

Original Research Article

EVALUATION OF FUNCTIONAL OUTCOMES FOLLOWING OPERATIVE MANAGEMENT OF ANKLE FRACTURES: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Ankle fractures represent a frequent orthopaedic problem and, when associated with instability or displacement, may require operative treatment to re-establish anatomical alignment and preserve ankle function. This study was undertaken to evaluate functional recovery following surgical fixation of ankle fractures in a prospective cohort of 88 patients.

Materials and Methods: In this prospective cohort study, 88 patients with ankle fractures underwent open reduction and internal fixation (ORIF). Functional recovery was evaluated six months after surgery using the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale and the Olerud-Molander Ankle Score (OMAS). Postoperative radiographs were reviewed to determine fracture healing, restoration of alignment, and maintenance of reduction.

Results: At six-month follow-up, the mean AOFAS Ankle-Hindfoot score was 82.6 ± 9.4 , while the mean OMAS was 78.2 ± 11.3 , demonstrating generally favourable functional recovery. Postoperative complications included superficial surgical-site infection in 4.5% of patients, delayed wound healing in 6.8%, and radiographic or clinical evidence of post-traumatic arthritis in 9.1%. Patient age, fracture pattern according to the Weber classification, and the interval between injury and surgery were identified as significant factors affecting functional outcomes.

Conclusion: Operative treatment of appropriately selected ankle fractures can provide favourable functional outcomes. Restoration of anatomical alignment through timely reduction and achievement of stable internal fixation remain important determinants of successful postoperative recovery.

Keywords: Ankle fractures; open reduction and internal fixation; AOFAS; Olerud-Molander Ankle Score; functional outcome; fracture healing.

INTRODUCTION

Ankle fractures constitute a substantial proportion of injuries involving the lower limb and represent a frequent indication for orthopaedic consultation and operative treatment. They account for approximately 9% of fractures occurring in adults, with reported annual incidence rates reaching nearly 187 cases per 100,000 population.^[1,2] The majority result from rotational or torsional mechanisms, frequently following falls or slips, although high-energy trauma associated with road traffic accidents and sporting activities may also produce significant ankle injuries.^[3] The ankle is a mechanically complex

articulation in which the distal tibia, fibula, and talus function together with the collateral ligaments and distal tibiofibular syndesmosis to maintain stability. Disruption of any of these structures can compromise joint congruity and alter normal load transmission across the ankle.

Treatment selection is primarily influenced by the fracture configuration, degree of displacement, mechanical stability, syndesmotic involvement, and condition of the surrounding soft tissues. Stable and minimally displaced fractures can frequently be managed with immobilization or functional bracing. In contrast, displaced or unstable injuries, particularly those associated with syndesmotic

disruption such as Weber B and Weber C patterns, commonly require operative stabilization.^[4] Open reduction and internal fixation (ORIF) is widely used for unstable ankle fractures because it facilitates restoration of anatomical relationships, provides mechanical stability, and permits early functional rehabilitation. Achieving accurate restoration of the articular surface and ankle mortise is particularly important because residual incongruity may contribute to abnormal joint loading and subsequent post-traumatic degenerative changes.^[5]

Functional recovery following fixation is not uniform and may be influenced by several patient- and treatment-related variables. Fracture complexity, delay between injury and surgery, quality of reduction, fixation strategy, postoperative complications, and adherence to rehabilitation can all affect the result.^[6] Inadequate restoration of alignment, surgical-site infection, wound problems, malunion, restricted ankle motion, and postoperative stiffness have been associated with less satisfactory functional recovery.^[7] Consequently, objective assessment using validated functional instruments provides an important means of evaluating treatment effectiveness. The American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale and the Olerud-Molander Ankle Score (OMAS) are commonly used measures incorporating pain, mobility, function, and other aspects of patient recovery.

Although the outcomes of operative treatment for ankle fractures have been extensively investigated, published studies frequently concentrate on large populations or individual fracture configurations. Additional prospective data from routine clinical practice can help clarify how fracture characteristics, patient age, timing of surgery, and postoperative events influence functional recovery.

The present study therefore evaluates the six-month functional outcomes of patients undergoing surgical treatment for displaced ankle fractures. A cohort of 88 patients was assessed, with particular attention to the relationship between functional recovery and variables such as age, fracture classification, timing of operative intervention, radiographic healing, and postoperative complications. The findings are intended to provide clinically relevant information regarding factors associated with successful recovery following ORIF of unstable ankle fractures.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was undertaken at a tertiary-level orthopaedic centre over a period of two years. The study enrolled 88 adult patients presenting with displaced ankle fractures considered appropriate for operative stabilization.

Eligibility Criteria: Patients older than 18 years with closed Weber B or Weber C ankle fractures requiring surgical fixation were considered eligible. Patients

with open fractures, pre-existing ankle arthritis, or associated polytrauma were excluded to minimize the influence of these factors on postoperative functional assessment.

Preoperative Assessment and Data Collection: All eligible patients underwent a systematic clinical assessment before surgery. Standard anteroposterior, lateral, and mortise radiographs of the ankle were obtained for fracture characterization. Computed tomography was additionally performed when greater anatomical detail was required, particularly in complex fracture patterns. Fractures were categorized according to the Weber classification, with the Lauge-Hansen system also used where appropriate to describe the mechanism and pattern of injury.

Surgical Technique: Operative treatment was performed using a standardized open reduction and internal fixation protocol under tourniquet control. Lateral malleolar fractures were reduced and stabilized using appropriate plates and screws, while medial malleolar fragments were generally secured with cannulated screws. In patients with associated syndesmotic instability, fixation was achieved using either a syndesmotic screw or a suture-button device according to the intraoperative findings and surgeon preference.

Fluoroscopic imaging was used during surgery to assess fracture reduction, restoration of the ankle mortise, implant position, and syndesmotic stability. The objective was to obtain satisfactory anatomical reduction and stable fixation while minimizing soft-tissue disruption.

Postoperative Care and Follow-up: Following surgery, the operated limb was immobilized in a splint for approximately two weeks. Subsequent management consisted of progressive mobilization, graduated weight-bearing according to fracture stability and radiographic progression, and structured physiotherapy aimed at restoring ankle range of motion, strength, balance, and functional activity. Patients were reviewed clinically and radiographically during follow-up. Fracture healing, maintenance of alignment, and postoperative complications were documented. Functional status was formally evaluated at six months after surgery using the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale and the Olerud-Molander Ankle Score (OMAS).

RESULTS

Functional Outcomes: The present prospective cohort demonstrated generally favourable functional recovery following operative treatment of displaced ankle fractures. At six months, the mean AOFAS Ankle-Hindfoot score was 82.6, while the corresponding mean OMAS was 78.2. These findings are broadly consistent with functional outcomes reported in previous clinical series,^[6,7] supporting the role of anatomical reduction and stable fixation in restoring satisfactory ankle function.

Table 1: Demographic and Fracture Characteristics

Variable	Value (N=88)
Age (years)	42.5±14.2
Gender	
male	54 (61.4%)
female	34 (38.6%)
Fracture Type	
Weber B	60 (68.2%)
Weber C	28 (31.8%)
Fracture Pattern	
Unimalleolar	36 (40.9%)
Bimalleolar	40 (45.5%)
Trimalleolar	12 (13.6%)
Time to Surgery (days)	5.2±2.8

Table 2: Functional Outcomes at 6 Months

Outcome Measure	Mean ± SD	Range
AOFAS Ankle-Hind foot Score	82.6±9.4	62–98
Olerud-Molander Score (OMAS)	78.2±11.3	55–95
Time to Union (weeks)	78.2±11.3	8–16

Table 3: Complications

Complication	Number (%)
Superficial Infection	4 (4.5%)
Delayed Wound Healing	6 (6.8%)
Post-Traumatic Arthritis	8 (9.1%)
Hardware Irritation	4 (4.5%)
Non-union	2 (2.3%)

Table 4: Subgroup analysis of functional outcomes

Subgroup	AOFAS Score (Mean ± SD)	OMAS (Mean ± SD)	P-Value
Weber B (N=60)	86.2±7.1	82.4±8.9	0.02*
Weber C (N=28)	75.8±10.3	68.5±12.6	
Age < 50 (N=56)	85.1±8.3	80.7±9.5	0.03*
Age ≥ 50 (N=32)	78.3±9.8	72.4±13.2	
Surgery ≤ 7 days (N=35)	84.5±8.6	80.1±10.2	0.04*
Surgery > 7 days (N=9)	74.8±11.2	68.3±14.7	

*Statistically significant: $p < 0.05$

DISCUSSION

An important consideration is the heterogeneity of fracture severity within the study population. Approximately 31.8% of patients sustained Weber C fractures, which are generally more complex because of the frequent association with disruption of the distal tibiofibular syndesmosis.^[8] The difference between the AOFAS and OMAS results may partly reflect differences in the domains emphasized by the two instruments. The OMAS incorporates patient-reported limitations such as pain, stiffness, swelling, and difficulties with activities, potentially resulting in lower scores in patients who have residual symptoms despite satisfactory radiographic healing.^[9]

Influence of Fracture Configuration: Fracture classification demonstrated a significant relationship with functional recovery. Patients with Weber B fractures achieved a higher mean AOFAS score than those with Weber C injuries (86.2 versus 75.8; $P=0.02$). This observation is clinically plausible because Weber C fractures commonly involve greater disruption of the syndesmotic complex and may therefore require more extensive restoration of ankle stability.^[10]

Although syndesmotic fixation was performed using either screw or suture-button techniques in the

present cohort, the study was not designed or sufficiently powered to establish superiority of one fixation method over the other. Existing evidence suggests that suture-button constructs may provide certain functional and mechanical advantages in selected syndesmotic injuries.^[11] Further comparative studies would be necessary to determine whether these theoretical advantages translate into superior long-term outcomes.

Trimalleolar fractures represented approximately 13.6% of the study population and demonstrated considerable variability in functional results. This finding emphasizes the importance of accurately addressing the posterior malleolar component, as residual displacement or altered posterior malleolar anatomy can influence ankle stability and joint mechanics.^[12]

Effect of Timing of Surgery: The interval between injury and operative fixation was another important factor associated with functional outcome. Patients who underwent surgery within seven days demonstrated a higher mean AOFAS score than those treated after this period (84.5 versus 74.8). Several mechanisms may contribute to this association.^[13] Early definitive management, when soft-tissue conditions permit, may facilitate restoration of joint

alignment before substantial tissue fibrosis and may reduce the duration of mechanical incongruity.

However, the timing of surgery must be interpreted alongside the condition of the soft tissues. Immediate fixation is not necessarily appropriate when significant swelling, blistering, or compromised skin is present. In healthcare settings where operating-room availability and other logistical limitations contribute to treatment delays, establishing efficient pathways for timely assessment and surgery may be particularly important.^[14]

Age and Functional Recovery: Age was also associated with postoperative functional performance. The observed difference of approximately 6.8 points in AOFAS scores between patients younger than 50 years and those aged 50 years or older suggests that increasing age may be associated with slower or less complete functional recovery. Age-related changes in periarticular tissues, muscle strength, balance, and joint condition may contribute to this finding.^[15]

Nevertheless, chronological age alone should not be regarded as an absolute predictor of poor outcome. The highest-performing older patients may achieve excellent functional recovery when anatomical reduction is obtained, and rehabilitation is followed appropriately. For example, the oldest patient in this cohort, aged 72 years, achieved an AOFAS score of 88. This observation highlights the potential importance of biological status, pre-injury activity level, motivation, and adherence to rehabilitation in addition to chronological age.^[16]

Postoperative Complications: The overall complication profile in this cohort was acceptable. Superficial infection occurred in 4.5% of patients, while delayed wound healing was documented in 6.8%. These figures compare favourably with higher complication rates described in some high-risk populations, including patients with diabetes.^[17] The relatively favourable infection rate may also be related to the exclusion of severe open injuries from the present study.

Post-traumatic arthritis was identified in 9.1% of patients at the six-month assessment. Although this proportion is relatively modest at early follow-up, it should be interpreted cautiously. Degenerative changes following ankle fracture may become increasingly apparent over longer periods, and previous longitudinal studies have reported substantially higher rates at later follow-up.^[18] Therefore, the six-month findings should not be considered representative of the eventual lifetime risk of post-traumatic arthritis.

Delayed wound healing was observed predominantly among smokers in this cohort, with three affected patients reported to be smokers. This observation is consistent with the established adverse effects of tobacco exposure on tissue perfusion and wound repair and supports the importance of smoking cessation as part of perioperative optimization.^[19]

Clinical Implications: Taken together, these findings indicate that functional recovery following

ankle fracture fixation depends on more than successful fracture union alone. Restoration of the ankle mortise, appropriate management of syndesmotic instability, timely surgery when soft-tissue conditions allow, and structured postoperative rehabilitation are all important components of treatment. Particular attention may be warranted in older patients and those presenting with more complex fracture configurations.

The results should, however, be interpreted within the limitations of the study design. The cohort was relatively modest in size, follow-up was limited to six months, and the study was not designed to compare individual fixation techniques. Longer-term prospective studies involving larger populations and standardized assessment of patient-related and surgical variables would provide stronger evidence regarding predictors of sustained functional recovery and development of post-traumatic arthritis.

CONCLUSION

Operative stabilization of displaced ankle fractures with open reduction and internal fixation was associated with generally satisfactory functional recovery at six months in this prospective cohort. Higher functional scores were observed among younger patients, individuals with Weber B fractures, and those who underwent surgery within seven days of injury. These findings emphasize the importance of restoring anatomical alignment, achieving stable fixation, appropriately addressing syndesmotic disruption, and initiating structured rehabilitation. Although early postoperative complications were relatively infrequent, the occurrence of post-traumatic arthritis highlights the need for continued clinical surveillance beyond the initial healing period. Longer-term follow-up with larger prospective cohorts is required to determine the durability of functional improvement and to better define the factors associated with progressive ankle degeneration.

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