



Conservative Management for Stable High Ankle Injuries in Professional Football Players

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Context: High ankle “syndesmosis” injuries are common in American football players relative to the general population. At the professional level, syndesmotoc sprains represent a challenging and unique injury lacking a standardized rehabilitation protocol during conservative management.

Evidence Acquisition: PubMed, Biosis Preview, SPORTDiscus, PEDro, and EMBASE databases were searched using the terms *syndesmotoc injuries*, *American football*, *conservative management*, and *rehabilitation*.

Study Design: Clinical review.

Level of Evidence: Level 3.

Results: When compared with lateral ankle sprains, syndesmosis injuries result in significantly prolonged recovery times and games lost. For stable syndesmotoc injuries, conservative management features a brief period of immobilization and protected weightbearing followed by progressive strengthening exercises and running, and athletes can expect to return to competition in 2 to 6 weeks. Further research investigating the efficacy of dry needling and blood flow restriction therapy is necessary to evaluate the benefit of these techniques in the rehabilitation process.

Conclusion: Successful conservative management of stable syndesmotoc injuries in professional American football athletes requires a thorough understanding of the anatomy, injury mechanisms, diagnosis, and rehabilitation strategies utilized in elite athletes.

Keywords: football; syndesmosis; high ankle; rehabilitation; ankle

Injuries to the ankle represent the most commonly encountered injury in professional American football, accounting for 29% of all documented injuries.³ While the majority of ankle injuries involve the lateral ligamentous structures,^{15,33} high ankle “syndesmosis” sprains comprise up to 26.4% of ankle injuries, with high morbidity and risk for development of chronic ankle dysfunction.¹⁸ Collision inherent to American football and the high-energy maneuvers performed during elite-level competition, mainly cutting, blocking, and tackling, place football athletes at high risk for syndesmotoc injury.¹⁷ The large forces required to produce syndesmotoc injuries² result in missed practices and games as well as significantly longer recovery and treatment times to successfully

return athletes to preinjury levels when compared with lateral ankle sprains.^{2,12,27,36} While various treatment and rehabilitation protocols have been described in the literature, no standard rehabilitation protocol is followed collectively at the professional level.³⁰ This article highlights the anatomy, mechanisms of injury, diagnosis, and rehabilitation in the conservative management of stable syndesmotoc injuries in professional American football athletes.

ANATOMY

The ankle syndesmosis complex consists of the anteroinferior tibiofibular ligament (AITFL), superficial and deep components of

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The following authors declared potential conflicts of interest: Michael J. Salata, MD, is a paid consultant for Smith & Nephew, and James E. Voos, MD, is a paid consultant for Arthrex.

DOI: 10.1177/1941738117720639

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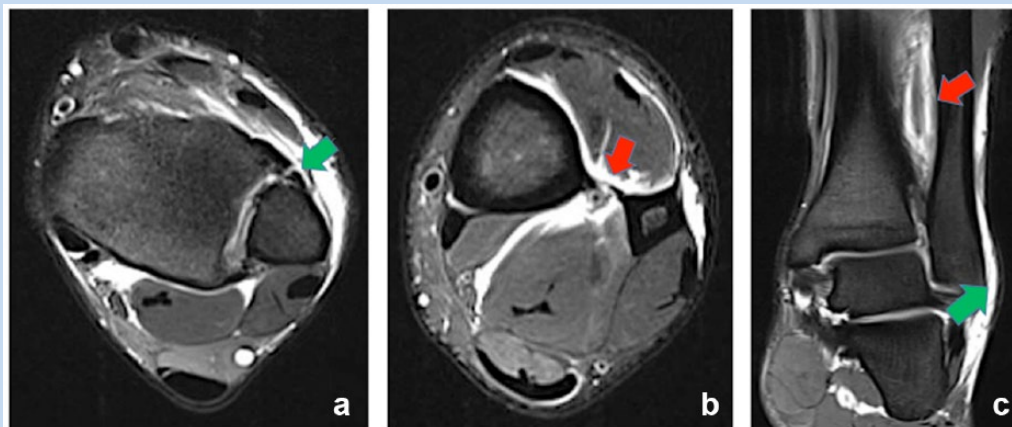


Figure 1. T2-weighted magnetic resonance imaging of the left ankle in the axial plane demonstrating surrounding edema and tearing of the anterior inferior tibiofibular ligament (a, green arrow) with associated defect within the interosseous membrane (b, red arrow). (c) Coronal section demonstrating edema and swelling to the interosseous membrane (red arrow) and lateral malleolus (green arrow).

the posteroinferior tibiofibular ligament (PITFL), inferior transverse tibiofibular ligament, and the interosseous membrane. The ligamentous complex connects the tibia to the fibula, stabilizing the distal articulation to the talus.^{2,7} In American football, the most commonly reported injury mechanism to the syndesmosis involves external rotation of the foot with simultaneous internal rotation of the tibia and fibula, commonly seen during cutting, twisting, or planting in which the foot becomes stuck in the turf.^{2,4,13} Syndesmosis injuries are also encountered after a direct blow to the posterolateral aspect of the leg, such as that which occurs when a player rolls onto the leg of another, forcing the foot into external rotation.³⁷ Reports of syndesmosis injury after hyperdorsiflexion associated with external rotation and axial loading of the ankle leading to disruption have also been reported.^{16,25} While significantly less common than lateral ankle sprains, syndesmosis injuries account for between 16% and 24.6% of all ankle injuries encountered in American football.^{18,20,21}

INJURY MECHANISMS

Because of the considerable forces required to disrupt and injure the syndesmosis, the majority of documented injuries occur during game competition. Feeley et al¹⁰ reported the injury rate per 1000 athlete-exposures to be 4 times higher in games than practices, while athletes were placed on injured reserve at a 13-fold higher rate after in-game injuries versus practice. Injuries to the syndesmosis ligaments follow an orderly pattern in which the weakest ligament, the AITFL, is the first and most commonly involved (Figure 1a).^{1,30} As the ankle is forced into further external rotation relative to the leg, injury risk to the interosseous ligament (Figure 1b and 1c) followed by the PITFL and the deltoid ligament are subsequently increased, resulting in potential ankle instability.^{4,30,37} The cadaveric study by Ogilvie-Harris et al²⁶ found that in the presence of ankle

instability secondary to tibiofibular diastasis, at least 2 of the 3 stabilizing ligamentous complexes of the ankle (the syndesmosis, deltoid ligament, and lateral ligamentous complex) must be compromised.²⁷

DIAGNOSIS

The recovery time required after syndesmosis injury has been shown to be significantly longer compared with lateral ankle sprains.^{2,13} Reporting on the incidence of ankle injuries in a single National Football League (NFL) team over a 6-year period, Boytim et al² found that athletes with syndesmosis injuries missed significantly more games ($P < 0.001$) and practices ($P < 0.001$) and required significantly more treatments ($P < 0.001$) compared with athletes with lateral ankle sprains. Osbahr et al²⁷ similarly reported on the increased time lost after syndesmosis injury when compared with NFL athletes with lateral ankle sprains ($P < 0.001$).

As such, discriminating between lateral ankle sprains and syndesmosis injuries is vital as player, coach, and organizational expectations regarding time lost and treatment differ significantly. Proper clinical examination on the sideline or in the office setting allows for accurate diagnosis of syndesmosis injury. Clinical tests such as the external rotation stress test,² squeeze test,¹⁶ and direct palpation of the syndesmosis ligaments allow for reliable evaluation for the presence of syndesmosis injury and discrimination from lateral ankle sprains.⁷ Of these provocative maneuvers, only the presence of a proximal squeeze test demonstrates prognostic value, as Sikka et al³⁰ found significant correlation with increased practices ($P = 0.012$) and games missed ($P < 0.01$) in athletes with a positive test compared with those without. No prognostic value in the presence of a positive external rotation test, pain with palpation, or ecchymosis has been reported.

The initial examination on the sideline or training room may be relatively innocuous with regard to swelling or tenderness. The single-leg heel rise provides additional clinical information with localized pain over the syndesmosis. It is more important, however, to pay close attention to the mechanism of injury to keep a high index of suspicion on the differential diagnosis. Repeat examination may be performed 3 to 5 days after initial injury if the initial diagnosis is in doubt, as patients with tenderness to palpation over the ankle ligaments, a positive stress test, and hematoma formation have been shown to possess a sensitivity of 96% for syndesmotic injury.²⁸

Weightbearing radiographic imaging including a mortise view immediately after or within 1 day after syndesmosis injury is routinely performed, providing clinicians with further diagnostic information regarding the type of injury along with prognostic value in the presence of true syndesmotic injuries. In his survey of athletic trainers (ATs) in the NFL, Doughtie⁷ reported that 96% of responding ATs indicated radiographs to be part of the initial evaluation to rule out concomitant malleolar fracture, a likely injury given the significant amount of force required to cause injury. In assessing interobserver reliability on conventional radiographs, Howard et al¹⁷ reported perfect agreement in diagnosing syndesmotic injuries, with substantial agreement among radiologists in diagnosing injuries to the PITFL (96% agreement) and the proximal extent of the syndesmotic injury (intraclass correlation coefficient [ICC], 0.83), with fair agreement in the diagnosis of AITFL injury (75% agreement) and the width of syndesmotic separation (ICC, 0.40). Radiographic imaging is also helpful in assessing joint stability by ruling out acute or latent tibiofibular diastasis using stress radiographs to determine the potential need for operative fixation.

Radiography can also be used postinjury to assess heterotopic ossification (HO) or synostosis within the interosseous membrane.^{23,33} Taylor et al³² reported evidence of HO in 50% (11/22) of collegiate athletes after syndesmotic injury. While thought to be associated with increased recovery times, the authors reported no statistically significant time lost in athletes with HO versus those without ($P > 0.05$).³² Meanwhile, Whiteside et al³⁵ found that the occurrence of tibiofibular synostosis increased the risk for subsequent lateral ankle sprain after initial syndesmotic injury.

Magnetic resonance imaging (MRI) evaluation is also routinely performed within 1 day after suspected syndesmotic injury to evaluate the syndesmosis complex, extent of the injury, and presence of concomitant injuries.^{5,17,24} MRI possesses a sensitivity of 93% to 100% and specificity of 96% to 100% in determining the pattern and number of ligaments damaged when compared with intraoperative findings.³⁴ Because of the significant difference in time lost in athletes sustaining syndesmotic injuries versus lateral ankle sprains, many authors support MRI evaluation for all suspected syndesmotic injuries to effectively rule in or rule out injury.^{4,36} Doughtie⁷ reported that more than 50% of NFL ATs surveyed obtained MRI for all suspected syndesmotic injuries. Furthermore, athletes with higher grades of injury based on the number of syndesmotic

ligaments involved on MRI have been shown to miss significantly more practices ($P = 0.003$) and games ($P = 0.002$) compared with athletes with lower-grade injuries with fewer injured ligaments.³⁰ In addition, Howard et al¹⁷ found that athletes with syndesmotic widening had significantly more time lost to injury ($P = 0.02$), while the status of the ligaments (torn vs intact) and the proximal extent of the injury did not correlate with time lost ($P > 0.05$). However, results from the study were limited by small sample size and poor interrelator reliability (ICC, 0.40) among authors in determining the width of syndesmotic widening, precluding syndesmotic widening from being used as a reliable prognostic factor.

REHABILITATION

Despite general agreement regarding the diagnostic workup after suspected syndesmotic injuries, no standardized rehabilitation protocol in professional football players currently exists.³⁰ However, in the absence of instability or frank diastasis, conservative management results in return to play typically between 2 and 6 weeks after injury.^{2,4,13,25} In his league-wide survey, Doughtie⁷ reported that 60% of responding ATs utilized ice, electrical muscle stimulation, casting or bracing, and nonsteroidal anti-inflammatory drugs in the acute phase after injury. While early range of motion after lateral ankle sprains is commonly used to hasten return to play, early mobilization after syndesmotic injury may place stress on the syndesmosis, prolonging recovery time and potentially contributing to HO formation by increasing the zone of secondary injury.³⁷ As such, a brief period of immobilization of up to 2 weeks using a controlled ankle movement (CAM) boot for protected weightbearing during the acute period appears beneficial.²⁷

An innovative treatment modality that may be utilized in the conservative treatment for syndesmotic injuries is dry needling. Dry needling involves insertion of a solid needle into the skin to regulate trigger points within the musculature, which in the presence of injury are believed to alter motor control patterns, increasing the risk for additional injury²² and accelerate muscle fatigability.^{6,8,11} While the exact mechanism of action remains unknown, trigger-point dry needling may reduce motor disturbances in the musculature, serving as an effective therapeutic adjunct for patients with ankle instability.^{8,19} Recently, Salom-Moreno et al²⁹ found that, compared with proprioceptive/strengthening exercises alone, inclusion of dry needling in active patients with ankle instability secondary to injury led to better outcomes in pain and function per the Foot and Ankle Ability Measure scale at 1 month. However, no long-term study examining the benefits of dry needling has been conducted in American football athletes, necessitating further investigation to determine the efficacy of dry needling in improving functional outcomes and return to play.

Rehabilitation may also include exercise under blood flow restriction (BFR). Immobilization of the affected extremity decreases protein synthesis of up to 30% of normal, which can lead to muscle atrophy.⁹ BFR promotes protein synthesis by

activating the mammalian target of the rapamycin complex (mTORC1) pathway via metabolic stress or muscle swelling, effectively decreasing atrophy of the immobilized lower extremity.¹⁴ Furthermore, acute spikes in levels of growth hormone (GH) have been demonstrated with BFR and low-load training.³¹ Although not fully understood, GH may aid in the healing process after injury by facilitating collagen synthesis. BFR has also shown increased capillarization, most likely through activation of vascular endothelial growth factor, which may improve the healing environment. Additionally, when coupled with endurance activities, BFR has demonstrated cardiovascular improvements such as increased oxygen delivery to the working muscles as well as muscle hypertrophy,³¹ allowing an immobilized individual to maintain and advance cardiovascular health and endurance. Prospective studies evaluating the benefit of injuries treated with BFR therapy are necessary to better understand its role in the treatment of syndesmotom injuries.

During the first 1 to 2 weeks of the immobilization period, athletes may perform hip and knee open kinetic chain activities with BFR therapy. Athletes may also ride a stationary bike in a restricted state, beginning at day 1, and continue as long as they remain in the CAM boot and are pain free. As the athlete progresses functionally, BFR exercises can progress to appropriately challenge each individual athlete. This may include ankle-specific strengthening and functional activities such as the lunge and squat.

After the first week, athletes continuing with treatment can begin hydrotherapy and isometric strengthening exercises, leading up to active strengthening exercises with band therapy while continuing dry needling and BFR therapy. As athletes continue to progress, they may begin to demonstrate painless single heel raise and single-leg hops. Athletes with pain-free running and cutting may return to full practice and then to competition in the absence of pain or limitations after 1 week of full practice. For stable syndesmotom injuries treated conservatively with appropriate rehabilitation, athletes can be expected to return to full competition between 2 and 6 weeks after injury.^{2,13,25}

CONCLUSION

Professional American football athletes are at high risk for syndesmotom injuries, leading to significant time lost from competition in relation to the short NFL regular season. An understanding of the anatomy and injury mechanisms is critical for proper diagnosis using clinical, radiographic, and MRI examination to determine the extent of syndesmotom injury. Conservative treatment is successful in the majority of athletes in the absence of instability secondary to frank diastasis.

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