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Original Research Article

COMPARATIVE OUTCOMES OF OPERATIVE VERSUS NON-OPERATIVE TREATMENT FOR DISPLACED INTRA-ARTICULAR FRACTURES OF THE CALCANEUM

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ABSTRACT

Background: Heel bone fractures make up around 2% of all fractures seen in orthopaedic practice. Among these, the displaced intra-articular type is the most serious. It damages the joint surface inside the calcaneum. This can lead to lasting pain, difficulty walking, and problems with footwear. Whether surgery gives better results than non-operative care is still a debated topic. Most published data come from high-income countries, and local evidence from Pakistan is limited. The objective is to compare radiological and functional outcomes in patients treated operatively versus non-operatively for displaced intra-articular calcaneal fractures. Study Design Prospective comparative study. Duration and Place of Study This study was conducted at Ghulam Muhammad Mahar Medical College Hospital Sukkur from August 2025 to August 2026

Materials and Methods: We enrolled 78 patients who had a total of 80 displaced intra-articular calcaneal fractures. Two patients had bilateral fractures. Patients were divided into an operative group (Group A, 40 fractures) and a non-operative group (Group B, 40 fractures). We obtained ethical approval before starting the study. Fractures were graded using the Sanders classification system, which is based on CT scan findings. We used four main outcome measures. These were the AOFAS ankle-hindfoot score, Böhler's angle, Gissane angle, and time to radiographic union. For comparing groups, we used independent samples t-tests and chi-square tests. A p-value below 0.05 was taken as significant.

Results: In Group A, Böhler's angle was better restored after surgery (mean 21.06° versus 17.5°; p=0.0012). The mean AOFAS score was also higher in Group A (84.2 versus 79.4; p=0.016). Time to bone union was similar in both groups (10.1 versus 10.6 weeks; p=0.33). Excellent or good AOFAS outcomes were seen in 77.5% of operated patients compared with 42.5% in the conservative group.

Conclusion: Surgery gave better radiological and functional outcomes in this study. However, the results must be read carefully. There was an imbalance in fracture severity between the two groups. Follow-up was also relatively short. The choice to operate should be made on a case-by-case basis.

Keywords: Calcaneus fractures; intra-articular fracture; open reduction and internal fixation; non-operative treatment; AOFAS score; functional outcome; Sanders classification.

INTRODUCTION

Calcaneus fractures are the most common tarsal bone injury in clinical practice. They account for roughly 2% of all fractures and up to 60% of all tarsal injuries.[1] Most of these fractures happen in working-age men. The usual cause is a fall from a height or a road traffic accident, where the heel takes a direct axial load.[2]

Displaced intra-articular fractures are the most difficult type to treat. The calcaneum has a complex shape and forms the main part of the subtalar joint. When the joint surface is broken, problems like post-traumatic arthritis, malunion, and wound breakdown can follow.[3,4] Patients may end up with long-term pain, stiffness in the hindfoot, and trouble fitting into normal shoes. These problems can limit daily activities for years after the injury.[5]

In earlier decades, surgeons avoided operating on these fractures. The anatomy was poorly understood. Complication rates from surgery were also high. Over time, CT scanning improved our understanding of fracture patterns. Better plates and screws became available. Because of this, open reduction and internal fixation (ORIF) is now used much more widely.[6] Even so, the debate has not been settled. Some randomised trials and meta-analyses found no clear advantage for surgery.[7,8] Others did find better X-ray and functional results with operative management.[9,10]

Several factors make it hard to compare studies. Fracture severity varies. Patient factors like smoking and diabetes affect healing. Surgeon experience and the exact technique used also differ between centres.[11,12] On top of this, most available data come from Western countries. Very few studies have been done in South Asian populations.[13]

We carried out this study at a tertiary orthopaedic unit in Pakistan. Our aim was to compare the radiological and functional results of operative and non-operative treatment in our local patient population. We hoped to add to the small but growing evidence base from this region.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective comparative study. It was carried out at XXXXX during the period XXXXX. We obtained ethical clearance from the Institutional Review Committee (Reference No: XXXXX) before any patients were recruited. All participants gave written informed consent.

Sample Size: We recruited 78 patients. These patients had a total of 80 displaced intra-articular calcaneal fractures. Two patients had injuries on both sides.

Eligibility Criteria: We included adults aged 18 years or above. All had a displaced intra-articular calcaneal fracture confirmed on plain X-ray and CT scan. All provided written informed consent before joining the study.

We excluded patients who had open fractures or fractures through bone tumours. We also excluded those with severe soft tissue damage that would make surgery unsafe. Patients with a pre-existing deformity of the foot or ankle were not included. Anyone who was unable or unwilling to give consent was also excluded.

Allocation to Treatment Groups: Patients were placed into one of two groups. Group A received operative treatment and had 40 fractures. Group B received non-operative treatment and also had 40 fractures.

Interventions: Operative group (Group A): We waited for the swelling to settle before performing surgery. The standard approach used was the lateral extensile incision. Fracture reduction was checked under fluoroscopy during the procedure. An example of the intraoperative check was confirming that Böhler's angle was restored to within the normal range on the fluoroscopy image.

Non-operative group (Group B): We allowed the initial swelling to settle first. We then applied a below-knee calcaneal cast. Patients were kept non-weight-bearing during this period. They were mobilised gradually with the help of physiotherapy once healing allowed.

Fracture Classification: We graded all fractures using the Sanders CT-based classification. This system divides displaced intra-articular calcaneal fractures into Types II, III, and IV. The grading is based on how many articular fragments are present in the posterior facet.[14] As an example, a Type II fracture has two fragments, while Type IV has four or more and is the most complex.

Outcome Measures: The main outcome we used was the AOFAS ankle-hindfoot score at the final follow-up visit.[15] This score runs from 0 to 100. Higher scores mean better function. We should note that the AOFAS tool includes both clinician-scored and patient-reported items. It has not been fully validated as a pure patient-reported outcome measure. Results should therefore be interpreted with this limitation in mind.

We also measured three secondary outcomes. These were Böhler's angle, Gissane angle, and time to radiographic union.

Böhler's angle is measured on a lateral X-ray. We draw two lines on the image. One runs from the tip of the anterior process to the top of the posterior facet. The other runs from that same point down to the tuberosity tip. The angle between them is Böhler's angle. A normal value falls between 20 and 40 degrees.[16] The Gissane angle, also known as the crucial angle, is similarly measured on the lateral view. Normal values are roughly 95 to 105 degrees.[16]

Assessment Schedule and Blinding

Statistical Analysis: We reported continuous data as mean plus or minus standard deviation. We reported categorical data as counts and percentages. To compare means between the two groups, we used the independent samples t-test. For categorical

comparisons, we used the chi-square test or Fisher's exact test where appropriate. We set the significance threshold at $p<0.05$. We used SPSS version XXXXX for all analyses.

RESULTS

We enrolled a total of 78 patients. They had 80 calcaneal fractures in all, as two patients had bilateral injuries. Of the 78 patients, 67 were male (85.8%) and 11 were female (14.2%). The mean age was 34.7 years in Group A and 35.1 years in Group B.

[Table 1] shows the sex distribution across the full study group.

[Table 2] shows how fractures were classified by Sanders type in each group. There was a clear difference in fracture severity between the groups. Type III fractures were more common in Group A, making up 50.0% versus only 17.5% in Group B. In contrast, Type IV fractures were found in 50.0% of Group B patients but only 17.5% in Group A. Type IV is the most severe category. This imbalance must be kept in mind when comparing outcomes.

Table 1: Gender Distribution

Gender	N	%
Male	67	85.8
Female	11	14.2
Total	78	100.0

Table 2: Sanders Classification by Treatment Group

Sanders Type	Group A — Operative (n=40) n (%)	Group B — Non-operative (n=40) n (%)
Type II	13 (32.5)	13 (32.5)
Type III	20 (50.0)	7 (17.5)
Type IV	7 (17.5)	20 (50.0)

[Table 3] gives the radiological and clinical outcome results for both groups.

Table 3: Radiological and Clinical Outcome Parameters

Parameter	Group A — Operative Mean ± SD	Group B — Non-operative Mean ± SD	p-value
Radiological parameters			
Böhler's angle (°)	21.06 ± 3.10	17.50 ± 3.00	0.0012
Gissane angle (°)	134.9 ± 7.08	140.2 ± 6.64	0.0015
Radiographic union (weeks)	10.1 ± 2.13	10.6 ± 2.38	0.33†
Clinical parameters			
AOFAS score (0–100)	84.2 ± 7.75	79.4 ± 9.04	0.016

† The difference in union time was not statistically significant (p=0.33).

Böhler's angle was better in the operative group after treatment (21.06° versus 17.5°; p=0.0012). The Group A mean fell within the lower end of the normal range of 20 to 40 degrees. Group B did not reach this range. Gissane angle was 134.9° in Group A and 140.2° in Group B after treatment (p=0.0015). Both values were above the normal range of 95 to 105 degrees. This may point to remaining joint surface irregularity in both groups.

The time to bone union was similar in both groups. Group A healed at a mean of 10.1 weeks and Group B at 10.6 weeks. The p-value was 0.33, which means the difference was not significant. This tells us that surgery did not speed up or slow down bone healing compared to conservative care.

The mean AOFAS score was higher in Group A (84.2 versus 79.4; p=0.016). The difference was 4.8 points. Whether this gap is large enough to matter to patients in daily life is not clear. No agreed minimum clinically important difference has been set for the AOFAS score. The result should therefore be read with some caution.

Table 4 shows AOFAS grading in both groups. We graded results as Excellent (90 or above), Good (75 to 89), Fair (50 to 74), and Poor (below 50), following the published cut-offs.[15] When we combine Excellent and Good grades, 77.5% of Group A patients reached these levels. In Group B, only 42.5% did.

Table 4: AOFAS Functional Outcome Grading

AOFAS Grade	Group A — Operative (n=40) n (%)	Group B — Non-operative (n=40) n (%)
Excellent (≥90)	11 (27.5)	5 (12.5)
Good (75–89)	20 (50.0)	12 (30.0)
Fair (50–74)	4 (10.0)	11 (27.5)
Poor (<50)	5 (12.5)	12 (30.0)
Total	40 (100)	40 (100)

[Table 5] shows the average follow-up period in each group.

Table 5: Mean Follow-up Duration

Parameter	Group A — Operative	Group B — Non-operative
Follow-up period	12.4 months	11.03 months

DISCUSSION

We studied 78 patients with 80 displaced intra-articular calcaneal fractures. The operative group did better on two key measures. Böhler's angle restoration was significantly better after surgery. The mean AOFAS functional score was also higher in operated patients at around 12 months. These findings are broadly in line with those from several earlier studies, though they need to be understood in the context of some important study limitations.

Better radiological restoration in Group A matches what others have reported after ORIF.[9,10] A good Böhler's angle on the post-treatment X-ray does suggest that the joint surface was reconstructed. However, we must be careful about reading too much into this. A better angle on X-ray does not always mean a better experience for the patient. Pain, function, and return to work are what matter most. The link between radiology and clinical outcome is not simple.[17]

The AOFAS score difference of 4.8 points was statistically significant. But statistical significance does not always equal clinical importance. We do not have a well-established threshold for what difference patients would actually notice in daily life. For example, one patient with an AOFAS score of 84 may walk almost as well as one with 79, while another might feel a clear difference. We should also note that the AOFAS tool combines scores given by the doctor with scores given by the patient. This mix makes it harder to interpret.[15]

Our results differ from some of the largest randomised trials in this field. The UK Heel Fracture Trial by Dickenson et al,.[5] found no significant difference in AOFAS scores at two years. Our follow-up was shorter, around 12 months. Our case mix was also different. These factors could explain why we found a significant difference where they did not. Comparing studies is always difficult because fracture severity, surgical technique, and outcome timing all vary.

Ågren et al,.[18] ran a multicentre randomised study in 82 patients. They too found no significant functional advantage for surgery at longer follow-up. A follow-up of only 12 months may be too short to see the full picture. Post-traumatic subtalar arthritis, for example, often develops over two to three years after injury. We cannot draw conclusions about this complication from our current data.

One issue that deserves special attention is the Sanders type imbalance. Group A had more Type III fractures (50.0% versus 17.5%). Group B had more Type IV fractures (50.0% versus 17.5%). Type IV is the most severe category. Having more Type IV cases in the non-operative group would naturally tend to give worse outcomes in that group. This alone could explain some or all of the functional score difference we found. The imbalance is a serious limitation and must be highlighted clearly.

The decision to operate on a calcaneal fracture should not be made on a blanket basis. Each case needs individual assessment. The surgeon should consider the fracture type and severity. Soft tissue condition at the time of surgery matters a great deal, for instance, skin blistering is a well-known reason to delay or avoid surgery. Patient factors like diabetes and smoking affect wound healing. What the patient wants and can tolerate also plays a role.

Limitations: Our study has seven main limitations. First, it was done at a single centre, so the findings may not apply to other settings. Second, the way patients were allocated to groups has not been fully described. If allocation was not truly random, hidden differences between the groups may have affected the results. Third, there was a clear imbalance in fracture severity. More complex Type IV fractures ended up in the non-operative group. This likely made outcomes look worse in that group. Fourth, we only followed patients for about 12 months. This is not long enough to capture late problems like joint arthritis. Fifth, we did not record complications in a systematic way. Wound infections, hardware failure, and nerve damage were not reported. Sixth, we relied only on the AOFAS score as our functional tool. This score has known limitations as a patient-reported measure. Seventh, we did not record or report pre-treatment radiological values or baseline characteristics separately for each group.

CONCLUSION

In this prospective comparative study, surgery gave significantly better Böhler's angle restoration and higher AOFAS scores at around 12 months compared with non-operative care. However, we found a marked imbalance in fracture severity between groups. Follow-up was relatively short. Complications were not recorded. Because of these limitations, the results should not be used to support a blanket recommendation for surgery. Instead, the decision to operate should be made individually, taking fracture type, soft tissue condition, and patient factors into account.

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