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Arthroscopic Assisted Reduction and Fixation of Medial Malleolus Fractures

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Abstract

Background: Ankle fractures are a common cause of lower limb injuries, accounting for nine percent of all fractures and a significant portion of trauma workload.

Aim: To assess the role of ankle arthroscopy in handling intraarticular fractures around the ankle and determine the extent to which arthroscopic intervention contributes to enhancing the outcome.

Patients and methods: From January 2021 to December 2022, a prospective case series was performed at Al-Azhar University hospitals in Cairo, Egypt. The research involved 20 patients, with an average follow-up of ten months postoperatively, ranging from 7 to 14 months.

Results: According to the ankle joint flexion-extension arc, 12 cases were more than 30, 5 patients were from 15 to 29, and 3 were less than 15. Pain was evaluated according to the AOFAS questionnaire. 8 cases had no pain, 4 cases had mild pain, 4 cases had moderate, daily pain, and four patients had severe, almost present pain. According to the Olerud & Molander scoring system, there was a highly significant decrease in postoperative compared to preoperative postoperative.

Conclusion: No dispute that postoperative pain associated with an articular fracture of the ankle is connected to cartilage and ligamentous damage sustained during the injury. These injuries might be concealed and reveal themselves gradually. The primary objective of arthroscopy is to identify these injuries and anticipate the joint's future.

Keywords: Arthroscopic reduction, Medial malleolus fractures, ankle arthroscopy, arthroscopic surgery

1. Introduction

Lower limb injuries frequently result from ankle fractures, which constitute nine percent of the total fracture incidence and a significant portion of the trauma workload. They predominantly impact young males and elderly females, with males being more impacted below 50.¹ ankle fracture classification systems involving the Danis Weber AO and Lauge-Hansen. A stable anatomic reduction of the talus and correction of fibula length constitute the treatment. A one-millimeter lateral shift results in a forty-two percent decrease in contact area, whereas a fibula displacement leads to a rise in joint contact pressures. Additional research is required to determine the optimal fixation

technique.^{2,3}

Ankle fractures are a common orthopedic injury requiring operative treatment. Despite generally favorable outcomes, suboptimal functional results may occur even with anatomic reduction.^{4,5} This may be due to overlooked intra-articular injuries, with reported incidence ranging from 20% to 79%. To address this, innovative techniques of arthroscopically assisted ankle fracture evaluation have emerged to improve the identification and therapy of concurrent intra-articular ankle injuries.^{6,7}

The aim of this work was to assess the role of ankle arthroscopy in handling intraarticular fractures around the ankle & determine the extent to which arthroscopic intervention contributes to enhancing the outcome.

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2. Patients and methods

From January 2021 to December 2022, a prospective case series was performed at Al-Azhar University hospitals in Cairo, Egypt. The study included 20 cases, with an average follow-up of ten months postoperatively, ranging from 7 to 14 months.

Inclusion criteria: Age range: 18 to 65 years, encompassing both males and females who recently sustained a medial malleolus fracture (0-14 days), with or without involvement of the lateral malleolus.

Exclusion Criteria: Patients with recent active infections, mental illnesses, high anesthesia risk, pilon or plafond-variant injuries, open fractures, fractures displaying radiologically detectable intraarticular lesions, uncontrolled diabetes, heavy smokers, neuropathic joint conditions, and Tri malleolar ankle fractures.

Methods:

On hospital admission, cases were exposed to History taking, clinical examination, neurovascular condition, radiological evaluation, and CT scan.

Surgical Technique: The surgical intervention was performed when edema subsided and skin wrinkles became apparent. The average delay from injury to surgery is 3 to 7 days. The case was in a supine position and under spinal anesthesia. A tourniquet was placed around the thigh, the limb elevated and exsanguinated, and the tourniquet inflated for hemostasis. Manual distraction was performed by an assistant and regulated by the surgeon's hand or waist. A 2.7 mm 30° angled arthroscopic lens was used along with the standard arthroscopy set. The patient's foot and leg underwent typical preparation, including sterilization and draping. A gravity irrigation system with a saline solution was used, entering the ankle through one valve of a double-valve Arthroscopic cannula and exiting through the other valve. The procedure began with an injection of 20 to 30 cc of normal saline into the ankle joint to facilitate capsule distension.

Insertion of the Arthroscope: A 0.5 cm vertical skin incision was made near the tibialis anterior tendon to avoid injury to articular cartilage. A hemostat was used to retract soft tissues. A blunt trocar (obturator) was introduced into the cannula, and the cannula was gently rotated into the joint. The obturator was then replaced with an arthroscope, and the cannula was securely twisted into its attachment. The inflow was activated by turning the stopcock on the side arm of the Arthroscopic cannula.

Arthroscopic evaluation of the Joint: The arthroscope is used to examine ankle joint injuries, focusing on deep segments of the deltoid ligament, medial malleolus, talus-medial malleolus joint, talar dome, distal tibiofibular

articulation, and anterior talofibular ligament. All cases undergo surgery using anterolateral and anteromedial portals, aiming to eliminate loose bodies, reduce cartilaginous surfaces, and address ligamentous injuries. The International Cartilage Repair Society (ICRS) method is used for cartilage injury evaluation.

Method of fixation: In 10 cases of lateral malleolus fractures, plates and screws were used for fixation, including eight bimalleolar ankle fractures. In 3 isolated medial malleolus fractures, partially threaded cancellous 4 mm screws were used, while in 9 cases of bimalleolar fractures, partially threaded 4 mm screws were used. Cannulated 4 mm screws were used for percutaneous fixation in 4 cases of medial malleoli fractures.

Evaluation of fracture reduction: Arthroscopy was found to be more effective in evaluating fracture reduction, while fluoroscopy was used for assessing reduction and guiding screw placement.

Postoperative: Postoperative care involved splint, leg elevation, antibiotics, and analgesia. X-rays were conducted to monitor bone healing, and active exercises were encouraged. Suture removal occurred 15 days postoperatively, and monthly follow-up visits were scheduled. Weight-bearing was not permitted until bone healing was observed, and progressive weight-bearing was allowed as tolerated. Follow-up visits were scheduled monthly.

Statistical analysis: The data that was collected was analyzed utilizing version 23.0 of the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA). In the case of parametric (normal) data distributions, quantitative information was presented as the mean \pm standard deviation and ranges. Conversely, for non-parametric data with non-normal distributions, the median was used along with the interquartile range (IQR). The values of qualitative variables were expressed as percentages and integers. To examine the normality of the data, the Kolmogorov-Smirnov and Shapiro-Wilk tests were applied. Comparing related samples with a paired sample t-test, the research employed a 5% margin of error and a 95% confidence interval. P-values were considered statistically significant when they were below 0.05, highly significant when they were below 0.001, and insignificant when they exceeded 0.05.

3. Results

Out of the 20 patients, 9 were men & 11 were women with mean age of 26 years, varied from 17 to 35 years. The right ankle was affected in 10 cases, while the left ankle was affected in the remaining 10. (Table 1)

Table 1. Demographic data distribution among the studied cases.

DEMOGRAPHIC DATA	TOTAL (N=20)
AGE (YEARS)	
RANGE	17-36
MEAN±SD	27.20±6.25
GENDER	
FEMALE	9 (45%)
MALE	11 (55%)
BMI [WT/(HT) ²]	
RANGE	18-36
MEAN±SD	27.30±5.64
SIDE	
LEFT	10 (50%)
RIGHT	10 (50%)
MODE OF TRAUMA	
PER	8(40.0%)
SER	12(60.0%)
TOTAL	20(100.0%)

Out of the 20 patients, 12 felt pain while walking on an uneven surface, 16 had only evenings swelling, 14 had no problem with stair climbing, 6 had impaired stair climbing, 17 could run, 16 could jump, 15 had no problem with squatting, work and daily activity was same as before the injury in 11 patients while 8 loss of tempo. (Table 2).

Table 2. Olerud and molander scoring system distribution among the studied cases.

OLERUD AND MOLANDER SCORING SYSTEM	NO.	%
PAIN		
NONE	4	20.0%
WHILE WALKING ON AN UNEVEN SURFACE	12	60.0%

Table 3. Comparison between preoperative & postoperative according to Olerud & molander scoring system.

OLERUD AND MOLANDER SCORING SYSTEM	PREOPERATIVE (N=20)	POSTOPERATIVE (N=20)	PAIRED SAMPLE T-TEST		
			MD±SE	t-test	p-value
RANGE	30-60	50-95	35.25±3.00	11.744	<0.001**
MEAN±SD	45.50±10.75	80.75±15.41			

**p-value <0.001 is highly significant, MD: Mean difference and SE: Standard error

According to ankle joint flexion-extension arc, 12 patients was more than 30, 5 patients was from 15 to 29 and 3 was less than 15. (Table 4).

Table 4. The mean ankle joint flexion-extension arc as compared to the normal side.

ANKLE MOTION	MORE THAN 30	15 - 29	LESS THAN 15
NO OF PATIENT	12	5	3
PERCENTAGE	73.4%	20.4%	6%

Pain was evaluated according to the AOFAS questionnaire. 8 cases had no pain, 4 cases had mild pain, 4 cases had moderate, daily pain, & 4 patients had severe, almost present pain (Table 5).

WHILE WALKING ON EVEN SURFACES OUTDOORS	4	20.0%
WHILE WALKING INDOORS	0	0.0%
CONSTANT AND SEVERE	0	0.0%
STIFFNESS		
NONE	20	100.0%
STIFFNESS	0	0.0%
SWELLING		
NONE	4	20.0%
ONLY EVENINGS	16	80.0%
CONSTANT	0	0.0%
STAIR CLIMBING		
NO PROBLEMS	14	70.0%
IMPAIRED	6	30.0%
IMPOSSIBLE	0	0.0%
RUNNING		
POSSIBLE	17	85.0%
IMPOSSIBLE	3	15.0%
JUMPING		
POSSIBLE	16	80.0%
IMPOSSIBLE	4	20.0%
SQUATTING		
NO PROBLEMS	15	75.0%
IMPOSSIBLE	5	25.0%
SUPPORTS		
NONE	11	55.0%
TAPING WRAPPING	9	45.0%
STICK OR CRUTCH	0	0.0%
WORK AND DAILY ACTIVITY		
SAME AS BEFORE THE INJURY	11	55.0%
LOSS OF TEMPO	8	40.0%
CHANGE TO SIMPLE JOB PART-TIME WORK	1	5.0%
SEVERELY IMPAIRED WORK CAPACITY	0	0.0%

According to olerud and molander scoring system, there was highly significant decrease postoperative than preoperative. (Table 3)

Table 5. Distribution of pain severity among patients according to the AOFAS questionnaire.

PAIN	NO OF PATIENTS	%
NO	8	47%
MILD	4	22.4%
MODERATE	4	16.3%
SEVER	4	14%

According to complications, 3 patients had ankle fistula, equal number of patients (2) had Extravasation and Infection and one patient had Nerve injury. Table 6

Table 6. Complicated cases in this study

COMPLICATIONS	NO OF PATIENTS	%
EXTRAVASATION	2	10%
NERVE INJURY	1	5%
INFECTION	2	10%
NON-UNION	0	0%
ANKLE FISTULA	3	15%
ARTHRITIS	0	0%
TOTAL	8	40%

The functional outcomes of one patient were classified as poor, five patients as acceptable, and two cases as fair. The outcomes that were categorized as outstanding or good were regarded as satisfactory, whereas those that were categorized as fair or poor were deemed unsatisfactory. Consequently, satisfactory results were observed in 14 patients, while unsatisfactory results were noted in 6 patients (Figure 1).

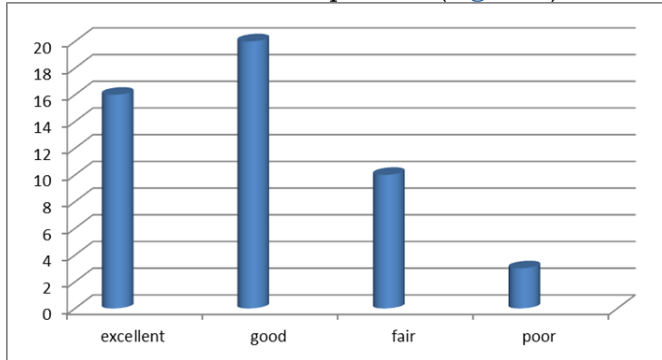


Figure 1. AOFAS distribution among patients

CASE PRESENTATION

A 45-year-old man case was admitted to Al Azhar University Hospital 20 days after experiencing a twisting injury to the left ankle. The patient was diagnosed with a medial malleolar fracture and had previously been treated with a below-knee cast. The skin condition was favorable with mild edema. Plain X-rays revealed osteochondritis dissecans (OCD) of the talus, presenting as a radiolucent area on the medial aspect of the talus. We performed a diagnostic arthroscopy and microfracture of the ulcer bed, along with percutaneous fixation of the medial malleolar fracture.

Operation tricks

Following the removal of the organized hematoma and hypertrophied synovium, the ulcer was cleared of friable cartilage until reaching a stable edge. Drilling was performed using a 1.8 mm K-wire. The fracture of the medial malleolus was then fixed with a single partial 3.5 mm percutaneous screw. A 2 cm incision over the fracture site was made to confirm that no periosteal flap was entrapped through the fracture, and it was confirmed that no periosteum was entrapped.

Follow up: below knee cast was done for 3 weeks, non-weight bearing was started 2nd day of operation, follow up x ray after 2nd week, at 3rd months and clinical follow after 7 months.

Results: complete healing of the ulcer, full healing of medial malleolar fracture and the AOFAS score was 74



Figure 2. Photos of case presentation

4. Discussion

Out of the 20 cases, 9 were men & 11 were women with mean age of 26 years, varied from 17 to 35 years.

According to Weber's classification, the distribution of fractures in our study comprised 5 cases with fractures distal to the syndesmosis (Weber type A), six fractures at the level of the syndesmosis (Weber type B), and nine fractures above the syndesmosis (Weber type C).

Utilizing the AOFAS score, the functional outcomes were categorized as excellent in 12 cases, good in 5 cases, fair in 2 cases, & poor in one case. The combined percentage of excellent & good results, considered satisfactory, amounted to 60%, while fair and poor results, deemed unsatisfactory, constituted 15%. Consequently, satisfactory results were observed in 17 patients, while unsatisfactory results were noted in 3 patients.

In comparison with B. Hintermann et al.,⁸ our study identified variations among the arthroscopic findings of 288 consecutive cases (148 male & 140 female) with a mean age of 45.6 years who were prospectively evaluated for acute ankle fractures. As per the AO-Danis-Weber classification, the fractures observed were as follows: 76 types C, 14 type A, and 198 type B. A total of 228 ankles (79.2%) exhibited cartilage lesions, with a higher incidence observed on the talus (69.4%) compared to the distal tibia (45.8percent), fibula (45.1 percent), or medial malleolus (41.3%). The incidence of injuries to the anterior tibiofibular ligament has risen from type B.1 to type C.3 fractures ($p < 0.05$), although not all cases involved torsion. Although lateral ligamentous injuries were more prevalent in type-B fractures compared to type-C fractures ($p < 0.05$), there was not a significant distinction in the occurrence rate of deltoid ligamentous lesions.

Our study yielded results that closely mirrored theirs in terms of the incidence of cartilage injury (72% vs. 79.2%). Notably, our study showed a higher incidence of injury to the articular surface of the tibia, while their study indicated more injury to the talus.

Our study results closely resembled those achieved by Yassin M et al.,⁹ who conducted arthroscopy on twenty-two patients with ankle fractures. In their study, abnormal findings not visible on radiographs were revealed in 15 out of 22 patients (68%). Significantly, damage to the distal tibia surface was observed to be prevalent (69%), whereas damage to the fibular cartilage was detected in just twenty-eight percent of the cases. In thirty-six percent of cases with cartilage injury of grade 4, loose bodies were extracted. Syndesmosis injury was detected in 78% of the patients examined. The results were generally good at the two-year follow-up, as evidenced by the average AOFAS score of 828. Compared to cases with grade 3 talar damage (83 ± 7) and those with a normal talus throughout arthroscopy (87 ± 9), those with grade 4 talar damage had considerably worse outcomes (70 ± 8).

The results of our study were compared to Smith KS et al.,¹⁰ who conducted a comparative analysis between two groups: the first group underwent arthroscopy (ARIF), and the second group underwent traditional open reduction and internal fixation (ORIF). The study encompassed a total of 213 cases (142 in the traditional ORIF group & 71 in the ARIF group) with an average age of forty years. The average follow-up period was 32.4 months.

Our study results closely resembled those of Smith KS et al.¹⁰ in terms of the incidence of cartilage injury, with 72% in our study compared

to 77% in their study. Notably, as they had a group managed by the traditional method without arthroscopy (ORIF), they were able to compare the functional outcomes of both groups and suggested that arthroscopy enhances the functional outcome.

In our study, similar to the findings of Chan KB et al.¹¹ the frequency of cartilage injury was greater in cases with Weber B fractures. Additionally, the incidence of syndesmotic injury in their study was 55%, compared to 48% in our study, indicating a resemblance in the patterns of injury between the two studies.

Our study results closely resemble those of Da Cunha RJ et al.¹² particularly in the incidence of arthroscopic findings. The study detected chondral lesions in 78% of the cases involving 116 consecutive patients who underwent concurrent arthroscopy and acute ankle fracture ORIF. There was a significant difference in the incidence of chondral lesions between cases aged thirty and greater and those less than thirty years. Osteogenesis imperfecta and complete syndesmosis disruption and instability were correlated with a higher risk of chondral lesion development in cases of dislocation at the time of injury. According to the Foot & Ankle Outcome Score (81.2 vs. 92.1; $P = .009$), cases who presented with chondral lesions experienced clinical outcomes that were significantly worse compared to those who did not.

By the end of their study, they identified advantages of arthroscopy in handling ankle fractures, including the ability to scope and evaluate nearly all aspects of the joint, assess the accuracy of reduction, address cartilage injuries, provide expectations about future complications, and minimize surgical wounds.

On the flip side, the disadvantages of arthroscopy in the context of ankle fractures can be viewed as potential drawbacks. These may include an increase in the duration of the operation by approximately 30 minutes, the risk of extravasation, the possibility of nerve injury, and the potential formation of a fistula.

Considering the balance between advantages and disadvantages, it can be concluded that arthroscopy adds value to the management of ankle fractures.

In our research, limitations included a short period of follow-up, a limited number of participants, and constraints in resources.

4. Conclusion

There is no debate that postoperative pain related to articular fractures of the ankle is linked to cartilage and ligamentous insult during the injury. These injuries may be hidden and manifest themselves over time. The primary objective of arthroscopy is to detect these injuries and

anticipate the future condition of the joint.

Disclosure

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