Lisfranc Injury Operative and Rehabilitation Protocol

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Abstract

Background: Athlete is a twenty-one year old male football player and initially reports to the head athletic trainer during practice. He was unable to bear much weight. The athlete reports that he rolled his ankle left while walking, felt it "give way," motioning toward an inverted and plantar flexed ankle positioning as the mechanism of injury. The athlete did not present with apprehension during physical examination. Neurovascular finding were unremarkable. Range of motion was normal but pain limited. The athlete mentions that the pain is coming from the superior-medial aspect of the midfoot. Upon further examination, extreme laxity is noted on the lateral aspect of the midfoot along with mild swelling, indicative of a ligamentous injury. **Differential Diagnosis:** Metatarsal/Tarsal Fracture, Lisfranc Sprain/Fracture, Subluxed Cuboid **Treatment:** The athlete remained on the sideline with ice applied to the foot. The athlete was unable to bear weight on his foot at the conclusion of practice and was given a boot and was instructed to walk assisted with crutches. After imaging was completed, athlete received fixation surgery using metal screws and was reduced to a cast for two and a half weeks. After cast was removed, ice and compression was utilized to reduce the presence of significant swelling. Ankle range of motion and strength exercises was utilized until athlete was instructed and cleared by the surgeon to begin weight bearing and return to play progression about seven weeks after surgery. **Uniqueness:** Lisfranc injuries are commonly associated with high energy mechanisms. The athlete was walking on the sideline of the field, had a misstep and rolled his ankle. The athlete also presented with medial midfoot pain and did not display much apprehension during initial examination. The athlete complained of medial foot pain on the lateral side of the foot. The initial pain is speculated to have resulted from a sort of boney contusion. **Conclusions:** This case highlights the importance of maintaining a global approach in observation. Foot pain paired with a low energy mechanism of injury may have been diagnosed as an ankle sprain. What was once considered a career ending injury can now be expected to return to play within eight months of fixation surgery. Increased advancements in imaging techniques has improved the accuracy of properly diagnosing nondisplaced Lisfranc injuries. This has led to an increased association of Lisfranc injuries with low energy mechanisms.

Introduction

In a study by the American Journal of Sports Medicine, in NCAA athletes, foot, ankle, and lower leg injuries made up 27% of all injuries and athletes missed a mean of 12.3 days of participation from practice or games due to these injuries (Hunt, 2017). This loss of days of practice and conditioning can be, as previously mentioned, financially, physically, and emotionally detrimental to an athlete. When an athlete is condemned with an injury that could remove them from months of participation, the detrimental effects exponentially compound. The Lisfranc fracture, an injury to the tarsometatarsal (TMT) joints of the midfoot, was previously believed to be an athlete's career-ender. However, with proper management, an athlete can be expected to return to full participation within 8 months of the injury.

Purpose

Proper management is dependent upon when the injury is diagnosed. According to the International Journal of Sports Physical Therapy, Lisfranc injuries are the second most common foot injury and most misdiagnosed foot injury in athletics (Lorenz, 2013). Most of these misdiagnoses are often due to the inadequate technology and methodologies used in the initial assessment of Lisfranc injuries. In an article published by the Journal of Foot and Ankle Swurgery, up to 24% or 1 in 5 Lisfranc injuries are missed on primary radiographs (Stødle, 2019). Other reports, such as the one found in the Journal of Radiologic Clinics of North America, found that up to one-third of injuries can be missed during the initial assessment (Hyojeong, 2018). If these injuries are missed and not treated properly, it could lead to progressive flatfoot deformity, midfoot instability, and symptomatic osteoarthritis (Ho, 2019). Improved radiographic technologies may change the way we think about Lisfranc injuries. With more research and awareness toward Lisfranc injuries, there is now a revitalized focus on judiciously returning athletes to sport. There are not many standardized approaches in handling Lisfranc injuries once they are given as a diagnosis, the detrimental effect that these injuries can have, it is important now more than ever, to ensure that these injuries are not mismanaged.

Anatomy

These injuries can be divided into sub-categories based on their severity of displacement. A systemic review published in the Journal of Foot and Ankle Surgery describes the method of classification as follows, which is known as the Nunley classification (Robertson, 2019).

- Stage 1 – Lisfranc diastasis <2 mm on antero-posterior (AP) weight-bearing radiographs
- Stage 2 – Lisfranc diastasis 2-5 mm with no loss of mid-foot arch on lateral radiographs; can be further sub-divided into those which are stable, with no increase in diastasis or deformity on stress testing, examination under anesthetic (EUA) or serial follow-up; and those which are unstable, with increase in diastasis or deformity following stress testing, EUA or serial follow-up.
- Stage 3 – Lisfranc diastasis >5 mm with loss of mid-foot arch or height on lateral radiographs. Avulsion fractures are commonly grouped under ligamentous injuries given the similar injury pattern. (p. 654).

Dangers of Misdiagnosis

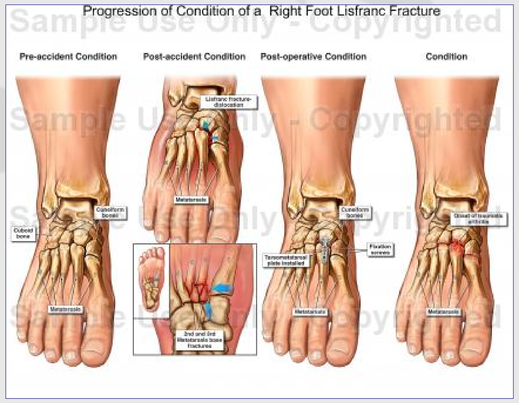
The primary mechanism of injury was thought to be high-energy traumas such as those from falls, motor vehicle accidents, or crushing injuries. Crushing injuries can be either from a direct load or an indirect load. The Journal of Sport & Society describes the difference by stating that a direct load is when a heavy object, another player forcefully stepping on another player's foot, or some other force is applied to the mid-foot when the foot is planted on the ground. An indirect load is the most common mechanism of the two types seen in sports, and it is when the foot is on the ground in a plantar-flexed position with an axial load applied to the foot (Bandac, 2012). The Journal of Radiologic Clinics of North America states that 40% to 45% of injuries are caused by these high-energy traumas and 30% are from low-energy "miss-step" by planting the foot in a dorsiflexed position with additional axial load or a twisting of the midfoot (Hyojeong, 2018). These miss-step injuries tend to occur during the toe-off positing of a walking gait. In this position, the medial midfoot experiences an abduction force of 5% of the individual's body weight (Ho, 2019). In the 2018 study in the Journal of Radiologic Clinics of North America, the original conclusion appears to be true, stating that the majority of Lisfranc injuries have come from high energy mechanisms. However, in a more recent study in the Journal of Foot and Ankle Surgery, the researchers hypothesized that the bias toward Lisfranc injuries primarily occurring from high energy mechanisms may have influenced the initial evaluation of patients. The researchers suspected that if and when an individual reported to a healthcare practitioner that they rolled their ankle or miss-stepped rather noting something more severe occurring, and the health care practitioner may have ruled out a Lisfranc injury (Stødle, 2019). When imaging was requested, these more subtle or non-displaced Lisfranc injuries did not show up on a standard computed tomography (CT) scan. This, the researchers concluded, may be the reason why so many Lisfranc injuries are misdiagnosed in the initial assessment.

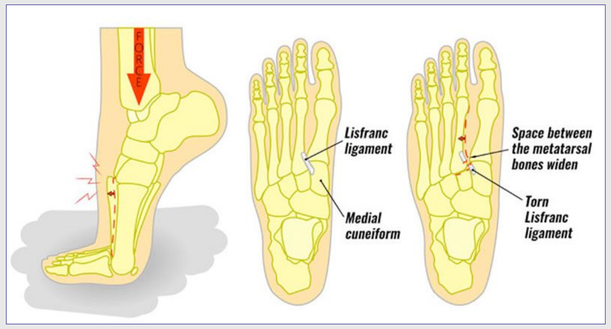
The strategy in diagnosing a Lisfranc injury is to utilize what is known as a stress fluoroscopy or a weight-bearing radiographic image. A weight-bearing radiograph is when the patient stands on a solid surface while the imaging is being done. A stress fluoroscopy is when the operator manually applies passive force on the fore-foot while immobilizing the hind-foot. Both of these approaches are typically used in the second stage of imaging and only when the first CT scan does not reveal anything, and the patient continued to still have midfoot pain. This is because the weight-bearing radiographs and stress fluoroscopy can be uncomfortable or painful for the patient, but so far it is the most reliable way to diagnose more subtle Lisfranc injuries. Sometimes these techniques are done under anesthetic if they reveal that they are too painful. The researchers found that about 28% of the Lisfranc injuries were missed on the initial CT scan, consistent with previous belief of misdiagnosis. They found that 31% of the injuries were from high-energy mechanisms, 31% were from low-energy mechanisms, and 21% were sports related (Stødle, 2019). The researchers summarized their findings by stating, "The most important finding of the present study is that we observed a higher incidence of Lisfranc injuries than previously reported in the literature, and that the majority of the injuries are low-energy or sports related" (Stødle, 2019, p. 3). In other words, Lisfranc injuries should not be ruled out because they were caused from low energy mechanisms. With the increases in technology and awareness of Lisfranc injuries, there is a high demand for a standardized approaches and evidence-based return to play protocols for athletes and sports medicine specialists.

Rehabilitation and Results

An interesting note about management of Lisfranc injuries, an injury that was once seen as a career ender and necessitated surgery, now appears to be managed better using a non-operative approach. An injury like a more severe grade 3 Lisfranc injury or a displaced injury was once thought to be a career-ender because the treatment method was an ORIF surgery that was permanently implanted into the patient's foot. Today's surgical tactic still involves the ORIF approach, but the screws are removed approximately 4 to 6 months after surgery. This technique as outlined in the Journal of Sport & Society as a beneficial treatment because it protects soft tissue, is less painful, there are less secondary deformities, and, in the case of acute crush injuries, prevents forefoot compartment syndrome as opposed to prolonged cast immobilization (Bandac, 2012). Another advantage of ORIF over prolonged cast immobilization is the ability for early mobilization, which appears to be the key to having a successful recovery. Proper surgical repair is only one part of the recovery process. Conservative management and rehabilitation is the second half that will prolong the success of athletes and patients.

After surgery, there is a focus on reducing swelling and retaining the integrity of soft tissue followed by progressive mobilization. The Journal of Sport & Society outlines a gradual postoperative care mediation. The first 2 to 3 weeks, the sutures are removed. Weight bearing progression does not begin until at least 6 weeks. Anticoagulation therapy is administered during the immobilization period. Anticoagulation is administered because the foot is highly vascular and if there is inadequate blood flow, or necrosis could occur. The pedal artery of the foot is also vulnerable to Lisfranc injuries. Necrosis is not the main concern with damage to the pedal artery, however, it could make the foot vulnerable to compartment syndrome with the excess pressure present. The patient can then begin a weight bearing progression using a brace. Screws, plates, and other hardware is removed anywhere between 12 to 18 months after surgery (Bandac, 2012). This can change depending on the individual patient's readings. If radiographs show evidence of repair or ossification, the hardware is safe to remove. Hardware may also limit a patient or athlete's ability to perform functional drills, therefore removing them would be necessary to continue the rehabilitation and to progress an athlete to return to play. A study in the Journal ACTA Orthopaedica Belgica followed patients who had their ORIF hardware removed in the range of 8 to 12 months. One of the concerns about keeping hardware in patients for too long, the research states, is the risk of damaged or broken screws. In the study featuring 34 patients, none of the screws were found to be broken (Wang, 2017). Literature that does mention broken screws, occurred between the 18 and 24 months post-surgery and many patients were asymptomatic. Though the patients did not feel or experience any detrimental effects from the broken screws, it could delay the patient's full recovery for up to two years (Bandac, 2012). This case highlights the importance of effective functional testing. Another example is found in a case study published in The International Journal of Sports Physical Therapy. This case study follows a 14-year-old male football player who experienced a Lisfranc injury with a 5 mm separation. After surgical repair and therapy sessions, the athlete was running with a normal gait and was participating in 7-on-7 drills, but bilateral testing revealed a significant deficit in single leg power (Lorenz, 2013). These examples highlight the importance of following evidence based practices and for healthcare practitioners to take due diligence in ensuring that the patient or athlete has not only recovered but has returned to full functional activity.





Discussion and Summary

The Lisfranc injury is one of the most misdiagnosed injuries in sports because it tends to have similar presentation to less serious injuries and it usually does not show up well on initial CT scans. These scans usually miss Lisfranc injuries that are nondisplaced or injuries that occur from low-energy mechanisms. With improved imaging technology and techniques like the weight bearing scans or the stress fluoroscopy, there is now more awareness of Lisfranc injuries occurring from low-energy mechanisms. This newfound ability to quickly diagnose patients and less invasive surgical techniques means that those patients can receive timely treatment, meaning that there is a higher chance of success in their recovery. Timely diagnosis, higher awareness, and appropriate management (including surgical or non-surgical techniques) means the difference between an athlete remaining out of practice for a few months or indefinitely. There is a lack of what conservative treatment and rehabilitation entails, and because of this, more research and reports need to be completed to prove the effectiveness of functional progression and establish a return to sport criteria.

References

Bandac, R. C. (2012). Modern diagnostic and treatment principles of lisfranc midfoot dislocations in athletes. *Sport & Society / Sport Si Societate, 12*(1), 46–54. Retrieved from http://search.ebscohost.com.ezproxy.fgcu.edu/login.aspx?direct=true&db=s3h&AN=78558062&site=eds-live

Ho, N. C., Sangiorgio, S. N., Cassinelli, S., Shymon, S., Fleming, J., Agrawal, V., Ebramzadeh, E., Harris, T. G. (2019). Biomechanical comparison of fixation stability using a lisfranc plate versus transarticular screws. *Foot and Ankle Surgery, 25*(1), 71-78. DOI: 10.1016/j.fas.2017.08.004

Hunt, K. J., Hunwit, D., Gatewood, C., Botser, I. B., Matheson, G., & Robell, K. (2017). Incidence and Epidemiology of Foot and Ankle Injuries in Elite Collegiate Athletes. *American Journal of Sports Medicine*, *45*(2), 426–433. DOI: 10.1177/0363546516666815

Hyojeong, M. (2018). Lisfranc injury: Current concepts. *Radiologic Clinics of North America. 56*(6), 859-876. DOI: 10.1016/j.rcl.2018.06.003

Lorenz, D. S., Beauchamp, C. (2013). Functional progression and return to sport criteria for a high school football player following surgery for a lisfranc injury. *The International Journal of Sports Physical Therapy, 8*(2), 162-171. Retrieved from http://search.ebscohost.com.ezproxy.fgcu.edu/login.aspx?direct=true&db=s3h&AN=87406354&site=eds-live

Munro, A. G., Herrington, L. C. (2011). Between-session reliability of four hop tests and the agility t-test. *Journal of Strength and Conditioning Research. 25*(5), 1470-1477. DOI: 10.1519/JSC.0b013e3181d83335

Ren, W., Li, H., Lu, J., Hu, Y. (2019). Undisplaced subtle ligamentous lisfranc injuries, conservative or surgical treatment with percutaneous position screws? *Chinese Journal of Traumatology, 22*(4), 196-201. DOI: 10.1016/j.cjtee.2019.03.005

Robertson, G. A. J., Ang, K. K., Maffulli, N., Keenan, G., & Wood, A. M. (2019). Return to sport following Lisfranc injuries: A systematic review and meta-analysis. *Foot and Ankle Surgery, 25*(5), 654–664. DOI: 10.1016/j.fas.2018.07.008

Stødle, A. H., Hvaal, K. H., Enger, M., Brøgger, H., Madsen, J. E., Ellingsen Husebye, E. (2019). Lisfranc injuries: incidence, mechanisms of injury and predictors of instability. *Foot and Ankle Surgery.* DOI: 10.1016/j.fas.2019.06.002

Wang, L.-P., Yang, C., Huang, J.-F., Shen, J.-J., He, C., & Tong, P.-J. (2017). Open Reduction and Internal Fixation Versus Primary Partial Arthrodesis for Lisfranc Injuries Accompanied by Comminution of the Second Metatarsal Base. *ACTA ORTHOPAEDICA BELGICA*, *83*(3), 396–404. Retrieved from http://search.ebscohost.com.ezproxy.fgcu.edu/login.aspx?direct=true&db=edswsc&AN=000429033000006&site=eds-liv