

## OSTEOSYNTHESIS IN SURGICALLY MANAGED BIMALLEOLAR ANKLE FRACTURES IN ADULTS

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### Abstract

**Introduction:** Ankle fractures are the most common type of fractures treated by orthopaedic surgeons. Malleolar fractures are one of the most common fractures in orthopaedic traumatology. As with all intra-articular fractures, malleolar fractures necessitate accurate reduction and stable internal fixation. As for the treatment of malleolar fractures, the stable ones are reduced by conservative treatment. The other unstable, displaced and open fractures require Open Reduction and Internal Fixation (ORIF). The superiority of ORIF over closed treatment has been thoroughly demonstrated in literature. The purpose of this study is to assess the functional outcome and results of surgical treatment of bimalleolar fractures.

**Materials and methods:** This study is conducted in GVPIHC&MT, Visakhapatnam. Patients presenting to the casualty and admitted with bi-malleolar fractures were selected. This is a prospective observational study. The duration of study period is one year 6 months of regular study from Jan 2023 to Jun 2024 including 6 months of follow up after surgery. A total of 40 cases satisfying the following the inclusion and exclusion criteria alone were included in the study.

**Results:** We worked with 40 adult patients. The overall score secured under the O-M system was used to categorise patients into four groups as having the functional outcome 'excellent', 'good', 'fair' and 'poor'. It was seen that the patients falling in the four categories constituted 22.5%, 55%, 17.5% and 5% respectively. Minor complications arose in 5 cases and they were treated with medication. It was further found that, with increase in age, the time taken for union also increased. It was also evident that sex of the patient had no bearing on the functional outcome of surgery.

**Conclusion:** The study lends support to the hypothesis that Open Reduction and Internal Fixation yields excellent to good results in restoring the normal anatomy of the joint. This conclusion assumes importance because every single patient is unique.

**Key Words:** Trauma, Internal Fixation, fracture, Open Reduction, functional outcome, O-M (Olander and Mollerud score).

### INTRODUCTION

Hippocrates is a pioneer. His medical essays deal with, among others, the management of injuries, including fractures. The biologic aspects of fractures expanded in recent years. Patients have become more demanding. Technology has also evolved to meet the expectations of the patients (Paige Whittle,

2017).<sup>1</sup>The chosen treatment method should ideally result in bone and soft tissue healing and optimal functional recovery with least complications (Paige Whittle, 2017).<sup>1</sup>

Ankle fractures are the most common type of fractures treated by orthopaedic surgeons. There has been an increase in the prevalence of such fractures over the last two decades both in the young and in the elderly (Krishna Bhargava et al, 2017)<sup>2</sup>. Sir Robert Jones is of the opinion that ankle is the most injured joint of the body but the least well treated. Ankle injuries gain importance because body weight is transmitted through the joint and locomotion depends upon the stability of it. They are usually mixed injuries, ligamentous and bony, each injury is an end result of the sequence of ligamentous and bony failure due to deforming forces (Carragee, et al, 1991).<sup>3</sup>

Malleolar fractures are one of the most common fractures in orthopaedic traumatology. As with all intra-articular fractures, malleolar fractures necessitate accurate reduction and stable internal fixation. When malleolar fractures are not reduced accurately they may lead to post-traumatic painful restriction of motion or osteoarthritis or both (Beris, et al, 1997)<sup>4</sup>. As for the treatment of malleolar fractures, the stable ones are reduced by conservative treatment. The other unstable, displaced and open fractures require Open Reduction and Internal Fixation (ORIF) (Weber, 1993)<sup>5</sup>. The superiority of ORIF over closed treatment has been thoroughly demonstrated in literature. (Attarian DE, Mc Crackin HJ, De vito DP et al)<sup>6</sup>

### **AIM & OBJECTIVES OF THE STUDY**

The overall aim here is to study the functional outcome of osteosynthesis of bimalleolar ankle fractures by various surgical modalities in adults. Specifically the study seeks to:

- a) To re-establish the anatomy of the malleoli by maintaining the fibular length and ankle joint congruity perfectly, by operative treatment with internal fixation.
- b) To assess the union of fractures after surgical treatment.
- c) To assess complications after surgical treatment.
- d) To assess the range of movements of the ankle joint after surgical treatment.

### **MATERIALS AND METHODS**

This study is conducted in GVPIHC&MT, Visakhapatnam. Patients presenting to the casualty and admitted with bi-malleolar fractures were selected. This is a prospective observational study. The duration of study period is one year 6 months of regular study from January 2023 to June 2024 including 6 months of follow up after surgery. A total of 40 cases satisfying the following the inclusion and exclusion criteria alone were included in the study.

#### **Inclusion Criteria:**

- 1. Patients who are medically fit for surgery.
- 2. Patients in whom achievement or maintenance of closed reduction failed.
- 3. Patients with closed type of fractures.
- 4. Patients having unstable bimalleolar fractures of ankle that may result in talar displacement or widening of ankle mortise.

5. Patients in the age group of 20-60 years.

#### **Exclusion Criteria:**

1. Patients who are medically unfit for surgery.
2. Patients who are treated by non-operative methods.
3. Patients with compound fractures of the ankle.
4. Patients with stable malleolar ankle fractures (treated conservatively).
5. Patients who are below 20 years and above 60 years.

#### **OPERATIVE STEPS:**

The operative steps to be followed in the study are as follows. Spinal anaesthesia or General anaesthesia is administered. The patient is placed in supine position with a sand bag under the ipsilateral buttock. Following exsanguination, tourniquet is inflated with time being noted. The affected limb is prepared with Betadine. The parts are then painted with Betadine and Spirit. Surgical draping is done using the standard methods and the foot is covered with a hand towel or a glove. The operative approach for the fixation of the lateral malleolus is done as per the standard approaches, depending on the mode of fixation planned. The lateral malleolar fracture is exposed first. Lateral malleolar fixation is done. Later Medial malleolus is approached according to the mode of fixation planned using the standard approaches. Surgery is done under tourniquet control. The implants used for the fixation of fractures are as follows:

The medial malleolus is fixed with one of the following:

- Cannulated cancellous screws.
- Malleolar screws.
- Tension band wiring with screw and sand
- K-wires.

The lateral malleolus is fixed with one of the following:

- Semitubular plate.
- One third tubular plate.
- Dynamic compression plate.
- Syndesmosis screw.
- Rush nail.

#### **POST-OPERATIVE PROTOCOL:**

Parenteral antibiotics were given in the post-op period. After 10 to 12 days, the sutures were removed and a below knee cast was applied for 4 weeks. Non-weight bearing gait was started from first or the second postoperative day. Partial weight bearing was started after the removal of the cast (after clinical and radiological signs of union become evident). Active exercises of the ankle were advised.

## RESULTS

The findings of the study conducted in GVPIHC&MT, Visakhapatnam among 40 patients surgically managed for malleolar fractures of ankle between January 2023 and June 2024 are presented below. To begin with, we employ simple statistical tools like means, percentages etc., to comment on the characteristics of the patients, surgical procedures and the functional outcome of surgeries day. Towards the end we also employ a multiple linear regression model to provide statistical dimension to the study. The regression model is used to find out the factors that influence the functional outcome of surgical procedures adopted in treating the patients.

### CHARACTERISTICS OF THE PATIENTS AND INJURIES:

#### Distribution of patients by age& sex:

As noted, we worked with 40 adult patients. A large majority of them, to be precise, 65% of them, were in the age-group between 21 and 40 years. The rest, 35% of the patients fell in the 41-60 age-group. We classified the patients by gender, 70% of them were males. The likelihood of males meeting with accidents appears more.

Table1:Distribution of patients by age					
Age in years	21-30	31-40	41-50	51-60	Total
No. of cases	15	11	5	9	40
Percentage	37.5	27.5	12.5	22.5	100

Table2:Distribution of patients by sex			
Sex	Males	Female	Total
No. of cases	28	12	40
Percentage	70	30	100

#### Distribution of patients by fracture type:

Lauge-Hansen (LH) classification is used to identify the type of fracture. Most injuries, 40%; were of the SER type. SA type injuries amount to 25%, PER type 22.5% and PA type12.5%.

Table 3: Distribution of patients by fracture type according to LH type					
LH Type	SA	SER	PA	PER	Total
No. of cases	10	16	5	9	40
Percentage	25	40	12.5	22.5	100

## DISTRIBUTION OF PATIENTS BY TYPE OF TREATMENT:

### Medial Malleolus:

The most common type of treatment in case of medial malleolus fractures is to fix it with Malleolar Screw – 72.5% of the patients were treated in this manner. The other types of treatment in order of importance were K-wire (12.5%), LCP (10%) and TBW (5%) (Table 4).

Table 4: Distribution of patients by type of treatment: Medial Malleolus					
Implants	Mal. Screw	LCP	TBW	K-Wire	Total
No. of cases	29	4	2	5	40
Percentage	72.5	10	5	12.5	100

### Lateral Malleolus:

Table 5: Distribution of patients by type of treatment: Lateral Malleolus					
Implants	PIN	LCP	TBW	K-Wire	Total
No. of cases	2	22	5	11	40
Percentage	5	55	12.5	27.5	100

LCP was the most common type of

treatment for fixing lateral malleolus – 55% of the cases were treated this way. Next important way of fixing lateral malleolus is through K-wire these cases account for 27.5%. In 12.5% of the cases TBW was employed and in 5% of the cases Pin was used (Table 5).

## DISTRIBUTION OF PATIENTS BY FUNCTIONAL OUTCOME:

### Duration of union:

The shorter the duration taken for union, the better it is. It is seen that in 35% of the patients the union occurred in 3months, 30% of the cases in 4months and another 30% of the cases in 5 months. It is only in 5% of the patients the union occurred in 6 months (Table 6).

<b>Table 6: Distribution of patients by duration of union in months</b>					
<b>Duration</b>	<b>3 months</b>	<b>4 months</b>	<b>5 months</b>	<b>6 months</b>	<b>Total</b>
No. of cases	14	12	12	2	40
Percentage	35	30	30	5	100

**Summary statement of the Olerud and Molander scores:** Based on the total score secured under Olerud and Molander system, the functional outcome was found to be ‘excellent’ among nine of the 40 patients (22.5%), ‘good’ in respect of 22 cases (55%), ‘fair’ in seven cases (17.5%) and ‘poor’ in two cases (5%) (Table 7).

<b>Table 7: Distribution of patients by functional outcome</b>					
Functional Result (score)	Excellent 91-100	Good 61-90	Fair 31-60	Poor 0-30	Total
No. of cases	9	22	7	2	40
Percentage	22.5	55	17.5	5	100

**Functional outcome versus surgical procedure (Medial Malleolus and lateral malleolus):**

In the two-way Table 8 & 9 given below we cross classified patients by functional outcome and the surgical procedure involving Medial Malleolus and lateral malleolus.

**Table 8: Distribution of patients by functional outcome and by surgical procedure–  
Medial Malleolus**

<b>Functional outcome</b>	<b>Surgical procedure: Medial Malleolus</b>				<b>Total</b>
	<b>Screw</b>	<b>LCP</b>	<b>TBW</b>	<b>K-Wire</b>	
Excellent	6	1	1	1	9
Good	17	1	0	4	22
Fair	5	1	1	0	7
Poor	1	1	0	0	2
Total	29	4	2	5	40

**Table 9: Distribution of patients by functional outcome and by surgical procedure –Lateral Malleolus:**

<b>Functional outcome</b>	<b>Surgical procedure: Lateral Malleolus</b>				<b>Total</b>
	<b>Pin</b>	<b>LCP</b>	<b>TBW</b>	<b>K-Wire</b>	
Excellent	0	5	0	4	9
Good	1	12	3	6	22
Fair	0	4	2	1	7
Poor	1	1	0	0	2
Total	2	22	5	11	40

### Complications:

It is observed that complications arose in respect of 5 patients—superficial infection in 2 cases, deep infection in 1 case and delayed union in 2 cases. The infections were treated with debridement and antibiotics, where as continued immobilisation was resorted to, for the delay in the union.

### STATISTICAL ANALYSIS OF FUNCTIONAL OUTCOME:

It is useful to statistically analyse our data for a proper understanding of the efficacy of the surgical procedures. We employ the regression technique in the process. Through the regression analysis it is possible to find the factors influencing the functional outcome. Employing the multiple linear regression technique, we study as to what extent the functional outcome (as indicated by the total score under Olerud and Molander system and by the months taken to secure union) depends upon variables such as age of patient, gender, and gap between injury and surgery.



Fig1:PreOperativeX-Ray



Fig 2:ImmediatePostOpX-Ray



Fig3:FollowUpX-RayAfter10Weeks



Fig4:SquattingPosition





**Fig 5: Pre and post op**



**Fig 6: follow up xray and squatting**

## **DISCUSSION**

In the Indian context, where a majority of people belong to the lower rung of the economic ladder and, therefore, need early mobility of the ankle to carry out their usually manual work, it is important to make sure that malleolar fractures of the ankle are appropriately treated through open reduction and internal fixation (ORIF) in order to avoid complications. The goals of treatment of ankle fracture include achieving a sound union of fracture and an ankle that moves and functions normally without pain. The overall aim of the present study was to assess the functional outcome of osteosynthesis of bimalleolar ankle fractures by various surgical modalities in adults in the 20-60 years age-group.

The study gives the impression that men were more likely to suffer from the ankle fractures than women. Road traffic accidents were the main cause of the fractures. The government's healthcare programme under *Arogyasri* seemed to enable patients to seek medical attention rather quickly. Therefore, the gap between injury and surgery was found to be generally short. Most injuries were of the SER type and in 80% of the cases hospitalization of the patients extended over 6 to 9 days.

The surgical procedures adopted to manage the ankle fractures differs depending on whether it is medial malleolus or lateral malleolus fracture. Fractures of the medial malleolus type were fixed with malleolar screw, LCP, TBW or K-wire. On the other hand, fractures of the lateral malleolus type were fixed with pin, LCP, TBW or K-wire. (Barnett CH, Napier JR)<sup>7</sup>.

It was noted that the time taken for union was 5 months or less in all but two cases. The efficacy of the surgical procedures was assessed following the Olerud and Molander scoring system. Of the 40 patients, pain ceased totally within the follow-up period in 16 cases, there was no stiffness at all in 37 cases, swelling was not a problem in 24 cases, there was no difficulty in stair climbing in 25 cases. However, for many running, jumping and squatting was a problem. It was noted that 21 of the 40 patients could carry out their activities of daily life in just the same way as they did before the injury, in nine cases the patients had to switch to simpler jobs. In no case was a patient severely impaired to work.

The overall score secured under the O-M system was used to categorise patients into four groups as having the functional outcome 'excellent', 'good', 'fair' and 'poor'. It was seen that the patients falling in the four categories constituted 22.5%, 55%, 17.5% and 5% respectively. It was further noted that the functional outcome was generally better when the fractures were of the SER and SA type. Further, the results were excellent or good where a screw was used in the surgical procedure involving Medial Malleolus. In case of lateral malleolus, LCP generally yielded excellent to good results. Use of K-Wire also proved to be excellent or good. Minor complications arose in 5 cases and they were treated with medication.

A multiple linear regression technique was employed to statistically assess the efficacy of the surgical procedures (Baumhauer J 2006)<sup>8</sup>. Employing the regression technique, we studied as to what extent the functional outcome (as indicated by the total score under Olerud and Molander system and by the months taken to secure union) depended upon variables such as age of patient, gender, and gap between injury and surgery (Bray TJ, Endicott M, Capra SE. 1989)<sup>9</sup>. It was seen that the three variables together accounted for 55.32% variation in the functional outcome as evident from the O-M score. However, of the three independent variables, only the coefficient of the age of the patient was statistically significant. It had a negative sign meaning that surgical procedure was less likely to yield excellent results as the age of the patient increased (Bröstrom L. 1964)<sup>10</sup>. It was further found that, with increase in age, the time taken for union also increased. It was also evident that sex of the patient had no bearing on the functional outcome of surgery.

### **CONCLUSION**

In the Indian context, where a majority of people belong to the lower rung of the economic ladder and, therefore, need early mobility of the ankle to carry out their usually manual work, it is important to make sure that malleolar fractures of the ankle are appropriately treated through open reduction and internal fixation (ORIF) in order to avoid complications. The goals of treatment of ankle fracture include achieving a sound union of fracture and an ankle that moves and functions normally without pain. The study lends support to the hypothesis that Open Reduction and Internal Fixation yields excellent to good results in restoring the normal anatomy of the joint. This conclusion assumes importance because every single patient is unique.

### **REFERENCES**

1. Paige Whittle. (2017) *Campbell's Operative Orthopaedics*, 13th Edition, 2656.
2. Krishna Bhargava Vem, Anvesh Kumar Kondlapudi, Saipavan Kumar Murari, Srinivasa Murthy D. (2017) Outcome of surgical management of bimalleolar fractures in adults. *Asian J Pharm Clin Res*, 10 (11), 252-256.
3. Carragee, E. J., Csongradi, J. J., & Bleck, E. E. (1991) Early complications in the operative treatment of ankle fractures. Influence of delay before operation. *The Journal of bone and joint surgery. British volume*, 73(1), 79-82.
4. Beris AE, Kabbani KT, Xenakis TA, Mitsionis G, Soucacos PK, Soucacos PN. (1997) Surgical treatment of malleolar fractures – a review of 144 patients. *Clin. Orthopaedics Related Research*. Aug; 341:90-8.
5. Weber MJ. (1993) Ankle fractures and dislocations. *Operative Orthopaedics*, Chapter-50, 2nd edn., Ed. Chapman MW, Madison M. Philadelphia: J.B. Lippincott Company; 3:731-748.

6. Attarian DE, Mc Crackin HJ, De vito DP et al. (1985) Biomechanical characteristics of human ankle ligaments. Foot and Ankle,6: 54-58.
7. Barnett CH, Napier JR. (1952) The axis of rotation at the ankle joint in man; its influence up on the form of the talus and the mobility of the fibula. J.Anat;86(1):1-9.
8. Baumhauer J (2006) Foot and ankle.Chap.19.Greene:Netter's Orthopaedics, 1st ed. Saunders:398.
9. Bray TJ, Endicott M, Capra SE. (1989) Treatment of open ankle fractures. Clin. Orthop. 240:47-52.
10. Bröstrom L. (1964) Sprained ankles. Anatomic lesions in recent sprains. Acta Chir Scand; 128:483.