Posttraumatic Attenuation of the Lisfranc Ligament in a 14-Year-Old Athlete: A Case Report

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Abstract

Lisfranc injuries in children are rare and range from mild midfoot sprains to severe traumatic fracture-dislocations. Management of sprains is nonoperative, whereas treatment of fracture-dislocations often requires internal fixation. We present a unique case of a midfoot sprain in a 14-year-old adolescent boy, with gradual increased instability at the joint owing to attenuation of the Lisfranc ligament. Closed reduction and percutaneous pinning resulted in successful treatment at 3 weeks postoperatively. Midfoot sprains may lead to further ligamentous attenuation and widening as seen on radiographs and thus should be monitored for signs of persistent pain and instability. Because midfoot instability contributes considerably to posttraumatic arthritis, we recommend reduction when nonoperative interventions are unsuccessful.

Introduction

The tarsometatarsal complex (TMC), often referred to as the "Lisfranc joint," is an intricate region of anatomy encompassing the tarsometatarsal, intermetatarsal, and intertarsal articulations. The Lisfranc ligament is an important structure for longitudinal and transverse stability of the osseous arch formed in this region.[1] This interosseous ligament is the strongest of the ligaments in the region and originates on the medial cuneiform, inserting at the plantar surface of the second metatarsal base. Other important ligaments of the TMC include the plantar tarsometatarsal ligaments and the interosseous ligament between the medial and middle cuneiforms. The plantar tarsometatarsal ligaments maintain transverse stability at the joint, whereas the interosseous ligament between the medial and middle cuneiforms maintains longitudinal stability in the region.[2]

Injuries to the TMC range from mild sprains of the ligaments to complete articular disruption and dislocation. TMC sprains, or "midfoot sprains," occur in competitive athletes of all types.[3] Competitive American football players seem to be especially at risk for TMC injury. Annually, 4% of college football players sustain a midfoot sprain.[3] These low-energy injuries to the tarsometatarsal complex may occur when an axial load is applied to a plantar-flexed foot with simultaneous rapid abduction or twisting.[4] Each of these injuries by definition involves some compromise of the Lisfranc ligament.[4]

While walking down a staircase, pain is common in subtle midfoot sprains.[5] Ecchymosis of the plantar arch is considered pathognomonic for Lisfranc injury.[5] Diagnosis by perceived widening on plain radiographs can be subjective, depending on the quality of the radiographs and the precise orientation of the X-ray tube and plate.[6] Diagnosis of a severe Lisfranc injury can be obvious, yet minor sprains in the region are commonly missed in the clinic.[7] Up to 35% of these injuries are misdiagnosed or missed at the initial visit.[8]

Although sports-related injuries are also the greatest contributor to Lisfranc damage in children, the occurrence is rarely reported in these younger populations.[9] Nonoperative treatment of Lisfranc injuries in children has been common, with use of immobilization and protected weight bearing.[10] Yet Lisfranc injuries that show signs of instability often necessitate operative fixation for successful treatment.[4] Overall, limited data exist to guide evidenced-based diagnosis and treatment of pediatric patients. We describe an adolescent patient who presented with a seemingly mild midfoot sprain with attenuation of the Lisfranc ligament. Initially, no clinical evidence of instability was noted. The patient's family was informed that the data concerning the case would be submitted for publication, and they provided verbal consent.

Case Report

A 14-year-old male athlete injured his left foot while playing American football. He was tackled while planting his plantar-flexed foot on the ground and felt a "pop." The

patient was unable to bear weight after the injury. He was initially seen at an urgent-care facility, where his injury was diagnosed as an ankle sprain because radiographs of the foot and ankle did not indicate any abnormality.

He reported to the emergency department at 12 days after the injury, with swelling and bruising on the plantar arch of his foot. The patient had been ambulating without crutches intermittently, and the pain did not resolve. The emergency-department physicians ordered weight-bearing radiographs (these did not include the uninjured foot), which the radiologist read as negative for widening at the Lisfranc joint or other fractures (Figures 1A and 1B). Owing to his increasing amount of pain, the patient was referred to our pediatric orthopaedic clinic. He was given a walking boot at discharge.

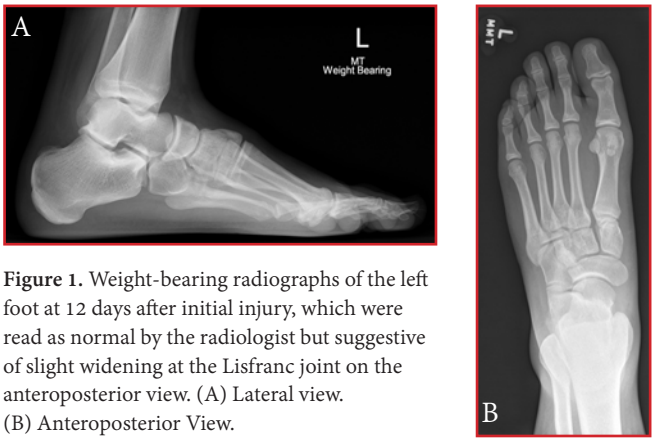

Figure 1. Weight-bearing radiographs of the left foot at 12 days after initial injury, which were read as normal by the radiologist but suggestive of slight widening at the Lisfranc joint on the anteroposterior view. (A) Lateral view. (B) Anteroposterior View.

At 17 days after his injury, the patient presented to our clinic with continued pain while ambulating. Results of physical examination revealed ecchymosis of the plantar arch. The midfoot region was tender to palpation, and abduction and pronation of the forefoot elicited pain. Despite the negative findings of previous radiographs, the clinical examination results were suggestive of a Lisfranc injury. We believed that the radiographs showed evidence of widening, and recommended non-weight bearing. Radiographs and magnetic resonance imaging (MRI) were obtained (Figures 2 and 3, respectively). The MRI showed a small fracture on the lateral aspect of the second metatarsal base, and an intact but attenuated Lisfranc ligament with heterogeneously mixed high and low signals. Because the patient had not shown considerable widening of the joint radiographically, he began weight bearing in the walking boot.

Figure 2. At 17 days after initial injury, weight-bearing radiograph of both feet shows subtle widening of the Lisfranc interval of the left foot.

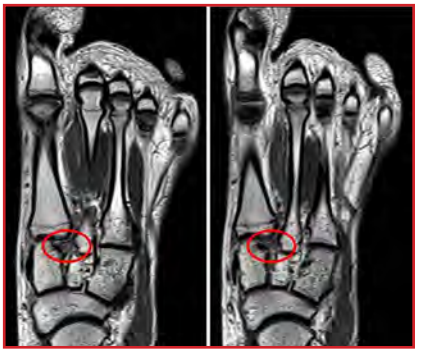

Figure 3. At 17 days after initial injury, sequential coronal cuts at 3 mm apart in the proton density-weighted magnetic resonance imaging series shows the Lisfranc ligament with heterogeneous signal (circle) that indicates injury.

At 2 months after his injury, the patient had continued mild pain, but new MRI showed an increase in widening at the Lisfranc interval (Figures 4A and 4B). Because of the continued pain and instability on weight-bearing radiographs, we offered the patient a surgical intervention with open versus closed reduction and internal fixation. The patient and parents were in favor of the operation.

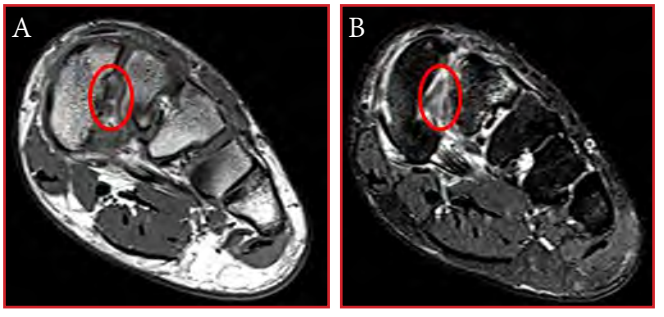

Figure 4. At 3 months after the injury, magnetic resonance imaging in axial view shows the Lisfranc ligament with heterogeneous signal (circle) indicating injury. (A) Proton density-weighted sequence. (B) T2-weighted sequence.

At 3 months after the initial injury, we performed closed reduction and percutaneous pinning. With the patient under anesthesia, we placed a percutaneous two-point clamp across the medial cuneiform and the third metatarsal. The joint was fluoroscopically visualized to close. We placed a 4-mm cannulated screw from the medial cuneiform to the second metatarsal base. A second screw was placed from the medial cuneiform to the middle cuneiform (Figures 5A and 5B). The patient was immobilized in a cast and made non-weight bearing.

Follow-up radiographs at 3 weeks postoperatively showed maintenance of the reduction and fixation without complication (Figures 5A and 5B). The patient's pain has been improving and he will begin weight-bearing between 12 to 16 weeks postoperatively.

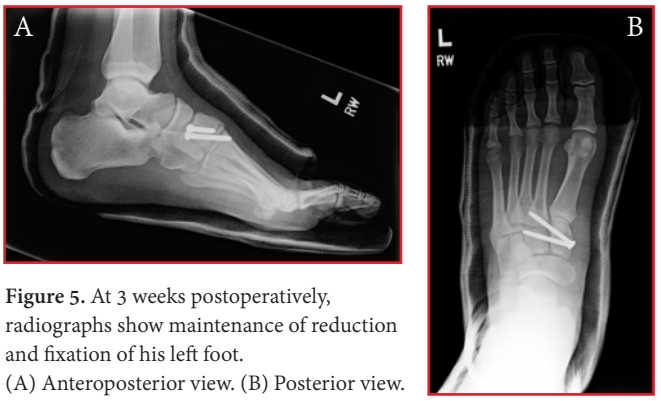

Figure 5. At 3 weeks postoperatively, radiographs show maintenance of reduction and fixation of his left foot.
(A) Anteroposterior view. (B) Posterior view.

Discussion

Unstable Lisfranc injuries that are unsuccessfully treated using conservative approaches can warrant operative fixation.[4] Although most mild sprains may be treated nonoperatively, attenuation of the ligament can progress to increased instability as shown in the current case.

Advanced imaging techniques can be useful in diagnosis, especially when findings of clinical examination are suggestive of an injury yet radiographs are not. Computed tomography can help detect bony avulsions or subtle subluxations at the articulation points.[11] Furthermore, MRI has a 95% sensitivity and 75% specificity for detecting disruption of the Lisfranc ligament.[11] Bone scintigraphy has been described as a sensitive imaging modality that can detect the subtle inflammation at the corners of the medial cuneiform and the second metatarsal base when injured, although the sensitivity and specificity have not been determined.[4]

In the current case, the findings of MRI helped confirm a Lisfranc injury, despite the normal findings on previous radiographs. Generalized pain in the midfoot and a typical mechanism of injury should lead the practitioner to include midfoot sprain on their list of differential diagnoses, especially if the pain persists for an extended period after initial injury.

Continued pain months after injury and increased radiographic widening of the Lisfranc interval led us to perform a closed reduction and internal fixation for treating our patient. We believed that continued nonoperative management of the subacute injury would yield inadequate final alignment. Operative fixation of this injury was performed to prevent progressive osteoarthritis of the midfoot, beginning at an early age. Although posttraumatic arthritis may precipitate, studies have suggested that reduction and internal fixation of unstable Lisfranc injuries significantly decreases the rates of future arthritis.[12]

The current case report has limitations. Notably, the follow-up data was reported recently at 3 weeks postoperatively, which may not accurately reflect complete treatment outcomes. Additionally, the patient was a skeletally mature adolescent boy whose treatment may better reflect that of an adult population rather than children. Furthermore, the MRI findings (particularly the small osseous avulsion) may indicate a Lisfranc ligament rupture and less of a sprain, which could affect the success of treatment.

Lisfranc injuries in the pediatric population are rare. Minor sprains are more common and can usually be managed nonoperatively. However, midfoot sprains may lead to further ligamentous attenuation and widening on radiographs and thus should be monitored for persistent pain and instability. Because midfoot instability contributes notably to posttraumatic arthritis, reduction and fixation can be helpful when nonoperative interventions are unsuccessful.

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Conflict of Interest

The authors report no conflicts of interest.

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