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Common Football Foot and Ankle Injuries: Non-Surgical and Surgical Management

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Introduction

In American football, players complete explosive, shifting movements and participate in high-energy collisions with other players. Trauma to the foot and ankle in football players is common, with an estimated incidence as high as 20% to 30% of all football-related injuries [44,56,61,70,79]. Presentation of these injuries varies widely, and they require specific treatment and rehabilitation protocols. This article highlights the standard surgical and conservative treatment options for the most common foot and ankle injuries in American football: lateral ankle sprains, ankle fractures, Lisfranc injuries, Achilles tendon tears, turf toe, and fifth metatarsal fractures [25,44]. We also offer techniques to consider when surgical and conservative management is appropriate, with supporting outcome data. Understanding how to diagnose and treat the different types of football-related foot and ankle injuries allows for effective management as well as quick and safe return to play.

Lateral Ankle Sprains

A retrospective chart review of 2285 players who participated in the National Football League (NFL) Scouting Combine from 2009 to 2015 found that 1242 (86%) players experienced ankle sprains [44]. Lateral ankle sprains, among the most common, involve damage to the lateral ligamentous complex of the ankle—consisting of the anterior talofibular ligament (ATFL), the posterior talofibular ligament (PTFL), and the calcaneofibular ligament (CFL)—and occur when a supination force is applied to a plantarflexed foot [44]. The high incidence of these sprains in elite athletes can be partially attributed to the relative weakness of the lateral ligamentous complex along with the ankle's natural tendency to invert [17]. The most common soft tissue injuries reported was to the ATFL (n=158, 12.7% of sprains) [44]. This is thought to be the result of the ATFL being maximally stretched during inversion of a plantarflexed foot as well as the ATFL outputting the lowest load tolerance at around 150N [17,29,64]. Furthermore, patients with a history of lateral ankle sprains are at 3.5 times greater risk of re-injury. Regardless of initial treatment, multiple sprains can cause lasting damage to the lateral ligaments and potentially lead to chronic lateral ankle instability (CLAI).

Proper diagnosis of lateral ankle sprains is essential, as it is associated with a better prognosis and return to play time. Athletes with lateral ankle sprains often report sudden twisting of the ankle joint, lowered weightbearing ability, and the ability to identify the painful spot on palpation [17]. All bony structures and lateral ankle ligaments should be palpated for tenderness. If the patient does not feel pain upon palpation of the ATFL, it is likely that there is no apparent rupture of the lateral ligaments [67,68]. The 2 most common manual stress tests for the ankle are the anterior drawer test and the talar tilt test. The anterior drawer test assesses the stability of the ATFL, with differences of 5 mm between the ankles or a displacement of more than 10 mm in injured ankle marked as indications of instability. On the other hand, the talar tilt test assesses the inversion stress of the CFL, with differences between the ankles of 5° or more than 10° of tilt in the injured ankle as indications of instability. If both ecchymosis and either palpatory pain or

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positive stress are present, the patient most likely sustained a partial ligamentous rupture to their lateral ligamentous complex [67,68]. However, manual stress tests in the acute phase are less reliable because of inhibitory swelling and pain. Therefore, delayed physical examination is more reliable and thus considered the gold standard for diagnosing acute lateral ankle injury [67,68]. While there has been substantial research on the validity and techniques of these 2 manual stress tests, further research on subtalar stress tests is warranted to improve clinical outcomes.

Ankle microinstability has recently been described as a form of mechanical ankle instability (MAI) following damage to the ATFL's superior fascicle [69]. Mechanical ankle instability is defined as laxity of the ankle that results from damage of the ligamentous tissue supporting the ankle joint and leads to the ankle joint exceeding the normal physiological range of motion [22]. These injuries can be difficult to diagnose, as clinical evaluations can be misleading; anterior drawer and talar tilt tests cannot recognize microinstability, and patients only present symptoms of intraarticular injuries such as osteochondral lesions of the talus (OLTs) [69].

Lateral ligament injuries are usually managed non operatively. Conservative management consists of protected mobilization in a controlled ankle motion (CAM) boot, brace, or wrap, followed by physical therapy, nonsteroidal anti-inflammatory drugs, and anti-edema measures such as rest, ice, compression, and elevation (RICE). Given the frequency with which inversion sprains occur and the relative infrequency of symptoms requiring an operation, 80% to 85% of patients can be managed conservatively with good results and minimal disability [71]. Patients for whom conservative treatment fails and/or who have CLAI may require surgery, with techniques ranging from direct repairs to anatomic and non-anatomic reconstructions. Variations of procedures using anatomic repair yield good to excellent results in 85% of patients [5].

Return to play after a modified Brostrom repair has been reported to be an average of 77 days (approximately 2.5 months) for athletes with isolated injuries, and 105 days (approximately 3.5 months) for athletes with concomitant injuries [75]. However, because there are limited articles looking specifically at return to play following a modified Brostrom repair for lateral ankle sprains [38], further research is warranted.

Ankle Fractures

"Ankle fracture" refers to any fracture that occurs in the distal tibia, the distal fibula, and the talus. These injuries can be caused by sharp inversion or eversion of the ankle joint or a high-energy trauma from a fall or tackle [77]. While ankle fractures in the general American population occur at an incidence rate of 184 per 100,000, ankle fractures comprise 7% of all sport-related fractures and have been reported to consist of 9.5% of all ankle injuries among participants at the NFL Combine [44,62,74].

Ankle fractures can coincide with damage to surrounding structures, such as the deltoid ligament and the ankle syndesmosis, a fibrous joint connecting the distal tibia to the distal fibula, that can affect ankle stability [36,54,80]. Approximately 10% of all ankle fractures and 20% of internal fixations lead to syndesmotic injury [27,51].

Given the variance of rotational and impaction trauma that can occur in the event of an ankle fracture, several systems have been developed to differentiate these injuries. While the Lauge-Hansen and Danis-Weber classifications are popular among physicians, the most common system used in clinical practice is the anatomical classification, which categorizes fractures based on their position relative to the tibia, fibula, and talus [20,77]. Subgroups within this system include isolated medial malleolus fracture, isolated lateral malleolus fracture, bimalleolar ankle fracture, and trimalleolar ankle fracture. Isolated malleolar ankle fractures are the most common, accounting for roughly 70% of all ankle fractures yearly [14,77]. Bimalleolar fracture incidence is around 20%, while trimalleolar fractures consist of 7% of all ankle fractures [14]. Trimalleolar fractures typically showcase the most cartilage injury and have the highest risk of post-traumatic arthritis [35].

Ankle fracture surgery is one of the most common surgical procedures among professional football players [11]. Determining whether conservative or surgical treatment is appropriate, however, depends on the joint's stability and bone alignment [52]. A stable fracture with no bone fragments or malalignment can be treated nonoperatively with a closed reduction and/or immobilization in a CAM walking boot for 6 weeks. The competency of the deltoid is critical in determining if an ankle fracture is stable or unstable. In most cases for stable ankle fractures, partial weight-bearing is allowed immediately in the CAM boot. After 6 weeks, the patient can transition toward full weightbearing without the CAM boot and return to sports and physical activities around 3 to 4 months.

Open reduction and internal fixation (ORIF) is standard for patients with more serious fractures and is ideally performed as soon as possible to reduce the risk of infectious wound complications [60]. Patients remain immobilized and non-weight bearing in a splint for 2 weeks after surgery followed by a transition into a CAM walking boot if a stable fracture pattern is observed. Partial weight-bearing can begin at 4 to 6 weeks with full weight-bearing at 6 to 8 weeks. By 3 to 4 months, patients can return to physical activity and sports.

Lisfranc Injuries

Lisfranc injuries, when one or more ligaments supporting the midfoot are torn, can range from stable and non-displaced

ligamentous injuries to more severe midfoot fractures or dislocations [31,73]. Lisfranc injuries are often seen in football players when one player lands on the back of another player's foot in the plantarflexed position or when a plantarflexed foot is axially loaded and abducted or rotated [3]. They can be difficult to treat in sports.

While Lisfranc injuries are relatively uncommon in the general population, comprising around 0.2% of fractures, they are more prevalent collision sports, affecting around 1.8% of collegiate football players participating in the NFL Combine [3,40].

Lisfranc injuries have been associated with high-energy trauma such as motor vehicle accidents, and thus most studies have focused on such. However, more subtle and low-energy Lisfranc injuries have been increasingly reported in athletes and can be challenging to diagnose without advanced imaging [43]. It is commonly misdiagnosed as a sprain. When not properly treated, unstable Lisfranc injuries can result in cartilage damage and persistent instability of the arch, leading to arthritis and flattening of the foot, respectively.

Patients suffering from low-energy Lisfranc injuries tend to present with pain and swelling, absence of foot deformity, and a maintained ability to walk. They may hear a pop in their midfoot at the time of injury and experience pain while weight-bearing that subsides over time. Indications of Lisfranc injuries include plantar ecchymosis of the midfoot, pain on palpation or manipulation of the tarsometatarsal (TMT) joints, and altered sensitivity in the first intermetatarsal space [2]. The "piano key test," in which the head of the affected metatarsal is moved while holding the midfoot and hindfoot in place, can be used to identify the affected TMT joint. Additionally, a "positive gap," an increased distance between the base of the second metatarsal and the medial cuneiform, is a predictor of instability [43]. As part of the workup for Lisfranc injuries, the patient should receive radiographs on both feet, preferably weightbearing radiographs. Recently, an angle of 28.9° in the anteroposterior (AP) radiograph has been reported to enhance visualization of the Lisfranc joint [55]. If there is proximal first webspace diastasis or a stepoff of the first TMT joint on the AP or lateral X-ray, surgical intervention should be considered.

Surgical treatment is advised to achieve anatomical reduction if there is any displacement [3]. One study found that patients with Lisfranc injury who underwent an open reduction/internal fixation (ORIF) surgery had less arthritis and better AOFAS midfoot scores 7 years postoperatively, supporting the concept that stable anatomical reduction leads to good long-term outcomes [30]. Beyond standing radiographs, standing computed tomography (CT) scans, magnetic resonance imaging (MRIs), and stress X-rays have been helpful to delineate the instability of this area. Greater than 2 mm of displacement should not be tolerated. It is advised to wait for soft tissue swelling to subside before surgery [3]. The definitive treatment for surgical patients usually involves an ORIF, although percutaneous pinning and primary arthrodesis have also been proposed. We recommend bridge plating of an unstable first TMT and screw fixation of intercuneiform instability to preserve joint cartilage and maintain alignment [21]. After surgery, patients should be immobilized in a splint for 2 weeks, and then placed in a non-weight bearing walker boot for 4 weeks. At that point, weight bearing can be advanced. Return to play usually occurs at 5 to 6 months, depending on the degree of injury. Hardware removal should occur no sooner than 5 months after the index procedure based on symptoms rather than a premeditated routine.

Achilles Tendon Ruptures

Achilles tendon (AT) ruptures are one of the most common tendon injuries in adults, occurring in competitive athletes at a rate of 18 per 100,000 person-years [49]. Most AT ruptures occur in the following positions: dorsiflexed foot with triceps surae contraction, pushing off a weight-bearing foot during knee extension, and dorsiflexion on a plantar-flexed ankle [66,78]. In football, this commonly occurs when players explode forward out of a backpedaling position. Due to its prolonged recovery, requiring up to 1 year of rehabilitation regardless of treatment type, AT ruptures can be career-ending injuries for professional athletes. Football players are at an increased risk of sustaining AT ruptures due to the frequency and force with which they load the AT during rapid acceleration and changes in direction during play [78]. In a study analyzing AT ruptures in professional football players during the 2010 to 2015 NFL seasons, 26% of players were not able to return to play, and those who did took an average of 9 months from the time of injury to recover [47]. Additionally, they found a net decrease of 22% in power ratings over 3 years following players' return to sport after AT rupture [47].

Risk factors for acute AT ruptures include male sex, participation in sports requiring an eccentric load of the AT, and use of anabolic steroids and fluoroquinolones [63]. At the time of injury, patients often describe hearing a "pop" sound or experiencing a feeling of being kicked in the back of the ankle. Diagnosis is made on the presence of a positive Thompson test, and a gap in the tendon as confirmed on an MRI. While the Thompson test has generally high accuracy, routine imaging is usually not needed except in equivocal cases [48].

AT ruptures can be managed either conservatively or surgically. Conservative treatment consists of 2 weeks of immobilization and then an accelerated rehabilitation protocol [76]. While the recovery period of non-surgical treatment is lower and avoids the risks of surgical complications,

it is associated with higher re-rupture rates (12.6% vs 3.5% with surgical treatment) and decreased regain of calf strength (10 to 18% loss) at 18 months postoperatively compared to patients undergoing surgical treatment [28,49]. Therefore, elite athletes who wish to return to sport following AT rupture undergo surgical treatment.

In our practice, we use a minimally invasive open repair technique for the surgical treatment of acute AT ruptures; infection rates of less than 1% can be expected.

Turf Toe

"Turf toe" refers to a plantar capsule-ligament sprain of the hallux metatarsophalangeal (first MTP) joint [9]. In football players, turf toe injuries often occur during a tackle, upon application of an axial load to the heel of a plantarflexed foot while the first MTP is extended [59,65]. The mechanism of injury is similar to that of Lisfranc injuries. A retrospective 5-year analysis of National Collegiate Athletic Association football players demonstrated an incidence rate of 0.062 per 1000 with an average of 5 turf-toe injuries per team per year [19].

Injury severity can range from partial to complete disruption of the plantar tissues, depending on the force of the injury as well as the position of the hallux at the time of impact. The most common variation results from a valgus-directed force [1], resulting in injury to the plantar medial complex or tibial sesamoid that can lead to hallux valgus deformity.

Turf toe injuries are classified into 3 grades. Grade 1 injuries refer to a ligamentous complex sprain in which the first MTP joint remains competent and able to resist dorsiflexion. Players with grade 1 turf toe injuries can be treated with symptomatic management and expected to return to sport within a week. Grade 2 injuries refer to partial ligamentous tears with symptoms including moderate swelling and restricted motion. Grade 3 injuries refer to complete ligamentous tears, with complete disruption and weakness in the plantar structures and instability during hallux flexion. Surgery is often indicated for grade 3 injuries with recovery taking up to 5 to 6 months.

Regardless of injury grade, early treatment for all turf toe injuries consists of anti-edema measures such as RICE and anti-inflammatory medications [13]. Patients experiencing grade 1 injuries can usually return to competition as tolerated. After anti-edema measures, the great toe should be taped in a slightly plantar-flexed position. Upon return to sport, the patient should use a stiff-soled shoe with either a turf toe plate insert or a custom orthotic with a Morton's extension to limit hallux motion. For patients with grade 2 injuries, in addition to symptomatic management, a walking boot and protected weight-bearing may be required. The patient should be monitored in the early phases of recovery to make sure the deformity does not progress with athletic activity. Patients with grade 2 injuries should also be advised to use footwear with a turf toe plate or Morton's extension. For patients with grade 3 injuries, the first MTP should have 50º to 60º of painless passive dorsiflexion before attempting to run or do any form of explosive activity [45].

Surgical intervention is required in less than 2% of turf toe injuries but should be considered for cases of large capsular avulsion with instability in the first MTP joint, diastasis of bipartite sesamoid or sesamoid fractures, retraction of sesamoids, traumatic bunion formation, a positive vertical Lachman's test, or chondral injuries or loose bodies [1,19]. Regarding surgical technique, the type of incision used is left to the surgeon's discretion. Options include a dual incision technique, plantar medial, medial, and plantar lateral, or a "J" configuration incision [39]. Regardless, the surgeon must take care to identify and protect the plantar medial digital nerve. Next, the degree and extent of soft tissue injury must be assessed. Surgical techniques and variations for different cases of turf toe injuries have previously been described in the literature [1,18,37,39,45].

Postoperative management consists of gentle passive motion under supervision starting at 7 to 10 days after surgery. The patient should remain non-weightbearing with the hallux protected for 4 weeks, after which time the active motion of the first MTP joint may increase. Return to contact activity can occur at 4 to 5 months postoperatively, and full recovery should be expected to take 6 to 9 months [1].

Jones Fracture

In 1902, Sir Robert Jones reported on 6 patients with indirect fifth metatarsal fractures that occurred "as a cross breaking strain directed anteriorly to the metatarsal base and caused by body pressure on an inverted foot while the heel was raised" [23]. Before that time, it was believed that metatarsal fractures were the result of direct trauma [46]. Nowadays, fifth metatarsal base fractures are commonly referred to as "Jones fractures."

There is, however, historical inconsistency as to what "Jones fracture" refers to. Michalski et al [41] recently reported poor inter-rater reliability among American Orthopaedic Foot and Ankle Society surgeons in locating a Jones fracture along the proximal fifth metatarsal and deciding upon a preferred management strategy. Using Lawrence and Botte's 3-zone classification system of the fifth metatarsal base, with its recommended implication on treatment strategy [4,12,32], Jones fractures are defined as fractures to the proximal metadiaphyseal region in zones 2 and 3.

Proximal fifth metatarsal fractures are among the most common foot fractures, with an incidence rate of 21 to 46 per 100,000 persons per year (0.021 to 0.046%) [16,50]. Incidence among football players, however, is significantly higher: 86 Jones fractures were identified in 83 athletes out of 4738 participants (incidence rate of 1.8%) in the NFL

Combine, and 42 Jones fractures were identified during the 2010 to 2015 NFL seasons [34,47].

Pettersen et al [50] found that union rates for 834 nonoperatively treated proximal fifth metatarsal fractures were 97.3% for zone 1, 96.8% for zone 2, and 92.5% for zone 3. In addition, Josefsson reported a rate of union over 95% with satisfactory long-term functional outcomes by cast immobilization [24]. However, more recent studies have reported several disadvantages of nonoperative treatment with a cast, such as a prolonged immobilization and protected weight-bearing, as well as a decreased union rate compared to surgical treatment [7,33,42]. In our practice, we recommend weight bearing as tolerated in a CAM walker boot instead of a cast for 6 to 8 weeks, followed by a return to sport and physical activity at 3 to 4 months.

Nonoperative management is viable for most patients, but surgical fixation is recommended for athletes due to improved union rates, decreased complication rates, and shorter return to play times [7,12,42]. Zone 2 fractures in elite athletes should be treated with surgery over nonoperative management for 3 reasons: higher union rates (95% vs 70 to 90%, respectively) [34,57], quicker time to union (7 weeks vs 10 to 12 weeks, respectively) [10], and lower refracture risk (<5% vs 10 to 13%, respectively) [6,15,26]. Different operative techniques have been described in the literature, such as intramedullary screw, tension band wiring, differential pitch screw, and percutaneous bi-cortical screw [8,58]. Fixation with an intramedullary compression screw with or without a bone graft is the most common technique and the treatment of choice for NFL team physicians [34,58]. Porter et al [53] reported a 100% union rate, high satisfaction, and no refractures in a group of active patients using 4.5-mm cannulated intramedullary screw fixation.

Postoperative rehabilitation begins with immobilization in a non-weightbearing splint for 2 weeks followed by replacement in a CAM walker boot with progressive weight-bearing for an additional 4 to 6 weeks. By 6 to 8 weeks postoperatively, patients can start full weight-bearing walking and resume normal activities. Return to sport, however, can vary depending on fracture severity. While a return to sport as early as 4 weeks has been argued for, a return to pre-injury activity level should be allowed only after radiographic evidence of union and an asymptomatic clinical evaluation [58,72], typically occurs 10 to 12 weeks after surgery. The use of orthotics and supplemental vitamin D may also be of benefit.

In summary, foot and ankle injuries account for 20% to 30% of all football-related injuries [70]. Factors such as timing in the season, athlete expectations, football-specific ankle load, personal medical history, and the stage of an athlete's career must always be considered for effective management. While several months of rest may be required for a full recovery, prompt diagnosis and proper treatment allow most players with foot and ankle injuries to return to play with good outcomes.

Declaration of Conflicting Interests

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Human/Animal Rights

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Informed Consent

Informed consent was not required for this review article.

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