Original Article

Functional Outcome of Calcaneal Fractures Treated by Various Methods

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Abstract

Introduction: Calcaneal fractures make up about 2% of all fractures. They account for 60% of major tarsal injuries. Anatomic restoration of the three-dimensional anatomy of the calcaneum and restoration of weight-bearing function is the goal of surgical management of calcaneal fractures. Over the years, various techniques have been developed to accomplish this goal. All these techniques have certain steps in common including disimpaction of the fragments, reduction of the displaced fragments either manually or percutaneously and protection of reduction with plaster pins and plaster, external fixation and open reduction and internal fixation. **Materials and Methods:** This is a retrospective study of 41 patients (50 fractures) with calcaneum fractures from 15 to 60 years of age, managed either conservatively or operated at our institution between 2012 and 2017, with regular detailed clinical and radiological follow-up for minimum of 6 months. **Results:** In this series, we have used American Orthopaedic Foot and Ankle Society score for assessment of our result. Ninety-three per cent fractures had good to excellent result in non-operative group and 77% fracture had good to excellent result in the operative group. In intra-articular fractures with joint depression pattern, 9 (69%) of the percutaneously fixed fractures had good to excellent results and 8 (66%) of the Open reduction and internal fixation (ORIF) group had good to excellent results. Eight (33%) with fair result had persistent heel widening and pain. One patient had loss of reduction, but all of them have returned to their original occupation. In intra-articular fractures with Tongue type fracture, all 7 (100%) fractures had good to excellent results, whether they were fixed percutaneously or via open fixation. **Conclusion:** In this retrospective study, we observe that there was no significant difference noted, with respect to the functional outcome, between the operated and non-operated group.

Keywords: Calcaneum, extra-articular, intra-articular, percutaneous surgery

Introduction

The calcaneum is the largest bone of the foot and is the major weight-bearing osseous structure of the foot. The mere mention of the word fracture as applied to the calcaneum brings to mind the image of a bone with its structure and shape grossly disrupted and its articular relationships seriously disorganised. What follows then are arduous and complicated efforts to attain a satisfactory reduction, prolonged disability and the tedious stages of functional restoration.[1]

Calcaneal fractures have a track record of being difficult to treat and have frustrated doctors for years. Calcaneal repair not only requires reapposition of multiple fracture patterns but also requires restoration of the subtalar joint. In some cases, additional joint surfaces may be affected (the calcaneocuboid joint) but are of lesser importance due to their limited weight-bearing roles.[2]

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Anatomic restoration of the three-dimensional (3D) anatomy of the calcaneum is the goal of surgical management of calcaneal fractures. Over the years, various techniques have been developed to accomplish this goal. All these techniques have certain steps in common including disimpaction of the fragments, reduction of the displaced fragments either manually or percutaneously and protection of reduction with plaster pins and plaster, external fixation and open reduction and internal fixation.[3]

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The purpose of this study is to evaluate the treatment of calcaneum fractures as per the fracture pattern or type and assess their clinical and functional effectiveness.

Materials and Methods

We have done a retrospective study of 41 patients with 50 calcaneal fractures managed either conservatively or operated at our institution between 2012 and 2017, with regular detailed clinical and radiological follow-up of 6 months. This study included patients who were between 15 and 60 years with unilateral or bilateral, closed or open calcaneal fractures.

Patients with neurovascular involvement in the lower limb and patients presenting after 4 weeks of injury were excluded from this study. A complete history of the patients was obtained, and a thorough clinical examination was done. Swelling of the heel and condition of the skin were noted. After the patient was stabilised, investigations were done, as listed. Anteroposterior, lateral and Harris axial views of the concerned foot were done. Special views were taken only when the interpretation of these routine X-rays was difficult. Two-dimensional and 3D computed tomography (CT) scan were done in all the patients.

All calcaneal fractures were classified and assigned to a particular group based on Essex–Lopresti's classification system (radiograph) and Sanders system (CT scan) and open fractures were classified with the Gustilo–Anderson system as mentioned above. Once the fracture was classified, a treatment protocol, i.e., whether conservative or operative was decided.

Patients with undisplaced/minimally displaced closed fractures, patient not willing for surgery and patients not fit for surgery were treated conservatively. Patients were treated on outpatient basis with application of below knee slab and elevation along with required medications for swelling and pain. Below knee cast was given once the swelling was reduced. Side to side compression was given in cases of heel widening. Patients were kept non-weight bearing for 6 weeks, and thereafter, they were allowed weight bearing with soft footwear.

Patients with impaction and/or lateral shift of the tuberosity fragment at the medial wall fracture site, intra-articular displacement >1 mm and extra-articular fractures compromising the soft tissues and/or with unacceptable positioning, shortening and broadening of the calcaneus (>10 valgus/>5 varus) were treated operatively. Surgery was planned when the swelling subsided which was appreciated by 'wrinkle sign,'[4] and it routinely appears, 4–7 days after injury.

Closed reduction and fixation was done for Essex–Lopresti tongue type (Type 1), open beak fracture or avulsion fracture and thalamic depression fractures with 6.5 mm cannulated cancellous screws.

Open reduction and internal fixation was done for excessive intra-articular depression and lateral wall comminution which could not be addressed through a sinus tarsi approach. The fracture was approached through the standard extended lateral approach and fixed with calcaneal plates.

Postoperatively, the patient was given intravenous antibiotics for the first 2 days in closed fractures and for 5 days in open fractures, and then, oral antibiotics was given till suture removal. All the patients were immobilised with a below knee splint and asked to perform active toe movements. Percutaneously fixed patients were discharged after the swelling subsided, which was on average 2–3 days [Figure 1].

Patients fixed with extensive lateral approach were discharged for 4–7 days on an average.

Suture removal was done between 10 and 15 days [Figure 2]. A below knee cast was applied after suture removal and continued for 1.5 months. After which, ankle mobilisation was started without any weight bearing. Patients were evaluated clinically and radiologically at monthly intervals. Weight bearing was allowed at 6–8 weeks. The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score was used to assess the functional outcome of the patients.

Results

In our retrospective study of 41 patients with 50 calcaneal fractures, the following observations were made. Calcaneal fracture was most commonly found in young males on the right side.

In this present study, 36 cases were males (88%) and 5 cases were females (12%), showing male preponderance with male to female ratio of 7:1. The most common cause of calcaneal fracture is fall from height, which involves axial loading. Hence, other associated injuries are possible. In this study, other injuries were found in 15% of the patients.

In our study, intra-articular pattern accounted for 34 (68%) fractures and extra-articular for 16 (32%) of them. Of the intra-articular variety, we found 27 (80%) fractures to be of joint depression type and 7 (20%) of tongue type. Fourteen (88%)

Figure 1: (a) Intra-articular bilateral calcaneum fracture (b) 6-month postoperative

extra-articular fractures were managed conservatively, except open beak type, i.e., 2 (12%) fractures which were fixed percutaneously. Nineteen (55%) intra-articular fractures were fixed percutaneously and 13 (37%) via extensive lateral approach. However, 2 (8%) of intra-articular fracture had to be treated conservatively as patients were not willing for operative intervention. Thirteen (47%) fractures of thalamic depression pattern were fixed percutaneously using minimal invasive approach (Sinus Tarsi) and 12 (44%) fractures via extensive lateral approach, when required as per the comminution of lateral wall.

Forty (97.5%) patients have returned to their original occupation. One patient with extra-articular fracture and 6-month follow-up has not yet returned to work because of some pain but his functional result as per AOFAS scoring is excellent.

In our series, we observed that seven patients had subtalar arthritis, of which two had extra-articular fracture and five had intra-articular fracture. Two fractures with extra-articular fracture were of old age and probably had degenerative arthritis. Peroneal tenosynovitis was observed in two patients with intra-articular fracture. Superficial infection was observed in two patients with intra-articular fracture treated with extensive lateral approach, but it healed with regular dressing. Heel widening was found in 22 patients, of which 5 had extra-articular fracture and 17 had intra-articular fractures. Despite these complications, all the patients returned to their original occupation except one.

Discussion

Calcaneal fractures usually affect young males who belong to the economically active age group which contributes to significant socioeconomical loss. The possible reason might be higher involvement of young males in activities involving working on heights. In the present study, the stratified distribution of the patients shows that 54% were within 20–40 years of age, which is comparable to the study of Nambiar *et al*.[5] who noted that 56% of their patients were in the third to fourth decade of life and Buckley and Meek[6] noted that in their study, the maximum age incidence was between 30 and 39 years (60%). Paley and Hall[7] noted male to female ratio of 6:1, Nambiar *et al*.[5] 10:1 and Pozo *et al*.[8] 4:1.

In our study, it was observed that fall from height is the most common cause of calcaneal fracture which accounted for 68% of the fractures. In the study done by Hammesfahr and Fleming[9] which reported 60% cases due to fall from height and Wilson[10] who reported 75%, it was found to be comparable to our series.

Hildebrand *et al*.[11] reported associated spine fractures in 10%, Buckley *et al*.[12] reported 15% and Nambiar *et al*.[5] reported 21% associated spine injuries whereas in this study, spine injuries accounted for 3 (7%) cases.

In our study, intra-articular pattern accounted for 34 (68%) fractures and extra-articular for 16 (32%) of them which was comparable to a study by Essex–Lopresti,[13] where 75% patients had intra-articular and 25% had extra-articular fractures. Essex–Lopresti,[14] in another study, found 66% fractures of joint depression-type fractures and 34% tongue-type fractures.

In this study of 41 cases (50 calcaneum fractures) were analysed statistically with a minimum follow up of six months. We have used AOFAS score for the assessment of our result. Ninety-three per cent fracture had good to excellent result in non-operative group and 77% fracture had good to excellent result in operative group [Figure 3].

In this study, there was no significant difference noted, with respect to the functional outcome, between the operated and non-operated group. This was at par with Buckley and Meek[6] and Ibrahim *et al*.,[15] which shows equal outcomes between operative and non-operative treatment. However, it contradicts the studies of Leung *et al*.[16] and O'Farrell *et al*.,[17] which shows better functional outcome in operated cases.

In the extra-articular variety, 13 (93%) of the conservatively treated fractures had good to excellent results and 2 (100%) of the percutaneously fixed fractures had good to excellent results.

Figure 2: (a) Intra-articular calcaneum fracture (b) 6-month postoperative

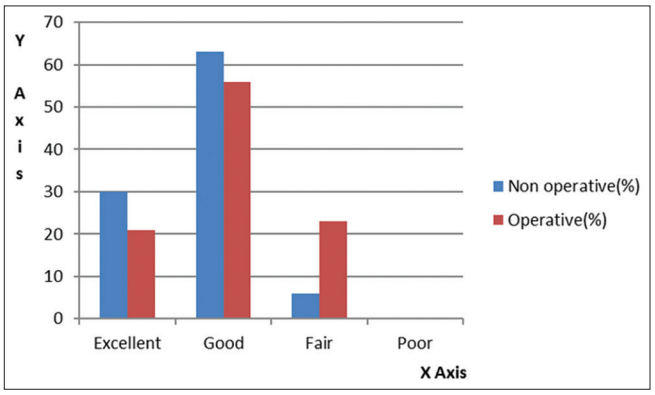

Figure 3: Final outcome according to American Orthopaedic Foot and Ankle Society score

In our study, in intra-articular fractures with joint depression pattern, 9 (69%) of the percutaneously fixed fractures had good to excellent results and 8 (66%) of the ORIF group had good to excellent results. Eight (33%) with fair result had persistent heel widening and pain with one patient having loss of reduction of thalamic depression, but all of them have returned to their original occupation. Surprisingly, two patients with intra-articular fracture of joint depression type who did not opt for operative intervention also had good to excellent results.

In our study, in intra-articular fractures with tongue depression type fracture, all 7 (100%) fractures had good to excellent results, whether they were fixed percutaneously or via open fixation. In this retrospective study, we observe that if a logical protocol, like the one mentioned in materials and method, is followed in the treatment of calcaneal fractures, we get good functional outcome.

Conclusion

Every calcaneal fracture is unique. It should be meticulously assessed preoperatively. Based on the skin condition and fracture pattern, judicious use of treatment modality as per our protocol would give gratifying result. In this retrospective study, we observe that there was no significant difference noted, with respect to the functional outcome, between the operated and non-operated group.

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Conflicts of interest

There are no conflicts of interest.

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