

Percutaneous Reduction and Screw Fixation in Displaced Intra-Articular Fractures of the Calcaneus

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Purpose: This study retrospectively reviewed patients with intra-articular calcaneal fractures who were treated with percutaneous reduction and fixation with screws alone and assessed their clinical outcomes and radiographs using a novel CT scoring system.

Methods: Between 2000 and 2011, 153 consecutive patients with 182 displaced intra-articular fractures of the calcaneus (Sanders type 2 in 17%, type 3 in 66%, and type 4 in 17%) were operatively reduced and fixed with screws alone using percutaneous techniques. During the study period, there were no patients treated with other operative techniques. All patients' records were assessed for early postoperative complications at 3 months from the injury and radiographs were measured for maintenance of reduction. Midterm clinical results for pain and late complications were assessed for patients seen at a minimum of 1 year after surgery (90 patients, 106 feet). This subgroup had a mean follow-up of 2.6 ± 1.7 years (range, 1-8.9 years). In patients who had both preoperative and postoperative CT scans (50 patients, 60 feet), the articular reduction was quantitatively analyzed by measuring the widest gap or step in the anterior talocalcaneal joint, posterior talocalcaneal joint, and calcaneocuboid joint in 3 scanning planes. Bohler angle, Gissane angle, talocalcaneal angle, calcaneal width, height, and length were measured by a nontreating surgeon on preoperative, immediate postoperative, and 3-month postoperative radiographs.

Results: At 3-month follow up, early complications were identified in 4 patients (2.6%). There were 2 superficial infections and 2 patients with screw irritation that required removal. The midterm complications in patients with a minimum 1-year follow-up were: screw irritation requiring removal in 10 feet (9.4%), subtalar osteoarthritis needed subtalar fusions in 6 feet (5.7%), 2 malunion (1.9%), 1 deep infection (0.9%), and 1 Achilles tendinopathy (0.9%). The clinical results in this subgroup were good-excellent in terms of pain, stiffness, and function at 54.5%, 52.2%, and 60%, respectively. Comparing preoperative and immediate postoperative radiographs, there was significant improvement in Bohler angle ($P < 0.0001$), calcaneal facet height ($P < 0.0001$), and calcaneal width ($P < 0.0001$). On radiographs after healing the reduction was maintained for all parameters except Bohler angle, which was significantly decreased compared to immediate postoperative films ($P = 0.0002$). Comparing the CT composite score of preoperative and postoperative CT showed significant improvement in posterior talocalcaneal joint ($P < 0.0001$) and calcaneocuboid joint ($P = 0.0303$). Of the patients with either subtalar fusion or late-stage arthritis, there was significant correlation between both the pre-operative and postoperative CT composite scores ($P = 0.05$ and 0.03 , respectively). The visual analog scale scores did not correlate with the preoperative CT scores ($P = 0.4$), although they showed a strong trend to correlate with postoperative scores ($P = 0.06$).

Conclusion: These radiographic measurements suggested that the shape of the calcaneus (height, width, and Bohler angle) could be significantly improved using percutaneous

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techniques and screw fixation alone and the improvements were largely maintained (average 4.3 screws per foot). The complication rate was low compared to other reported techniques. The posterior facet reduction on postoperative CT was significantly improved from the preoperative status. However, residual articular displacement and settling of Bohler angle were present. The clinical significance of these residual displacements is uncertain.