The Peroneus Brevis and Plantar Fascia Insertions Are Related to Proximal Fifth Metatarsal Fractures

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Introduction/Purpose: Proximal fifth metatarsal fractures (PFMF) are among the most common fractures in the foot and can be categorized into three fracture zones [1]. To investigate the fracture mechanism of PFMF in different zones, a better understanding of the anatomy of the bone and its surrounding soft tissues is required. Both the plantar fascia (PF) and the peroneus brevis (PB) tendon insertions are at the base of the fifth metatarsal, and may contribute to the pathophysiology of PFMF. However, the role of the PB and PF insertions in the pathogenesis of PFMF remains unclear. The purpose of this study was to accurately define the footprint of the PB and PF insertions of the base of the 5th metatarsal in relation to the different zones of PFMF.

Methods: 21 cadaveric fifth metatarsal bones were harvested from cadaveric feet. All bones were freed of any remaining soft tissue adherence, except for the PB and the PF insertions. Three reference screws with a diameter of 1 mm were placed and secured on each bone with 2 screws distally and 1 screw proximally for registration. All bones were CT scanned to create a 3D bone reconstruction. Next, the insertions of the PB and PF and the reference screws of each bone were digitized and then mapped to its corresponding 3D bone model. In order to describe the three different fracture zones of the 5th metatarsal, an established coordinate system was made for each bone to simulate separate fracture zones (Figure a) based on Lawrence guideline [1]. The shape, location and surface areas of both insertions and their relation to the different fractures zones were determined (Figure b).

Results: The insertion of the PB was oval shaped and located on the dorsal side of the base, with a mean surface area of 88.1 ± 46.4 mm². The PF was oval shaped and situated around the tip of tuberosity, with a mean surface area of 150.7±53.5 mm². The PB insertion was present in zone 1 fractures in 100% (21/21) of the 5th metatarsal models and 29% (6/21) of the models for zone 2 fractures. The PF insertion was involved in 100% (21/21) of the 5th metatarsal models for zone 1 fractures and 43% (9/21) of the models for zone 2 fractures.

Conclusion: Results of this study demonstrate that the insertion of both the PB and PF are involved in all zone 1 PPFMF and a significant percentage of zone 2 PPFMF. The location of tendon insertions affect the forces exerted on the bone, which may indicate a relation of the insertions of both the PB and the PF with the fracture mechanism of many zone 1 and 2 PPFMF. Moreover, in the treatment of these fractures, care should be taken to maintain or restore the anatomy of these insertions to maximize functional outcomes.