



ISSN (P): 2521-3466
ISSN (E): 2521-3474
© Clinical Orthopaedics
www.orthoresearchjournal.com
2018; 2(3): 95-99
Received: 16-05-2018
Accepted: 17-06-2018

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A prospective study of surgical management of fractures around ankle joint

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Abstract

Introduction: Ankle joint fractures are commonly encountered by orthopedic surgeons. Fractures are result of twisting and sport injuries. Ankle joint is maximum weight bearing joint of body and has maximum load per unit surface as compared to other joints. Minimum soft tissue coverage around ankle joint makes it susceptible to injury. The aim of the study was to figure out modalities available for ankle fractures surgical management and their outcomes on early mobilization.

Materials and Methods: It was a prospective hospital based analytical study. Total 30 ankle joint fracture cases (preferably malleolar fractures) occurred in a period of 2 years were selected for surgical treatment and assessment. Minimum follow up period was of 5 months to a maximum of 1 and half years. Symptoms and functions were assessed using scoring system of Olerud and Molander. Complications were noted followed by assessing of results.

Results: Twisting injuries and Road Traffic Accidents were found to be trivial for around ankle joint fractures. Twenty seven fractures were found to be united in a satisfactory manner at an average of 13 weeks. Functional outcome was excellent in most of the patients. Pronation Abduction and Supination Adduction are common causes of fractures according to Lauge Hansen's classification. Only 2 patients had complication of wound infection. 27 of the 30 patients had more than satisfactory results.

Conclusion: Open surgical reduction and stabilized internal fixation are treatment methods which lend valuable results in form of early mobilization, faster rehabilitation and swift return of function.

Keywords: Ankle fractures, surgical treatment, functional outcome, malleolus

Introduction

Orthopedic surgeons are first to treat ankle fractures, but strong differences in opinion are still exist regarding the preferred method of treatment adopted, fixation type used, post-operative length of immobilization and criteria of what constitutes a stable reduction. The increasing demands of modern life bring the problem of ankle fracture into greater focus and the question raised is how to achieve rapid healing and quick restoration of ankle functions.

Like any other intra-articular fracture, the fracture disruption of ankle also requires anatomic reconstruction and if possible early mobilization to achieve optimum results. There is direct correlation between displacement of fracture and occurrence of degenerative arthritis. Even a minor displacement of talus gives rise to substantial change in weight bearing capacity. Which increases risk of post traumatic arthritis. It has been observed that, with a few exceptions, most of fractures are unstable and closed methods of treatment are not capable of achieving satisfactory results. Conservative treatment quite often fails as it is not only difficult to obtain a perfect anatomic reduction but there is always a possibility of re-displacement. Loss of reduction, repeated manipulation, prolonged immobilization (leading to osteoporosis and joint stiffness) has made outcomes of traditional treatment method unsatisfactory. In contrast, surgical management gives better function, wide range of mobility, subjective satisfaction and early returns to routine work.

Sir Robert Jones said ^[1] "Ankle joint is the most common injured joint in body but not treated satisfactorily". As body weight is transmitted through ankle joint, injuries pertaining to it have gain much more importance. Locomotion will be determined by stability of joint.

This study will help to evaluate the various modalities available for ankle joint fracture management by surgical method and their results on early mobilization and weight bearing of the patient. With surgical treatment and proper anatomical alignment of ankle joint can lead to rewarding outcome for patients and surgeon.

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Study Methodology

Following were the aims and objectives of the study: 1) To Study the mechanism of ankle injuries and classify ankle fractures. 2) To Study different modalities of fixation of ankle fractures. 3) To evaluate the incidence of complications in surgical fixation. 4) To evaluate the post-operative period after which weight bearing is advised. Duration of the study was 2 years. 30 fracture patients of malleolar involvement admitted in hospital were included in study. Information about the study was given to all subjects involved in study. Inclusion criteria kept was adults above 18 years requiring surgical management, fibular and tibial fractures with 1/3rd involvement and compound fracture up to Grade III B. Exclusion criteria kept was undisplaced fracture which can be treated conservatively, comminuted fractures, pathological fractures, compound Grade III C & old untreated ankle fractures.

A complete survey was carried out on casualty patients to rule out significant injuries. Patient's radiographs in different positions - antero-posterior, lateral and mortise view of ankle joints were done.

Detailed demographic & medical history was noted during admission. Clinical examination was done after a preliminary assessment of patient's general condition.

In all these patients the following clinical signs were looked for.

Inspection: On inspection look for any visible deformity as compared to the normal side.

Palpation: All bones forming the ankle i.e. lower end of tibia fibula including both malleoli, calcaneus and talus are looked for, local bony tenderness and bony irregularities, displacement, unnatural mobility crepitus, inter relation of malleoli, springing of fibula, dorsalis pedis and posterior tibial artery pulsations were noted after analysis. Ankle joint active and passive movements were noted down. Injury mechanism and fracture pattern acted as a guide to identify instability of syndesmosis. Clinical syndesmotic instability were elicited with help of external rotation stress tests and via squeeze test by manual medial-lateral compression across the syndesmosis radiologically. Indicators of clinical instability considered were less than five millimeter tibio fibular clear space and more than four millimeters medial clear space. Fibular manipulation was done intra-operatively to assess excessive lateral displacement, which is an indicator of syndesmotic injury. Alleviation of pain was done with help of analgesics and a below knee posterior POP. In adults, Laue-Hansen's classification was used for

fracture classification. All patients went under routine investigations. Once the general condition got stabilized, patients were operated.

Lateral column instability and shifting of talus more than 2 mm laterally were routed for operative management. Curved anterior or posterior incision centered over fracture site was the avenue for lateral fractures. Neutralization plate was used to fix torsion fractures after inter fragmentary fixation. One third tubular or neutralization plate was used to fix transverse fractures. Medial approach was used to treat medial malleolus fractures and fixation was done either single malleolar screw, cancellous screw or k-wires or with tension band wiring with 2 screws or k-wires.

Fractures having disruption of syndesmosis (exceeding 3 millimeters) were fixated operatively, when medical stabilization was not possible. Three cortices of Tibia were approached via medial fibula by placing a 4.5 mm screw. Poster operative removal of screw for all cases were done at 6 weeks.

Fragment comprising more than 25 percent surface area was kept as a criteria for fixation of posterior malleolus. Posterior malleolus was fixed when the fragment comprised more than 25 per cent of the surface (according to estimates of the fracture size made from plain radiographs). A stab incision was made over tibia from anterior direction was done with use of a lag screw. It was directed antero-posteriorly, thereby engaging the posterior fragment. A below knee plaster was placed for patients during discharge and non-weight bearing crutch walking was advised. At 6 weeks, partial weight bearing was advised. Full weight bearing will be advised once fracture is united, clinically & radiologically. Stich removal was done after 14 days. Questions regarding pain, analgesic use, stiffness, swelling, activities of daily living, use of walking aids, return to work & participation in sports were asked to patients during each assessment. At examination, evaluation of gait, thickening, swelling or tenderness of ankle and range of motion was done. At time of examination, radiographs of affected ankle (antero-posterior & lateral) and mortise radiographs of both ankles were made.

Results

Assessment Criteria

All patients will be reviewed in a dedicated clinic and radiographs obtained at From 5 weeks onwards symptoms and functions will be assessed using the scoring system of Olerud and Molander (1984)^[2].

Table 1: Scoring System of Olerud and Molander (1984)

	Parameter	Degree	Score(maximum)
1.	Pain	None	25
		While walking on uneven surface	20
		While walking on even surface outdoors	10
		While walking indoors	5
		Constant and severe	0
2.	Stiffness	None	10
		Stiffness	0
3.	Swelling	None	10
		Only in Evening	5
		Constant	0
4.	Stair Climbing	No problems	10
		Impaired	5
		Impossible	0
5.	Running	Possible	5
		Impossible	0

6.	Jumping	Possible	5
		Impossible	0
7.	Squatting	No Problems	5
		Impossible	0
8.	Supports	None	10
		Taping, Wrapping	5
		Stick or Crutch Walking	0
9.	Work, Activities of daily life	Same as before injury	20
		Loss of tempo	15
		Change to simpler job	15
		Severely Impaired work capacity	0

Excellent – If Score More Than 75 Points, Good - Between 50-75, Fair- Between 30 -50, Poor- Below 30

Table 2: Functional outcome

Excellent	Good	Fair	Poor	Lost to Follow-up
16	6	2	3	3

Table 3: Functional end result and fracture type based on malleolarity

Malleolar types	Results					Total
	Excellent	Good	Fair	Poor	Lost to Follow-up	
Medial Malleolar	5	2	1	1	1	10
Lateral Malleolar	2	0	0	1	1	4
Both Malleolar	8	3	1	1	1	14
Trimalleolar	1	1	0	0	0	2

Table 4: Functional end results and fracture types based on Lauge and Hansen types

Lauge and Hansen ³	Results					Total
	Excellent	Good	Fair	Poor	Lost to Follow-up	
I(SER)	3	0	1	0	0	4
II(SA)	3	0	1	1	2	7
III(PER)	5	3	0	1	0	9
IV(PA)	5	3	0	1	1	10

SER- Supination External Rotation

SA- Supination Adduction

PER- Pronation External Rotation

PA- Pronation Abduction

Table 5: Comparison of complications with other studies

Study	Eugene [4]	Beauchamp <i>et al.</i> [5]	Our Study
Major Infection	12%	8%	6.66%
Minor Infection	9%	9%	0%
Failed Reduction	9.1%	0%	0%
Miscellaneous	1%	4.5%	0%
Others	31.1%	21.4%	0%

Observation

Study was done on 30 malleolar fracture patients. All were treated by operative methods. Three patients lost to follow up.

- Age, sex distribution and leg side involved:** In our study, 15(50%) cases were from 18-30 yrs of age group, 5(16.66%) in 31-40 yrs of age group, 2(6.66%) in 41-50 yrs of age group and 8(26.66%) in 51 and above age group. Regarding age incidence most of the patients were aged between 18 to 30 years, so the young and active individuals are more prone for ankle injuries. Males cases were 26 and females cases were 4. In our study most commonly involved side of leg was right with 20 (66.66%) patients and left sided involvement was in 10 (33.33%) patients.
- Mechanism of Injury:** In our study, ankle twist was found in 20 patients (66.66%), road traffic accident in 8 patients (26.66%) and fall from height injury was found in 2 patients (6.66%).
- Associated Injuries:** 7 cases (23.33%) were of associated fractures. People in operative group has fractures of

humerus, femoral shaft, trochanteric, clavicle. Also, few cases of stable compression vertebral fractures.

- Treatment of Individual fractures:** 14 cases of medial malleolus fractures were filled with tension band wiring, 8 cases with malleolar screw and 4 cases with cancellous screw. 12 cases of lateral malleolus fractures were fixed with lateral plate, 6 cases were fixed with lateral plate and interfragmentary fixation. 2 cases were fixed with intramedullary tens nail. 2 cases were fixed with posterior malleolar fixation, while one case was fixed with syndesmotic screw. At average of 13 weeks, 27 fractures united in a satisfactory manner (range of 6 -16 weeks). Three patients were lost to follow-up. Regular interval follow up for an average of 11 months (range 9 to 15 months) was done for all patients. Satisfactory results were seen in 27 cases out of 30 patients along with entirely normal ankles. Totally free pain was seen in most patients, but few experienced a sensitive ankle. One patients had occasional twinge discomfort but didn't required any treatment.

Complications

In our study there were 2 (6.66%) infected patients of the surgical wound of ankle fractures which were treated with debridement and antibiotic according to culture report.

Discussion

Ankle fracture is certainly a challenge to all orthopaedic surgeons, but literature doesn't provide any consensus or appropriate treatment for ankle fractures especially associated with ligament tears.

Displaced ankle fractures, if treated with conservative methods may lead to malunion, altered biomechanics of ankle and further to early degenerative arthritis with painful stiff ankle.

Excellent results are reported by many surgeons in treatment of displaced ankle fractures if operated by open reduction internal fixation using the AO-ASIF principles.

Most widely used systems for classification of ankle fractures are the Lauge-Hansen and Denis-Weber (A.O). Lauge – Hansen classification has genetic, detailed in nature and provides critical information about skeletal extent and ligamentous involvement.

On other hand, Weber classification focuses only on fracture of fibula with relation to syndesmosis. Thus, it is insensitive to degree of skeletal and ligamentous involvement. Furthermore type B included various injuries with different prognosis.

- **Age Distribution:** In our study, 15(50%) cases were from 18-30 yrs of age group, 5(16.66%) in 31-40 yrs of age group, 2(6.66%) in 41-50 yrs of age group and 8(26.66%) in 51 and above age group. Regarding age incidence most of the patients were aged between 18 to 30 years, so the young and active individuals are more prone for ankle injuries. No patients were seen below age of 18 years since all the green stick and epiphyseal injuries were excluded from the study. In a study done by Robert SR on 25 patients of ankle fractures, the mean age group having ankle fracture was around 40 years. In another study by Beris⁶ et.al done on 144 patients for ankle fractures, the mean age group having sustained ankle fracture was 30 years.
- In one more study by Liestal⁷ done on 108 patients of ankle fractures, the mean age group of patients with sustained ankle fracture was 41 years. Ankle fracture study series by Gardner MJ (2006)⁸ reported average was 59 years (range 18 to 84 years).
- **Sex Distribution:** In our study Males were more commonly involved. Males - 26 cases and Females -4 cases. In a study by ROBERT SR on 25 patients of ankle fractures the male: female ratio was 11:14 and male percentage was found to be 44%. Beris *et al.*⁶, in his study on 144 patients of ankle fractures the male: female ratio was 56:88 and male percentage was 38.8%. Xu HL (2012)⁹ in this study series of 235 ankle fractures did study on 105 males and 130 females. Steen L Jensen (1998)¹⁰ in his study had equal incidence rate of ankle fractures in both sexes of elderly age group. Incidence rate of ankle fracture was double in younger males compared to females.
- **Mode of Injury and Associated Injuries:** In our study, twisted ankle injury was found in 20 patients (66.66%), road traffic accident injury in 8 patients (26.66%) and fall from height injury in 2 patients (6.66%).
- There were 3 associated injuries seen in 3 patients. Among them 2 had major injuries and on the same side of ankle fracture which were treated simultaneously. One patient had head injury and surgery was delayed by 10 days. Baird *et al.*¹¹ in their study of ankle fractures of 25 patients found that 15 patients sustained injury due to fall from Height.
- Lee *et al.*¹² in his study done on 168 ankle fracture patients found that 98 patients had sustained injury due to Road Traffic Accident. Steen L Jensen (1998)¹⁰ in their study all the ankle fractures were caused by accidents which can be a fall due to slippery ground, while playing sports,

twisting of leg on stairs, fall from height and road traffic accidents. More than half of the fractures occurred in sports, play or leisure activities of which soccer is the most common sport during which injury occurred. In their study of 202 patients two third injuries were sport's related and one third injuries were related to road traffic accidents most common is cycling. 59 patients (28%) sustained injury due to slip of leg on a slippery floor and 62 patients (29%) were under the influence of alcohol within 4 hours before the accident.

- **Lauge Hansen's Classification:** In the present series 10 patients had Pronation Abduction type of injuries (33.33%), followed by Pronation External-rotation injuries 9 patients (30%), followed by Supination Adduction type of injury 7 patients (23.33%), and then Supination External Rotation injury with 4 patients (13.33%). ROBERT SR in this study on 25 patients of ankle fractures, Supination External Rotation (34%) was the most common type of injury, while another study by Beris⁶ *et al* on 144 patients found supination external rotation (45%) as most common type of injury in ankle fracture patients. Gardner MJ⁸ 2006 in their series of the 59 ankle fractures evaluated, 37 (63%) were classified as supination external rotation, 11 (19%) were pronation external rotation, 1 (2%) was supination adduction, and 10 (17%) were not classifiable on the basis of the Lauge-Hansen system. Of the 49 fractures that fit into Lauge-Hansen categories, 26 (53%) had patterns of ligamentous injury and fracture morphology that did not coincide with the Lauge-Hansen predictions.
- **Side of Leg Affected:** In our study most commonly involved side of leg is Right with 20 (66.66%) patients and Left sided involvement is in 10 (33.33%) patients. ROBERT SR in the study of 25 patient's ankle fractures observed that 14 (56%) patients had Right sided ankle fracture and 11 (44%) patients had Left sided ankle fracture. Beris *et al*⁶ in their study of 144 patients of ankle fractures observed that 73 (50.6%) patients had Right sided ankle fracture and 71 (49.3%) patients had Left sided ankle fracture.
- **Fixation of Posterior Malleolus:** In our study of 30 patients we had 2 (6.66%) cases with posterior malleolus of which one was fixed with help of Cannulated Cancellous Screw. Another was small fragment less than 30% of the articular surface so was not fixed. According to McLaughlin (1959) operative fixation was thought to be the only treatment that consistently produced a stable painless ankle when fracture of posterior malleolus involved more than 25% of the articular surface. Another study by McDaniel and Wilson in 1977 concluded that when posterior fragment is involved 25% or more, posterior malleolus treatment was associated with better functional results as compared to close reduction.
- **Different Fractures in Ankle:** In our study mostly 14 (46.66%) patients had Bi-Malleolar Fracture, 10 (33.33%) patients had Medial Malleolus Fracture, 4 (13.33%) had Lateral Malleolus Fracture and 2 (6.66%) had Tri-Malleolar Fracture. Ho PY¹³ in their study in June 2006 has isolated lateral malleolar fracture was the most common (8/18), whilst six had bi-malleolar fractures, 3 were isolated medial malleolus fracture and 1 was tri- malleolar fracture.
- **Final Result:** In our series of 30 patients we found 16 patients with excellent functional end result, 6 patients having good functional end result 2 having fair and 3 having poor functional end result with 3 lost to follow up patients.

In all 30 patients having 73.33% (excellent and good) end results. This result is compared with the series of R A Denham^[14] (1964) 67%, H. Nevile Burwell^[15] (1965) 82%, Skillbred (1974) 80%, I.A.O.D. Brodie^[16] (1974) 80%, Jeffery W. Mast^[17] (1980) 91%, Babis G.C. (July 2000) 88.4%. Lash N, Horne^[18] *et al.* in October 2002 in his study on 141 patients having sustained ankle fractures, 74 were followed up 2 years. Fractures of all type had an averaged Olerud-Molander ankle scores of 71.1. While other like Weber A fractures had an average ankle function scores of 90, Weber B fractures 80, and Weber C fractures 78. Four patients (5%) achieved 'poor' results, twelve (16%) patients managed to achieve a 'fair' result, thirty (41%) patients gained a 'good' result, while twenty seven (36%) patients' attained 'excellent' results in their study on 73 patients.

Results of our study highlighted almost 53.33% patients had excellent, 20% good, 6.66% fair and 10% poor results according to Scoring system devised by Olerud and Molander^[2]. 10% patients lost to follow up. Therefore, open reduction and internal fixation is an important therapeutic treatment option in case of ankle joint fracture, with very less chance of developing complications.

Our study puts forward that anatomical reduction of the fracture and restoration of the joint congruity of the ankle is possible at the earliest. A plaster slab or cast upto 6 weeks for post-operative immobilization will not affect final outcome with respect to achievement of ankle and subtalar range of movements. Most patients will have full range of motion by end of 12 weeks.

Conclusion

Ankle fractures occur most commonly due to ankle twist as a result of leg slip in adults. Right sided ankle is most commonly involved. According to Lauge Hanse Classification on ankle fractures, pronation dorsiflexion is extremely rare and pronation abduction injury dominates the study.

Open reduction and internal fixation with k wire tension band wiring for medial malleolus and 1/3rd semi-tubular plate for fibula is the treatment of choice for displaced bi- malleolar fractures. In case of posterior malleolus fracture if the intra-articular fragment is more than 30% then should be fixed with percutaneous Cannulated Cancellous Screw with washer. Close to anatomical reduction should be achieved for better outcome. Early reduction and fixation seems to have been giving good results. Early fixation reduces the hospital stay, if the fixation is stable can start with early mobilization which avoids the post-operative ankle stiffness. Weight bearing should be delayed upto 2 months as it may lead to implant failure. Post-operative immobilization in a plaster slab or cast for 6 weeks will not affect final outcome of ankle movements and would gain full range motion by end of 12 weeks.

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