

A Prospective Study of Surgical Management and Functional Outcome of Medial Malleolus Fracture in Adults

Javid Ansari¹, T. Sankaralal²

^{1,2}Department of Orthopaedics, Sri Lakshmi Narayana Institute of Medical Sciences Affiliated to Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India.

²sankaralal.bharathuniv@gmail.com

ABSTRACT

To analyse surgical management and to evaluate the functional outcome of medial malleolus fracture using various modalities like tension band wiring, cannulated cancellous screw and K-wire.

Keywords:

1. Introduction

Ankle fractures represent 10% of all fractures. The most injured joint in the body is ankle but least treated, said by Sir Robert Jones¹. It is second most common lower limb fracture affecting people of all ages especially about 45 to 55 years, usually young males and elderly females being the high-risk victim with respect to osteoporosis. These are typically low-energy injuries with majority occurring due to simple falls or sport events. In RTA, associated with incidence of open injuries susceptible to high velocity of injury. [1] Obesity also place a co-factor in sustaining ankle fracture whereas increase incidence of morbidity, fracture outcome is associated with tobacco smoking and alcohol intake. Many Ankle injuries are usually mixed injuries with ligamentous and bony component due to deforming force. The various presentation of malleolar fracture gives rise to wide variety of classification of which only three are dominant Lauge-Hansen, Danis Weber and AO classification. Now-a-days MRI is useful for precisely diagnosing ligamentous injury and treat them appropriately. [2,3]

The main concern to treat ankle fracture is to achieve early restoration in day to day activities obtained through anatomic joint reduction and congruity yielding effective ankle range of motion. Treatment of ankle fractures plays a vital role in terms of fracture integrity and stability, especially if planned surgically. Various treatment modalities are available for fracture reduction, maintaining the reduction and achieving union at the fracture site for the betterment of patient in terms of pain relief, improved range of movements without stiffness. Management of ankle fractures and its outcome has a deliberate impact on patient's socioeconomic status and wellbeing. [4-6]

Non-operative treatment of medial malleolus fracture was tried with splinting/casting which showed debatable outcomes in terms of union and maintaining the normal anatomical architecture. When the malleolar fracture is not reduced properly it will result in painful restriction of movement or osteoarthritis or both². ORIF is superior than conservative treatment which is thoroughly demonstrated in literature. [7] Various Operative techniques like Tension band wiring, anti glide plate technique, cannulated cancellous screw fixation, headless screw fixation and recent techniques like Sled devices have been reported in restoring the normal anatomy and joint function.

Though being a subcutaneous fracture with limited soft tissue envelope following fixation, various postoperative complications like instability, wound dehiscence, superficial skin necrosis, hardware visibility and irritability, non-union, ankle stiffness have been reported. The appropriate

surgical technique considering patient factors are planned to attain union at the fracture site with good range of movements and very minimal complications.[8-10]

2. Materials And Method

Source of data:

The material for present study was collected from the patient who attended and admitted in department of orthopaedics with medial malleolar fracture. 30 cases of either sex were taken up for the study. Patients were well informed about the study in every aspects and informed written consent was obtained.

The period of study was August 2018 to September 2020 The period of follow up was up to 6 months to 1 year. The results of 30 fractures in 30 patients were analyzed and studied. The analyzed data was compared with other series in literature and discussed. A master chart was put up which deals all the aspects and variables taken for consideration.

Method of collection of data

Inclusion criteria:

1. Age ranging from 20 to 60years
2. Both male andfemale
3. Closedfractures
4. Fractures not more than a weekduration.
5. Freshfracture.
6. All fracturepattern.
7. Patients who are fit forsurgery.
8. Patient willing to participate in thestudy

Exclusion criteria:

1. Age less than 20 and more than 60 years.
2. Old operated, neglected fractures
3. Fractures more than a weekduration.
4. Openfractures
5. Medical comorbidities.
6. Unwillingness to participate in the study.
7. Patients unfit for surgery and/oranaesthesia.

Cases was selected based on history, clinical examination, radiographs and routine investigations. Careful examination about the presence or absence of vascular or neurological deficits, open or closed injury, associated spine or extremity injuries were documented. A selective proforma was made for all the cases in this study. Clinical diagnosis was confirmed by Antero-Posterior, Lateral and Mortiseviews.

The fracture was classified by Lauge-Hansen and Danis weber classification. Initially patient was treated with Analgesic, Anti-inflammatory with limb elevation for pain relief and swelling and below knee POP slab was applied for immobilization. Patient also supplemented with tetanous toxoid and Antibiotics asindicated.

Laboratory investigations: Hb, TC, DC, Urea , creatinine ,ESR ,serum electrolytes, Urine routine profile, BT, CT , Blood grouping and typing , RBS, HIV, HbsAg , ECG, and Chestx-ray.

Radiographic investigation:

X-ray: Antero-Posterior, Lateral and Mortise views: to view the fracture morphology and pattern
CT scan: Is taken to evaluate fracture pattern and to exclude intra articular fracture of tibial plafond.

Preoperative preparation:

- Inj.TT 0.5 mg IM stat
- Inj.Xylocaine 2% Test Dose
- Parts preparation such as extremity, umbilicus and private parts.
- Informed and Written consent was taken.
- Proctolysis enema was given to every patient before sleeping.
- Adequate blood was reserved for safety purpose.
- Inj. Cefoperazone 1 g intravenous was administered 30 min before surgery.

Cannulated cancellous screws:

A cancellous bone screw is a modified wood-type screw. Its tip is not tapered. It has a larger threads and higher pitch when compared to cortical screw. The core diameter is smaller than the shaft, which provides a greater surface area for purchase of the screw threads on bone. The pull-out strength is stronger due greater diameter of screw threads. A cancellous screw can be inserted into an untapped pilot hole; the size of the pilot hole should be equal to core diameter of the screw. The spring reaction is created in the cancellous bone which is deformed during the thread forming process.

The lag effect is produced by the smooth shaft of the cancellous bone screw without the need of over-drilling. A partially threaded cancellous screw is used as a lag screw.

Stainless steel wire:

Stainless steel wire are now routinely used for internal fixation of fractures. The strength of the wire varies with the material. It is dispensed in various thickness and gauge.

The wire is drawn from the raw material and finished by two processes called annealing and cold working. The tensile strength of two single wires increases as they are twisted and it varies with the tightness of twist.

Properties: 1. Low modulus of elasticity, 2. High flexibility, 3. High resiliency, 4. Good corrosion resistance, 5. Easy to manipulate.

Washer :

A washer is often used with cancellous screw to prevent the screw head from burying into the thin cortex overlying the cancellous one.

The flat side of the washer rests on the bone while its countersunk side matches the underside of the screw head. The washer provides uniform compression. The one-third tubular plate can exist only in 3.5 mm version. The counterpart of this system in 4.5 mm system is semi tubular plate. The one-third tubular plate is available in titanium and stainless steel. It has a thickness of about 1.0 mm, its ability to confer stability is somewhat limited. Each hole of plate is surrounded by a small collar that prevents the spherical screw head from penetrating the plate and producing a crack in the near cortex. The oval shape of each hole allows the eccentric screw placement that produces fracture compression.

Operative technique:

All cases were subjected for open reduction and internal fixation of medial malleolus specifically to avoid trapping of periosteum at the fracture site and to achieve anatomical reduction.

Under spinal anesthesia the patient is on supine position on table with sand bag underneath the affected side buttock.

Pneumatic tourniquet was applied to the proximal thigh after noting the time.

The affected limb was painted with betadine solution and draped in layers from the knee joint to the nail tip and foot was covered with a glove.

Timing of surgery lasted around 1 to 1 ½ hours, open reduction and internal fixation of the medial malleolar fractures were performed by tension band wiring, cannulated cancellous screw, K- wire fixation and lateral malleolus is fixed with 1/3rd tubular plate and screws. Additionally syndesmosis is fixed with syndesmotomic screw.

Baird and Jackson Scoring system³¹:

Pain	Score
No Pain	15
Mild pain with strenuous activity	12
Mild pain with activities of daily living	8
Pain with weight bearing	4
Pain at rest	0
Stability of ankle	
No clinical instability	15
Instability with sports activities	5
Instability with activities of daily living ability to walk	0
Able to walk	
Able to walk desired distances without limp or pain	15
Able to walk desired distances with mild limp or pain	12
Moderately restricted in ability to walk	8
Able to walk short distances only	4
Unable to walk	0
Able to run	
Able to run desired distances without pain	10
Able to run desired distances with slight pain	8
Moderate restriction in ability to run with mild pain	6
Able to run short distances only	3

Unable to run	0
Ability to work	
Able to perform usual occupation without restrictions	10
Able to perform usual occupation with restrictions in some strenuous activities	8
Able to perform usual occupation with substantial restriction	6
Partially disabled; selected jobs only	3
Unable to work	0

Motion of the ankle	
Within 10° of uninjured ankle	10
Within 15° of uninjured ankle	7
Within 20° of uninjured ankle	4
<50% of uninjured ankle, or dorsiflexion <5°	0
Radiographic result	
Anatomical with intact mortice(normal medial clear space, normal superior joint space, no talar tilt)	25
Same as a with mild reactive changes at the joint margins	15
Measurable narrowing of the superior joint space, superior joint space 2mm, or talar tilt >2mm	10
Moderate narrowing of the superior joint space, with superior space between 2 and 1mm.	5
Severe narrowing of the superior joint space,with superior joint space <1mm, widening of the medial clear space, severe reactive changes (Sclerotic subchondral bone and osteophyte formation)	0

Maximum possible score 100
Scores according to the Baird and Jackson scoring system

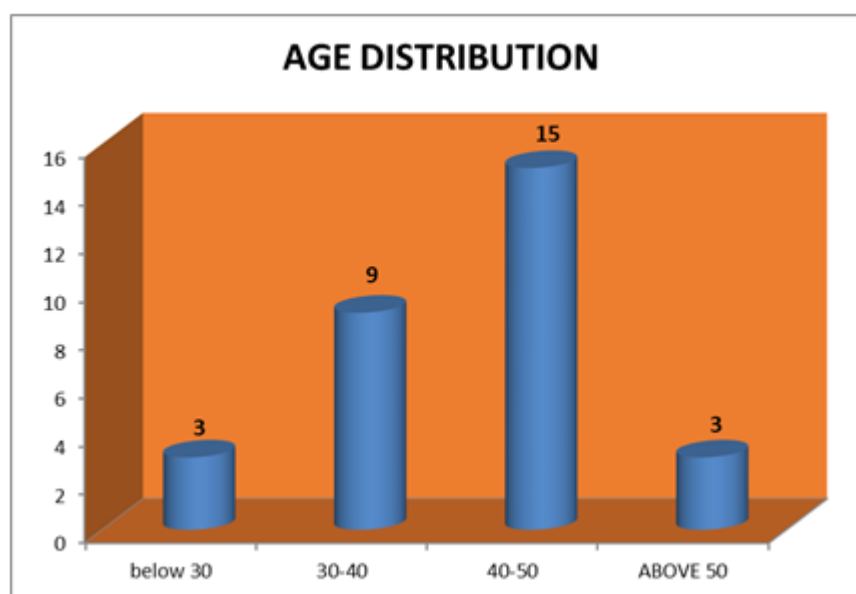
Excellent	96-100
Good	91-95
Fair	81-90
Poor	0-80

Final scores were based on the combined point scores from seven categories of subjective objective and radiographic evaluation. Results were designated as excellent, good, fair and poor. A score of 96- 100 points was considered excellent; 91 to 95 good; 81- 90 points fair and zero to 80 points poor.

3. Results:

From this study sample of 30 patients, 15 patients were between 40-50 years of age (50%) followed by 9 patients between 30-40 years of age (30%). The mean age being 41.43 ± 7.45 .

FIG 1: AGE DISTRIBUTION



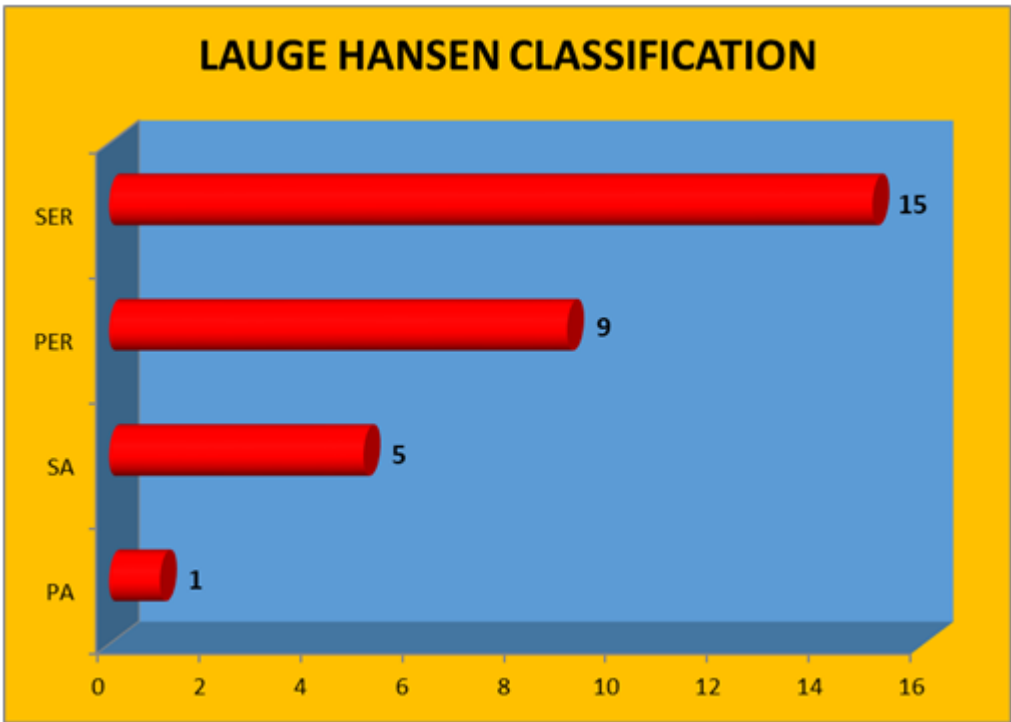
In our study 21 patients were male (70%) and 9 patients were female (30%) showing male preponderance of (M:F=2.3:1)

TABLE 1: GENDER DISTRIBUTION

GENDER	NO OF PATIENTS	%
M	21	70.0
F	9	30.0
TOTAL	30	100.0

In our study 21 patients (70%) had involvement of right ankle and 9 patients (30%) had involvement of left ankle. There were no Bilateral cases in this study.

FIGURE 2: LAUGE-HANSEN CLASSIFICATION



In this series all patients were classified under Danis Weber classifications system, 15 patients (50%) were grouped under type B followed by 10 patients (33.3%) were grouped under type C and 5 patients (16.7%) were grouped under type A.

Operated site



Follow up

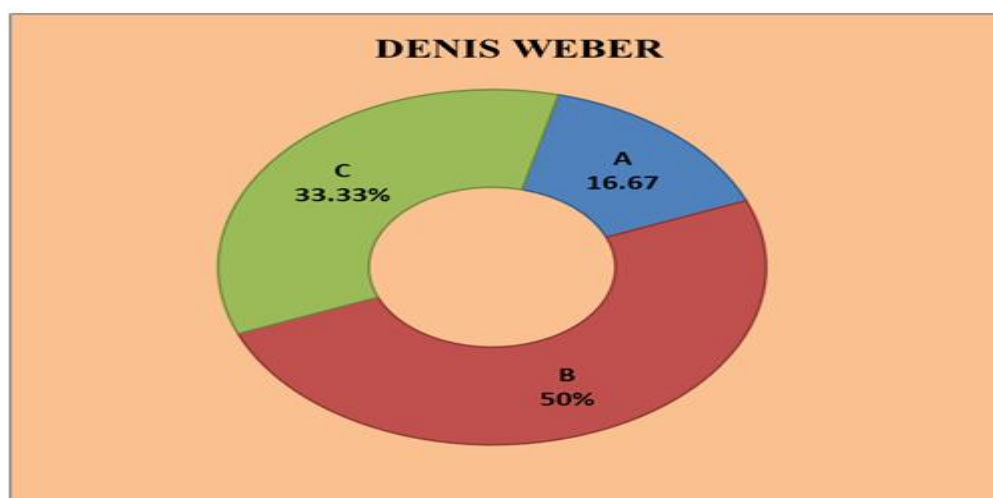
6 weeks x-ray



TABLE 7: CLASSIFICATION BASED ON DANIS WEBER SYSTEM

DANIS WEBER	NO OF PATIENTS	%
A	5	16.7
B	15	50.0
C	10	33.3
TOTAL	30	100

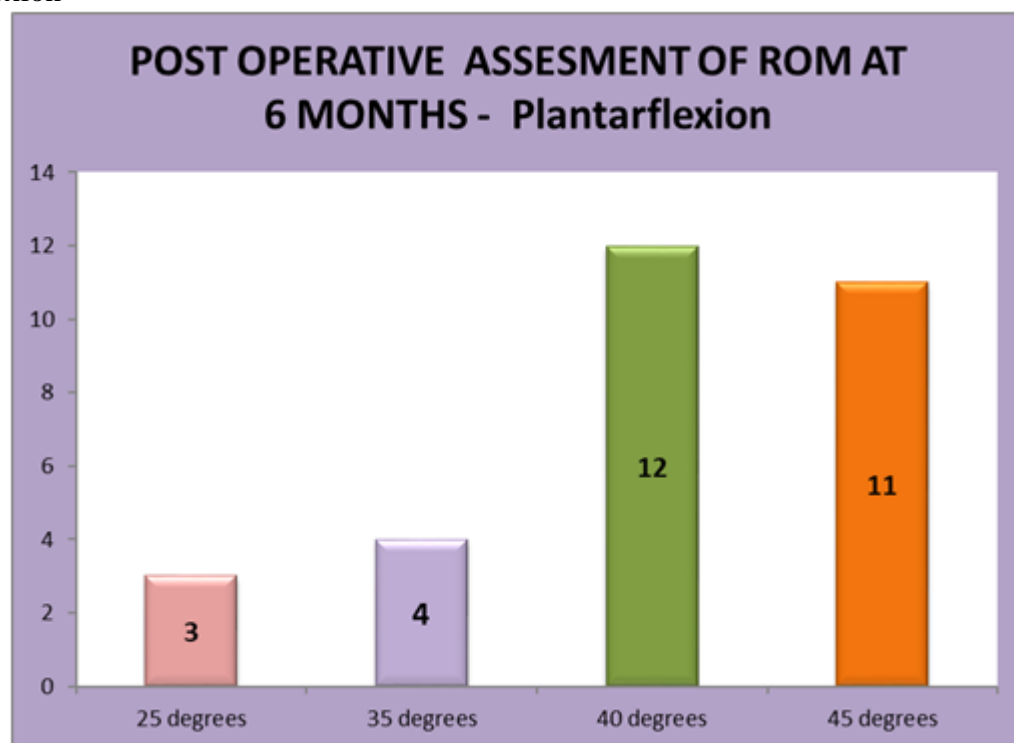
GRAPH 7: DANIS WEBER CLASSIFICATION



In our study 27 patients (90%) were Bimalleolar fracture followed by 3 patients (10%) were Unimalleolar fracture (Medial malleolus).

GRAPH 14: POST OPERATIVE ASSESMENT OF ROM AT 6 MONTHS –

Plantarflexion



Case report

Case 1

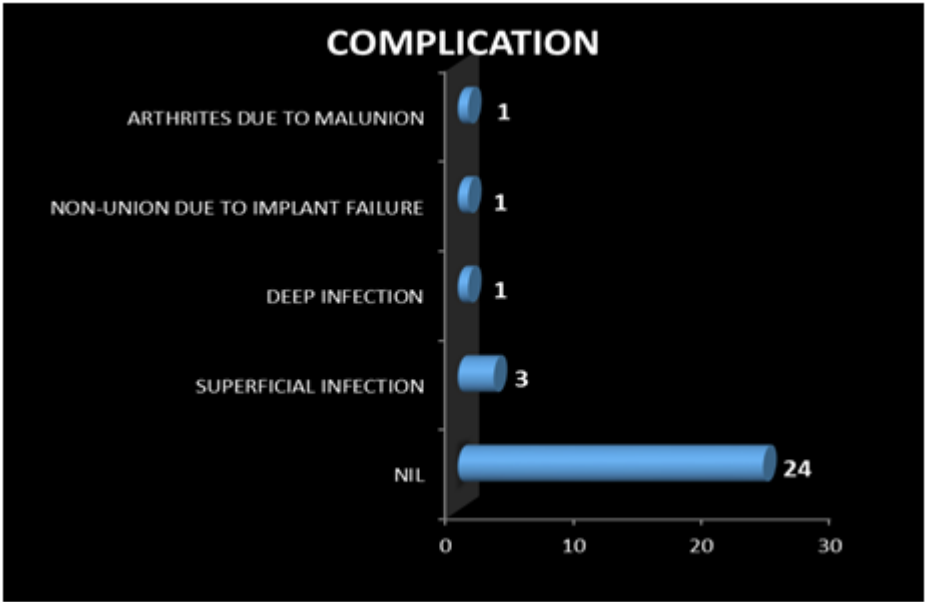
Preoperative xray



Post operative x-ray



GRAPH 16:COMPLICATION



In our study the mean Baird and Jackson score was 92.0 ± 6.33 . About 11 patients (36.7%) showed excellent result followed by 13 patients (43.3%) showed good result and 4 patients (13.3%) showed fair whereas 2 patients (6.7%) showed poor outcome..
6 months post operative x-ray



Movements



TABLE 17: BAIRD AND JACKSON SCORING

RESULT	NO OF PATIENTS	%
EXCELLENT	11	36.7
GOOD	13	43.3
FAIR	4	13.3
POOR	2	6.7
TOTAL	30	100.0

GRAPH 18: BAIRD AND JACKSON SCORING

4. Discussion

Ankle fractures represent 10% of all fractures. It is second most common lower limb fracture affecting people of all ages especially about 45 to 55 years. Ankle fracture occurs as a result of high energy trauma and most common modality being road traffic accident and fall from height and low energy trauma such as simple fall with twisting injury. [11-13] In our study the main aim is to assess the functional outcome and the results of surgical management of medial malleolar fracture and evaluated by Baird and Jackson scoring system.[14] In our study the key feature was restoration of anatomical architecture of ankle joint by using cannulated cancellous screw, kirschner wire and tension band wiring. Prevention of infection and promoting early motion with restoration of daily activities. In our study there were 27 Bimalleolar fracture and 3 were Unimalleolar (medial malleolus) fracture. From our study sample of 30 patients, 15 patients were between 40-50 years of age (50%) followed by 9 patients between 30-40 years of age (30%), mean age being 41.43 ± 7.45 .

In our study 9 out of 30 patients (30%) reported to hospital on the day of injury and 9 out of 30 patients (30%) reported on 2nd day followed by 6 patients (20%) reported within 1 day. After admission initiation of appropriate medications and limb elevation gives good reduction in swelling. In our study 17 patients (56.7%) gave history of Road Traffic Accident followed by 12 patients (40%) gave history of Twisting injury and 1 patient (3.3%) had Fall From Height. Sahu Gaurav et al reported in his study the most common mode of injury is Road Traffic Accident for 29 patients (72.5%) followed by Twisting injury for 8 patients (20%) and Fall From Height for 3 patient (7.5%). Lee et al reported in his study the most common mode of injury is Road Traffic Injury. Girish N Motwani et al [15-17] reported in his study the most common mode of injury is Road Traffic Accident (45%) followed by Fall (37.5%) and Twisting injury (17.5%). [18]

Rakesh Singh [65] reported in his study the most common mode of injury is Road Traffic Accident (40.9%) followed by Accidental fall (36.3%) and Twisting injury (22.8%). Suhas D et al noticed in his study most common mode of injury is Road Traffic Accident followed by Slip and Fall whereas Naik Lokesh Gudda G et al [66] noticed in his study most common mode of injury is Road Traffic Accident followed by Accidental fall. In our study 18 patients (60%) had no external injury and 9 patients (30%) had external injuries as Abrasion around Ankle followed by 3 patients (10%) had Contusion around ankle. In this study series Lauge-Hansen classification was

used to see mechanism of injury and their fracture pattern. The most common type of injury is Supination External Rotation for 15 patients (50%) followed by Pronation External Rotation for 9 patients (30%) and Supination Adduction for 5 patients (16.7%).[19-21]

Girish N Motwani et al⁶³ observed in his study the majority of patients about

16 (40%) showed Supination External Rotation injury followed by 11 patients (27.5%) showed Pronation External Rotation injury. Karamdeep Singh Kahal et al reported in his study that most common type of injury is Supination External Rotation for 15 patients (50%) followed by Pronation External Rotation for 7 patients (23.33%) and Pronation Abduction for 5 patients (16.67%). Roberts SR et al reported in their study series about 45% of patients had Supination External Rotation type of injury.[22-25]

Beris et al and reported in their study majority of patients had supination external rotation injury. Naik Lokesh Gudda G et al observed in his study 29 patients (54.7%) had Supination External Rotation type of injury followed by 13 patients (24.6%) had Pronation External Rotation type of injury. In our study all the patients were classified under Danis Weber classification system. 15 patients (50%) grouped under type B followed 10 patients (33.3%) were grouped under type C and 5 patients (16.7%) were group under type A. Girish N Motwani et al^[26] observed in his study majority of patients were operated between 2 and 5 days (77.5%). The mean time interval was 3.5 days.

In our study series 14 patients (46.7%) had 45 degree of dorsiflexion post operatively at 6 months followed by 11 patients (36.7%) had 20 degree of dorsiflexion post operatively at 6 months. The means range value is 21.0 ± 4.014 degree. In our study 24 patients (80%) had no complication whereas 3 patients (10%) had superficial infection which was controlled by oral antibiotic and regular dressing and 1 patient (3.3%) had deep infection which was managed by wound debridement and higher antibiotics (Inj. Piperacillin 400mg + Tazobactam 500mg) followed by 1 patient (3.3%) had Post traumatic arthritis due to mal-union because patient has lost the follow up and turned up after 22 weeks and 1 patient (3.3%) had implant failure with non-union because patient did early weight.

5. Conclusion

In our study group of 30 patients 3 were isolated medial malleolar fracture remaining 27 patients were Bimalleolar fracture, In that 16 showed syndesmotic disruption. All this patients were subjected to surgery, Open Reduction and Internal Fixation was preferred to prevent trapping of periosteum at the fracture site and retaining anatomical reduction, articular congruity to improve clinical and radiological union with adequate joint motion. Open Reduction and Internal Fixation was successful in terms of union and restoration of joint function by Tension Band Wiring, Cannulated Cancellous Screw, K-wire (Kirschner wire) and Cannulated Cancellous Screw + K-wire fixation achieving good functional outcome of the affected ankle joint.

In our study all medial malleolus fractures were subjected to open reduction rather than percutaneous fixation in order to avoid the risk of non-union in terms of anatomical reduction and periosteal trapping at the fracture site. Open Reduction and Internal Fixation is considered to be the best option to have good radiological union with good functional outcome of the ankle joint.

Funding: No funding sources

Ethical approval: The study was approved by the Institutional Ethics Committee

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

References

- [1] Shelton Marvin L. Complication of fractures and dislocation of the ankle. In: Complications in orthopaedic surgery, Chapter 23, 3rd edn., Vol.I, ed. EPPS, Charles H, Philadelphia : J.B. Lippincott Company, 1994;595-648pp.
- [2] Beris AE, Kabbani KT, Xenakis TA, Mitsionis G, Soucacos PK, Soucacos PN. Surgical treatment of malleolar fractures – a review of 144 patients. Clin Orthop Related Research, 1997 Aug; 341: 90-98.
- [3] Weber MJ. Ankle fractures and dislocations. In : Operative orthopaedics, Chapter-50, 2nd edn., Vol.3, Ed. Chapman MW, Madison M. Philadelphia : J.B. Lippincott Company, 1993; 731-748pp.
- [4] Geissler WB, Tsao AK, Hughes JL. Fractures and injuries of ankle. In: Rockwood and Greens fractures in adults. Chapter- 31, 4th edn., Vol.2, ed. Rockwood CA, Green DP, Bucholz RW, Heckman JD. Philadelphia : Lippincott Raven, 1996; 2201- 2266pp.
- [5] Gumann G. Ankle fractures. In: Foot and ankle trauma. Chapter- 28, Ed. Scurran BL, New York: Churchill Livingstone, 1989; 579-638pp.
- [6] Wilson FC. Fractures and dislocations of the ankle. In: Fractures in adults, Chapter- 18, 2nd edn., Vol.2, Ed. Rock wood CA, Green DP, Philadelphia : J.B. Lippincott Company, 1984; 1665-1702pp.
- [7] Griend RAV, Saroie FH, Hughes JL. Fractures of the ankle. In: Rockwood and Greens fractures in adults. Chapter-23, 3rd Edn., Vol.2, Ed. Rockwood CA, Green DP, Bucholz RW, Philadelphia : J.B. Lippincott Company, 1991; 1983-2040pp.
- [8] Desouza LJ. Fractures and dislocations about the ankle. In: Fractures and dislocations, Chapter- 30, Vol.II, ed. Gustilo RB, Kyle RF, Templeman D, St. Louis : Mosby Year book Inc., 1993, 997- 1043pp.
- [9] Yablon IG, Heller FG, Shouse L. The key role of the lateral malleolus in displaced fractures of the ankle. J Bone Joint Surg, 1977; 57A:169-173.
- [10] Beauchamp CG, Clay NR, Tehxton PW. Displaced ankle fractures in patients over 50 years of age. J Bone Jo int Surg, 1983; 65B:329-332.
- [11] Pettrone FA, Gail M, Pee D. Fitzpatrick T, Van Herpe LB. Quantitative criteria for prediction of the results after displaced fracture of the ankle. J Bone Joint Surg, 1983; 65A:667-677.
- [12] Lindsojo U. Operative treatment of ankle fracture – dislocations. Clin Orthop, 1985; 199: 28-38.
- [13] Bauer M, Bergstrom B, Hemborg A, Sandegard J. Malleolar fractures : Nonoperative versus operative treatment. Clin Orthop, 1985; 199:17-27.
- [14] Segal D, Wasilewski S. Total dislocation of the talus. J Bone Joint Surg, 1980; 62A:

1370-1372.

- [15] Limbird RS, and Aaron RK. Laterally comminuted fracture – dislocation of the ankle. J Bone Joint Surg, 1987; 69A: 881-885.
- [16] Carragee EJ, Csongradi JJ, Bleck EE. Early complications in the operative treatment of ankle fractures. J Bone Joint Surg, 1991; 73B: 79-82.
- [17] Johnson EE, Davlin LB. Open ankle fractures – indications for immediate open reduction and internal fixation. Clin Orthop, 1993; 292: 118-127.
- [18] Hedstrom M, Ahl T, Dalen N. Early postoperative ankle exercise : A study of postoperative lateral malleolar fractures. Clin Orthop, 1994; 300: 193-196.
- [19] Georgiadis GM, White DB. Modified tension band wiring of medial malleolar ankle fractures. Foot Ankle Int, 1995 Feb; 16(2): 64-8.
- [20] Bostman O, Hirvensalo E, Vainiopaa S, et al. Ankle fractures treated using biodegradable internal fixation. Clin Orthop, 1989; 238:195-203.
- [21] Dogras AS, Ranga A. A prospective randomised control study comparing early mobilisation versus immobilisation of surgically treated ankle fractures (abstract). J Bone & Joint Surg Br, 1997 Sept; 79-B(3S):367-368.
- [22] Papachristou G, Levidiotis C, Tilentzoglou A, Efsthathopoulos N. Early weight bearing following ORIF of posterior malleolar fractures of the ankle joint. J Bone & Joint Surg Br, 1999; 81-B (Suppl.II):181.
- [23] Tornetta, Paul III, Creevy, Villiam. Lag screw only fixation of the lateral malleolus. J Orthop Trauma, 2001 Feb; 15(2):119-121.
- [24] Lamontagne Jean, Blachut, Piotr A, Broekhuysen, Henry M, O'Brien Peter J, Meek Robert N. Surgical treatment of a displaced lateral malleolus fracture : The antiglide technique Versus lateral plate fixation. J Orthop Trauma, 2002 Aug; 16(7):498-502.
- [25] Lee Yih- Shiunn, Huang, Chun-Chen NSP, Chen, Cheng- Nan, Lin Chien- Chung. Operative treatment of displaced lateral malleolar fractures : The Knowles pin technique. J Orthop Trauma, 2005 Mar; 19(3):192-197.
- [26] Konrad Gerhard, Markmiller Max, Lenich Andreas, Mayer Edgar, Ruter Axel. Tourniquets may increase postoperative swelling and pain after internal fixation of ankle fractures. Clin Orthop & Related Research, 2005 Apr; 433: 189-194.