

Open Reduction and Internal Fixation of Displaced Intra-articular Calcaneal Fractures with Norian Skeletal Repair System (SRS) Bone Cement: Surgical Technique, Clinical and Radiographical Results

Dear Editor,

The treatment of displaced intra-articular calcaneal fractures remains a topic of debate among orthopaedic surgeons.

In this study, we introduced a surgical technique for the treatment of displaced intra-articular calcaneal fracture with minimal hardware and Norian SRS bone cement. In addition, we also evaluated the cost-effectiveness of our technique.

Materials and Methods

This is a prospective review of patients with displaced intra-articular calcaneal fractures admitted to a Level 1 trauma centre under the care of a single primary trauma surgeon over a 1-year period from February 2010 to January 2011. A total of 9 patients with 11 closed calcaneal fractures were enrolled into the study. Only 1 calcaneal fracture per patient was treated.

Sanders classification was used to describe the fracture configuration and only type II and III calcaneal fractures were recruited.

Pre- and post-operative radiographic imaging was obtained to determine and monitor the Bohler's angle, Gissane's angle and talocalcaneal angles. All patients had preoperative computed tomography (CT) of the calcaneum to evaluate the fracture configuration.

Operative Technique

We employ the lateral extensile approach in all cases for open reduction and internal fixation. The full thickness fasciocutaneous flap, with the peroneal tendon and sural nerve, is elevated and two 2 mm Kirschner wires are inserted into the talus to retract the flap.

The lateral wall fragment is then elevated, revealing the degree of joint depression. Fracture depression is either reduced manually or with a lamina spreader under image intensifier guidance.

Four to five 1.6 mm non-threaded Kirschner wires are inserted in parallel from the posterior aspect of the plantar surface of the heel to reach the subchondral bone of the posterior facet. They function as a raft to maintain calcaneal height and aid in obtaining length and anatomical alignment.

The posterior facet is then reduced and compressed by the insertion of a 3.5 mm cortical lag screw, lateral to medial, into the sustentaculum tali.

Depending on the amount of bone void, 3 to 10 cm³ of Norian SRS bone cement are then inserted. Preparation of Norian SRS bone cement is according to the manufacturer's instructions and is injected via a delivery needle (Fig. 1).

The lateral wall fragment is then replaced and a 5-hole one-third tubular plate is used to buttress the lateral wall. Two fully threaded cancellous screws are inserted into the tubular plate, one into the most anterior hole directed toward the sustentaculum tali and another into the most posterior hole. Satisfactory anatomical reduction and anatomical alignment are verified with lateral and axial views obtained with the image intensifier. Figure 2 shows immediate post-operative X-ray images.

The 1.6 mm Kirschner wires on the heel are shortened and left exposed. The incision site is carefully closed in a tension-free fashion with interrupted subcutaneous and mattress skin sutures.

Postoperative Care

Kirschner wires were removed in clinic at 6 weeks postoperatively and full weight bearing commenced thereafter.

Results

There was no loss of reduction with respect to Bohler's angles, Gissane's angles and talocalcaneal angles except in 1 patient. However, we found no statistical significance ($P > 0.05$) between intraoperative angles and their corresponding angles on subsequent follow-ups for all patients, indicating no significant collapse of reduction.

On clinical assessment of postoperative axial alignment, all calcaneal bodies were restored to neutral or valgus alignment.

We utilised The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle and Hindfoot Scale scoring system and Visual Analogue Scale (VAS) score to assess the functional outcome. Subgroup analysis revealed that

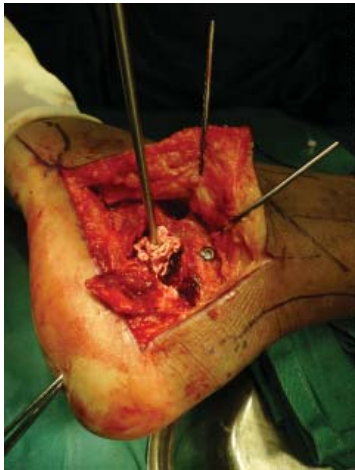


Fig. 1. Insertion of Norian SRS bone cement.

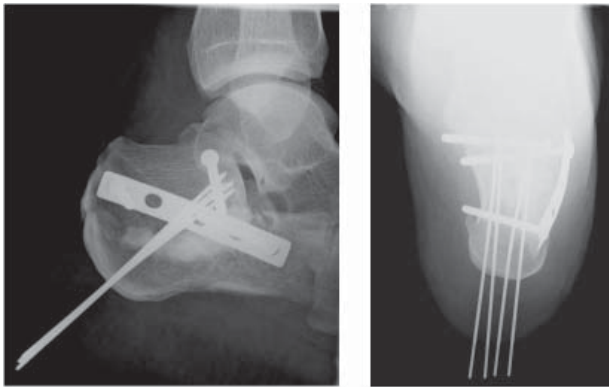


Fig. 2. X-ray images showing the insertion of Norian SRS bone cement.

patients who were receiving workmen compensation had a poorer functional score compared to patients who were not receiving workmen compensation.

Four patients were unable to return to work, all of whom were foreign workers under workmen compensation. Six patients complained of subjective subtalar ankle stiffness but only 1 of the 6 patients was confirmed with significant subtalar stiffness on clinical examination.

Discussion

Demcoe et al¹ used an extensile lateral approach with threaded Kirschner wire and a 5-hole one-third tubular plate for fixation. Alpha bone substitute material (α -BSM, DePuy) bone cement was used to fill the bone void. Kirschner wires were removed only at 12 weeks postoperatively and full weight bearing started thereafter.

We too, have utilised the extensile lateral approach and a 5-hole one-third tubular plate. However, we used non-threaded Kirschner wires and did not encounter any premature loosening or pin site infection. Norian SRS bone cement was used instead of α -BSM. In our series, Kirschner wires were removed at 6 weeks postoperatively and full

weight bear commenced thereafter, with no substantial collapse seen in our patients. We therefore recommend that threaded Kirschner wires are not required and that because of the compressive strength of Norian SRS bone cement, earlier weight bearing can be initiated using this technique.

Complications described by many other authors^{2,3} such as wound dehiscence, infections, tendon impingement, complex regional pain syndrome (CRPS), neuroma, tarsal tunnel syndrome, exostosis formation and revision operations were all not encountered in our series.

We also evaluated the cost-effectiveness of our technique. Using quotations given by local suppliers, the total estimated cost of the implants using a calcaneal locking plate with only locking screws is S\$720, compared with S\$395 for utilising our technique. There is a cost reduction of 55%.

Conclusion

We conclude that our method is an excellent and cost-effective technique for the surgical treatment of displaced intra-articular calcaneal fractures.

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