

Functional and radiological outcome of the malleolar fractures of the ankle joint treated with various surgical modalities

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Abstract

Background: The bones of the ankle mortise are injured more often than any other bones except lower end of radius. Ankle joint is the most congruous joint in the lower extremity bearing upto five times the body weight. In treating malleolar fractures, restoration of anatomical alignment is highly essential. This is because; only a slight variation from normal is incompatible with good joint function. The aim of the study is to determine functional and radiological outcome of various surgical modalities for treating malleolar fractures, which will allow us to practice more efficiently. **Materials and Methods:** This is a prospective, non-randomized single center study of 30 patients with fresh unimalleolar, bimalleolar and trimalleolar fractures. The fractures were classified based on Lauge-Hansen's and Denis-Weber classification in adults. Under spinal anesthesia, Open reduction and internal fixation of the malleolar fractures were performed by tension band wiring, malleolar screw, K-wire fixation or semi-tubular plating with screws. All patients were functionally evaluated by using The Karlsson functional Scoring System of ankle fractures. **Results:** In present study 17 (56.67%) were bimalleolar fracture, 8 (26.67%) were trimalleolar fracture and 5 (16.67%) were unimalleolar fractures. According to Kristenson's radiological criteria 25 (83.3%) patients have good criteria and 4 (13.3%) patients have fair and 1 (3.3%) patient have poor criteria. In the present study of 30 patients with ankle fractures treated by open reduction and internal fixation; Good results were achieved in 23 (76.66%) patients, fair in 5 (16.66%), and Poor in 2 (6.66%) patients. Good results were observed in all isolated malleolar and bimalleolar fractures. Two (14%) patients of with tri-malleolar fracture had poor results. **Conclusion:** Anatomical reduction is essential in all intra articular fractures more so if a weight bearing joint like ankle is involved. Open reduction and internal fixation guarantee high standard of reduction besides eliminating the chances of loss of reduction. Results of different operative modalities used for treating malleolar fractures of the ankle joint cannot be compared to each other, as selection criteria for them are entirely different. We recommend the use of Karlsson's functional scoring for functional assessment of patients with ankle fractures which are treated surgically because it is easier and more precise.

Keywords: Ankle Joint, Fracture, Mortise, Malleolar Fractures.

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Received Date: 04/05/2020 Revised Date: 19/07/2020 Accepted Date: 14/08/2020

DOI: <https://doi.org/10.26611/1031611>

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Accessed Date:
05 October 2020

INTRODUCTION

The bones of the ankle mortise are injured more often than any other bones except lower end of radius. This is because they are relatively mobile and bear much of the stresses associated with weight bearing. On occasions such as during vigorous exercise the ankle has to endure forces greater than 5 times the body weight. The Ankle joint supports more weight per unit area than any other joint in the body¹. Ankle joint is the most congruous joint in the lower extremity bearing upto five times the body

weight². To understand the treatment of any fracture of ankle joint, it is of paramount importance to understand the mechanism of injury by which it is produced. Different classification system in case of malleolar fractures are:

- Ashurst and Bromer's Aetiological Classification³
- Henderson's Anatomical Classification⁴
- Lauge - Hansen's Genetic Classification^{5,6}
- Danis – Weber⁷ and AO's Topographical Classification⁸

In treating malleolar fractures, restoration of anatomical alignment is highly essential. This is because; only a slight variation from normal is incompatible with good joint function. This is especially true in cases of displaced fracture of fibula. Ramsey and Hamilton have reported that only 1mm lateral shift of talus decreases contact area by 40% and displacement of 3 mm decreases contact area by 60%⁹. In today's age, when different implants and different modalities are available for the treatment of malleolar fractures, no method is perfect and each one has its pros and cons. It is important to individualize treatment modality for every patient and not to be restricted by rigid protocols. So, Aim of the study is to determine functional and radiological outcome of various surgical modalities for treating malleolar fractures, which will allow us to practice more efficiently.

MATERIALS AND METHODS

This is a prospective, non-randomized single center study of 30 patients with fresh unimalleolar, bimalleolar and trimalleolar fractures. As soon as the patients were brought to the casualty a complete survey was carried out to rule out significant injuries. Then the patients radiograph's were taken in anteroposterior, mortise and lateral views of the ankle joints. The fractures were classified based on Lauge-Hansen's and Denis-Weber classification in adults. Routine investigations were done for all patients. Under spinal anesthesia, Open reduction and internal fixation of the malleolar fractures were performed by tension band wiring, malleolar screw, K-wire fixation or semi-tubular plating with screws. All patients were functionally evaluated by using The Karlsson functional Scoring System¹⁰ of ankle fractures. Clinical assessment included the physical examination of swelling, tenderness, range of motion, and strength. Criteria to be consider is Karlsson-Peterson Ankle Score to evaluate postoperative outcomes, and functional assessments at final follow-up will be graded according to the criteria of Okuda *et al.* (good, 90-100; fair, 75-89; poor, <75). We will consider good (more than 90 points) as satisfactory improvement and fair and poor (less than 90) as unsatisfactory improvement.

The Karlsson functional Scoring System of ankle fractures (100Points)¹⁰

CHARACTERISTICS	POINTS
Instability	
No instability	25
1 or 2 sprains each year (during exercise)	20
1 or 2 sprains each month (during exercise)	15
Walking on uneven ground	10
Walking on even ground	05
Constant (severe), using ankle support	00
Pain	
None	20
During exercise	15
Walking on uneven surface	10
Walking on even surface	05
Constant (severe)	00
Swelling	
None	10
After exercise 5	05
Constant 0	00
Stiffness	
None	05
Moderate	02
Marked (constant, severe)	00
Work, sports activities, and activities of daily living	
Same as preinjury	15
Same work, less sports, normal leisure activities	10
Light work, less sports, normal leisure activities	05
Severe impaired working capacity, decreased	00
Leisure activities	
Stair climbing	
No problems	10
Impaired (instability)	05
Impossible	00
Running	
No problems 10	10
Impaired 5	05
Impossible 0	00
Support	
None	05
Ankle support during exercise	02
Ankle support during daily activities	00

All patients were radiologically evaluated by Kristenson's radiological criteria¹¹ at final follow up.

Kristenson's criteria¹¹

The criteria for the radiological assessment as given by is

Good-

Talus Correctly placed Medial Malleolus No displacement or fracture gap of less than 2mm Lateral malleolus Negligible lateral displacement and up to 2mm of Posterior displacement Posterior malleolus Upward displacement of less than 2 mm

Fair -

Talus Correctly positioned. Medial Malleolus Anterior or posterior displacement of 2-5 mm and a fracture gap of 2-5 mm

Lateral malleolus Lateral displacement up to 2mm and posterior displacement of 5 mm
Posterior malleolus Displacement of 2-5mm

OBSERVATION AND RESULTS

All the fractures were followed until fracture union occurred. Results were analyzed by both clinically and radio graphically. Almost all fractures were united at the end of 10 weeks. Majority of patients i.e.10 (33.33%) were from 36-40 years age group. The youngest was 23 years old and oldest was 62 years of age. The mean age in our study was 35.13 years. The major cause of fracture in our study was road traffic accidents in 22 (76.67%) and in 5 (13.33%) patients fracture was due to slipping and stumbling. The rest three patients had fractures due to other causes.

In the present series 12 (40%) patients had pronation abduction injuries which is the majority followed by 8 (26.7%) patients having supination external rotation and 5 (16.7%) patients supination adduction and among the remaining three (10%) had pronation external rotation and two (6.7%) patient had pronation dorsiflexion.

Table 1: Distribution of patients with respect to type of fracture by LH

Type of Fracture (LH Classification)	Number of Patients	Percentage (%)
PABD	12	40.0
PD	2	6.7
PER	3	10.0
SADD	5	16.7
SER	8	26.7
TOTAL	30	100.0

Majority of patients had Denis Weber type B fractures 18 (60%) followed by type A in 8 (26%) patients and least is type C in 4 (14%) patients. In present study 17 (56.67%) were bimalleolar fracture, 8 (26.67%) were trimalleolar fracture and 5 (16.67%) were unimalleolar fractures. According to Kristenson's radiological criteria 25 (83.3%) patients have good criteria and 4 (13.3%) patients have fair and 1 (3.3%) patient have poor criteria. In present study 23 (76.7%) patients have good Karlsson's score, 5 (16.7%) patients have fair and 2 (6.7%) patients have poor Karlsson's score. There were total of 28 lateral malleolar fracture. Majority 21 (75%) were fixed with 6 holed 1/3rd semitubular plate; 2 (7.14 %) was fixed with 8 holed 1/3rd semitubular and one (3.57%) was fixed with 12 hole semitubular plate. Tension band wiring was done in 3 (10.71 %) cases. Lag screw was done in one case (3.57%). In our series there were 27 cases with medial malleolar fractures, tension band wiring was done in 9 (33.33 %) cases with medial malleoli fractures. In 18 (66.66 %) cases 4.5 mm malleolar screws were used. In our series there

were 8 cases of posterior malleolar fractures, only one case was fixed with 4.5 mm lag screw (12.5%).

Majority 29 (96.66%) patients could walk desired distances without limp or pain and only one patient was able to walk desired distance with slight pain. 24 patients were able to run desired distances without pain, 5 (16.66%) patients were able to run desired distances with slight pain and 1 (3.33%) patients had moderate restriction in ability to run with mild pain. In our series 29 (96.66%) patients were able to perform usual occupation without restriction and the rest 1 (3.33%) patients were able perform usual occupation with restriction in some strenuous activities. In this series 27 (90%) patients had range of motion of the ankle within 10° of uninjured ankle and 2 (6.66%) patients were having motion within 15° of uninjured ankle. The rest 1 (3.33%) patient had motion with in 20° of uninjured ankle.

Table 2: Distribution of patients with respect to age group and final outcome

Age Group	Outcome			Total	P-Value
	Good	Fair	Poor		
≤ 25	4	0	0	4	0.685
26-30	5	1	0	6	
31-35	4	1	0	5	
36-40	8	1	1	10	
> 40	2	2	1	5	
Total	23	5	2	30	

By using Fisher's exact test p-value > 0.05 therefore there is no significant association between final outcome and age (years).

Table 3: Distribution of patients with respect to type of injury by LH and final outcome

Type of Fracture (LH classification)	Outcome			Total	P-Value
	Good	Fair	Poor		
PABD	11	1	0	12	0.012
PD	0	2	0	2	
PER	1	1	1	3	
SADD	4	1	0	5	
SER	7	0	1	8	
Total	23	5	2	30	

Fisher's exact test p-value < 0.05 therefore there is significant association between final outcome and type of injury by LH.

Table 4: Distribution of patients with respect to type of fracture and final outcome

Type of Fracture	Outcome			Total	P-Value
	Good	Fair	Poor		
Unimalleolar	5	0	0	5	0.029
Bimalleolar	15	2	0	17	
Trimalleolar	3	3	2	8	

By using Fisher's exact test p-value < 0.05 therefore there is significant association between final outcome and type

of fracture. In the present study of 30 patients with ankle fractures treated by open reduction and internal fixation; Good results were achieved in 23 (76.66%) patients, fair in 5 (16.66%), and Poor in 2 (6.66%) patients. Good results were observed in all isolated malleolar and bimalleolar fractures. Two (14%) patients of with tri-malleolar fracture had poor results. The patient with poor result had mild pain with activities of daily living, diminution in the abilities to run and to do work, reduced motion of ankle and narrowing of joint space.

DISCUSSION

Increased knowledge about the normal and post traumatic anatomy and function of the ankle joint has led to demand for exact reduction and rigid fixation of the ankle fractures. Prompt operative treatment of displaced ankle fractures decreases morbidity and improves functional outcomes^{12,13,14}. The treatment of malleolar fractures with accurate open reduction and stable internal fixation using AO method and principles was found to give a high percentage of excellent and good results¹⁵. This present study supports this conclusion. Although the functional scoring system of Karlsson has proven to be strict allowing only very small fluctuation from normal joint; about 76.66% patients in this series achieved good results by that scoring system; 16.66% patients achieved fair results and 6.66% patients achieved poor results. According to Kristenson's radiological Criteria, 83.33% patients achieved good results; 13.33% patients achieved fair results and 3.33% patients achieved poor results. The results in this study were compared with that of Burnwell and Charnley¹⁴, Colton¹⁶, DeSouza *et al.*¹⁷, Beris *et al.*¹⁵. In Colton¹⁶ series he found that eighteen (70%) patients had good to excellent results. Burnwell and Charnley¹⁴ in their series of 132 patients, 102 (77.3%) had good results, 16% had fair results and 6% patients were found to have a poor score. In the study conducted by DeSouza *et al.*¹⁷ on 150 fractures of ankle treated by open reduction and stable internal fixation using AO ASIF method obtained 90% good results. In a study conducted by Beris *et al.*¹⁵ of 144 patients with ankle fracture there were good to excellent results in 74.3% patients, fair results in 14.6% and poor result in 11.1%. All these were comparable to this present study where 76.66% patients with ankle fractures had good results, 16.66% patients had fair results and poor results in 6.66% patients. Observation in this study support the contention of Yablon *et al.*¹⁸ that lateral malleolus is the key to the anatomical reduction of bimalleolar fractures, because the displacement of the talus faithfully followed that of the lateral malleolus. Poor reduction of distal part of fibula would result in persistent lateral displacement or residual shortening. This does not necessarily lessen the importance of the medial malleolus in contributing to the

congruity of medial aspect of ankle, but it does serve to emphasize that the lateral malleolus should no longer be ignored in the treatment of ankle injuries. The patient who had poor result did not have anatomical reduction of lateral malleolus. The extent of skeletal involvement had a significant prognostic value in the outcome where uni-malleolar and bimalleolar fracture were associated with better result compared with tri-malleolar fractures. The presence of a posterior bony fragment greater than 25% of the joint surface has been shown previously to affect the outcome and increase the risk of osteoarthritis. In this series there were eight patients with posterior malleolar fractures. Only one (14.2%) patient with tri-malleolar fracture was treated by fixing the posterior fragment. Posterior malleolar fragment was fixed with posterior lag screw. Out of 8 patients with posterior malleolar fracture 25% had good results. 50% of the patients who had tri-malleolar fractures had fair results and 25% had poor results. The decision of fixing was taken according to the assessment of the size of the posterior malleolar fragment. According to Makwana¹⁹ the risk of complications after internal fixation is low but higher with closed treatment. Most of the complications were minor which resolved within 3 months. Significantly in this study there were no non unions of the medial malleolus and no malunions which were reported in some series to occur in 30% and 48% respectively after closed reduction.

In the present study the decisive factors that influence the results are –

1. Type of fracture, severity of injury is inversely proportional to the final results obtained.
2. The number of patients with fracture of posterior malleolus who had residual displacement was relatively small, but the results confirmed the general impression that such injuries are of little significance when they involve less than 25% of the articular surface. In the present study 8 cases had posterior malleolus fractures and only 2 cases had more than 25% involvement of the articular surface. This is suggestive that severities of tri-malleolar fractures at the ankle joint are associated with poor functional and radiological outcome.
3. Plaster cast immobilization for 3 weeks did not diminish the ankle motion. The ranges of motion were reduced initially but after the cast removal the ankle movements rapidly improved. The rapid gaining of motion from 3 to 12 weeks may be due to the positive attitude to exercise and resumption of weight bearing at 6 weeks.

CONCLUSION

Malleolar fractures of the ankle have a varied presentation. They can range from isolated fibular fractures with no

displacement to a tri-malleolar injury with dislocation and vascular compromise. A broad understanding of all aspects of mechanism of injury, pathoanatomy and treatment options coupled with training experience is required before any attempt should be made to treat these injuries with thorough understanding of injury patterns repair of the damaged ankle joint can lead to rewarding outcomes for the patient and physicians. Anatomical reduction is essential in all intra articular fractures more so if a weight bearing joint like ankle is involved. Open reduction and internal fixation guarantee high standard of reduction besides eliminating the chances of loss of reduction. Results of different operative modalities used for treating malleolar fractures of the ankle joint cannot be compared to each other, as selection criteria for them are entirely different. Our study used Lauge-Hansen's classification for mechanism of injury and Kristenson's criteria for radiological assessment. We recommend the use of Karlsson's functional scoring for functional assessment of patients with ankle fractures which are treated surgically because it is easier and more precise.

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Source of Support: None Declared
Conflict of Interest: None Declared

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