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ORIGINAL RESEARCH

A retrospective study of open reduction internal fixation with platting in calcaneal intraarticular fractures with 1 year follow up

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ABSTRACT

Introduction: This study evaluates the feasibility, effectiveness, and challenges of open reduction and internal fixation (ORIF) with plating for calcaneal fractures in resource-limited settings. It assesses functional and radiological outcomes, identifies challenges like limited resources. **Material and Methods:** This study evaluates patients with displaced calcaneal fractures who underwent open reduction and internal fixation (ORIF) with plating at a tertiary care center. Using Sanders classification, fractures were categorized based on preoperative clinical and radiological assessment (X-rays and CT scans). Inclusion criteria included adults aged 18-60 years with displaced fractures.**Results:** Between June 2022 and December 2023, 19 patients with 31 calcaneal fractures were treated. The majority were male (87.5%) with a mean age of 32.6 years. Clinical outcomes showed 90% had mild to no pain, 95% had no gait abnormalities, and 86% achieved good to excellent functional results with significant radiological improvements.**Conclusion:** Open reduction and internal fixation (ORIF) for intra-articular calcaneal fractures effectively improves clinical and radiological outcomes, restores joint alignment, reduces pain, and preserves mobility. Despite complications in comminuted fractures, ORIF remains reliable, with early intervention and rehabilitation essential for optimal recovery.

Key words: Calcaneal fractures, Open reduction internal fixation (ORIF), Functional outcomes, radiological outcomes, resource-limited settings

INTRODUCTION

Calcaneal fractures, commonly referred to as "heel bone" fractures, are among the most challenging injuries in orthopaedic trauma due to the complex anatomy of the calcaneus and its critical role in weight-bearing and mobility[1]. These fractures often result from high-energy trauma, such as motor vehicle accidents or falls from height, and can lead to significant morbidity if not managed appropriately.

A calcaneal fracture, also known as a heel bone fracture, typically occurs due to high energy trauma or direct impact. The mechanism of injury can be divided into the following main categories: Axial Loading This is the most common mechanism[2]. Results from a fall from a significant height (e.g., from a ladder or building) where the person lands on their feet. The talus bone is driven downward into the calcaneus, causing a comminuted or intra-articular fracture. Direct Trauma Occurs when there is a direct blow to the heel, such as in a motor vehicle collision (MVC), where the heel is crushed against the floorboar Torsional or Rotational Forces Less common and occurs due to twisting or shearing forces applied to the foot, leading to stress fractures or less severe types of calcaneal injuries[3].Repetitive Stress (Stress Fractures) Caused by repetitive loading of the heel, common in runners, soldiers, or athletes. Results in microfractures in the calcaneus that can develop into full fractures if untreated. Additional Risk Factors: Falls from heights and car accidents are the

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primary causes Osteoporosis or weakened bone conditions may predispose individuals to calcanealfractures even with low-energy trauma[4]. The severity of the injury often correlates with the energy of the trauma, and calcaneal fractures are frequently associated with other injuries, such as spinal compression fractures, due to the nature of axial loading[5].

The calcaneus has a complex structure with several important parts.Body,the largest portion of the calcaneus which bears weight and articulates with the talus superiorly and the cuboid anteriorly. Calcaneal tuberosity located posterior and divided into Medial process larger and weight-bearing and Lateral process: Smaller and assists in stability.Sustentaculum Tali a bony shelf on the medial side of the calcaneus.Supports the talus and serves as an attachment point for ligaments[6]. (e.g., the spring ligament),Grooves beneath it for the flexor hallucis longus tendon. The Böhler angle and Gissane angle are critical radiographic measurements used in the evaluation of calcaneal fractures. These angles provide important information about the integrity of the calcaneus and help assess fracture severity, displacement, and alignment[7]. Normal bohler angle ranges from 20 to 40 degree collapse in fractures if <20 degree and normal range of gissane angle is 120 to 145 degree which increased in intraarticular or comminuted fractures.

The treatment of calcaneal fractures depends on the type, severity, and displacement of the fracture as well as the patient's overall health and activity level. Non-operative treatment is typically reserved for undisplaced or minimally displaced fractures, extra-articular fractures, and patients who are poor surgical candidates[8]. This approach involves immobilization with a cast or splint, non-weight-bearing for 6-8 weeks, pain management, and gradual physical therapy to restore range of motion and strength. Operative treatment is indicated for displaced intra-articular fractures, comminuted fractures, or fractures involving the subtalar joint that disrupt foot mechanics. Surgical options include open reduction and internal fixation (ORIF) to restore anatomic alignment, percutaneous fixation for minimally invasive stabilization, and external fixation for fractures with severe soft-tissue injuries. In cases of chronic pain or severe joint damage, primary subtalar arthrodesis may be performed[9].

The main aim of studying calcaneal fracture fixation with plating in developing countries is to evaluate the feasibility, effectiveness, and challenges of this surgical technique in resource- limited settings. Specifically, the study seeks to Assess Surgical Outcomes in which analyze functional and radiological outcomes following open reduction and internal fixation (ORIF) with plating for calcaneal fractures, focusing on the restoration of anatomy, mobility, and pain relief, and to Understand Challenges in which Identify the unique obstacles faced in developing countries, such as limited access to advanced surgical equipment, trained personnel, and postoperative rehabilitation services, and to Evaluate Cost-Effectiveness in which examine the affordability and sustainability of plating techniques in comparison to alternative treatment options, considering the economic constraints of patients and healthcare systems[10].

MATERIALS AND METHODS

Total number of 19 patients taken for the study in which 7 unilateral cases and 12 bilateral cases, therefore 31 calcaneum fractures were evaluated. The study was conducted on patients with displaced calcaneal fractures who underwent open reduction and internal fixation (ORIF) with plating at a tertiary care center. Inclusion criteria included adults aged 18-60 years with intra-articular calcaneal fractures. Patients with extra-articular fracture, severe comorbidities, open fractures, or contraindications to surgery were excluded. Preoperative evaluation included detailed clinical and radiological assessment using X-rays lateral and axial views and CT scans to classify fractures based on the Sanders classification, The Sanders classification is a widely used system for categorizing intra-articular calcaneal fractures based on computed tomography (CT) imaging, specifically coronal CT cuts through the posterior facet of the subtalar joint. It evaluates the number and location of fracture lines within the posterior facet, dividing it into three regions: medial, central, and lateral. According to this classification, Type I fractures are non-displaced, with less than 2 mm of displacement. Type II fractures involve a single fracture line and two fracture fragments, classified as IIA (lateral), IIB (central), or IIC (medial). Type III fractures have two fracture lines, resulting in three fragments, labelled IIIAB (lateral and central), IIIAC (lateral and medial), or IIIBC (central and medial). Type IV fractures are comminuted, with more than three fracture fragments and severe joint disruption. The Sanders classification is crucial for guiding treatment decisions, as less severe fractures (Types I and some Type II) may be managed conservatively, while displaced or comminuted fractures (Types II to IV) typically require surgical intervention to restore joint congruity and alignment. Patient came at the time of evaluation we took radiographs of calcaneum axial and lateral views. Followed by AOFAS score was measured.

SURGICAL TECHNIQUE

OPERATIVE NOTE: The procedure of open reduction and internal fixation of a calcaneal fracture using the extended lateral (Seattle) approach begins with positioning the patient in the lateral decubitus position on the non-injured side on a radiolucent operating table to allow for proper imaging during the procedure. The affected limb is prepped and draped in the standard sterile fashion, ensuring coverage of the hip and foot for potential manipulations. An L-shaped

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curved incision is made over the lateral aspect of the heel, extending from the lateral malleolus along the posterior and inferior border of the heel toward the sole and along the border of the Achilles tendon. This incision provides optimal exposure of the calcaneus while protecting critical neurovascular structures. During dissection, care is taken not to expose the peroneal tendons except at the peroneal tubercle, where the medial sheath is absent. Distally, the peroneal tendons are gently mobilized within their sheath to expose the calcaneocuboidal joint. The skin and subcutaneous tissue are carefully incised, and a flap is created to expose the calcaneus, with dissection extended to visualize the subtalar joint. Progressive exposure of the calcaneus allows for adequate visualization for reduction and fixation. Once the subtalar joint is visualized, three 2.0 mm K-wires are inserted into the talar body and neck near the joint, with an additional K-wire placed into the cuboid if necessary. Two 2.0 mm K-wires are also placed through the posterior aspect of the calcaneus for additional support. Fracture reduction is performed to restore calcaneal height and proper alignment, followed by the application of a calcaneal plate for internal fixation, secured with screws to stabilize the fracture and maintain correct positioning.The wound is thoroughly irrigated to minimize infection risk, and closure is performed using the Allgöwer-Donati suture technique, which involves interrupted sutures combining horizontal and vertical mattress sutures to ensure strong, reliable wound closure and minimize wound dehiscence.

POSTOPERATIVE CARE

Postoperative care following calcaneal fracture fixation with plating is critical to ensure optimal healing, prevent complications, and restore function. Initially, the affected limb is immobilized in a splint or cast, with strict elevation to reduce swelling and promote venous return. Weight-bearing is strictly avoided for the first 6-8 weeks to allow proper fracture healing and prevent hardware failure. Early range-of-motion exercises are encouraged to maintain ankle and subtalar joint mobility and prevent stiffness. Sutures are typically removed after 2 weeks, and wound care is closely monitored to detect any early signs of infection or dehiscence. At around 8-12 weeks, gradual weight-bearing is introduced under the guidance of a physiotherapist, with progression depending on radiographic evidence of healing. Physical therapy focuses on strengthening, balance training, and gait correction. Long-term follow-up is necessary to assess the maintenance of anatomical alignment, joint stability, and functional recovery. Adherence to postoperative protocols significantly enhances outcomes and minimizes complications.

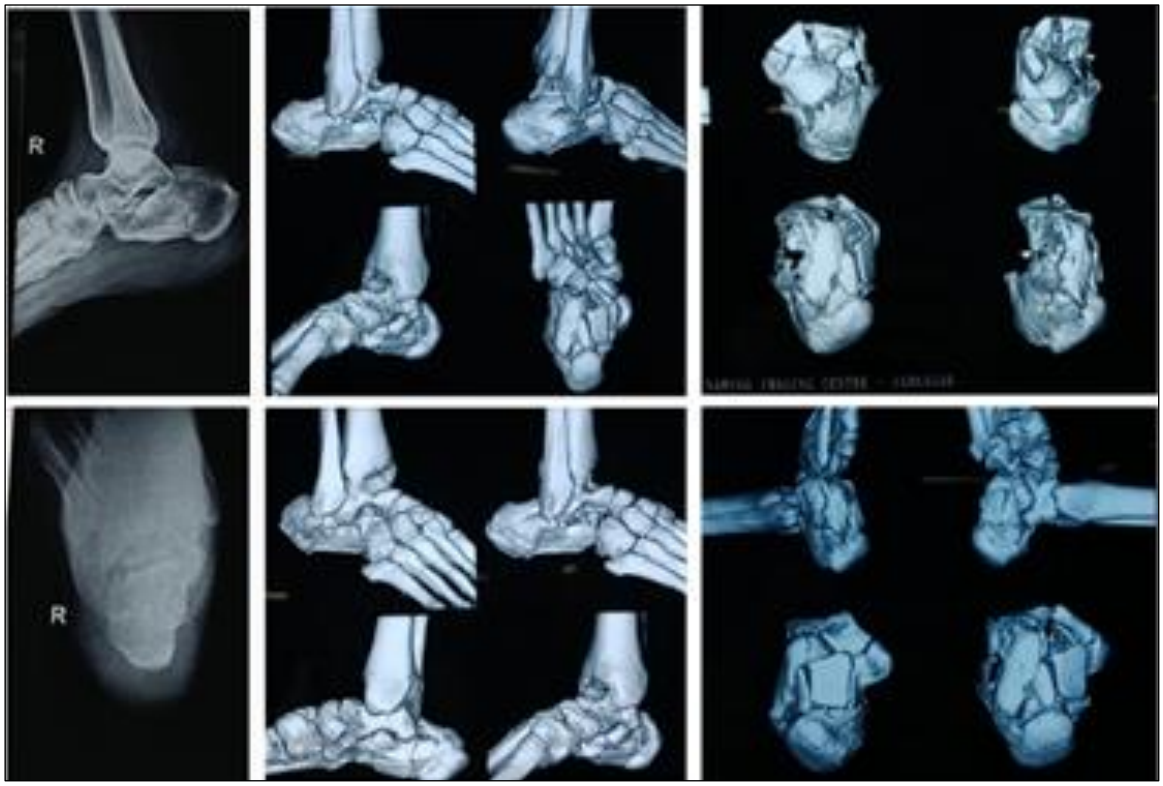

Fig 1:Pre Operative X-Rays and CTscan of Calcaneum

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Fig 2: Landmarks of calcaneum

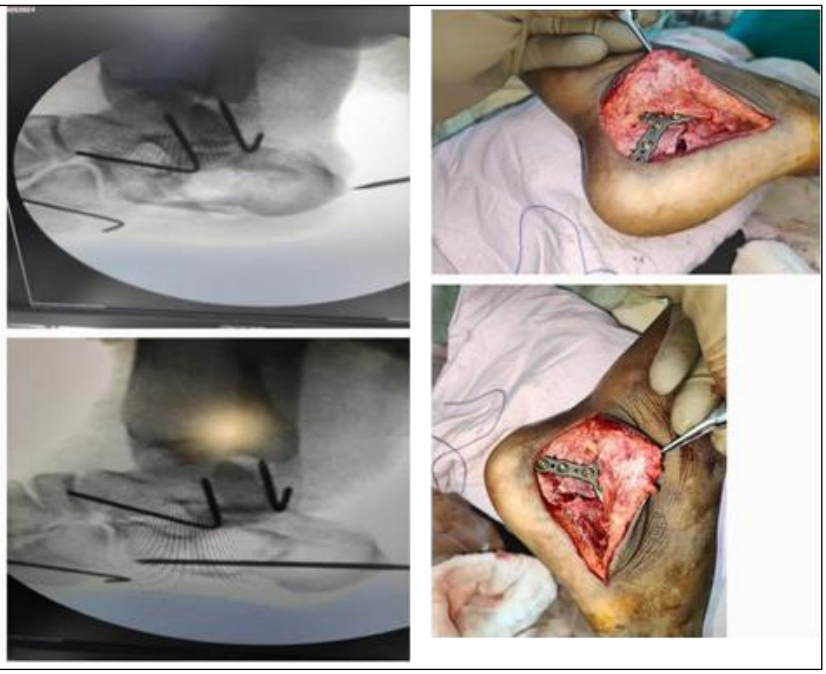

Fig 3: Per op images of open reduction internalfixation of fracture calcaneum

RESULT

A total of 19 patients with 31 calcaneal fractures were treated in the Orthopaedic Department of G.G. Hospital, Jamnagar. Among these, 12 patients (64%) presented with bilateral calcaneal fractures. The mean age of the patients was 32.6 years, ranging from 18 to 60 years. The majority of patients were male (87.5%), with females accounting for 12.5% of cases.

The study evaluated 19 patients with joint depression-type calcaneal fractures (intra-articular type) with 1 year follow up. The primary mode of injury was falls from height, followed by road traffic accidents, assaults, and suicidal traumas. Clinical outcomes showed that over 90% of patients experienced no or mild occasional pain, while over 95% reported no gait abnormalities and the ability to walk at least 200 meters, although some had difficulty on uneven surfaces. All patients had stable ankle joints with average dorsiflexion and plantarflexion exceeding 30 degrees. Radiological assessments revealed significant improvements in Böhler's and Gissane's angles. Böhler's angle improved from a preoperative mean of 6.4° to 28.5° postoperatively, slightly decreasing to 26.47° at the final follow-up but remaining within the normal range except in 6 patients with significant comminution.

Similarly, Gissane's angle improved from a preoperative mean of 154° to 131.2° postoperatively, reducing further to 124.6° at the final follow-up. Functional outcomes were positive, with an average AOFAS score of 80.2. Overall, 86% of patients achieved good to excellent results.

DISCUSSION

The discussion on calcaneal fracture fixation with plating highlights its effectiveness as a surgical intervention in restoring anatomical alignment and improving functional outcomes. Calcaneal fractures, particularly intra-articular types, commonly result from high-energy trauma such as falls from height[11]. Historically, conservative treatment was considered the gold standard; however, recent advancements and studies have led to an increased preference for internal fixation due to superior outcomes[12]. Surgery for calcaneal fractures is typically delayed for 10-14 days in the presence of significant edema or fracture blisters to reduce the risk of complications and ensure better surgical results[13]. The technique of open reduction and internal fixation (ORIF) for intra-articular calcaneal fractures has gained prominence since Palmer introduced the lateral approach, which allows for precise fracture reduction, restoration of the subtalar joint surface, bone grafting to fill gaps, and immobilization[14]. Buckley *et al*. further demonstrated that operative fixation in displaced intra-articular calcaneal fractures led to better functional outcomes compared to non-operative management, especially in carefully selected patient groups[15].

Conservative treatment for intra-articular fractures is often associated with increased morbidity due to persistent incongruency of the articular surface, widening of the heel, loss of talar dorsiflexion, disruption of the talocalcaneal lever arm, and peroneal tendon impingement[16]. These complications emphasize the importance of achieving anatomical restoration through surgical fixation. The choice of osteosynthesis material, such as low-profile plates, is crucial to provide stable fixation and facilitate early

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movement of the ankle and subtalar joints, minimizing stiffness and promoting functional recovery[17]. In this study, surgical fixation with plating significantly improved key radiological parameters. Böhler's angle improved from a preoperative mean of 6.4° to 28.5° immediately postoperatively and stabilized at 26.47° at the final follow-up, except in cases of severe comminution. Similarly, Gissane's angle improved from 154° preoperatively to 131.2° postoperatively and stabilized at 124.6°[18]. These improvements are critical for maintaining hindfoot biomechanics and ensuring long-term functionality.

Functionally, the outcomes of surgical fixation were highly favorable. Most patients reported minimal or no pain, stable ankle joints, and the ability to walk long distances with only mild difficulty on uneven surfaces. The high average AOFAS (American Orthopaedic Foot and Ankle Society) score of 80.2, with 86% of patients achieving good to excellent outcomes, underscores the success of this intervention. Complications were minimal and manageable[19]. Wound dehiscence was one of the complications observed, along with deep infections, which are consistent with findings in other studies[20]. Both complications were managed conservatively without the need for secondary surgical interventions, demonstrating that appropriate postoperative care and early intervention can mitigate potential risks. These findings reinforce the role of plating as a reliable and effective treatment for calcaneal fractures, provided it is performed with meticulous surgical technique and careful patient selection to ensure optimal outcomes and minimize complications[21].

CONCLUSION

This study supports the efficacy of open reduction and internal fixation (ORIF) for treating intra- articular calcaneal fractures. The surgical approach demonstrated significant improvements in both clinical and radiological outcomes. Radiographic assessments, including Böhler's and Gissane's angles, showed substantial restoration of the calcaneal structure, with postoperative alignment remaining within normal ranges in most cases, except in fractures with severe comminution. Functional outcomes were generally positive, with 86% of patients achieving good to excellent results, as evidenced by an average AOFAS score of 80.2.

The majority of patients reported mild pain and no gait abnormalities, indicating successful restoration of foot mechanics. Moreover, 95% of patients could walk at least 200 meters, although some experienced difficulty on uneven surfaces. This suggests that ORIF, when performed in carefully selected patients, can effectively restore both the function and stability of the foot, reducing long-term complications such as chronic pain or joint instability.

However, challenges such as the complexity of the fracture, particularly in cases with significant comminution, can influence outcomes. In such cases, the surgical technique and postoperative management must be carefully tailored to ensure optimal recovery. Additionally, the study highlights the importance of early intervention and proper rehabilitation to achieve the best functional results.

Overall, ORIF for intra-articular calcaneal fractures provides a reliable surgical option, leading to satisfactory functional and radiological outcomes, particularly when performed in an experienced setting with appropriate patient selection and postoperative care.

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