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Optimal Fixation of Jones Fractures Sacrifices the Peroneal Brevis Tendon Insertion and the Plantar Fascia

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Objectives: Patients with Jones fractures (JF) frequently undergo operative management with intramedullary screw fixation. Screw insertion through the base of the fifth metatarsal potentially compromises attachment points of the plantar fascia (PF) and peroneal brevis tendon (PB), and appropriate screw length and diameter remains controversial. The aim of this study was to define the anatomy of the fifth metatarsal bone using CT modeling in order to provide better guidance regarding optimized screw insertion point, screw length, diameter, and thread length and, moreover, to give better insight in the possible compromise of the PB and PF when placing a screw.

Methods: Following IRB approval, 21 cadaveric fifth metatarsal bones were harvested. Three reference screws (1mm diameter) were placed and secured on each bone, with 2 screws distally and 1 screw proximally, to act as a geographic register. All bones were CT scanned to create 3D reconstructions using modeling software (Rhinoceros, v5.0). The outer cortex, intramedullary canal and articular cortex of each bone were identified. Using a digitizer (MircoScribe, G2LX), the PB and PF insertions, alongside the reference screws, were mapped onto the corresponding specimen. The total length of the bone, the shape and diameter at the narrowest point of the intramedullary canal were also measured. Optimal screw diameter and length were calculated in this position, and the impact of screw placement on the insertion sites of both the PB and PF was recorded.

Results: The mean length of the bones was 74 ± 3.6mm, with the narrowest diameter of the intramedullary canal being 4.3 ± 0.7 mm. Ideal screw position was identified as parallel to the cuboid and coaxial with the intramedullary cortex, partially sacrificing the PB and PF insertions in 62% (13/21) and 33% (7/21) of specimens respectively, with an average sacrificed area of 1.6 ± 0.8 mm of the PB and 1.3 ± 0.8 mm of the PF insertion. The ideal screw length was 48 ± 5.8 mm, with a minimal thread length of 28 ± 6.8 mm and a minimal diameter of 4.5 mm. The screw length:total bone length ratio was 0.64 (range .050-0.72).

Conclusion: To maximize compression and pull-out strength, as well as minimize destruction of soft tissue insertions during screw placement for the treatment of JF, screws should be placed parallel to the cuboid and collinear with the intramedullary cortex—mitigating but not avoiding injury to the PB and PF. Average optimal length of the screw should cover 64% of the length of the bone, with a minimum 4.5 mm diameter and 50% thread length. Given variability in anatomy, however, screw choice should be tailored to the individual. Operative treatment of JF, a common foot injury, represent one of the more controversial surgical techniques in foot care today. Improving anatomic understanding of the implications of screw insertion will be paramount to maximizing functional outcomes.

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