First Metatarsal Fractures

OVERVIEW

First metatarsal fractures deserve careful evaluation. The first ray is unique biomechanically and anatomically. The first metatarsal and its two associated sesamoids bear approximately one third of the body weight. The first metatarsal also has unique anatomic relationships with the medial cuneiform, and this articulation is important to the stability of the transverse arch. For all these reasons, it is important to restore the length and stability of the first metatarsal anatomically in both the transverse and sagittal planes.

ANATOMY

As stated above there is a complex relationship between the first metatarsal head and the sesamoid complex including the adductor hallicus and intermetatarsal ligaments. The ligamentous complex of the tarsal metatarsal articulations is composed of dorsal, plantar and interossoeus components. However the first and second metatarsal bases lack an interosseous ligament. There is very little inherent motion in the first TMT articulation whereas the first MTP joint has an arc of motion of approximately forty degrees of plantarflexion and need to put something in here degrees of dorsiflexion. The first metatarsal in addition to the joint complexes has attachments of the tibialis anterior tendon and peroneus longus which can also act as deforming forces. There is a relatively small soft tissue envelope around the first MT especially when compared to the lesser metatarsals.

BIOMECHANICS

In summary, the first ray supports approximately one third of the weight of the foot. The first metatarsal is integral in the relationships of the first metatarsal phalangeal and tarsal metatarsal joints. In addition to these two articulations, the metatarsals are all connected by the deep transverse intermetatarsal ligaments. Displaced fractures of the first metatarsal may lead to biomechanical alterations of the entire forefoot and tarsal metatarsal articulations.

PATHOGENEIS

First metatarsal fractures result from a variety of low and high energy mechanisms. Low energy mechanisms include a stress response, and low energy injuries such as a twisting moment arm on the forefoot. High energy trauma includes lawn mower injuries, industrial accidents, and motor vehicle accidents.

CLINICAL PRESENTATION

First Metatarsal fractures arise in patients of all ages. Most injuries are closed but the high energy and lawn mower injuries can present with open fractures. Typically, in low energy mechanisms, there is dorsal soft tissue swelling and ecchymosis and pain with weightbearing. When patients present with high energy mechanisms, the examiner should pay close attention to the neurovascular exam and both the TMT and MTP articulations.

EXAMINATION

As with all disorders of the foot and ankle, a thorough examination is performed including inspection, palpation, range of motion, sensory and vascular exams. If the patient is able, a gait analysis and position of the lower extremities should also be performed with the patient weight bearing. Examiners should pay close attention to the MTP and TMT articulations particularly to assess for lisfranc or turf toe variant injuries. Pain localized over the first MT shaft and with flexion and extension of the great toe are common exam findings in addition to soft tissue swelling and ecchymosis. Palpation over the tibial and fibular sesamoids should be performed to rule out a stress fracture that may be limited to this specific anatomic structure.

IMAGING STUDIES

Plain radiographs are the mainstay of imaging modalities for first metatarsal fractures. If the patient is able, weightbearing: AP, Oblique, and lateral views are preferred. The examiner is looking for any displacement, shortening, and angulation in any plane. Close attention to the anatomy of the MTP and TMT anatomy is essential as any displacement into the joint complex is indicative of a more involved injury. In some instances MRI or CT may be helpful when examining intra-articular pathology, such as possible Lisfranc injuries, but are not routinely performed. Weight bearing CT scans are becoming increasingly helpful in defining more subtle fractures or those that may be intra-articular or suspected Lisfranc injuries. If there is a

fracture involving the first metatarsal base, stress views may also be helpful. Lisfranc stress views are performed in the AP, and Lateral planes. The hindfoot is pronated and the forefoot abducted through the TMT articulations. In the AP plane, the examiner is looking for any displacement of the first metatarsal base in the medial or lateral planes. On the lateral view, displacement is most commonly dorsally due to the weaker dorsal versus plantar ligaments.

TREATMENT

If the fracture is non- or minimally displaced, closed treatment is sufficient. Fractures involving the shaft and metatarsal neck are more commonly stable. Conservative treatment typically consists of short leg cast or CAM walker with limited weight bearing for 4-6 weeks. If there is any displacement, shortening, or angulation, operative intervention is indicated. Techniques include lag screw placement of longer oblique fractures and plate fixation. If the metatarsal fracture has significant comminution, particularly the first MT base, may require bridge plating fixation or spanning external fixation with a uni-rail fixator across the TMT articulation.

CONCLUSION

First metatarsal fractures require close evaluation and treatment. The first ray is integral to the function of the forefoot and biomechanics of the foot. Non or minimally displaced fractures can often be treated without surgery but any displacement requires ORIF for anatomic restoration of the first metatarsal length and align.

Written by Julie Johnson, MD
Reviewed by Troy Watson, MD
Last reviewed June 2015