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Outcome assessment of calcaneal fracture fixation via extended lateral approach and plating: Experience from a tertiary care centre in India

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Abstract
Background and Aims: Displaced intra-articular calcaneal fractures represent some of the most demanding injuries to manage in the hindfoot, often causing marked alteration of heel anatomy and disruption of subtalar joint congruity. Non-operative treatment in such cases frequently results in residual deformity, malunion, loss of heel height, and persistent joint incongruence, which may lead to chronic pain, functional limitations, and post-traumatic subtalar arthritis. Surgical fixation has become the preferred strategy to restore anatomy, optimize joint alignment, and reduce long-term disability. This study explores our experience and outcomes of managing these fractures with open reduction and calcaneal plating via the extended lateral approach.
Material and Methods: Total of 20 patients were studied having calcaneum fractures classified by Sanders classification treated surgically with lateral approach and calcaneum plating . Monthly follow up was taken and evaluation maintaining upright posture and facilitating human gait. It transmits the done by Modified Maryland foot score. Follow up was taken upto 8 months

Keywords: Calcaneal fracture, extended lateral approach, calcaneal plating, intra-articular fractures, Sanders classification, Modified Maryland Foot Score, open reduction internal fixation (ORIF), hindfoot

Introduction
The calcaneus is the foundation of the hindfoot, plays an essential biomechanical role in body's weight to the ground, forms a critical part of the longitudinal arch, and serves as a lever arm for the triceps surae complex, enabling efficient push-off during walking. Due to this central role, fractures of the calcaneus are functionally disabling and pose a significant challenge to orthopaedic management. [1]
Among all tarsal injuries, calcaneal fractures account for nearly 2% of all skeletal injuries [2], with intra-articular fractures comprising around 70% of cases. These are predominantly caused by high-energy axial loading mechanisms, such as falls from height or road traffic accidents. The remaining 30% are extra-articular fractures, frequently involving the calcaneal tuberosity or anterior process. [3] Given the anatomical complexity and limited soft tissue envelope surrounding the bone, achieving favorable outcomes remains difficult, especially when articular congruity is compromised.
The alignment and morphology of calcaneum influence hindfoot motion, subtalar joint mechanics, and lateral column stability. Disruption to its structure can lead to:

- Collapse of Böhler's and Gissane's angles
- Loss of calcaneal height and heel widths
- Subtalar joint incongruity and arthritis
- Impingement of the peroneal tendons
- Dorsiflexion tilt of the talus, affecting ankle biomechanics

If not addressed adequately, these changes contribute to chronic pain, loss of mobility, and poor quality of life. Conservative management of displaced intra-articular fractures, though historically prevalent, has shown high rates of malunion, non-union, and post-traumatic arthritis in long-term studies. [4]

Over the past decades, there has been a marked shift toward surgical intervention, with the goal of restoring normal anatomy and joint congruity. The extended lateral approach has become the preferred route for achieving accurate visualization and reduction, especially for complex intra-articular patterns. [5] The development of low-profile, anatomically contoured locking plates has further improved fixation stability and minimized implant-related complications.

Early surgical techniques, including Essex-Lopresti's percutaneous pinning, offered limited access and often resulted in secondary collapse or pin-tract infection. These shortcomings have since been addressed with open reduction and internal fixation (ORIF) using plating systems, which allow correction in multiple planes and better load distribution across the subtalar joint. [6]

Management of calcaneal fractures in the Indian population presents unique clinical challenges. Factors such as:

- Barefoot ambulation, particularly in rural communities, result in compromised plantar skin integrity and reduced soft tissue vascularity, elevating the risk of wound complications post-surgery.
- Cultural practices involving cross-legged sitting, kneeling, and squatting place functional demands on the foot that are not considered in conventional outcome scores.
- Additionally, patients often present late, sometimes with compounded soft tissue injuries, further complicating surgical planning.

Recognizing these limitations, A Modified Maryland foot score assessment system tailored to Indian functional expectations—addressing tasks such as floor sitting and squatting, which are crucial for occupational and daily life in this setting.

Given the need to balance radiological correction, joint restoration, and functional recovery in a socio-culturally specific population, this study was undertaken to evaluate the outcomes of calcaneal fracture fixation using ORIF via the extended lateral approach with plating.

Material and Methods

- **Sample Design:** Prospective cohort study
- **Sample Size:** 20

Treatment Protocol

1. Assessment involved anteroposterior, lateral, and axial (calcaneal) radiographs to define fracture morphology and plan intervention.
2. Open injuries underwent prompt surgical debridement to reduce infection risk and maintain tissue viability.
3. Pre-surgical measures included tetanus immunisation, intramuscular diclofenac for pain relief, and intravenous Ringer's lactate for fluid support.
4. In cases of multiple trauma, fixation proceeded once the patient was fit for anaesthesia.
5. Below-knee slab immobilisation was applied when required for protection.
6. Early postoperative ankle mobilisation was introduced according to the achieved fixation stability.
7. Weight-bearing commenced after confirmed union.
8. Follow-up involved clinical review with repeat radiographs.

Inclusion Criteria

- Patients willing and able to provide informed consent
- Adults aged >18 years, of either sex.
- Acute calcaneal fractures diagnosed.
- Closed fracture cases.
- Open fractures classified as Gustilo–Anderson grade I or II.

Exclusion Criteria

- Patients aged <18 years.
- Presence of active infection at or near the fracture site.
- Open fractures of Gustilo–Anderson grade III.
- Patients unwilling or unable to provide informed consent.
- Patients unfit for surgery.

Time for the surgery

The surgery will be performed within 12-24 hrs of trauma when there is minimal soft tissue edema.

Fig 1: Surgical incision marking

Surgical Technique – Lateral Approach

Patients were positioned laterally with the injured side up. A pneumatic tourniquet ensured a bloodless field. Anaesthesia (spinal, general, or epidural) was chosen based on patient condition and surgical needs.

Fig 2: Calcaneum Plate fixation done by lateral approach

Exposure of Skin and Soft Tissue

A lateral extensile incision was made, starting with a horizontal cut along the junction between the dorsal foot skin and the thicker plantar skin. The vertical limb was directed upward, positioned midway between the posterior fibular border and the Achilles tendon. The corner where both limbs met was gently curved to avoid creating sharp-angled flaps. This lateral flap, supplied by the lateral calcaneal branch of the peroneal artery, was handled with utmost care, and undermining was strictly avoided to prevent vascular compromise and necrosis. Dissection continued through the deep fascia and inferior peroneal retinaculum to reach the periosteum of the lateral calcaneal wall, ensuring the peroneal tendon sheath remained intact before mobilising the tendons

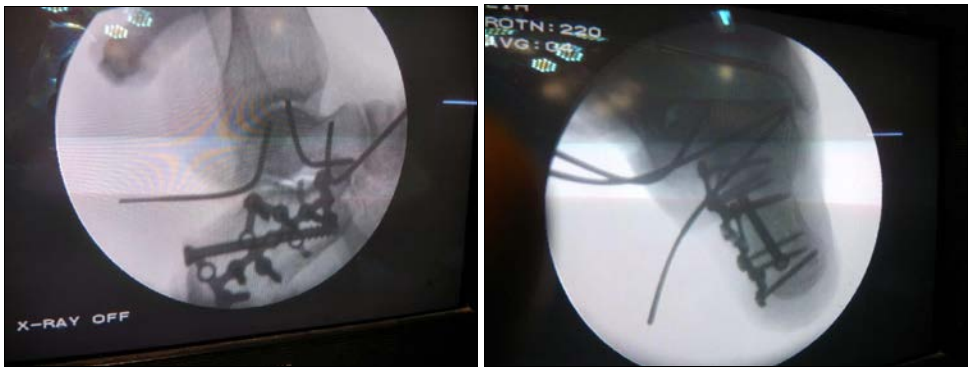

Fig 3: Intraoperative c- Arm images of plate fixation

Fig 4: Post operative x ray images of clacneum plate fixation.

Post-operative management

- Below-knee slab
- Limb elevation
- Regular sterile dressings
- Monitor wound and blood counts
- Early physiotherapy for mobility

Results

Table 1: Post-operative range of movement

Range of motion	No. of patients	Percentage
<15 degree	1	5%
16-30 degree	3	15%
>30 degree	16	80%
Total	20	100

The above table states that majority of patients(80%) had post-operative range of movement more than 30 degree with 15% patients between 16-30 degree and 5% of patient with less than 15 degree

Table 2: Immediate post-operative complications

Complications	No. of Patients	Percentage
Post op Infection	0	0
Skin Necrosis	1	5%
None	19	95%
Total	20	100

The above table narrates that there was no post-operative Infection noted. Only 1 patient had skin necrosis. Out of all the participants 19 patients did not have any post operative complications

Table 3: Age vs result

Age				
Result	21-30	31-40	41-50	>51
Excellent	6	4	3	2
Good	1	1	2	0
Fair	0	0	1	0
Poor	0	0	0	0
Total -20	7	5	6	2

This table concludes that patients with better outcomes belong to the age 21 to 40 years, fair outcomes were noted in age group of 41-50 years.

Table 4: Occupation vs result

Result Occupation			
	Job	Labourer	Housewife
Excellent	6	0	4
Good	3	3	3
Fair	0	0	1
Poor	0	0	0
Total	0	0	0

This table depicts that patients who were on job which demand minimal mobility had best outcomes . significant amount of housewives also showed excellent outcomes whereas labourers had fair outcomes.

Table 5: Pre- Operative Bohler's angle in all fractures

Bohler's angle	No. of fractures	Percentage
<10°	4	20%
10–14°	14	70%
>15°	2	10%

The above table depicts the Pre- Operative Bohler's angle in which 4 patients had <10°, 14 patient had angle ranging between 10–14°and 2 patients had >15°.

Table 6: Pre-Operative Gissane's Angle in all fractures

Gissane's Angle	No. of fractures	Percentage
110-119 °	7	35%
120-129 °	13	65%

The above table states that Pre-Operative Gissane's Angle measured in the patients showed 7 patients with 110-119° and 13 patients with 120-129 °.

Table 7: Gissane's Angle at the Final Follow Up in all Fractures

Range	No of fractures	Percentage
90-99 °	5	25%
>100 °	15	75%

This table shows the Gissane's Angle when measured at the Final Follow Up, 5 patients had angle ranging between 90-99 ° and 15 patients had angle>100 °.

Table 8: Ability to go back to work

Occupation status	No. of patients	Percentage
Went back to same work	20	100%
Had to change profession	0	0
Unable to go back to work	0	0

The above table depicts that all the participants were able to go back to their previous work without any change in the profession.

Table 9: Ability to Squat

Ability to Squat	No. of patients	Percentage
Able	18	90%
Unable	2	10%

The above table states that 18 patients were able to squat after the operative procedure whereas 2 patients were unable to squat.

Table 10: Ability to sit Crossed legged

Cross leg sitting	No. of patients	Percentage
Can sit	15	75%
Cannot sit	5	25%

The above table depicts that only 5 patients were not able to sit crossed leg after the surgery whereas 15 patients were comfortable with sitting crossed legged.

Table 11: Assessment of Heel Widening

Heel Widening	No. of patients	Percentage
Absent	15	75%
Present	5	25%

The above table states that heel widening was noted absent in 15 patients and was noted present in 5 patients.

Table 11: Results based on Modified Maryland foot score

Results	No. of patients	Percentage
Excellent	17	85%
Good	2	10%
Fair	1	5%
Poor	0	0

According to the Modified Maryland foot score , 17 patients had excellent results , 2 with good results and 1 with fair results.

Discussion

The calcaneum is a crucial bone in the body that aids in the proper distribution of body weight and efficient locomotion. Historically, calcaneal fractures were associated with a high risk of morbidity and deformity post operatively; therefore, they were managed conservatively. [7] However, in recent times, surgical management has been increasingly employed for intra-articular calcaneal fractures. [8]

The mechanism of injury in calcaneal fractures commonly includes falls from height, high-velocity trauma, twisting forces, and axial loading injuries.

Since the subtalar joint has a complex anatomy, it cannot be adequately visualized on standard anteroposterior and lateral views of the foot. Hence, special radiographic views such as Borden's view and the axial (Harris) view of the calcaneum are required. Computed tomography (CT) provides superior visualization of fracture patterns, facilitating accurate classification and guiding management. [9]

Intra-articular calcaneal fractures often involve extensive damage to the posterior facet. The lateral approach provides optimal exposure of the subtalar joint, allowing for precise reduction and fixation while minimizing the risk of neurovascular injury. [10]

Conclusion

Calcaneal plating techniques offer better anatomical reduction and improved clinical outcomes in patients with calcaneal fractures.

Early surgical intervention is recommended for optimal results. To prevent postoperative infection, appropriate surgical techniques respecting the soft tissues, strict aseptic precautions in the operative and postoperative settings, and proper antibiotic care should be ensured.

Patients should remain non–weight bearing until radiological and clinical evidence of union is achieved, to promote better mobility outcomes and maintain joint stability.

In our study, we used calcaneal plates in the majority of patients, and almost all of them were able to return to their previous occupations and resume daily activities after surgery. Postoperative evaluation using the Modified Maryland Foot Score demonstrated excellent results in most patients. Early mobilization in the postoperative period is essential to prevent joint stiffness; hence, patients were mobilized with the support of a below-knee splint.

Conflict of Interest

Not available

Financial Support

Not available

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