CASE STUDY

Open Reduction with Primary Arthrodesis of an Acute Lisfranc Fracture-Subluxation using an Anatomical Tarsometatarsal Compression Plating System

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FEATURED PRODUCT: GORILLA® PLATING SYSTEM / LISFRANC PLATES

PRESENTATION

A healthy 42 y/o male sustained an acute fracture-subluxation of his left 1st, 2nd and 3rd tarsometatarsal (TMT) joints following a fall from a ladder. The patient attempted to self-reduce the deformity upon injury noting partial improvement. He presented to a local urgent care center with complaints of severe pain, swelling and deformity of the left foot. He was unable to bear weight on the involved extremity. Radiographs were obtained which demonstrated fractures of the 2nd and 3rd metatarsal bases. He was placed in a short leg splint for immobilization and was referred to the office for definitive care of his acute midfoot injury. A Lisfranc fracture-dislocation was suspected.

He presented to the office 1 day post-injury for evaluation and treatment. He complained of severe pain and moderate swelling of the left foot. He remained non-weightbearing utilizing crutches.

EXAMINATION

CLINICAL EXAM

Physical examination revealed a moderate amount of soft tissue edema predominantly within the midfoot region. Although significant swelling was noted, the dorsal midfoot skin was intact. No fracture blisters were noted nor any open traumatic breaks in skin integrity were present. A plantar ecchymosis sign was noted along the plantar midfoot as well as ecchymosis more distally at the bases of the lesser toes. Tenderness to palpation was present along the dorsal aspect of the 1st, 2nd and 3rd TMT joints, in particular the bases of the 2nd and 3rd metatarsals. A pronation abduction stress maneuver was not performed given his pain level and obvious clinical exam and radiographic findings. Neurovascular status appeared grossly intact with the exception of slightly decreased sensation in the dorsal 1st web space corresponding to the deep peroneal nerve distribution. There were no signs of compartment syndrome.

RADIOGRAPHIC IMAGING

Radiographs displayed comminuted fractures at the base of the 2nd and 3rd metatarsal with lateral subluxation at the 1st, 2nd and 3rd TMT joints (Figs. 1a, 1b). The forefoot appeared abducted through the TMT joints. No obvious cuboid fracture or significant 4th/5th metatarsal-cuboid joint injury was noted. Weightbearing films were not able to be obtained due to patient's pain level.

The patient was placed back in a well-padded splint. In the interim, a CT scan was ordered to better assess and determine any fracture comminution, any fracture line extension to the joint surface, and the degree at which residual displacement persists.

The preoperative CT demonstrated a comminuted intra-articular fracture of the 2nd and 3rd metatarsal bases at the TMT joint level with lateral displacement recognized at the 1st, 2nd and 3rd TMT (joints) due to combined bone/ligamentous TMT joint injury (Figs. 2a, 2b, 2c).

INITIAL MANAGEMENT AND DECISION-MAKING

To lessen the chances of a potential surgical wound-related complication, surgical intervention was postponed until improvement of soft tissue edema was noted. In addition, given the findings on CT scan, a decision was made for performing a primary arthrodesis which mitigated the need for a more timely reduction. The patient remained in a well-padded splint with instructions for ice/elevation. At 3 weeks post-injury, the patient's swelling had decreased to an adequate degree to allow for an open reconstructive procedure. He was taken to the operating room for definitive care of his acute traumatic midfoot injury.


2a

INTRODUCTION

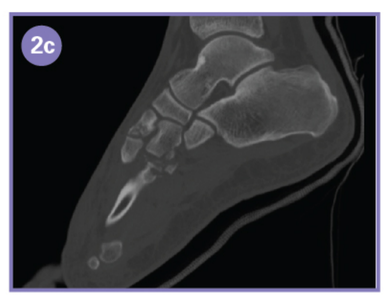
Trauma to the Lisfranc tarsometatarsal joint complex can have considerable long-term sequelae; most notable the development of post-traumatic arthritis along with alteration of normal gait mechanics secondary to pain and/or deformity. The medial and central columns of the midfoot form a rigid lever arm for which to transmit the forces of gait from heel strike through midstance to terminal push off. A painless stable midfoot is essential for the efficient propulsion seen during ambulation. Due to these reasons, optimal results have been noted with restoration of anatomical alignment as well as a secure stability of the medial and central columns. Despite these goals, anatomical restoration alone does not guarantee a successful outcome for many active patients.


2b

Standard percutaneous pin fixation has fallen out of favor due to the length of time required for the tarsometatarsal Lisfranc ligament to heal with adequate stability to withstand the forces generated through the midfoot. Lisfranc oblique screw combined with transarticular screw fixation was advocated by many to establish the rigid fixation desired through this zone. More recently, a trend towards bridge plating across unstable TMT joints when performing an ORIF with later hardware removal has been seen, thus eliminating drilling or placing a screw through the articular cartilage of the joint. Another trend has been a gravitation towards primary arthrodesis given the common occurrence of residual pain and/or development of post-traumatic arthritis following even well-aligned ORIF. Popular methods have included transarticular screw fixation, anatomical TMT compression plating or a combination of the two. Several studies have found better functional outcomes in patients that underwent an anatomically aligned primary arthrodesis of the medial and/or combined medial/central columns of the tarsometatarsal joints if severe ligamentous disruption or significant injury to the articular cartilage surface occurred.[1,2,3,4]

SURGICAL TECHNIQUE

An open reduction with primary realignment arthrodesis was undertaken. A dorsal approach utilizing a curvilinear lazy S incision was centered over the second tarsometatarsal joint and extended between the 1st and 2nd metatarsal bases distally and between the 2nd and 3rd cuneiforms proximally. Within the distal aspect of the wound, the superficial peroneal nerve was identified and retracted laterally. The extensor retinaculum was opened and, beneath this, the extensor hallucis brevis muscle belly was identified and used as a landmark for the underlying neurovascular bundle. The dorsalis pedis artery and deep peroneal nerve were retracted laterally and protected throughout the case.


2c

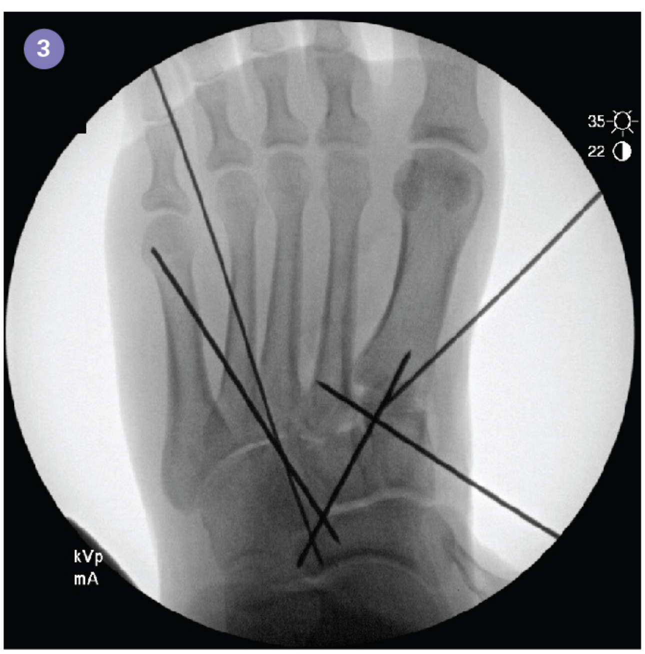
The 1st, 2nd and 3rd TMT joints were exposed. Dorsolateral displacement of the 2nd and 3rd metatarsals relative to their corresponding cuneiforms was noted. The articular cartilage surface had significant injury. The 1st TMT was unstable to pronation abduction stress confirmed on live fluoroscopy. A decision for arthrodesis was made.

The surfaces between the medial/intermediate and intermediate/lateral cuneiforms were curetted. A guide pin for a 4.0 mm cannulated screw was placed percutaneously from medial to lateral across the intercuneiform joints engaging all cuneiforms. The pin was placed transversely across the proximal aspect of the cuneiforms just distal to the naviculocuneiform joint to align and stabilize this level as one block. The pin was placed proximal enough to allow space for placement of dorsal plates over the TMT joints. The articular surfaces of the 1st-3rd TMT joints were then prepared for arthrodesis. The joints were individually realigned with good surface area contact of opposing joint surfaces and stabilized with provisional K-wire fixation. Realignment was established working in sequence from medial to lateral.

The 1st TMT joint had the typical subtle abduction deformity and therefore the base of the first metatarsal was brought back in proper position and provisionally pinned across the joint. Extreme focus was paid towards the initial realignment of the 1st TMT joint as it relates to medial/lateral/dorsal/plantar and rotational position of the 1st metatarsal base relative to the 1st cuneiform. Using the stabilized row of cuneiforms proximally and 1st TMT joint medially, the base of the 2nd metatarsal was then reduced anatomically within its keystone. A pin was placed obliquely from the medial cuneiform engaging the 2nd metatarsal base/metaphyseal region for stabilization. The 3rd metatarsal base was pinned across the 3rd TMT joint. This pin was placed percutaneously due to the angle required to engage the 3rd TMT joint (Fig.3).

In this case, a low profile anatomically contoured 1-2 Lisfranc/TMT compression plate (Paragon 28® Gorilla® 1st and 2nd Dual Ray Plate.) was chosen to provide rigid fixation and compress across the medial two columns. Olive wires were placed initially within the locking plate holes and the plate position relative to the underlying bone anatomy was confirmed. 3.5 mm locking screws were placed proximally within the locking screw holes of the 1st and 2nd cuneiforms. The compression screw slots were then used on the metatarsal side of the 1st and 2nd metatarsals. A drill hole was made eccentrically within the slot to provide compression upon screw placement. A 3.5 mm non-locking cortical screw was used for this hole. Upon initial engagement of the screw head contact with the plate, the olive pins were removed as well as any provisional pin fixation. The 1st and 2nd metatarsal screws were hand tightened on their final turns achieving excellent compression across the joints. The remaining locking screw holes within the metatarsal bases were then filled. A slanted-T Lisfranc plate (Gorilla® Slanted T-Plate 4 Hole with Compression) was used for the 3rd TMT joint.

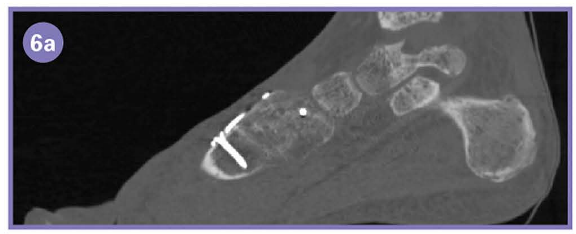
The fixation was finalized by placing a fully threaded 4.0 mm cannulated screw (Paragon 28® Mini-Monster® Cannulated Screw) transversely across the intercuneiform joints to incorporate the proximal aspect of the medial, intermediate and lateral cuneiforms. Intraoperative fluoroscopy confirmed hardware position and joint alignment as well as clinical assessment visually (Fig. 4). The wound was closed and the patient was placed in a short leg splint for immobilization.

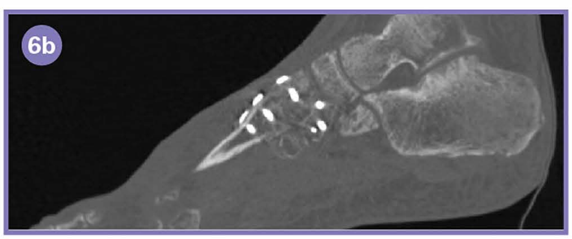


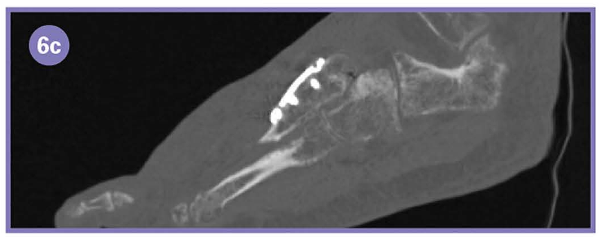
POST-OPERATIVE PROTOCOL

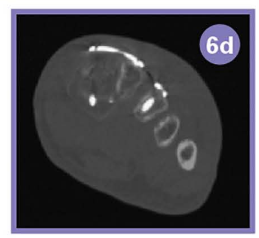
The patient returned for follow-up 2 weeks post-operatively. The sutures were removed and he was placed in a short leg non-weightbearing cast for an additional 4 weeks. The cast was removed at 6 weeks post-operative and x-rays were obtained (Fig. 5a, 5b, 5c). He was placed in a boot and was instructed to remain non-weightbearing for an additional 2 weeks but was able to come out of the boot for gentle range of motion exercises of the ankle. Between 8-10 weeks post-operative, the patient was allowed partial protected weightbearing within the boot. Per our midfoot fusion protocol, a CT scan was ordered at the 8-10 weeks post-operative visit to assess and confirm adequate bone consolidation across the arthrodesis sites. The CT scan demonstrated excellent alignment and good bone consolidation/union across the 1st, 2nd, and 3rd tarsometatarsal joints (Figs. 6a-6d). The patient was allowed to progress his weightbearing status within the boot to weightbearing as tolerated for the next 2-4 weeks. At 12-14 weeks postop, the patient was allowed to transition out of the boot into a supportive running sneaker with instructions to use a carbon fiber plate under the insole for another 4-6 weeks. Physical therapy was ordered to regain strength and coordination of movement. The patient displayed progressive improvement.

He is presently 1 year post-operative and is doing well. He has returned to most of his recreational activities and feels his strength continues to improve. He has no complaints of pain; there is no tenderness over the hardware. His only present complaint is a mild degree of soft tissue swelling in the afternoon/evening which he states is also improving monthly.









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