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The Peroneus Brevis and Plantar Fascia Insertions are Related to Proximal Fifth Metatarsal Fracture

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Summary:
The insertions of the PB and PF are involved in a significant percentage of proximal fifth metatarsal fractures, which may indicate a relation of the insertions with the fracture mechanism of these fractures.

Abstract:
INTRODUCTION:
Proximal fifth metatarsal fractures (PFMF) are among the most common fractures in the foot and can be categorized into three different fracture zones. In order to understand the fracture mechanism of PFMF in each zone, better understanding of the anatomy of the fifth metatarsal bone and its surrounding soft tissues is required. The plantar fascia (PF) and the peroneus brevis (PB) tendon, both attached to the base of the fifth metatarsal, may contribute to the pathophysiology of PFMF. However, their role in the pathogenesis of PFMF remains unclear. The purpose of this study was to accurately define the footprint of the PB and PF insertion on the base of the 5th metatarsal in relation to the different zones of PFMF.

METHODS:
Following IRB approval, 21 cadaveric fifth metatarsal bones were harvested. All bones were freed of any remaining soft tissue adherence, except for the PB and the PF. To facilitate registration, three reference screws (1mm diameter) were placed and secured on each bone with 2 screws distally and 1 screw proximally.
All bones were CT scanned to create 3D bone reconstructions, using modeling software (Rhinoceros, v5.0). Using a digitizer (MircoScribe, G2LX), the insertions of the PB and PF, together with the reference were digitized and mapped on its corresponding 3D bone model in the modeling software. The shape and location of both insertions were observed and the surface areas were determined.
An established coordinate system was made for each bone to obtain an identical view of each bone mutually, in order to describe the different fracture zones. The PFMF zones were determined and the shape and location of both insertions were mapped along with their corresponding surface areas to observe their relation to the different fractures zones.

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 involved in 100% (21/21) of the zone 1 PFMF and 29% (6/21) of the fractures in zone 2.The PF insertion was involved 100% (21/21) of the fractures in zone 1 and 43% (9/21) of the zone 2 fractures.

DISCUSSION:
This study demonstrates that the insertion of both the PB and PF are involved in all zone 1 PFMF and a significant

percentage of zone 2 PFMF. The location of tendon insertions affect forces exerted on the bone, which may indicate a relation of the insertions with the pathophysiology of many zone 1 and 2 PFMF. Moreover, in the treatment of these fractures, care should be taken to maintain or restore the anatomy of these insertions to maximize functional outcomes.

SIGNIFICANCE: With PFMF being one of the most common fractures in the foot, understanding of the pathophysiology and optimal treatment of PFMF is required. This study aids in understanding the fracture mechanism and creates a guide in the treatment of PFMF.