434, 1993.

Figure 26-91 Common mechanism for turf toe injury, with one player falling on the leg of another player whose foot is fixed on the turf. A, Defensive lineman number 60 being blocked onto the heel of the opposing lineman, whose foot is fixed on the artificial turf. B, Completion of injury mechanism.



sesamoid, or rarely, proximal to the sesamoids. Compression injury to the dorsal articular surface of the metatarsal head can occur at the extremes of hyperextension.¹¹⁴⁰ A similar hyperextension force is seen when a player is in a pileup with the forefoot on the ground and the heel raised and another player lands on the back of the first player's leg and forces the MTP joints into hyperextension (Fig. 26-91).

Other, less common mechanisms described are hyperflexion and valgus.¹¹⁴⁴ *Hyperflexion* injuries to the hallux MTP joint most commonly occur in sand volleyball players when the hallux is forced into flexion as it is buried in the sand while running. The term "sand toe" was applied to this injury by Frey. Hyperflexion can also occur when a ball carrier is tackled from behind and the knee is forced forward; a plantar flexed foot is pushed further in this direction, and the MTP joints are sprained at the same time. In the previously noted series of professional football players, 12% of the injuries were likely hyperflexion injuries.¹¹⁵² *Valgus* is often a variable in the hyperextension injury and is produced by the force of pushing off on the foot from stance. Depending on the mechanism of injury, different structures are damaged.

Another mechanism of injury seldom seen in turf-related injuries of the MTP joint is *varus* stress. Mullis and Miller¹¹⁵¹ reported one such injury in a basketball player who externally rotated on a fixed foot and sustained a tear of the adductor hallucis tendon from the base of the proximal phalanx along with a tear in the lateral capsule and collateral ligament. No other similar case has been reported, although we have seen this in a professional football player (Fig. 26-92).

Anatomy

The capsuloligamentous complex of the MTP joint is the key factor contributing to its stability.¹¹⁵⁷ Relatively minor stability is provided by the shallow socket of the proximal phalangeal base articulating with the biconvex surface of the metatarsal head. The tendinous portions of the abductor and adductor hallucis tendons

provide support to the medial and lateral capsules, respectively. The long flexor and extensor tendons contribute minimally to stability, whereas the short flexor and extensor tendons blend with the capsule and provide important stabilizing elements (Fig. 26-93A).

The medial and lateral sides of the joint are supported by strong collateral ligaments that have two components (Fig., 26-93B). At the first MTP joint, these are the metatarsophalangeal and metatarsos-sesamoid ligaments. These ligaments have a narrow origin on the medial or lateral border of the metatarsal head and fan out to insert on the border of the proximal phalanx and the plantar plate. The plantar plate is a thickened fibrous portion of the capsule that blends with the sesamoids and the tendons of the short flexor for the great toe. The medial and lateral sesamoid bones are integral to the stability provided by the capsuloligamentous complex of the first MTP joint (Fig. 26-93C). Sesamoids are much less common in the lesser MTP joints and occur in less than 10% of normal feet.¹¹⁵⁷ The plantar plate is firmly attached at its insertion to the base of the proximal phalanx, with a less firm attachment at its origin from the metatarsal neck through the capsule.¹¹⁴⁶

The nonuniform size of the metatarsal head creates a cam effect for the collateral ligaments that puts a different portion of the fibers under tension during different positions throughout range of motion. When the MTP joint is forced into hyperextension, the plantar portion of the capsuloligamentous complex usually tears. Although it has been asserted that these tears occur at the weaker area of the capsule near its origin from the metatarsal head and neck, MRI evaluation has shown that the plantar plate and capsule tear distal to the sesamoids.^{1146,1158} In rare cases the injury can involve fracture of a sesamoid or diastasis through a bipartite sesamoid (Fig. 26-94).¹¹⁵³

Etiologic Factors

Because these injuries were relatively uncommon in sports before the era of artificial playing surfaces, some

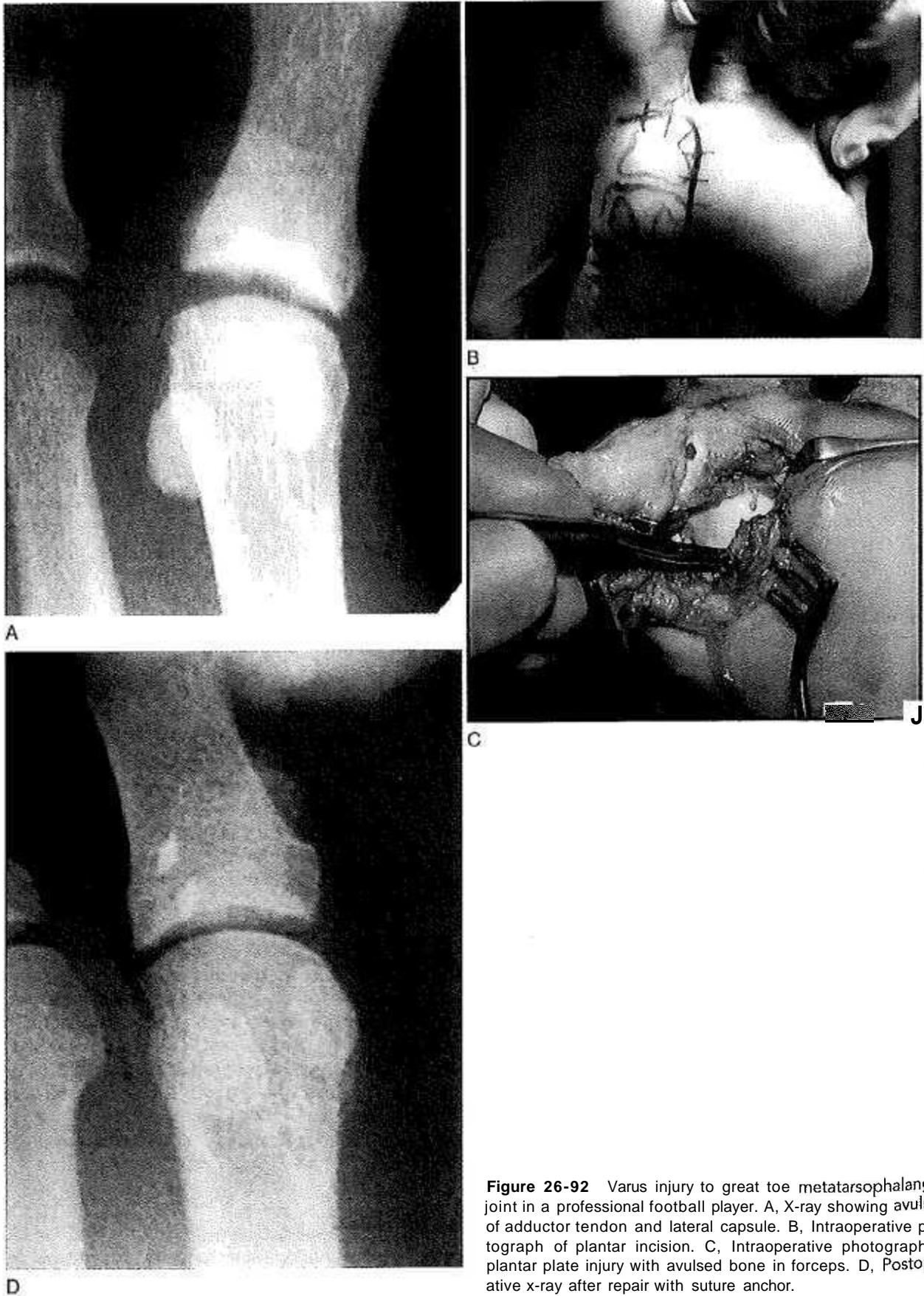


Figure 26-92 Varus injury to great toe metatarsophalangeal joint in a professional football player. A, X-ray showing avulsion of adductor tendon and lateral capsule. B, Intraoperative photograph of plantar incision. C, Intraoperative photograph of plantar plate injury with avulsed bone in forceps. D, Postoperative x-ray after repair with suture anchor.

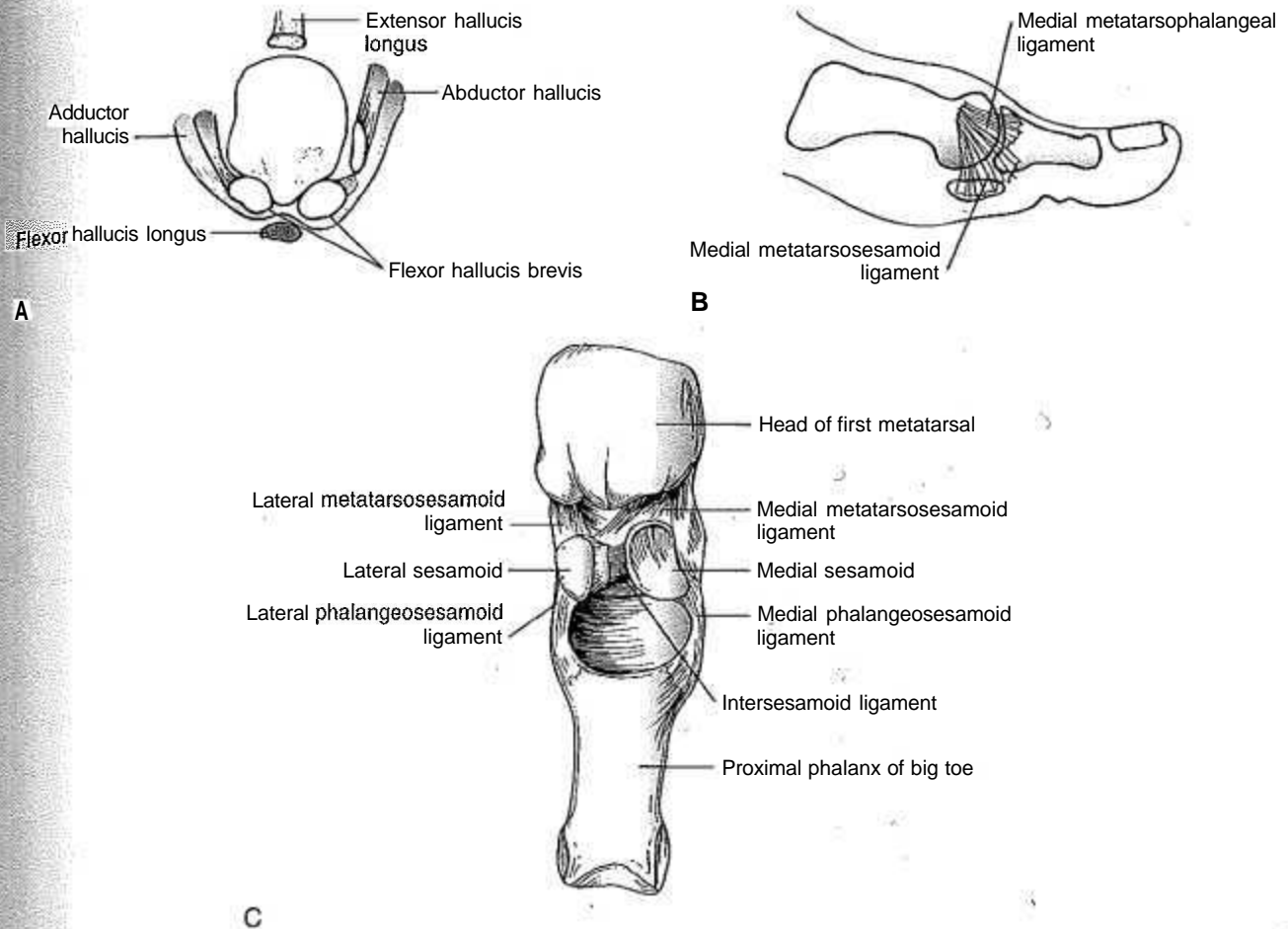


Figure 26-93 Anatomic relationships of the first metatarsophalangeal (MTP) joint. A, Frontal plane view. B, Sagittal plane view. C, Cutaway view. (From Clanton TO, Butler JE, Eggert A: *Foot Ankle* 7:162-176, 1986.)

pathologic relationship clearly exists. Bowers and Martin⁴⁰ theorized that the combination of the hard artificial playing surface together with flexible soccer-style shoes created a shoe-surface interface that potentiated first MTP joint sprains. The change from the

traditional grass shoe with seven cleats attached by posts into the sole of the shoe to more flexible varieties of soccer shoes and later to turf shoes seems to have been a major contributing factor in the natural history of the turf toe problem (Fig. 26-95). It also

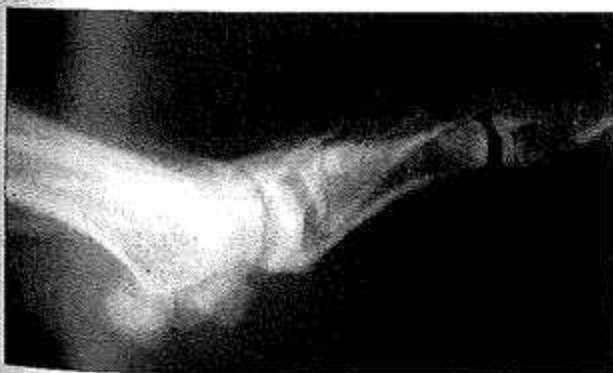


Figure 26-94 X-ray of sesamoid fracture in an athlete with wide separation of the fragments.

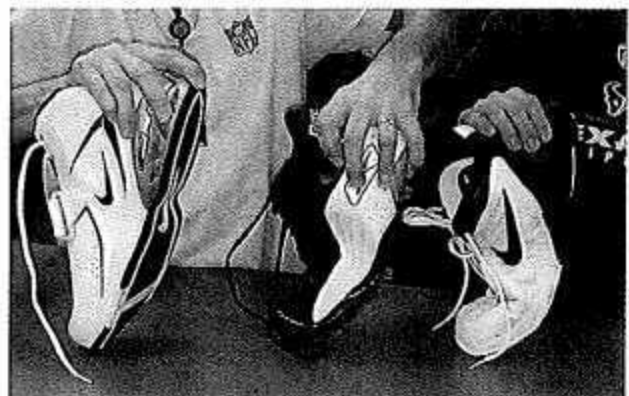


Figure 26-95 Athletic shoes for football participation demonstrating varying degrees of forefoot support.

may be that with the recent trend toward grass playing surfaces, the incidence of turf toe will decline.

The traditional shoe incorporated a steel plate in the sole that increased the shoe's stability but also increased its weight. As speed became an increasingly important factor in the game of football, more lightweight shoes were introduced, and stability was often sacrificed. Stress across the forefoot of the shoe was then applied more directly to the MTP joints, and an increasing incidence of sprains was the natural consequence.

In a study of turf toe injury evaluating shoe type, football players wearing a flexible turf shoe were compared with players wearing a modern turf shoe with a stiffened forefoot. The players wearing modern turf shoes were less likely to sustain a turf toe injury.¹¹⁴⁵ This is not to say that the surface plays no role in the injury, but it is subordinate to the shoe.

The previous edition of this text contains a more detailed discussion of etiologic factors.

Diagnosis

Clinical Evaluation

Any patient with suspected hallux MTP injury should receive a complete history and physical. The mechanism of injury may be helpful although the patient might not recall the initiating event. The chronicity of symptoms can help determine if this is an acute or a recurrent injury.

Physical examination begins with an inspection of the joint for swelling or ecchymosis. Range of motion should be assessed; if difficulty is encountered secondary to pain, a digital nerve block may be useful. Comparison to the other foot should reveal extension hypermobility, hypomobility, or other joint instability. The great-toe Lachman test (sagittal plane drawer instability of the MTP joint) is useful as well. Long-term instability can result in a swan neck deformity of the hallux due to avulsion of the flexor hallucis brevis (FHB) tendon and imbalance of flexor hallucis longus (FHL) against extensor hallucis longus (EHL) (Fig. 26-96).

Classification

With turf toe injuries, the initial pain and swelling may be relatively minor, but the swelling and pain tend to worsen over the course of 24 hours, and the player hobbles into the training room the following day. To plan treatment and allow some prediction for return to play, a clinically based classification system is useful.^{1141,1142} Nevertheless, the clinician should realize that turf toe constitutes a continuous spectrum

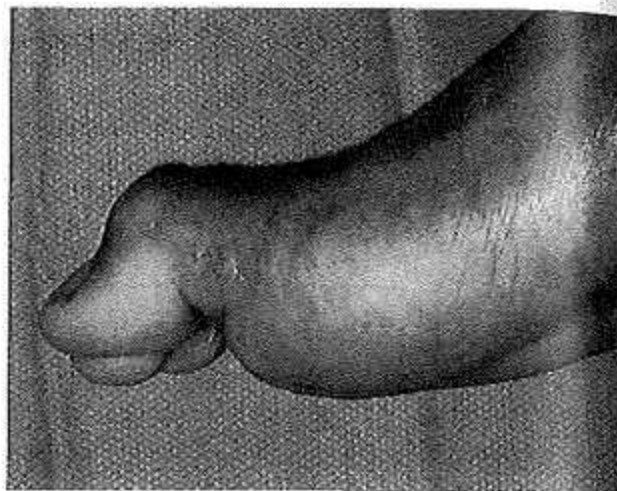


Figure 26-96 Interphalangeal joint flexion contracture and dorsal subluxation of the first metatarsophalangeal joint in a professional football player with a chronic turf toe injury. A, Clinical appearance. B, Lateral radiograph.

of injury, with great variability in the extent of injury as well as in the athletes' response to similar injuries.

Grade 1 sprains involve a stretching injury to the capsuloligamentous complex around the first MTP joint, and the patient has localized plantar or medial tenderness, minimal swelling, and no ecchymosis. Range of motion is minimally restricted, and the athlete is usually able to bear weight with minimal symptoms and continue athletic participation with mild pain. This is also the typical clinical picture in the athlete with the chronic sprain.

Grade 2 sprains have a partial tear of the capsuloligamentous complex and more severe symptoms and signs. The tenderness is more intense and diffuse,



Figure 26-97 Anteroposterior x-ray of the foot of a professional football player demonstrating severe proximal migration of the sesamoids.

with increased swelling and ecchymosis. Some restriction in range of motion results from pain and guarding. The athlete has moderate pain and a mild limp with weight bearing. Players are unable to perform at their normal level.

Grade 3 sprains are more complete tears, and patients have severe pain along with marked swelling and ecchymosis. Tenderness is severe on both the plantar and the dorsal surfaces. The disease (in the hyperextension mechanism) involves tearing of the plantar plate and impaction of the proximal phalanx into the metatarsal head dorsally. Fracture of a sesamoid or separation of a bipartite sesamoid can occur with this injury grade (see Fig. 26-94). In rare circumstances the tear of the capsuloligamentous complex is severe and located distal to the sesamoids, resulting in their proximal migration (Fig. 26-97). In any case, severe restriction of first MTP range of motion is present. Players are unable to bear weight on the medial portion of the forefoot and are clearly unable to play.

Radiologic Evaluation

Severe sprains deserve routine radiographs to rule out any potential bony disease such as capsule avulsions, sesamoid fractures, impaction injuries, separation of a bipartite sesamoid, or proximal migration of the sesamoids. Weight-bearing AP, lateral, and sesamoid views with contralateral comparison views should be obtained. Proximal sesamoid migration is a sign of plantar plate disruption. The difference in distance

from the MTP joint to the distal sesamoid pole should be less than 3 mm when compared to the other side. If an injury is still suspected but not visualized on the films, dorsiflexion stress views can accentuate signs of ligamentous disruption. Some authors believe MRI is the best modality for visualizing both ligamentous and osteochondral injury. T2-weighted images demonstrate both injury types and allow thorough characterization of the location of the injury prior to surgical treatment.

Conservative Treatment

The initial treatment of sprains of the MTP joint(s) proceeds along the same lines as discussed in the earlier sections on sprains of the ankle and midfoot. The RICE elements are essential to the treatment protocol.¹¹⁵⁶ Early joint mobilization is crucial because loss of motion is a common sequela of injury. Rest is the key component of treatment and usually the most difficult to control and enforce. The difficulty in compliance stems from the assumption by both player and coach that this is a minor injury. Unfortunately, returning too early to competition almost always extends the convalescence and results in a more prolonged disability.

Cryotherapy is best delivered for 20 minutes two or three times a day within the first 48 to 72 hours after acute injury.¹⁴⁷ (Beware of the rare athlete with cold sensitivity.) Progression to contrast treatment commences after 48 to 72 hours. NSAIDs are also prescribed. Compression is provided by taping the toe, but caution must be exercised in taping the toe after an acute injury, because it is theoretically possible to restrict circulation as swelling continues. A walking boot is quite useful in immobilizing the foot and allowing a more comfortable gait during the first few days after injury. It is rarely needed beyond a week except in the most severe injuries to this area.

Another component of treatment is equipment modification. The goal is to reduce the stresses across the forefoot, which is accomplished by reducing the flexibility of the footwear. Increased stiffness in the athletic shoe helps prevent hyperextension (or hyperflexion) of the MTP joints. This can be achieved by replacing the insole with one that incorporates a spring stainless steel or graphite plate in the forefoot region. Figure 26-98 shows an insole designed for this purpose.

If the stiffened insole is not tolerated well by the athlete or a more chronic condition exists, an insole that better conforms to the foot is custom molded. This insole is designed with a Morton's extension and is formulated from a stiff material (e.g., rigid plastic

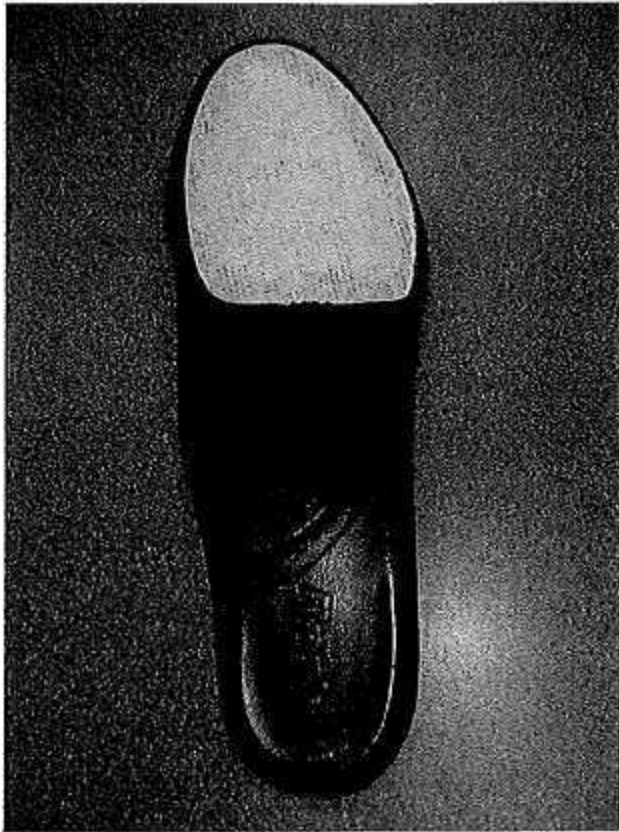


Figure 26-98 Commercially available orthosis incorporating a reinforced forefoot plate can provide protection for the athlete with a turf toe injury.

or graphite) to limit first MTP joint movement. As an alternative, a cobbler can modify the athlete's shoe by stiffening the sole and adding a slight rocker bottom.

The athlete with a grade 1 injury typically continues participation as symptoms allow. The toe is taped, and a stiffened insole is used in both practice and games. Usually, no playing time is lost. Grade 2 injuries usually result in loss of playing time ranging from 3 to 14 days. A grade 3 injury typically requires the athlete to use crutches and a walking boot for ambulation over the first few days to weeks. Loss of playing time is longer, often 2 to 6 weeks (see Table 26-5).

Taping of the hallux is designed to restrict movement (usually hyperextension) at the MTP joint. The principle of taping is to reinforce the structures that restrain dorsiflexion. A rehabilitation program should be started as soon as a decrease in symptoms allows.¹¹⁵⁶ Rehabilitation includes foot and ankle active and passive range of motion exercises, both non-weight bearing and weight bearing. The patient may return to play when pain and swelling have decreased and motion improves. The gait pattern should be near

normal. The use of anesthetic or steroid injections to allow athletes to continue play is not advocated due to the potential for further joint deterioration.

Surgical Treatment

Surgery to treat sprains of the MTP joints is often unnecessary. In certain situations, surgical therapy is warranted when conservative treatment fails or specific surgically correctable disease is identified. According to Anderson,¹¹³³ indications for surgery include a large capsular avulsion with an unstable joint, progressive diastasis of a bipartite sesamoid or sesamoid fracture, sesamoid retraction, traumatic bunion and progressive hallux valgus, a positive vertical Lachman's test, and the presence of a loose body or chondral injury.

Techniques

Once operative therapy has been chosen, the choice of an incision must be made. A J incision that begins medially and curves laterally along the flexor crease at the base of the hallux allows extensive exposure of the plantar surface of the joint and is usually preferred. Plantar medial, medial, and plantar lateral are all reasonable options and may be appropriate for certain repairs.

After the incision is made the plantar medial digital nerve is exposed and protected. The soft tissue is then dissected to expose and identify the injuries to be repaired.

For repair of complete plantar ruptures, the location of the rupture determines the technique to be employed. If the rupture is near the distal pole of the sesamoids, a stump of distal tendon should be preserved for primary repair to the proximal portion of the FHB tendon. For more distal ruptures, the use of suture anchors or drill holes in the base of the proximal phalanx may be necessary (see Fig. 26-92C).

Diastasis or fracture of the sesamoids should be treated with sesamoid resection and primary soft tissue repair. After tibial hallux sesamoidectomy, Anderson¹¹³⁹ recommends transfer of abductor hallucis to the resulting plantar defect to assist with defect closure as well as to provide additional restraint to dorsiflexion. Another option for both tibial and fibular* sesamoid diastasis is to reduce the diastasis and secure with nonabsorbable cerclage sutures.

Surgery for the late sequelae of turf toe can be more involved. Correction of traumatic hallux valgus can be accomplished with a modified McBride bunionectomy with lateral release, as discussed elsewhere in this text. Kay has advocated a Girdlestone (long flexor to the proximal phalanx) transfer with joint pinning when there is rupture of the plantar plate and dorsal subluxation or dislocation of the toe.¹¹⁴⁹ This is also effi-



Figure 26-99 Postoperative radiographs following interphalangeal joint fusion and transfer of the flexor hallucis longus to the proximal phalanx for repair of a chronic turf toe problem. A, Anteroposterior x-ray. B, Lateral x-ray.

carious for a cock-up deformity (Fig. 26-99). Chronic varus or valgus instability at the MTP joint can be reconstructed with an intrinsic transfer to rebuild the collateral ligament. The more complicated the reconstruction and prolonged the joint pinning, the more likely there is excessive swelling and stiffness. A return to competition is never assured.

Postoperative care involves a brief period of immobilization (1 week) followed by protected passive plantar flexion. Dorsiflexion is avoided for at least 1 month and return to light athletics is delayed for 3 to 4 months and until the patient has 50 to 60 degrees of dorsiflexion without pain.¹¹³⁹

Results

Coker et al¹¹⁴⁴ surgically treated four patients, including one with a sesamoid fracture. No patients were treated acutely. Among the three athletes with injury other than the sesamoid fracture, one had loose bodies within the first MTP joint, another had chondromalacia involving the first metatarsal head, and a third had calcification of the soft tissues over the first metatarsal head. Evidence revealed prior capsular injury in all three patients. In the study by Clanton et al,¹¹⁴¹ only one patient underwent delayed surgery for the removal of a symptomatic fragment of avulsed bone.

Rodeo et al¹¹⁵³ reported on athletes with diastasis of a bipartite tibial sesamoid. In three patients, observation and protection resulted in progressive widening of the sesamoid fragments. They were treated with excision of the distal sesamoid fragment and repair of the capsule. A fourth athlete underwent acute surgical treatment, again with distal fragment excision for the tibial sesamoid and capsular repair. All players had a full return to sports activity.

Anderson¹¹³⁹ has described a series of 19 collegiate and professional athletes presenting over a 10-year period, with nine patients requiring surgery for turf toe. All but two of these patients, both professional football players, returned to full athletic activity with minimal discomfort. Long-term sequelae from MTP joint injury, specifically turf toe, were first noted by Coker et al.¹¹⁴⁴ Persistent pain with athletic activity and restricted motion were the remaining symptoms at follow-up among nine patients reported. *Sports Illustrated* has published several articles on the problems of artificial turf and suggested lasting consequences from turf toe injuries in professional football players.^{1148,1150,1159}

Specific long-term consequences include hallux valgus and early hallux rigidus (Fig. 26-100).¹¹⁴¹ Calcification within the ligaments, metatarsalgia, and osteophyte formation are other potential aftereffects.¹¹⁵⁶ In an unpublished report, Clanton and Seifert¹¹⁴³ reviewed 20 athletes who had prior turf toe injury with more than 5 years of follow-up and noted a 50% incidence of persistent symptoms.

Further study is needed regarding the long-term effects of turf toe injury, but it is clearly a significant athletic injury that requires appropriate treatment tailored to its severity.

BUNIONS IN ATHLETES

Hallux valgus and hallux rigidus (dorsal bunion) are discussed in Chapters 6 and 16. Most patients with these problems are middle-aged women and nonath-

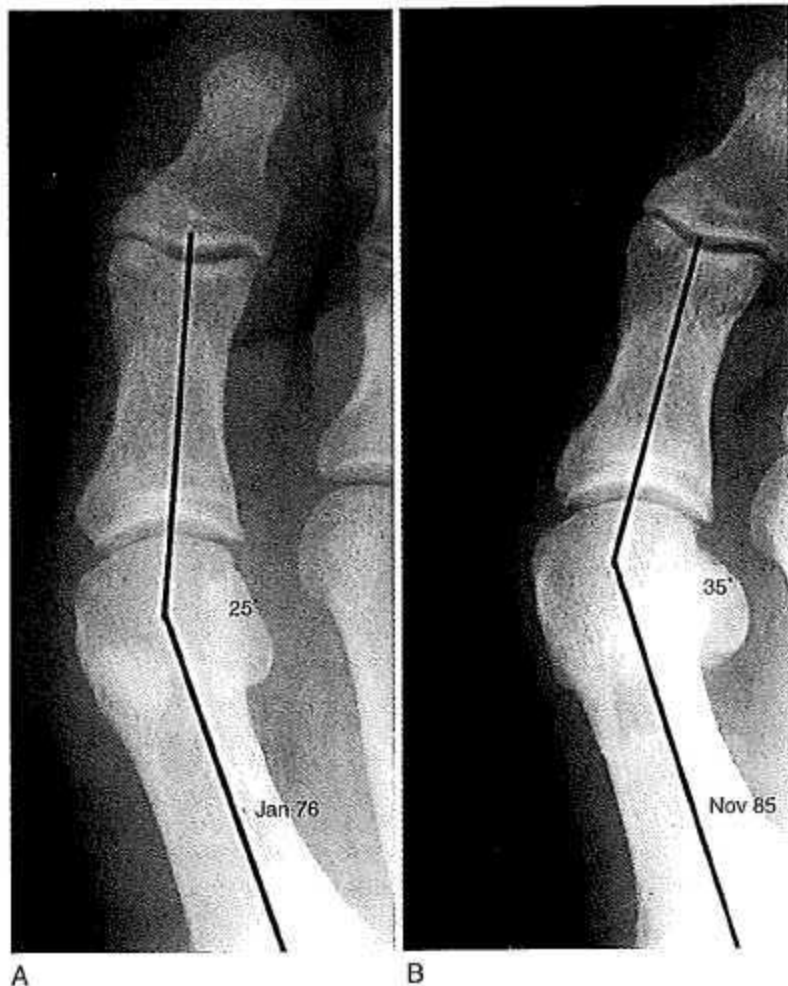


Figure 26-100 Chronic problems can be seen in some cases of turf toe injury. Hallux valgus developing in an athlete with prior turf toe injury. A, Football lineman 1 year after severe turf toe injury with 25 degrees of valgus at the metatarsophalangeal joint. B, Same player 10 years later with symptomatic hallux valgus and hallux rigidus and 10-degree increase in hallux valgus angle.

letes. An athlete with a bunion deformity presents a more complicated therapeutic dilemma.¹¹⁶⁰ The following discussion addresses this condition in regard to the young athlete.

Etiologic Factors

Acute hyperextension, subluxation, or dislocation of the first MTP joint may tear the plantar plate as well as the medial capsule, leading to either hallux valgus or hallux rigidus.^{1162,1164,1165} In running athletes, pronation during toe-off and cutting increase valgus stress on the first MTP joint. Abduction stresses on the first MTP joint are also high in the hindfoot in certain golfers, bowlers, and fencers. During the tennis serve, the front of the forefoot is stressed in abduction and dorsiflexion, which can increase symptoms from a bunion or hallux rigidus. Athletic footwear can also be at fault if it is sized improperly.

Diagnosis

Evaluation begins with a thorough history and physical. This includes gathering information regarding hereditary, metabolic, endocrine, and rheumatologic disorders, because athletes can be subject to these disorders just as easily as nonathletes. Because of the relationship of symptoms with shoes, the physician should always inspect the athletic footwear. The key issue is whether or not the athlete can continue to compete in view of the deformity and symptoms.

Accurately locating the patient's pain on physical exam is an important step in formulating a treatment plan. One should observe the following: pain on palpation of the dorsomedial eminence, sesamoids, dorsal first MTP joint, and plantar second metatarsal head; pain on range of motion of the first MTP joint and whether the great toe is in a fixed position;



whether crepitus is noted on range of motion; occurrence and location of callosities; presence of digital deformities, including over- or underlap of the second toe; and gait, noting excessive hindfoot pronation, maximal pronation of the foot in stance, abductory twist of the forefoot during heel-off, level of the forefoot through which propulsion passes, and comparison of the affected or more symptomatic side with the contralateral limb.¹¹⁶⁹

Appropriate radiographs include weight-bearing anteroposterior, lateral, and sesamoid axial views.

Conservative Treatment

Conservative treatment remains the ideal approach for athletes with bunions. The focus is on shoe modification to larger or wider sizes or models with higher, wider toe boxes. Numerous athletic shoe manufacturers have attempted to gain market niche by offering width sizing, as well as women's models with a wide toe box and narrow heel. When the problem is a dorsal bunion, thicker and stiffer soles in the forefoot are useful to reduce mobility of the first MTP joint. Adding a rocker bottom to the sole of the athletic shoe helps reduce the amount of dorsiflexion needed at the first MTP joint.¹¹⁶⁶ As mentioned for turf toe, use of an off-the-shelf stiffened insole or a custom made orthosis of graphite or plastic can protect the first MTP joint from painful movement.

When the goal is reducing pronation to alleviate stress on the medial forefoot, a medium- or high-density polyurethane orthosis with medial longitudinal arch support should be employed. Building up the orthosis proximal to the metatarsal heads provides relief beneath the sesamoids. A Morton's extension for hypermobility of the first ray is sometimes useful.

A toe spreader made of silicone-elastic, foam, or lamb's wool can decrease pain from pressure between the first and second toes. Localized nerve or sesamoid pain can be relieved with a horseshoe-shaped pad that is individually fabricated. Doughnut pads using comfortable cushioning materials can be used for various symptomatic bony prominences. Hallux valgus or claw toe taping may be useful for dynamic deformities. Other conservative modalities, including massage, physical therapy, NSAIDs, and trigger-point injection provide options in selected patients.

Surgical Treatment

Cheilectomy is the most appropriate surgical alternative for the athlete with a dorsal bunion or hallux rigidus.¹¹⁶⁷ Although a dorsal approach is standard, we have performed cheilectomies through medial and lateral incisions.¹¹⁶³ Occasionally, a proximal pha-

langeal dorsal closing wedge osteotomy is indicated when sufficient dorsiflexion is not achieved with cheilectomy (see Chapter 16). A plantar flexion osteotomy of the first metatarsal head has also been described to address the altered position or length of the first ray contributing to the symptoms of hallux rigidus in the athlete.^{1167,1170}

Various procedures for hallux valgus have been described, but simple bunionectomy (without a metatarsal osteotomy) combined with medial capsular reefing leads to a high incidence of recurrence and dissatisfaction.^{1161,1172} In a patient whose intermetatarsal angle is less than 12 degrees, a chevron osteotomy may be the best alternative.¹¹⁶¹ In patients with greater deviation between the first and second metatarsals, a proximal osteotomy is required.^{1168,1171} Another surgical choice when the intermetatarsal angle is greater than 12 degrees is a double osteotomy combining a chevron with an Akin procedure (proximal phalangeal osteotomy).¹¹⁷⁴ Obviously, fusion of the first MTP joint, interphalangeal joint, or metatarsocuneiform joint should be avoided because it decreases mobility and leads to deficient stress transfer. Resection arthroplasty of the first MTP joint (Keller procedure) creates a floppy, mobile toe and transfer of stress to the second or third metatarsals. It should never be performed on an athletic patient. A similar statement can also be made for silicone implants.

After surgery it is important to start non-weight-bearing rehabilitation earlier and to splint the toes for a longer period than would be required for nonathletes. The typical rehabilitative protocol includes using an exercise bike at 1 to 2 weeks, instituting swimming at 3 to 4 weeks, walking at 6 weeks, and beginning full weight bearing exercises at 8 weeks. The athlete may begin a full training program at about 3 months and resume competitive activity by 6 months. In a recent series of 31 bunionectomies with first metatarsal osteotomies, Saxena¹¹⁷³ discovered an average return to vigorous training in 8.9 weeks. This group included both professional and high-level recreational athletes. Individualization of the rehabilitation program depends on the patient, the activity, and the exact procedure performed.

Related Condition

Yokoe and Kameyama reported 10 cases of athletes with mean hallux valgus angles of 24.3 degrees and presenting with stress fractures of the medial, basilar portion of the proximal phalanx. The authors attribute this lesion to the opposing pull of the abductor hallucis medially and the adductor hallucis and the extensor hallucis longus (bow-strung across the first MTP joint) laterally. Six of these athletes healed their

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stress fractures in 8 weeks with conservative treatment. Four required screw fixation to achieve solid union.

Summary

Bunion deformities occur in athletes and are occasionally symptomatic. Biomechanical stresses inherent in various sport activities can contribute to the deformity and symptomatology. Evaluation of the athlete must include localized and general examination to determine the exact nature of the disease. Even though conservative treatment is successful in most patients, a symptomatic hallux valgus deformity occasionally requires surgical treatment. The choice of procedure is based on the patient's requirements and the specific underlying disease (see Chapter 6). When surgery becomes necessary, a bony procedure should be selected.

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