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Research Article

Comparison between percutaneous screw fixation and plate fixation for calcaneal fractures

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Statistics

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Abstract

Introduction: Fractures of the calcaneum, the most commonly injured tarsal bone, has an incidence of approximately 1%-2% of all fractures. About three quarters of all calcaneal fractures are intra-articular and involve the subtalar joint. The most common mode of injury is a fall from height with impact being directly on the heel. There are various methods of treatment for fractures of the calcaneum such as kirschner wire fixation, percutaneous cannulated screw fixation and plate fixation and yet there is still no single method which has proven to give consistently favourable results.

Material and Methods: This retrospective study was carried out by assessing patients with calcaneal fractures admitted to D Y Patil Medical College and hospital from June 2019 to March 2021. A group of these patients were treated by percutaneous screw fixation while plate fixation was used in the others. 40 patients qualified for the inclusion criteria, 20 being in one group and 20 in the other. The groups were classified according to age, sex, mechanism of injury, Sanders classification etc. The mean time between being hospitalized due to injury and commencement of surgery was 4 days.

Discussion: Calcaneum fractures were historically managed conservatively and that was considered the gold standard of treatment. However, over the years, various methods of internal fixation started showing excellent results. In our study, excellent results were achieved in 12(60%) patients in the percutaneous cc screw fixation group as compared to 0 patients in the plating group. Good results were achieved in 8(40%) patients in both groups whereas medium and poor results were achieved in 8(40%) and 4(20%) patients respectively in the plating group. This suggests that all of the patients treated by percutaneous cc screw fixation for calcaneum fractures in this study yielded either excellent or good results whereas those treated by plating yielded variable results.

Conclusion: On comparing percutaneous CC screw fixation and plating for calcaneal fractures Sander's types II, IIIa, IIIb, we found that the AOFAS score when integrated with patient satisfaction was statistically proven to be better for the group with percutaneous CC screw fixation as compared to the group with calcaneal plate fixation.

Keywords: calcaneum, locking plate, percutaneous, cc screw, internal fixation

INTRODUCTION

Fractures of the calcaneum, the most commonly injured tarsal bone, has an incidence of approximately 1%-2% of all fractures [1,2]. About three quarters of all calcaneal fractures are intra-articular and involve the subtalar joint. The most common mode of injury is a fall from height with impact being directly on the heel [3,4]. Over the years, management of calcaneal fractures has been a controversial topic of debate [5-8]. A conservative approach was often preferred historically due to the unpredictable nature of the surgical outcome [9,10]. There are various methods of treatment for fractures of the calcaneum such as kirschner wire fixation, percutaneous cannulated screw fixation and plate fixation and yet there is still no single method which has proven to give consistently favourable results [11,12].

Many studies have previously been performed separately taking into account the treatment efficacy and pain management by means of either calcaneal plating or CC screw fixation. Wound healing has also been a major concern over the years post-surgical management [13-15]. Although there have been comparative studies wherein both the methods have been pitted against each other but limited evidence exists in terms of Percutaneous CC screw Fixation in comparison to Calcaneum Plating for Sander's Type II, IIIA, and III B [16, 17]. By means of this study, we hope to give valuable insight into the comparison between percutaneous screw fixation and plate fixation for calcaneal fractures and superiority of one method over the other.

MATERIALS AND METHODS

PARTICIPANT DEMOGRAPHICS

This retrospective study was carried out by assessing patients with calcaneal fractures admitted to D Y Patil Medical College and hospital from June 2019 to March 2021. A group of these patients were treated by percutaneous screw fixation while plate fixation was used in the others. The decision to use plating or screw fixation was random and discussed with the patients in detail.

Inclusion Criteria:

Age group between 18-50 years

Displaced intra articular calcaneum fracture >2 mm

Unilateral fracture

Closed fracture

Non diabetic patients

Presenting within 2 weeks of injury

Exclusion Criteria:

Patients with severe cardiac and cerebrovascular diseases

Heavy smokers

Non reducible fractures requiring arthrodesis

40 patients qualified for the inclusion criteria, 20 being in one group and 20 in the other. The groups were classified according to age, sex, mechanism of injury, Sanders classification etc. The mean time between being hospitalized due to injury and commencement of surgery was 4 days.

SURGICAL METHOD

Lateral position was used for all patients with the injured side facing upwards. Following anaesthesia and routine disinfection, all patients were operated by the same surgeons.

PERCUTANEOUS FIXATION GROUP

Using the help of C-arm fluoroscopy, a 3.5 mm k-wire was drilled percutaneously at the supero-posterior margin of the calcaneum *via* the lateral aspect of the Achilles tendon. Then, the k-wire was delivered just below the distal aspect of the posterior facet of the subtalar joint maintaining the insertion angle at 15-20 degrees medially from the lateral margin of the foot and 60-70 degrees from the plantar aspect. The k-wire tip was halted around 1 cm below the posterior facet though being outside the joint, such that it touched the fracture bone block on the posterior facet of the calcaneum. The midfoot and calcaneum were then bent towards the plantar aspect using the k-wire. By adjusting the rearfoot valgus, the posterior facet of the subtalar joint was moved nearer to the sustentaculum tali. Reduction was then checked under the C-arm. The sustentaculum tali fracture block was then transversely fixed with a 1.5 mm k wire drilled medially from the posterior articular surface of the lateral bone block. To fix the primary and secondary fracture lines, one K-wire was drilled from the calcaneal tubercle towards the sustentaculum tali, and then further towards the calcaneal axis. The c-arm was then used to assess the Bohler's angle, Gissane's angle and height and length of the calcaneum. Following assessment, 1 mm-24.0 mm cannulated screws were inserted from the calcaneal tubercle for transverse fixation of the bone block on the posterior facet of the subtalar joint (Figure 1).

PLATE FIXATION GROUP

From the tip of the fibula to the lateral wall bone of the anterior process of a calcaneum, a 5 cm-7 cm incision was made parallel to the sole. After the visual field of the fracture was exposed and haematoma was cleared, a Steinmann was used to reposition the fracture fragments of the joint. A 2 mm-3 mm K-wire was temporarily fixed after suitable reduction and was established by fluoroscopy under the C-arm. After that, the lateral side of the calcaneus was squeezed by hand, followed by a poking reduction. The height of the calcaneum was adjusted to expose the lateral wall and body of the calcaneum, the subtalar joint and to reposition the joint's posterior articular surface. Bohler's angle and Gissane's angle were determined using a C-arm X-ray machine after the calcaneal length, height, and width were measured. Through

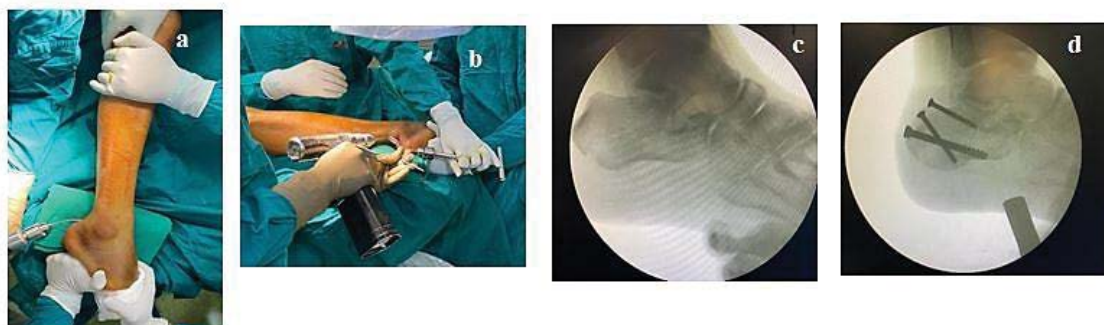


Fig. 1. Percutaneous fixation group; (a): Operating position; (b): Entry point of Kirschner wire; (c): Pre-operative c arm shoot lateral view; (d): Post-operative c arm shoot lateral view

the incision, the plate was then inserted followed by screw fixation (Figure 2)

POSTOPERATIVE TREATMENT AND FOLLOW-UP

Cast immobilisation without weight bearing given for 4- 6 weeks. A Fibre cast with partial weight bearing after 4-6 weeks, followed by full weight bearing without cast and exercises started after 3 months of post-operative period after assessing them radiographically as well as clinically. The patients were reviewed and followed up at 1 month, 3 months and 6 months post operatively (Figures 3 and 4).

STATISTICAL ANALYSIS

There was no bias of sex, age, mechanism of injury while choosing the samples.

Shapiro-Wilk test for Normal distribution was applied to give authenticity to the study due to the nature of the sample size being <50 overall. (W=0.9142 and P=0.0051)

Mann-Whitney test was applied for independent samples with the average of percutaneous cc screw group being 29.8500 and plating group being 11.1500, test statistic Z (corrected for ties) was 5.061 and two-tailed probability (p<0.0001) (Table 1).



Fig. 2: Plate fixation group; (a): Incision with plate placement; (b): Post suture line; (c): C arm shoot lateral view of k wire fixation; (d): Post plating c arm shoot lateral view

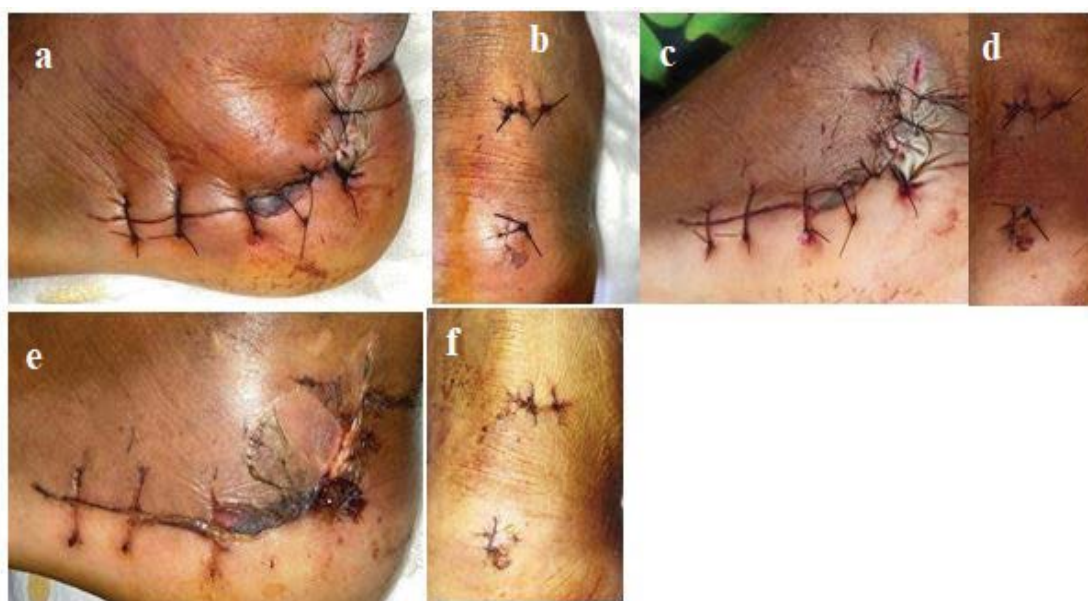


Fig. 3. Postoperative Treatment and Follow-up; (a): Post op day 2 wound condition for plating; (b): Post op day 2 wound condition for screw fixation; (c): Post op day 8 wound condition for plating; (d): Post op day 8 wound condition for screw fixation; (e): Wound condition for plating after suture removal on post op day 12; (f): Wound condition for screw fixation after suture removal on post op day 12

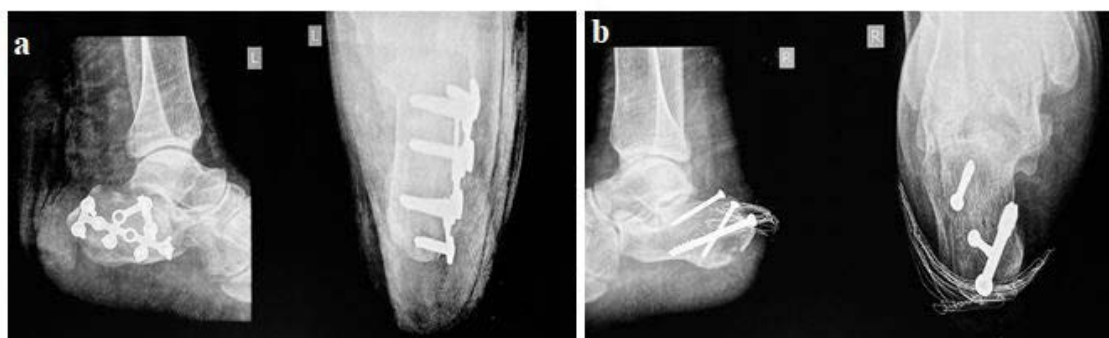


Fig. 4. Post operation view; (a): Post op day 11 x-ray for plating of left calcaneum in lateral and axial views; (b): Post op day 11 x-ray for screw fixation of right calcaneum in lateral and axial views

Table 1. Statistical Analysis

| Type of surgery | Treatment efficacy | | | | Total |
|-----------------------|--------------------|------------|----------|---------|----------|
| | Excellent | Good | Medium | Poor | |
| Percutaneous CC Screw | 12 (60%) | 8 (40%) | 0 (0%) | 0(0%) | 20(100%) |
| Plating | 0 (0%) | 8 (40%) | 8(40%) | 4(20%) | 20(100%) |
| TOTAL | 12(30%) | 16(40%) | 8(20%) | 4(10%) | 40(100%) |
| SCORE (CAT) | | | | | |
| Excellent | 6 (100%) | 0 (0%) | 0(0%) | 0(0%) | 6(100%) |
| Good | 6(26.09%) | 16(69.57%) | 1(4.35%) | 0(0%) | 23(100%) |
| Medium | 0(0%) | 0(0%) | 7(100%) | 0(0%) | 7(100%) |
| Poor | 0(0%) | 0(0%) | 0(0%) | 4(100%) | 4(100%) |
| TOTAL | 12(30%) | 16(40%) | 8(20%) | 4(10%) | 40(100%) |

Table 2. Age Distribution

| Age in years | Cases | Percentage |
|--------------|-------|------------|
| <20 | 1 | 0.025 |
| 20-30 | 14 | 0.35 |
| 31-40 | 12 | 0.3 |
| >40 | 13 | 0.325 |

Table 3. Sex Distribution

| Sex | Cases | Percentage |
|--------|-------|------------|
| Male | 27 | 67.5% |
| Female | 13 | 32.5% |

Table 4. Mechanism of Injury

| Mechanism | Cases | Percentage |
|-----------|-------|------------|
| Fall | 32 | 80% |
| RTA | 8 | 20% |

Table 5. Side of Calcaneus

| Side | Cases | Percentage |
|-------|-------|------------|
| Right | 23 | 57.5% |
| Left | 17 | 42.5% |

Table 6. Pre-Operative Bohler's Angle

| Pre-op angle | Cases | Percentage |
|--------------|-------|------------|
| <20 | 26 | 65% |
| 21-25 | 7 | 17.5% |
| 26-30 | 5 | 12.5% |
| 31-35 | - | - |
| 36 and above | 2 | 5% |

Table 7. Post-Operative Bohler's Angle in Plating

| Pre-op angle | Cases | Percentage |
|--------------|-------|------------|
| <20 | 3 | 15% |
| 21-25 | 2 | 10% |
| 26-30 | 13 | 65% |
| 31-35 | - | - |
| 36 and above | 2 | 10% |

Table 8. Post-Operative Bohler's Angle in Percutaneous Screw Fixation

| Pre-op angle | Cases | Percentage |
|--------------|-------|------------|
| <20 | 1 | 5% |
| 21-25 | 2 | 10% |
| 26-30 | 14 | 70% |
| 31-35 | - | - |
| 36 and above | 3 | 15% |

RESULTS

Results are mentioned in Tables 2-8.

DISCUSSION

Calcaneum fractures were historically managed conservatively and that was considered the gold standard of treatment [10,18]. However, over the years, various methods of internal fixation started showing excellent results [19,20]. In this study, we have compared internal fixation by percutaneous cc screw and plating in 40 patients at D Y Patil Medical College and Hospital from June 2019 to March 2021. The most common age group was found to be 20-30 years (35%) with a male predominance. The most common mechanism of injury was a fall from height. (67.5%) The difference between post-operative bohler's angle in both groups was not significant but post-operative wound healing problems were more in the plating group.

In our study, excellent results were achieved in 12 (60%) patients in the percutaneous cc screw fixation group as compared to 0 patients in the plating group. Good results were achieved in 8 (40%) patients in both groups whereas medium and poor results were achieved in 8 (40%) and 4 (20%) patients respectively in the plating group. This suggests that all of the patients treated by percutaneous cc screw fixation for calcaneum fractures in this study yielded either excellent or good results whereas those treated by plating yielded variable results.

CONCLUSION

Hence, on comparing percutaneous CC screw fixation and plating for calcaneal fractures Sanders types II, IIIa, IIIb, we found that the AOFAS score when integrated with patient satisfaction was statistically proven to be better for the group with percutaneous CC screw fixation as compared to the group with calcaneal plate fixation.

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