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Dr. Sahu Gaurav
Junior Resident, Department of Orthopaedics, KIMS, Karad, Maharashtra, India

Dr. Ravindra B Gunaki
Professor, Department of Orthopaedics, KIMS, Karad, Maharashtra, India

Dr. Vijaysinh Patil
Senior Resident, Department of Orthopaedics, KIMS, Karad, Maharashtra, India

Dr. Amit B Garud
Junior Resident, Department of Orthopaedics, KIMS, Karad, Maharashtra, India

Correspondence
Dr. Ravindra B Gunaki
Professor, Department of Orthopaedics, KIMS, Karad, Maharashtra, India

A study of functional outcome of bimalleolar fracture after internal fixation

Dr. Sahu Gaurav, Dr. Ravindra B Gunaki, Dr. Vijaysinh Patil and Dr. Amit B Garud

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Abstract
Aim: To analyse the functional outcome of Ankle joint after Internal Fixation of bimalleolar fracture.
Materials and Method: This is prospective study done in Krishna medical college and hospital, karad (Satara). In our study 40 cases of bimalleolar ankle fracture were analysed. Classifications used are Lauge-Hansen Classification and Denis-Weber Classification. Road traffic accident, Twisting injury and fall from height are major mode of injury. Cannulated cancellous screw, Malleolar Screw and TBW used for medial malleolus and semi tubular plate, cannulated cancellous screw and Rush Nail used for fibula are common mode of fixation.
Results: According to Baird and Jackson scoring system out of 40 cases, 92.5% were excellent and good, 5% were fair and 2.5% were poor.
Conclusion: Anatomical reduction and stable internal fixation restore the articular congruity of ankle joint results in high percentage of excellent and good results.

Keywords: Bimalleolar ankle fracture, lauge-hansen, danis weber, baird and jackson scoring system

Introduction
Ankle joint is usually highly susceptible to injuries. This is because it is relatively mobile and bear much of the stresses associated with weight bearing. The ankle joint supports more weight per unit area than any other joint in the body [1]. The most congruous joint in the lower extremity is The Ankle joint which bears upto five times the body weight [2]. Sir Robert Jones said-Ankle is the most injured joint of the body but the least well treated [3]. Ankle injuries are importance because body weight is transmitted through it and locomotion depends upon the joint stability. Many of the ankle injuries are both bony and ligamentous components. Magnetic resonance imaging now a days is useful for diagnosing ligamentous injury and repairing, while treating this fracture. The French had written extensively on ankle injuries beginning with Baron, Dupuytren and then Maisonneuve, but it was not until 1922 that a proper understanding of Classification and The Mechanism of the ankle fractures was published in a paper by Ashurst and Bromer [4]. In 1948-1954, Lauge-Hansen recognized four patterns based on pure injury sequences and taken into account at the time of Ankle injury, deforming force direction and position of the foot. To avoid complications as in all intra-articular fractures it is necessary to achieve anatomical reduction by open method and internal fixation of Bimalleolar ankle fracture. The results of bimalleolar ankle fractures are better with emphasis on anatomical reduction of fracture, stable internal fixation, regaining full fibular length and early active pain free mobilization, since the advent of A.O principles of management.

Objectives
To evaluate the Ankle Function after Internal Fixation of Bimalleolar fracture at the end of 6 months
a) Time required for union with respect to clinical and Radiological outcomes.
b) Range of movements.
c) Functional scoring system (Baird and Jackson)

- Pain
- Stability of ankle
- Able to walk, run and work
- Motion of the ankle
- Radiographic result

Methodology

This study was done to evaluate the functional outcome of ankle joint after internal fixation of bimalleolar fracture, those who are operated with different modalities. This is a prospective study (from November 2016 to March 2018) of 40 patients treated at Krishna hospital and Medical research center, Karad. It includes the patients presenting themselves in casualty and OPD of Department of orthopaedics and newly diagnosed as bimalleolar fractures. Maximum Follow up period was 6 months after operative management. When the patients were seen for the first time after injury, a through history was taken concerning about the time of injury, mechanism of injury, any significant past or personal history. Patients were examined giving special importance to whether the fracture was open or closed, presence of gross swelling, fracture blisters and presence of other associated injuries. Routine investigations were done as were necessary. The diagnoses was confirmed by antero-posterior, lateral and mortise radiographs. Stabilization was done with a below knee slab, and ORIF was done once the skin condition was good and swelling had subsided.

Inclusion criteria

1. Age above 18 years.
2. Patients of either sex.
3. Patients having bimalleolar fracture of either ankle joint.
4. Patients who are fit for surgery.
5. Patients fulfilling the above mentioned criteria and willing to participate in the study.

Exclusion criteria

1. Age below 18 years.
2. Unwillingness to participate in the study.
3. Patients unfit for surgery and/or anaesthesia.
4. Patients with history of previous bimalleolar fracture of either ankle.
5. Pilon fracture.
6. Trimalleolar fracture.

The basic idea was to achieve near anatomical reduction. ORIF was used in all 40 patients. It was done as a planned and elective procedure. Before patients were taken up for surgery, they were put on foot elevation and anti-inflammatory drugs for few days to reduce ankle swelling.

Post-operatively limbs were immobilized in plaster splint, patients were put on antibiotics and analgesics and limbs were elevated. Dressings were done regularly and sutures were removed on average on 15th day (decided according to the wound inspection). The below knee splint was continued or cast was done till 6 weeks of postoperative and was then removed. Patients were assessed for fracture union radiologically. Once the fracture showed signs of union, partial weight bearing was advised, which was approximately at 6-8 weeks and it was then gradually increased to full weight bearing. Physiotherapy exercises for ankle movements were started on removal of slab or cast.

Follow up: Weight bearing is restricted for 6 weeks. At 6 weeks the plaster was removed. Clinical examination was done regarding movement of ankle. At 6 weeks x-ray of the ankle was taken in Antero-posterior and lateral views and looked for signs of fracture union and then were advised partial weight bearing once the fracture showed signs of union. Patients were advised to keep the limb at elevation to night times and perform active movements of ankle joints. It was then gradually increased to full weight bearing. Regular follow up was done at 6 weeks, 3 months and thereafter at monthly intervals till 6 months after operation till the fracture united (Figure 1). Follow up X-rays were taken to assess fracture union and the condition of implant (Figure 2).

Fig 1(a): Dorsiflexion at end of 6 months

Fig 1(b): Plantar flexion at end of 6 months

Fig 2(a): Pre-operative X-ray

Fig 2(B): post-Operative X-rays

Assessment of results: Baird and Jackson scoring[5] system was used to evaluate the patients at the end of 6th month. Finally, correlation between results of the score and clinical data were used to evaluate functional outcome of ankle joint after internal fixation of Bimalleolar fracture.

Baird and Jackson Scoring System

1) Pain Score

a. No Pain 15
b. Mild pain with strenuous activity 12
c. Mild pain with activities of daily living 8
d. Pain with weight bearing 4
e. Pain at rest 0

2) Stability of ankle

a. No clinical Instability 15
b. Instability with sports activites 5
c. Instability with activites of daily living ability to Walk 0

3) Able to walk

a. Able to walk desired distances without limp or pain 15
b. Able to walk desired distances with mild limp or pain 12
c. Moderately restricted in ability to walk 8
d. Able to walk short distances only 4
e. Unable to walk 0

4) Able to run

a. Able to run desired distances without Pain 10
b. Able to run desired distances with slight pain 8
c. Moderate restriction in ability to run with mild pain 6
d. Able to run short distances only 3
e. Unable to run 0

5) Ability to work

a. Able to perform usual occupation without restrictions 10
b. Able to perform usual occupation with restrictions in some strenuous activities 8
c. Able to perform usual occupation with substantial restriction 6
d. Partially disabled; selected jobs only 3
e. Unable to work 0

6) Motion of the ankle

a. Within 10 of uninjured ankle 10
b. Within 15 of uninjured ankle 7
c. Within 20 of uninjured ankle 4
d. <50 of uninjured ankle, or dorsiflexion <5 0

7) Radiographic result

a. Anatomical with intact mortise (normal medial clear space, Normal 2mm superior joint space, no talar tilt) 25
b. Same as above with mild reactive changes at the joint margins 15
c. Measurable narrowing of the superior joint space, superior joint space 2mm, or talar tilt >2mm 10
d. Moderate narrowing of the superior joint space, with superior space between 2 and 1mm. 5
e. Severe narrowing of the superior joint space, with superior joint space <1mm widening of the medial clear space, severe reactive changes 0

(Sclerotic subchondral bone and osteophyte formation)

A Score According to the Baird and Jackson Scoring System

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

Maximum Possible Score- 100

Method of Statistical Analysis: The Excel and Graphpad Instat (Graphpad softwares inc, USA) software packages were used for data entry and analysis.

Observation and Results

This was a prospective study includes of 40 cases of bimalleolar ankle fractures who were treated surgically at Krishna medical college and hospital, karad from November 2016 to March 2018. Injury was more common in males -23 (57.5%) and females -17 (42.5%). Age distribution for age 18-28 is 5 patients (12.5%), 29-38 is 7 patients (17.5%), 39-48 is 9 patients (22.5%), 49-58 is 8 patients (20%), 59-68 is 8 patients (20%) and 69-78 is 3 patients (7.5%). The mean age was 46.775 and the standard deviation was 15.432. Left side were more commonly involved -23 patients (57.5%) and right sides are 17 patients (42.5%). Most common mode of injury is Road Traffic Accidents -29 patients (72.5%), followed by Twisting Injury contributed to 8 patients (20%) and fall from height were 3 patients (7.5%).

The most common injury pattern seen in this study was SER type injury -20 patients (50%), followed by supination adduction type were -13 patients (32.5%), PER type were 6 patients (15%) and pronation abduction type were 1 patient (2.5%) (Figure 3). SER was found to be most common as p-value is significantly less than 0.0001 and Chi-Square value is 27.467.

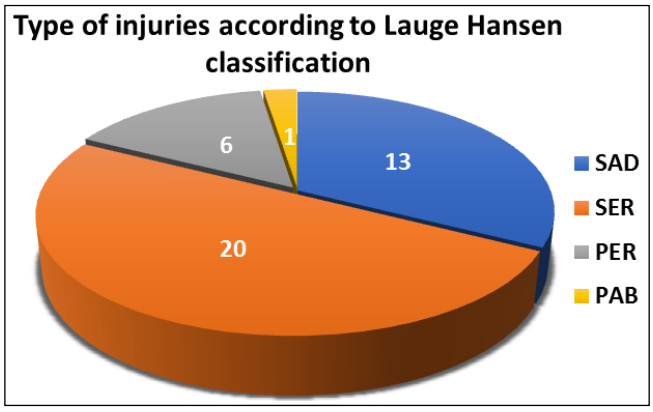

Fig 3: Type of injuries according to Lauge Hansen classification

Danis Weber type B was found to be most common -20 patients (50%), Type A was found in 13 patients (32.5%) and type C was found in 7 patients (17.5%) (Figure 4). Thus type B was found to be most common as p-value is significant 0.0085 and Chi square value is 9.525.

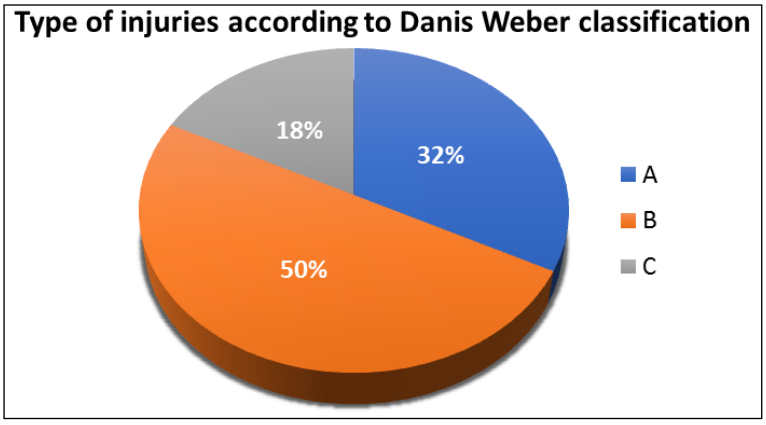

Fig 4: Type of injuries according to Danis Weber classification

In this study, at the end 6 weeks, the Plantarflexion mean range was 13.75 and Dorsiflexion was 7.75. At the end of 3 months, the Plantarflexion mean range was 20.625 and Dorsiflexion was 13.375 and at the end of 6 months, the Plantarflexion mean range was 32.875 and Dorsiflexion was 19 (Figure 5).

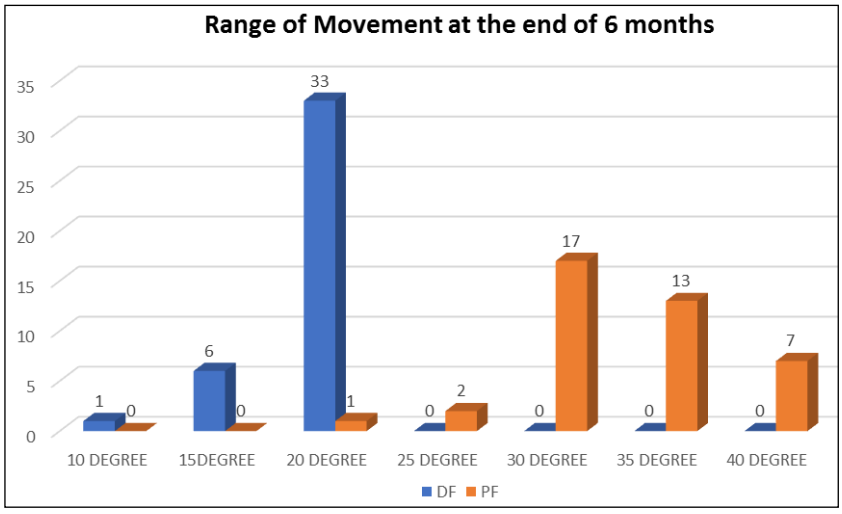

Fig 5: Range of movement at the end of 6 months

In this study 4 cases (10%) were developed post-operative infection. Average time taken for radiological union was 18.5 weeks (Figure 6). So union occurred earlier after operative management.

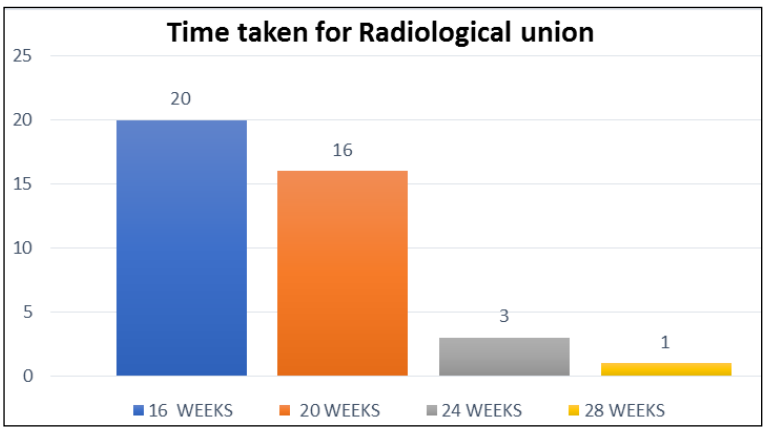

Fig 6: Time taken for Radiological union

According to Baired and Jackson scoring system 06 patients (15%) had excellent result, 31 patients (77.5%) had good result, 2 patients (5%) had fair result and 1 patient (2.5%) had poor result (Figure 7). SER injury is most common type of bimalleolar ankle fracture as p value is significantly less than 0.0001, chi square value is 27.467 and mean Baired score is 92.45.

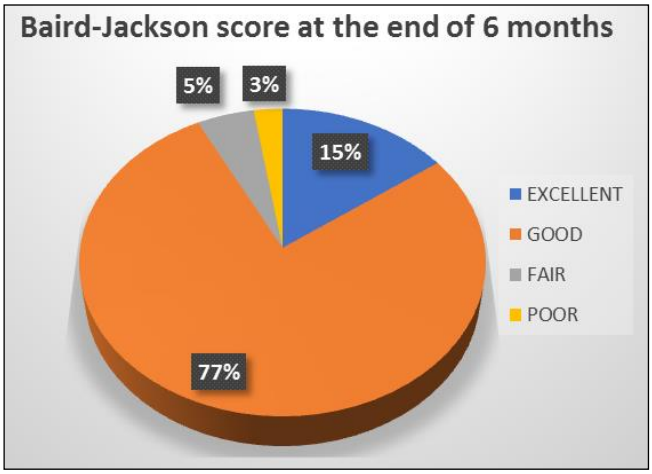

Fig 7: Baird-Jackson score at the end of 6 months

Gender, Age of the patients, Mechanism of Injury (According to Lauge-Hansen classification) and Types of Fracture (According to Danis-Weber classification) was not found to be statistically significant associated with the functional outcome.

Discussion

This study was consists of 40 cases of Bimalleolar ankle fractures treated at Krishna hospital and Medical research center, Karad. Bimalleolar fracture had a Male predominance with 57.5% and Male: female ratio of 23:17, which is comparable with the study by Motwani GN [6] and Maruthi CV [7].

Table 1: Sex distribution in various studies

Study	No of Patients	Male: Female	% males
Motwani GN [6]	40	5:1	82.5
Maruthi CV [7]	40	28:12	70
Present study	40	23:17	57.5

In this study, Bimalleolar fractures were common in the Fourth decade of life.

Mean age of patients was 46.77. Similar results were observed in Mohapatra A, Raj K [8] with mean age of 43.8, however finding by Beris *et al.* [9], Lee *et al.* [10], Roberts SR [11] and Baird and Jackson [5] bimalleolar fracture were common in age group of 31 to 40 years with slight varioution in this study.

Table 2: Mean age distribution in various studies

Study	Number of Patients	Mean age
Mohapatra A, Raj K [8]	84	43.8
Beris *et al.* [9]	144	30
Roberts SR [11]	25	40
Present study	40	46.77

Most common mode of injury is Road Traffic Accidents-29 patients (72.5%) which were in accordance with study by Mohapatra A, Raj K [8] and Lee *et al.* [10].

Table 3: Mode of Injury in various studies

Study	Number of Patients	Common mode of Injury
Lee *et al.* [10]	168 (98)	Road Traffic Accidents
Mohapatra A, Raj K [8]	84 (43)	Road Traffic Accidents
Present study	40 (29)	Road Traffic Accidents

Out of 40 patients, 20 patients (50%) are SER pattern, 13 patients (32.5%) of SAD pattern, 06 patients (15%) are PER pattern and 01 patients (2.5%) of PAB pattern. In which SER is most common type as 'p' value is significantly less than 0.0001, which was in accordance with study by Parvataneni Prathap DA [12], Roberts RS [11] and Beris *et al.* [9].

Table 4: Common type of injury in various studies

Study	Number of Patients	Most common type	Percentage
Parvataneni Prathap [12]	30	SER	46.6
Roberts RS [11]	25	SER	34
Beris *et al.* [9]	144	SER	45
Present study	40	SER	50

Average time required for radiological union was 18.5 weeks, which was in accordance with study by Parvataneni Prathap DA [12] and Maruthi CV [7].(Table-5)

Table 5: Radiological union in various studies

Study	Follow-up period	Mean for Radiological Union
Parvataneni Prathap[12]	6 Months	10.6 Weeks
Maruthi CV[7]	6 Months	8 Weeks
Present study	6 Months	18.5 Weeks

In this study, The Range of Motion of Ankle joint at the end of 6 months was 30^0 or more plantar flexion in 37 patients (92.5%) and 20^0 or more dorsiflexion in 33 patients (82.5%), similar results was observed in Shah ZA, Arif U [13] study.

Table 6: Range of motion in various studies

Study	Time Duration	$\geq 30^0$ Plantarflexion	$\geq 20^0$ Dorsiflexion
Shah ZA, Arif U[13]	6 Months	87.5%	82.5%
Present study	6 months	92.5%	82.5%

According to Baird and Jackson score at the end of 6 months, Out of 40 patients we studied 06 (15%) patients had excellent, 31 (77.5%) patients had good, 2 (05%) patients had fair and 1 (2.5%) patient had poor results, similar results was observed in other study like Shah ZA, Arif U [13], De souza *et al.* [14], Beris *et al.* [9], Motwani GN [6].

Table 7: Comparative Results in various studies

Study	Good to Excellent	Fair	Poor
Shah ZA, Arif U [13]	33 (82.5%)	5 (12.5%)	2 (5%)
Beris *et al.* [9]	105 (74.3%)	21 (14.6%)	16 (11.1%)
De souza *et al.* [14]	135 (90%)	9 (6%)	6 (4%)
Motwani GN [6]	33 (82.5%)	5 (12.5%)	2 (5%)
Present study	37 (92.5%)	02 (5%)	01 (2.5%)

In our study, Gender, Age of the patients, Mechanism of Injury (According to Lauge-Hansen classification) and Types of Fracture (According to Danis-Weber classification) was not found to be statistically significant associated with the functional outcome. In our series 04 cases (10%) had complications such as wound infection. Superficial infection with skin necrosis was the commonest complication we observed, as compare to Shah ZA, Arif U [13] study were 4 patients had superficial infection.

Conclusion

In this study it was observed that Bimalleolar fracture treated with ORIF gain Excellent to Good Ankle function after 6 months by using Baird and Jackson scoring system. Supination-external rotation type of injury was common. The Frequency of Pronation-external rotation and Pronation abduction type of injury was less. The Anatomical reduction and stable internal fixation restore the articular congruity of ankle joint results in excellent to good functional outcome and help in early mobilization after surgery.

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