

## Comparing Treatment Outcomes of Intra-Articular Fracture of Calcaneum with Steinmann Pin (K- Wire) and Plating

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### Abstract

**Introduction:** Calcaneal fractures usually occur by a fall from height when one lands on their feet. In this study we aimed to compare the functional outcome and radiological findings after treatment by steinmen pin (K-wire) and by plating method. **Methodology:** We designed a prospective study of all patients who were admitted and operated for calcaneum fractures in the Department of Orthopedics, Padmashree Dr. D. Y, Patil Medical College, Hospital & Research Centre, Navi Mumbai, Maharashtra from July 2015 till December 2017. Of the 30 cases, half received treatment with K-wire and the other half of the patients underwent plating. Baseline characteristics, pre- and post-operative Bohler's and Gissane's angles and complications were noted for all patients. Functional outcome was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS). **Results:** Bohler's angle increased significantly postoperatively ( $p < 0.05$ ) for both the group of patients. Similarly Gissane's angle decreased in the postoperative period significantly ( $p < 0.05$ ). Of the patients who received K-wire, 5 patients (34%) had excellent outcome, 6 patients (40%) had good outcome, 2 patients (13%) had fair outcome while 2 patients (13%) had poor outcome. For the patients who underwent plating procedure, 7 patients (47%) had excellent outcome, 6 patients (40%) had good outcome while 2 patients (13%) had fair outcome. In the group which received K-wire treatment, 5 out of 15 patients developed heel pain while 3 patients had subtalar and ankle stiffness. In the group which underwent plating, 2 out of 15 patients got wound infection while 1 had subtalar and ankle stiffness. **Conclusions:** Cannulated screw and plate fixation have similar clinical outcomes. Future studies are needed to support our findings.

**Keywords:** Calcaneus Fracture; Cannulated Screws Fixation; Plate Fixation.

### Introduction

Calcaneus acts as a lever to increase the power of the gastrocnemius soleus complex. Calcaneal fractures usually occur by a fall from height when one lands on their feet. First described in 1843 by Malgaigne, calcaneal fractures were not routinely diagnosed until the development of X-rays in late 18th century. These fractures represent approximately 2% of all fractures but 60% of tarsal bone fractures [1]. Despite high relative

prevalence of this fracture, no consensus could be developed on its definitive management. Because the architecture of calcaneus and the soft tissue envelope are complex open reduction is challenging and may result in lifelong morbidity. Closed functional treatment include relief of acute pain, control of swelling, and early motion. Some authors have also recommended closed manipulative reduction [2]. Several surgical methods have been described for calcaneal fracture surgery, including minimally invasive and open techniques. Closed manipulative reductions described by Essex-Loprest

have been modified in to modern percutaneous reduction and screw fixation techniques. Many of these procedures have been successful in carefully chosen surgical; candidates [3]. In this study we aimed to compare the functional outcome and radiological findings after treatment by steinmen pin (K-wire) and by plating method.

## Methodology

### *Study Design and Population*

We designed a prospective study of all patients who were admitted and operated for calcaneum fractures in the Department of Orthopedics, Padmashree Dr. D.Y., Patil Medical College, Hospital & Research Centre, Navi Mumbai, Maharashtra from July 2015 till December 2017. We included all patients with calcaneum fractures aged 18 years or above, of both sexes, with simple and open injuries. We excluded patients with grossly compound fractures and those who refused consent to be included in the study. Based on previous hospital admission rates a total of 30 cases of fracture of calcaneum were included in this study. The study was approved by the local ethical committee and the patients gave their informed consent to participate.

### *Surgical Procedure*

- *Group receiving K wire (Steinmann pin)*

Steinmann pin was introduced in long axis of sea-saw or depressed fragment inclining slightly lateral in axial view. Lifting leg and foot upward by the Steinmann pin and dorsum of foot at the head of talus reduced the displacement. Intra-operatively restoration of Bohler's and Gissane's angle was attempted with Steinmann pin under image control. Proper reduction was achieved and a guidewire was passed beneath and parallel to Steinmann pin and drilled over with cannulated drill bit. Length for the canulated cancellous (C.C.) screw to be inserted was measured with help of same length guidewire and scale. Selected length 6.5 mm CC screw was inserted with screwdriver and fixed passing through the guidewire. Redisplacement of fracture was prevented by incorporating foot and Steinmann pin in a below-knee plaster cast.

- *Group receiving AO plate*

Incision was taken near the lateral margin of insertion of tendoachilles and passed distally to a

point 4 cm inferior to and 2.5 cm anterior to the lateral malleolus. Superficial and deep fascia were divided, the peritoneal tendon and sural nerve were isolated and protected. Periosteum was elevated to expose the bone with entire wall of the calcaneum distal to calcaneocuboid joint. Fracture site was made visible. Reduction was achieved by passing multiple K-wires for provisional fixation and Schanz screw to correct the varus and loss of height and length. Reduction was confirmed under IITV. Lateral plate was applied which extended from the anterior process of the calcaneum into the most posterior aspect of the tuberosity. Locking screws were passed from 30mm, 50mm, 50mm, 18mm and 20mm respectively. A cortico-cancellous screw was passed from the posterior tuberosity of the calcaneum of size 65mm. Thorough lavage given with normal saline followed by closure in layers

- *Data Collection and Data Analysis*

On admission, a detailed history including the mechanism of injury and the complaints of the patients was noted, along with a thorough clinical examination. Radiographs of affected limb were taken in antero-posterior & lateral view and axial view. Pre-op measurement of Bohler's and Gissane's angle for selection of the cases for the two types of surgery, K-wire fixation and Plating methods. For primary treatment immobilization was given in the form of below knee slab. All routine investigations were done prior to anaesthesia fitness. Patients were posted for planned operative procedures after deciding the appropriate modality of fracture fixation. No primary subtalar arthrodesis was performed. Intraoperative restoration of Bohler's and Gissane's angle was attempted with Steinmann pin or AO plating under image control depending on the group to which the patient was randomized. This was complimented with Plaster Of Paris cast.

Patients were followed up in out-patient department at the end of one week, 6 weeks, 3 months, 6 months and 1 year post-operatively. The patients in both groups were mobilized earlier with partial weight bearing walk with bilateral axillary crutches and a walker. The patients were clinically assessed for signs of union of fracture, movements of ankle and subtalar joint and complications, if any. They were also radiologically assessed to confirm the process of union and then partial weight bearing was allowed with vigorous physiotherapy and gradual full weight bearing. Non weight bearing walking was allowed after 4 days post-

operatively. After one month, Steinmann pin was removed and cast reinforced. Total immobilization advised was for 6 weeks. After 6 weeks partial weight bearing and active physiotherapy was instituted with elastocrepe bandage or sport shoes support as and when required till patient started weight bearing after about 6 weeks of surgery. Assessment of functional outcome was done by the American Orthopaedic Foot and Ankle Society (AOFAS) score by Kitaoka and colleagues [4].

**Results**

During the study period we included a total of 30 patients of calcaneal fracture in the study. These patients were divided into two equal age and gender matched groups, one receiving K-wire fixation treatment and the other received plating procedure treatment (Table 1). In the group receiving the K-wire treatment, 8 patients had left sided fracture while 7 had right sided fracture. On the other hand, in the group receiving plating method intervention, 7 had left sided fracture while 8 had

right sided fracture. 13 patients in the K-wire fixation group had injury from fall from height while one had fracture due to vehicular and assault injury each. In the group treated by plating method, 12 had a fracture due to fall from height while the remaining 3 had a fracture due to bump injury (Table 1). In our patient population Bohler’s angle increased significantly postoperatively ( $p < 0.05$ ) for both the group of patients (Table 2). Similarly Gissane’s angle decreased in the postoperative period significantly ( $p < 0.05$ ) as compared to the mean preoperative levels. Of the patients who received K-wire, 5 patients (34%) had excellent outcome, 6 patients (40%) had good outcome, 2 patients (13%) had fair outcome while 2 patients (13%) had poor outcome (Table 3). For the patients who underwent plating procedure, 7 patients (47%) had excellent outcome, 6 patients (40%) had good outcome while 2 patients (13%) had fair outcome. In the group which received K-wire treatment, 5 out of 15 patients developed heel pain while 3 patients had subtalar and ankle stiffness. In the group which underwent plating, 2 out of 15 patients got wound infection while 1 had subtalar and ankle stiffness.

**Table 1:** Baseline characteristics of the patients included in the study

|                    | Group receiving K-wire fixation | Group receiving plating method |
|--------------------|---------------------------------|--------------------------------|
| Number of patients | 15                              | 15                             |
| Males              | 14                              | 13                             |
| Mean age (years)   | 40.13 ± 9.36                    | 38.9 ± 11.88                   |
| Side of fracture   |                                 |                                |
| Left side          | 8                               | 7                              |
| Right              | 7                               | 8                              |
| Type of fracture   |                                 |                                |
| Tongue             | 7                               | 8                              |
| Joint              | 8                               | 7                              |
| Mode of injury     |                                 |                                |
| Fall from height   | 13                              | 12                             |
| Vehicular injury   | 1                               | 0                              |
| Assault            | 1                               | 0                              |
| Bump injury        | 0                               | 3                              |

**Table 2:** Change in Bohler’s and Gissane’s angles pre and post operatively

|                        | Group receiving K-wire fixation | Group receiving plating method |
|------------------------|---------------------------------|--------------------------------|
| <b>Bohler’s angle</b>  |                                 |                                |
| Pre-operative angle    | 15.06 ± 2.76                    | 12.53 ± 1.64                   |
| Post-operative angle   | 21.26 ± 3.51*                   | 24.06 ± 3.75*                  |
| <b>Gissane’s angle</b> |                                 |                                |
| Pre-operative angle    | 120.47 ± 2.97                   | 121.26 ± 3.78                  |
| Post-operative angle   | 99.67 ± 2.38*                   | 101.8 ± 2.3*                   |

\*comparison of pre and post-operative angles using t-test with p value less than 0.05

**Table 3:** Post-operative outcomes of patients included in the study

|                              | Group receiving K-wire fixation | Group receiving plating method |
|------------------------------|---------------------------------|--------------------------------|
| Functional outcome           |                                 |                                |
| Excellent                    | 5                               | 7                              |
| Good                         | 6                               | 6                              |
| Fair                         | 2                               | 2                              |
| Poor                         | 2                               | 0                              |
| Complications                |                                 |                                |
| Heel pain                    | 5                               | 0                              |
| Wound infections             | 0                               | 2                              |
| Subtalar and ankle stiffness | 3                               | 1                              |

## Discussion

Calcaneum fractures are considered one of the most difficult fractures to manage. We measured the pre-operative values of Bohler's as well as Gissane's angle and compared the values in both the surgical groups to the post-operative values. It was found that the Bohler's angle was found to be significantly increased postoperatively ( $p < 0.05$ ) as compared to the mean preoperative levels (from 13.8 degrees to 25.67 degrees). Such a result was found in both the K-wire group and the plating group. For the Gissane's angle, there was a significant decrease in the post-operative values as compared to the pre-operative mean value (from 120.87 to 100.73). This was the trend in both the intervention groups. In the study by Li X et al., the pre-operative value of Bohler's angle was a mean of 7.8 degrees, which increased to an average of 33.2 degrees [5]. The Gissane's angle was 84 degrees on average, pre-operatively. The post-operative Gissane's angle value was 125 degrees. In the study by Kulkarni et al., the pre-operative mean value of Bohler's angle was 11 degrees in the operative group, which increased to an average of 23.66 degrees [6]. The Gissane's angle was 158.2 degrees on average, pre-operatively. The post-operative Gissane's angle value was 137.6 degrees, a decrease which is seen in our study as well. In a study by Takasaka et al. which compared the various surgical procedures for intra-articular calcaneum fractures, no difference was found in the change of the Bohler's and the Gissane's angle for all these surgical procedures [7].

According to AOFAS (American Orthopaedic Foot and Ankle Society) scoring system, in our series of total 30 patients, the K-wire surgery group, the excellent to good outcome was seen in 87% patients while in the plating group, the number is 73%. In the study by Li X et al., the functional outcome was mentioned as combined excellent plus good in

81.6% of patients, as compared to the 80% in our study. There was no difference in the functional outcome between the two surgical intervention groups, just like in our study. In the study by Kulkarni et al., 73% of the patients had excellent to good functional outcome in the surgical group. In a study by Tariq et al., the results were excellent to good in 79% of cases [8]. The study by Sidney Silva De Paula et al. revealed that the results were excellent in 18.32% cases while good in 40% surgical cases, similar to our study [9].

In our study, a total of 11 patients showed complications, 8 in K-wire operated group and 3 in plating group. Two cases of wound infection were seen in plating group, while none of the K-wire group had wound infection. Heel pain (5 cases) was seen in only the wiring group. In the study by Li X et al., the K-wire group had better wound healing, contrary to our study. Also, in the meta-analysis by Wu et al., it was found that K-wire group was associated with wound infection, again in contrary with our group [10].

## Conclusion

In our study both the operative groups showed a significant increase in the

Bohler's angle and a significant decrease in the Gissane's angle postoperatively. In majority of the patients the functional outcome ranged from excellent to good type. Future studies enrolling large samples of patients are required to support the results of this study.

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