RESEARCH PAPER

FUNCTIONAL OUTCOMES OF SURGICALLY TREATED DISPLACED INTRA-ARTICULAR CALCANEAL FRACTURES: A NARRATIVE REVIEW

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ABSTRACT

Displaced intra-articular calcaneal fractures (DIACFs) are associated with substantial morbidity due to disruption of the posterior facet, altered hindfoot morphology, and a high risk of post-traumatic subtalar arthritis. Surgical management aims to restore joint congruity and calcaneal shape while minimizing soft-tissue complications. Reported functional outcomes after surgery are variable and are strongly influenced by patient selection, fracture severity, quality of reduction, approach-related wound morbidity, and the outcome instrument used. This narrative review summarizes contemporary evidence on functional outcomes following operative management of DIACFs, contrasts extensile lateral and less invasive approaches, and outlines determinants of recovery and longer-term endpoints including return to work and secondary subtalar arthrodesis.

Keywords: calcaneus; displaced intra-articular fracture; open reduction and internal fixation; sinus tarsi approach; functional outcome; subtalar arthritis

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Introduction

DIACFs typically follow high-energy trauma and are frequently followed by persistent pain, stiffness, gait impairment, and reduced capacity for physically demanding work. Operative treatment is intended to (i) restore posterior facet congruity, (ii) correct calcaneal height, length, width, and hindfoot alignment, and (iii) facilitate rehabilitation while limiting soft-tissue compromise. Randomized evidence has shown that functional benefit is not uniform across all patients, reinforcing the need for appropriate indications and complication avoidance.

Literature Review

Evidence on functional outcomes after displaced intra-articular calcaneal fractures (DIACFs) has evolved from early prognostic work and open reduction–internal fixation (ORIF) series to randomized trials, systematic reviews, and long-term cohort follow-up. Key endpoints across studies include AOFAS hindfoot score, Maryland Foot Score, Foot Function Index (FFI), SF-36, return-to-work status, footwear limitation, and the need for subtalar fusion. Randomized controlled trials comparing operative versus non-operative treatment report mixed functional findings, with some demonstrating comparable long-term patient-reported outcomes despite improved radiographic parameters after ORIF. In the 15-year follow-up of a randomized cohort, Ibrahim et al. found no significant differences in AOFAS, FFI, or calcaneal fracture scores between groups, and no clear correlation between Böhler angle and clinical outcome. Meta-analyses of randomized trials similarly suggest that operative treatment may improve selected functional domains (e.g., shoe-wear problems and physical component scores) and return-to-work likelihood in appropriately selected patients, while consistently increasing wound-related and procedure-related complications. Surgical approach and soft-tissue strategy are major determinants of morbidity and can influence perceived recovery. A growing body of comparative literature and meta-analyses indicates that minimally invasive sinus tarsi approaches can reduce wound complications and operative time when compared with the extensile lateral approach, with broadly similar functional scores in many Sanders type II–III cohorts. Contemporary updated analyses continue to support lower wound complication rates with sinus tarsi approaches while emphasizing the importance of surgeon experience, fracture morphology, and restoration of hindfoot alignment. Long-term observational data highlight that functional outcomes may decline modestly over time and that subtalar post-traumatic arthritis remains a principal driver of disability. In a 15–20 year follow-up of minimally invasive percutaneous screw fixation, Driessen et al. reported generally acceptable long-term AOFAS and Maryland Foot Score values with high patient satisfaction, but noted deterioration compared with earlier mid-term results. Collectively, the literature

supports a tailored, patient- and fracture-specific strategy: aiming for anatomic joint reconstruction and hindfoot alignment when feasible, minimizing soft-tissue insult, and recognizing that late subtalar degeneration can limit ultimate function.

Outcome Measures and Reporting Considerations

Functional outcomes in DIACFs are reported using heterogeneous instruments. Commonly used clinician-based scores include the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score and the Maryland Foot Score, while broader health status is assessed using tools such as SF-36 or EQ-5D. Outcome heterogeneity limits inter-study comparability, and reliance on clinician-based scores may not fully reflect patient-perceived recovery. Standardization toward validated patient-reported outcome measures with clearly defined follow-up intervals would improve interpretability.

Fracture Severity and Prognosis

CT-based classification informs reconstructibility and prognosis. Increasing comminution and posterior facet fragmentation correlate with worse functional recovery and higher likelihood of post-traumatic subtalar arthritis. More complex fracture patterns are at increased risk of residual incongruity and stiffness even after operative fixation, and they more commonly progress to secondary subtalar arthrodesis.

Surgical Approaches and Functional Outcomes

Extensile Lateral Approach ORIF

The extensile lateral approach (ELA) provides wide exposure for reduction and fixation but carries a higher risk of wound complications. When anatomic reduction is achieved without soft-tissue morbidity, functional recovery is generally favorable. However, wound breakdown and infection prolong immobilization, delay weight bearing, and are consistently associated with inferior function and higher reoperation rates.

Sinus Tarsi and Other Less Invasive Approaches

Limited-incision strategies, particularly the sinus tarsi approach (STA), have been adopted to reduce soft-tissue morbidity while achieving acceptable reduction in suitable fracture patterns. Comparative reviews and meta-analyses consistently report lower wound complication rates with STA compared with ELA, with many studies demonstrating broadly comparable functional outcomes and radiographic restoration in reconstructible DIACFs.

Determinants of Functional Outcome After Surgery

Quality of Reduction and Restoration of Morphology

Posterior facet congruity and restoration of calcaneal morphology (including Böhler angle, height, width, and hindfoot alignment) are repeatedly associated with improved pain and function. The strength of these correlations varies across studies, partly due to differences in measurement methods and outcome instruments.

Soft-Tissue Complications

Soft-tissue complications are among the strongest predictors of poor functional outcome and represent a key modifiable determinant. Dehiscence, infection, and hardware exposure increase stiffness and pain through prolonged immobilization and repeated procedures, and they are a major driver of inferior patient-reported outcomes.

Patient Factors and Timing

Host factors such as smoking, diabetes, vascular compromise, severe swelling, and open injuries increase wound risk and worsen functional prognosis. Timing of surgery is typically guided by soft-tissue readiness to reduce wound morbidity. Structured perioperative pathways (edema control, meticulous handling of the lateral flap when used, and early motion protocols where appropriate) primarily improve outcomes by reducing complications.

Long-Term Endpoints: Subtalar Arthritis and Secondary Procedures

Post-traumatic subtalar arthritis remains a common long-term sequela and a principal driver of persistent disability. Secondary subtalar arthrodesis can improve pain but reduces hindfoot motion, and overall function thereafter depends on activity demands and adjacent joint health. Long-term studies should report arthritis incidence and the rate and timing of secondary arthrodesis in addition to functional scores.

Conclusion

Functional outcomes after operative management of DIACFs are variable and are most consistently influenced by soft-tissue complication avoidance, fracture severity and reconstructibility, and adequacy of posterior facet reduction with restoration of calcaneal morphology. In suitable fracture patterns, less invasive approaches such as STA are supported by pooled evidence demonstrating reduced wound morbidity with comparable functional outcomes. Future research should adopt standardized, validated patient-reported outcome measures, uniform complication definitions, and longer-term follow-up capturing subtalar arthritis and secondary arthrodesis.

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