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Atypical Stress-Avulsion Fracture of the Lisfranc Joint Complex

Barry J. O'Neill, Laura A. Sweeney, Paul J. Moroney, and Kevin J. Mulhall [AQ: 1]
[AQ: 2][AQ: 3]

Abstract: *Antiphospholipid syndrome and systemic erythematosis have been associated with metatarsal stress fractures. Stress fractures of the Lisfranc joint complex are uncommon injuries but have been reported to occur most frequently in ballet dancers. We present a case of an avulsion fracture of the Lisfranc joint complex that occurred spontaneously. We have reviewed the association between systemic conditions and metatarsal fractures and proposed a series of hypothetical pathological events that may have contributed to this unusual injury.*

Levels of Evidence: *Therapeutic, Level IV: Case report*

Keywords: trauma; general disorders; fractures; sprains; strains; sports podiatry

Introduction

The tarsometatarsal (TMT) joint complex, commonly referred to as the Lisfranc joint, is named after a French surgeon who served in Napoleon's army. Jacques Lisfranc described an amputation involving the TMT joint secondary to a

vascular injury that occurred when a rider fell from his horse with his foot caught in the stirrup.^{1,2} Injuries to the TMT joint complex are reported to account for approximately 0.2% of all fractures,³ but it has been suggested that up to 20% are missed on initial assessment.⁴ Low-energy trauma accounts for approximately one-third of all Lisfranc injuries,⁵ with athletic activity being the most common etiology.⁶ Stress fracture of the Lisfranc joint is uncommon but has been described predominantly in ballet dancers.⁷⁻¹⁰ We present a case of an avulsion type stress fracture involving the TMT joint complex in a 46-year-old female patient. This fracture differs from previous reports in that the patient was not involved in any form of sporting activity.

Case Report

A 46-year-old lady developed spontaneous pain in her left foot while walking. She described feeling a "pop" in her foot with immediate severe pain in

the sole of her foot on weight bearing. She denied any history of injury or trauma to the foot. She did not seek medical attention initially but self-medicated with simple over-the-counter analgesia.

Then, 6 weeks after the onset of symptoms, she attended accident and emergency (A&E), and an anteroposterior and lateral X ray of her foot was performed (Figure 1). This X

“Stress fracture of the Lisfranc joint is uncommon but has been described predominantly in ballet dancers.”

ray was interpreted by an A&E physician as normal, and the patient was discharged home. On subsequent review of the X ray by a consultant radiologist, it was reported as being suspicious for an avulsion injury at the Lisfranc ligament, and the patient was recalled for weight-bearing X rays of her foot. These X rays clearly demonstrated a bony injury at the medial aspect of the base of the left second metatarsal, and an urgent CT

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Figure 1.

A. Non-Weight-Bearing anteroposterior (AP) Radiograph Demonstrating Avulsion Type Fracture From Base of Second Metatarsal. B. Weight-Bearing AP Radiograph. C. Weight-Bearing Lateral Radiograph.

scan was performed. The CT scan clearly demonstrated an undisplaced fracture of the medial aspect of the base of the left second metatarsal. Clinically, the patient reported ongoing pain in her foot but was nontender to palpation and experienced no pain on bimanual

compression of her Lisfranc joint complex. **[AQ: 4]**

The patient suffered from antiphospholipid syndrome (APLS), systemic lupus erythematosus (SLE), and osteoporosis. She was taking regular warfarin therapy but was not taking

steroids. Her international normalized ratio at the time of her injury was 2.9. Albumin, calcium, phosphate, and alkaline phosphatase levels (bone profile) were all within reference ranges. A DEXA scan was performed that confirmed that the patient was osteoporotic, with a *T* score of -2.6 and a *Z* score of -2.4 .

Despite presenting 6 weeks postinjury, non-weight-bearing radiographs showed only minimal displacement of the Lisfranc joint complex. She was treated in an aircast boot for 4 weeks. She remained non-weight bearing on crutches for this time, and on review, her pain had resolved and she recommenced weight bearing. She was reviewed a further 6 weeks after commencing full weight bearing. She reported that all symptoms had resolved and that she had recommenced all regular activities of daily living without any difficulties. One year postinjury, the patient remained asymptomatic and reported no pain in her foot and no limitations to her activities of daily living.

Discussion

The TMT joint complex is made up of bony and ligamentous structures designed to add support to the transverse arch of the foot. The anatomical arrangement of these structures makes the TMT joint complex intrinsically very stable. Between the medial cuneiform and second metatarsal base, there are 3 oblique ligaments (dorsal, interosseous, and plantar). These ligaments maintain the crucial osseous mortise for the second metatarsal base. The Lisfranc ligament is the interosseous ligament. This ligament is the strongest structure supporting the TMT joint complex, followed by the plantar ligament, and finally the dorsal ligament.¹¹ Because of the relative strengths of the 3 ligaments, ligamentous disruption is thought to begin with the weaker dorsal ligament, followed by the plantar ligaments, and finally the Lisfranc ligament.¹²

Figure 2.

A. Coronal CT Slice Through Lisfranc Joint Demonstrating Avulsion Type Fracture From Base of Second Metatarsal. B. Axial CT Slice. C. Sagittal CT Slice.

In the case presented, the fracture line seen on the coronal CT (Figure 2) appears to delineate the footprint of the insertion of the Lisfranc ligament at the medial base of the second metatarsal, as described by Solan et al.¹¹ A weight-bearing radiograph of the left foot demonstrates widening of the mortise confirming that the dorsal and plantar ligaments are also ruptured. This widening is not evident on non-weight-bearing radiographs of the foot, but an avulsed fragment can clearly be seen. This fragment is more substantial than the “fleck” sign previously described by Myers.¹³ As described previously,¹² this injury is consistent with a rupture of the dorsal oblique ligament, followed by rupture of the plantar oblique ligament, and then an avulsion fracture of the insertion of the Lisfranc ligament. We cannot find any documented case in the

literature when this injury has occurred without injury or trauma. Most previous reports occur as repetitive strain injuries in ballet dancers and show the classical signs of stress fracture of normal initial radiographs followed by cortical reaction on subsequent investigation. We believe that this case of stress-avulsion fracture of the TMT joint complex is extremely uncommon, and possible contributing pathology was investigated.

This patient's past medical history included APLS, SLE, and osteoporosis. Sangle et al¹⁴ reported on 19 cases of metatarsal stress fractures in female patients with SLE; 13 patients also had APLS. All these fractures occurred in the metatarsal shaft, and none involved the TMT joint complex. Also, 6 patients were found to have decreased bone mineral density, but the other 13 had normal bone density on DEXA scan. Only 5

patients in this study had been taking oral steroid therapy for more than 6 months. The authors of this study found a link between metatarsal stress fractures and SLE and APLS but could not find a strong association with either decreased bone density or steroid use. They proposed a possible link between metatarsal stress fractures and microinfarcts within the bone.¹⁴ The authors postulated that microinfarcts are caused by a reaction between antiphospholipid antibodies and the endothelium, which leads to bone damage and fracture.¹⁵

Some authors have studied the association between warfarin and osteoporosis.^{16,17} A relationship between long-term warfarin therapy and osteoporotic fractures has been postulated.¹⁸ Warfarin works by interfering with the γ -carboxylation of glutamic acid residues on clotting factors II, VII, IX, and X. γ -Carboxylation of specific glutamic acid residues is also required for activation of osteocalcin and other bone matrix proteins.¹⁸ It has been hypothesized that warfarin may increase the risk of osteoporotic fractures.¹⁸ It remains unclear whether antithrombotic therapy plays a role in the development of metatarsal fractures. In the case series by Sangle et al,¹⁴ 2 patients were on long-term warfarin at the time of their metatarsal fracture, but no definite association could be proven. That study has proposed a possible link between microinfarcts and metatarsal stress fractures, but the use of antithrombotic therapy would seem to be protective against the development of microinfarcts.

Conclusion

An increased risk of metatarsal stress fracture has been described in patients with APLS and SLE. An association between metatarsal stress fracture in patients with osteoporosis and in patients taking long-term warfarin has been proposed but not confirmed. We cannot, therefore, state any definite link between these conditions and metatarsal stress fractures, but we feel that in patients with any of these comorbidities

who present with pain in the region of the Lisfranc joint complex with no history of trauma, it may be prudent to perform weight-bearing radiographs of the foot. Ongoing clinical suspicion in the absence of pathology on weight-bearing radiographs warrants a CT scan to exclude stress fracture of the Lisfranc joint complex.^{FAS}

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