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ORIGINAL RESEARCH

Surgical management of bi malleolar fractures:A comparative study between malleolar screw fixation with fibular plating versus cannulated cancellous screw fixation with fibular k-wiring

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ABSTRACT

Aim: The aim of the present study was to evaluate the result of internal fixation of bimalleolar fractures treated by ORIF with malleolar screw with fibular plate osteosynthesis and CRIF with cannulated cancellous screw with fibular K Wire fixation.**Methods:** After obtaining informed and written consent, 30 cases of bimalleolar fractures of ankle in adults were treated at Khaja Banda Nawaz Teaching and General Hospital, Kalaburagi from Jan 2022 to Dec 2023 by surgical intervention and were studied for a period of 2 years. 30 patients (divided into two groups of 15 each) were included.**Results:** In our series, majority of the cases i.e. 12 (40%) were in the age group of 31-40 years, followed by 11(36.6%) cases in the age group 41-50 years. The youngest patient was 21 years old and eldest patient was 65 years. The mean age was 41 years. In the present series, males were more commonly involved. Majority of the patients were males-21 cases (70%) and 9 (30%) were females. Right side was involved in 19 (63.3%) cases and left ankle in 11 (36.6%). Right ankle was more commonly involved. 14 cases (46.6%) affected were due to road traffic accident, 10 cases (33.3%) due to fall, and 6 cases (20%) due to twisting injury. Road traffic accident was the most common mode of injury. In our study, the average time taken for union was 10.5 weeks.**Conclusion:** In comparison with open reduction and internal fixation of medial malleolar fractures with malleolar screw and fibular plate and screw fixation for lateral malleolar fractures, this is a time-consuming surgery due to opening of the fracture fragment. Loss of fracture hematoma, more chances of skin infection and skin necrosis due to wider incision, and subcutaneous nature of the bone, hardware problems due plate and screw fixation and with more union time, and higher chances of ankle stiffness.

Key words: Bimalleolar fractures, ORIF with malleolar screw, fibular plate osteosynthesis, CRIF, cannulated cancellous screw, fibular K Wire fixation

INTRODUCTION

Ankle fractures are the most common type of fracturestreated by orthopaedicsurgeons. There has been an increase in the prevalence of such fracturesover the last twodecades both in the young, activepatients and in the elderly.[1,2]

Most ankle fractures are complex injuries that are difficult to manage.Theseinjuries gain importance because the whole body weight is transmitted through the ankleand locomotion depends upon the stability of the ankle joint. They have the potential toproduce a significant long-term disability and complications in the form of pain,instability and early degenerative arthritis.[3]

Accumulated clinical experience has led to the development of a treatment option involving the anatomical reduction of the ankle in ankle fractures[4,5].Displaced unimalleolar fractures are high-energy fractures and have been associated with good clinical outcomes with good anatomic reduction and

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internal fixation. However, there is still a lack of consensus on the optimal treatment of isolated medial malleolar fractures, despite the availability of advanced surgical techniques. The currently available fixation techniques for medial malleolar fractures include a single-lag screw for small fragment fractures; a 4-mm cannulated cancellous lag screw and a Kirschner wire (K-wire) for displaced large transverse fractures; a tension band wire (TBW) for low transverse fractures; and a vertical countersunk 4-mm lag screw for low transverse fractures or plate fixation for high horizontal fractures[6].

Medial malleolar injuries are ultimately intra-articular fractures characterized by high rates of non-union, delayed union, and delayed return to daily living activities, as well as early post-traumatic arthritis, if not treated surgically. Following open reduction and internal fixation, it is of utmost importance to initiate early joint motion exercises, although stable fracture fixation is required before the initiation of early motion in intra-articular fractures.

The aim of the present study was to evaluate the result of internal fixation of bimalleolar fractures treated by ORIF with malleolar screw with fibular plate osteosynthesis and CRIF with cannulated cancellous screw with fibular K Wire fixation.

MATERIALS AND METHODS

After obtaining informed and written consent, 30 cases of bimalleolar fractures of ankle in adults were treated at Khaja BandaNawaz Teaching and General Hospital, Kalaburagi from January 2022 to Dec 2023 by surgical intervention and were studied for a period of 2 years. 30 patients (divided into two groups of 15 each) were included.

INCLUSION CRITERIA

1. Patients with Bimalleolar fractures.
2. Patients of both sexes with age group 18 to 65 years.
3. Patients who are medically fit and willing to undergo surgery.

EXCLUSION CRITERIA

1. Open fractures of the ankle.
2. Patients which were treated by non-operative methods were excluded.
3. Patients who are medically unfit for surgery.
4. Pre-existing ipsilateral or contralateral ankle pathology.
5. Refracture of a previous ankle fracture.
6. Unimalleolar and trimalleolar fractures.
7. Concurrent foot deformities

METHODOLOGY

On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mode of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and a complete survey was done to rule out significant other fractures. Local examination of injured ankle and following clinical signs were looked for. Fractures of the ankle were confirmed using plain radiographs in antero-posterior and lateral views. The fractures were classified using the Lauge-Hansen, AO/OTA classification systems and anatomical types. Closed reduction and a below knee posterior POP slab were applied.

Routine investigations were done. The patients were taken for surgery as early as possible once the general condition is stable and fit for surgery. The routine investigations were DOEN.

OPERATIVE TECHNIQUE:

Under spinal or epidural anaesthesia, the patient was placed in supine position. The ipsilateral buttock was raised on a sandbag to improve the exposure of the lateral side. Pneumatic tourniquet was applied in cases where open reduction and internal fixation was to be done. The procedure was performed in a bloodless field, which facilitates good visibility to describe the fracture pattern and thus facilitating anatomical reduction and good fixation.

SURGICAL APPROACHES & FRACTURE FIXATION IN GROUP A LATERAL MALLEOLUS

LATERAL MALLEOLUS:A secure anatomic repair of a displaced lateral malleolus fracture is one of the most important steps in operative management of a malleolar fracture.

APPROACH:A direct posterior- lateral approach over the fibula was standard for reducing and internally fixing distal fibula fractures.

FRACTURE FIXATION

1. The lateral malleolus was approached through a postero-lateral incision.
2. The incision was taken about 12 cm proximal to the tip of lateral malleolus and extended distally along the posterior margin of the fibula to the tip of malleolus and curved it anteriorly for 2.5cm in line of peroneal tendons.
3. The fibula was exposed sub periosteally by deepening the incision through subcutaneous tissue and deep fascia.
4. Soft tissue and periosteum were cleared from the fracture site.
5. Reduction of the fracture was now done by bone holding forceps.
6. One third semi-tubular plate was contoured and used to accommodate the lateral bow of the fibula and held in reduction over the lateral side of fibula, with bone holding forceps.
7. Drill holes were made with 2.5mm drill bit. The length of the screws were measured with a depth gauge and tapped with 3.5mm tap. The plate was then fixed with the measured length of cortical screws.

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8. After fixation a thorough wash was given and wound was sutured in layers.

MEDIAL MALLEOLUS
APPROACH: Anterio-medial approach with J-shape incision.

FRACTURE FIXATION
1. A J-shape Anterio-medial Incision, approximately 2 cm proximal to the fracture line was taken.
2. The flap with intact underlying subcutaneous tissues was reflected.
3. Now, the fracture site was opened and if there is periosteum interposition, that was removed.
4. With bone holding clamp/towel clips the displaced fracture fragment was reduced.
5. A 2.5 mm K-wire was advanced through the tip of the medial malleoli through the fracture site into the proximal fragment.
6. Now, the K-wire was removed and, a 3.5 mm malleolar screw was inserted along the track and reduction was checked under fluoroscopy.
7. With thorough wash given, wound was sutured.

With sterile dressing done on both medial and lateral side, a below knee posterior POP slab was applied.

IN GROUP B
LATERAL MALLEOLUS
1. The approach to the lateral malleolar fractures was centered on the lateral malleolus itself.
2. After loading a 3.0mm/3.5mm K-Wire with Drill/T handle, the k-wire is passed through distal fibular fracture fragment from tip of lateral malleoli upto fracture site under fluoroscopy guidance.
3. Then, the Fracture was reduced with help of assistant by holding the ankle in reduced position. The finer adjustment of fracture reduction was done by passed K-Wire.
4. After checking the reduction in C-Arm. in both AP and Lateral view, the K-wire was now advanced in the proximal fragment under lateral view, and then checked in AP view also.
5. Now the K-wire was cut with K-wire cutter and then bent.

MEDIAL MALLEOLUS
Medial Malleolus usually get reduced with fibular fracture reduction and fixation.

POST-OPERATIVE PROTOCOL: IN GROUP A:
Parenteral antibiotics were given in the post-op period. Suture removal was done between 12-14 days and a below knee cast was applied for 6 weeks.
- At 6 weeks the cast was removed, clinical examination was done regarding tenderness and movements of ankle joint. Active movements of ankle were started for next two weeks without weight bearing.
- At 8 weeks clinical examination was done, later check x-ray of ankle were taken and looked for signs of fracture union and then partial weight bearing was started for further period of 4-6 weeks with Elasto Crepe bandage and elevation of the limb and active movements of ankle joint simultaneously.
- Patients were then allowed full weight bearing on the affected limb at 11-14weeks, after clinical examination and there radiograph showing Callous formation Later patients were followed up at regular interval upto 6 months.
- In patients with no radiological signs of union weight bearing was delayed.

IN GROUP B
Parenteral antibiotics were given in the post-op period. Suture removal was done between 12-14 days and below knee slab was continued for 4 weeks.
- Patient was asked to do active toe movements with dorsi and plantar flexion with continuing slab application.
- At 4 weeks the slab was removed, clinical examination was done and range of movements, of the ankle joint were noted. With Elasto Crepe bandage application, Patients were advised to continue regular toe movements with active and passive exercise of ankle.
- At 6 weeks patients were clinically assessed and check x-ray of ankle were taken and looked for signs of fracture union. And partial weight bearing was allowed with help of walker.
- In patients with no radiological signs of union partial weight bearing was delayed.
- At 10 weeks, patient were clinically assessed, and check x ray of ankle joint in AP and Lateral views were taken, later patient were advised for full weight bearing, and were advised to return back to their daily normal activities.

Follow up of cases was done at regular intervals of 6 weeks for a minimum of 6 months. At each assessment, all patients were questioned with regard to ankle pain, activities of daily living like ability to walk, squatting, crossed legged sitting, ability to run, ability to work and the stability of the ankle joint was assessed. At examination, the motion of the ankle joint was evaluated. Anteroposterior and lateral radiographs of the ankle were made at the time of examination to assess the radiographic results.
All patients were evaluated according to the Olerud and Molander ankle scoring system for statistical analysis and functional grading. Olerud & Molander ankle scoring system was used for the study. All the patients were evaluated and scores were given.

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RESULTS

Table 1: Demographic data

		Group A		Group B		Total	P Value
		No	%	No	%		
Age group in years	20-30	1	6.7	2	13.3	3	P=0.68
	31-40	5	33.3	7	46.7	12	
	41-50	7	46.7	4	26.7	11	
	>50	2	13.3	2	13.3	4	
Total		15	100.0	15	100.0	30	Not Significant
Sex	Male	9	60.0	12	80.0	21	P=0.23
	Female	6	40.0	3	20.0	9	
Total		15	100.0	15	100.0	30	
Fracture side	Left	5	33.3	6	40.0	11	P=0.7
	Right	10	66.7	9	60.0	19	
Total		15	100.0	15	100.0	30	
Mode of Injury	Fall	5	33.3	5	33.3	10	P=1
	RTA	7	46.7	7	46.7	14	
	Twist	3	20.0	3	20.0	6	
Total		15	100.0	15	100.0	30	

In our series, majority of the cases i.e.12 (40%) were in the age group of 31-40 years, followed by 11(36.6%) cases in the age group 41-50 years. The youngest patient was 21 years old and eldest patient was 65 years. The mean age was 41 years. In the present series, males were more commonly involved. Majority of the patients were males-21 cases (70%) and 9 (30%) were females. Right side was involved in 19 (63.3%) cases and left ankle in 11 (36.6%). Right ankle was more commonly involved. 14 cases (46.6%) affected were due to road traffic accident, 10 cases (33.3%) due to fall, and 6 cases (20 %) due to twisting injury. Road traffic accident was the most common mode of injury.

Table 2: Fracture type according to Lauge Hansen classification, AO classification

		Group A		Group B		Total	P Value
		No	%	No	%		
Lauge Hansen Type	PA	3	20.0	3	20.0	6	P=0.27
	PER	1	6.7	4	26.7	5	
	SA	2	13.3	0	0.0	2	
	SER	9	60.0	8	53.3	17	
Total		15	100.0	15	100.0	30	
AOType	B	9	60.0	7	46.7	16	P=0.46
	C	6	40.0	8	53.3	14	
Total		15	100.0	15	100.0	30	

In the present study, majority of the cases i.e. 17 (56.6%) had Supination-external rotation injury, followed by 6 (20.1%) cases had Pronation-abduction injury. The AO type B was most common, involving 16(53.3%) patients each, followed by type C 14 (46.6%).

Table 3: Treatment of individual fractures: Lateral malleolus and Medial malleolus

Implants	Group A (Plate and screwfixation)	Group B (Kwire)	Total no. of Lat.Malleolar
No. of cases	15	15	30
Percentage	50	50	100
Implants	Group A	Group B	Total no. of Medial Malleolar
No. of cases	15	15	30
Percentage	50	50	100

Lateral malleolar fractures i.e. 15 cases (50.0%) were fixed with plate and screw fixation in Group A. In the rest of the 15 cases i.e. in Group B (50.0%) fractures were fixed with K-wires. Medial malleolar fractures were fixed with malleolar screws in Group A i.e.15 cases (50.0%). In group B i.e. in remaining 15 cases medial malleolar fractures were fixed with cannulated cancellous screw.

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Table 4: Duration of Union in Weeks

No of Weeks	Group A		Group B	
	No. of Cases	Percentage	No. of Cases	Percentage
6-10 weeks	8	26.7	12	40
11-14 weeks	5	16.6	2	6.7
15-18 weeks	2	6.7	1	3.3

In our study, the average time taken for union was 10.5 weeks. In group A 8 cases showed union in 6-10 weeks, while 12 cases in group B showed union in the same duration.

Table 5: Radiological Union in Weeks

Group		N	Mean	Std.Deviation	T	P	Inference
Radiological Union in Weeks	Group A	15	10.13	2.77	-0.831	0.413	Significant
	Group B	15	10.93	2.49		(>0.05)	

P Value with Mean of 10.93 In Group B Showed Early Radiological Union When Compared with Mean of 10.13 In Group A.

Table 6: Complications

Complication				Total Cases
	No of Cases	Percentage	No of Cases	Percentage
Pain at Ankle Joint	2	13.3	1	6.7	3
Stiffness at Ankle Joint	2	13.3	1	6.7	3
Swelling	1	6.7	2	13.3	3
Superficial Infection	2	13.3	0	0	2
Deep Infection	0	0	0	0	0
Skin Necrosis	2	13.3	0	0	2
Delayed Union	0	0	0	0	0
Mal Union	0	0	0	0	0
Total	9	59.9	4	26.7	15

Group A Had More No of Complications When Compared with Group B.

Table 7: Functional outcome

		Group A		Group B		Total	P Value
		No	%	No	%		
Functional Grading	Excellent	6	40.1	7	46.6	13	P=1.005
	Good	5	33.3	6	40.1	11	
	Fair	2	13.3	2	13.3	04	
	Poor	2	13.3	0	00	02	
Total		15	100.0	15	100.0	30	

In the present study, 30 patients with Bimalleolar fractures were treated surgically. Group A patients had Excellent functional outcome result in 06 cases (40.1%), Good results in 05 cases (33.3%), Fair results in 02 cases (13.3%) and Poor in 02 cases (13.3%). Where as in Group B patients had Excellent functional outcome result in 07 cases (46.6%), Good results in 06 cases (40.1%), Fair results in 02 cases (13.3%) and no Poor results.

DISCUSSION

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, active patients and in the elderly[7,8].Most ankle fractures are complex injuries that are difficult to manage. These injuries gain importance because the whole-body weight is transmitted through the ankle and locomotion depends upon the stability of the ankle joint. They have the potential to produce a significant long-term disability and complications in the form of pain, instability and early degenerative arthritis[9].

In our study, fractures were commoner in the 31-40 yrs age group, with mean age being 41 yrs. Our findings are comparable to the studies made by, Beris *et al.*[10], Roberts RS *et al.*[11] and Lee *et al.*[12] Our series had a male predominance with 70 % i.e. 21 male patients and male:female ratio of 2.3:1 which is comparable to the study by Baird & Jackson[13] and SSV Raman *et al.*[14] In the present study, left ankle were more commonly affected, in accordance with

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Nitin Bither *et al*.[15] In the current study, the majority of the cases were affected due to road traffic accidents i.e. 14 cases (46.6%), which was in accordance with study by Polishetty*et al*.[16].

In the present study, Lauge-Hansen classification system was used for operative evaluation. The most common type of injury was supination-external rotation i.e. 17 cases (60.71%) followed by pronation-abduction 5 cases (17.86%), in accordance with by Roberts RS[11], Baird & Jackson[13] and Polisetty VSP *et al*.[16] In the present study, 30 patients with Bimalleolar fractures were treated surgically. Group A patients had Excellent functional outcome result in 06 cases (40.1%), Good results in 05 cases (33.3%), Fair results in 02 cases (13.3%) and Poor in 02 cases (13.3%). Where as in Group B patients had Excellent functional outcome result in 07 cases (46.6%), Good results in 06 cases (40.1%), Fair results in 02 cases (13.3%) and no Poor results. In Colton[17] series, 70% of the patients had an excellent to good results. Burnwell&Charnley[18] in their series of 132 patients, 102 (77.3%) had good results, 16% had fair results and 6% were found to poor score. In Polisetty VSP *et al*.[16], 85% had good to excellent results, 4% had fair results and poor results in 5%. In our study the following observation were made and support the contention of Yablon *et al*.[19] that the lateral malleolus is the key to the anatomical reduction of bimalleolar fractures. Poor reduction of the lateral malleolus # would result in persistent lateral displacement or residual shortening, which was also reported by Hughes *et al*.[20] Hughes *et al*.[20] recommended that lateral malleolus should be fixed first. The medial malleolus is then inspected for stability and fixed later. This allows minimal postoperative immobilization and rapid recovery of function. Closed reduction and internal fixation with k-wire fixation for lateral malleolar fractures and cannulated cancellous screw fixation for medial malleolar fractures, provides early mobilization, with less time-consuming surgery, preservation of fracture hematoma. With less chances of skin infection and almost no chances of skin necrosis, due to stab incisions. This method of closed reduction shows early mobilization, early union rate and good range of motion. Hence, in our study the surgical management of Bimalleolar fractures by CRIF with K-wire fixation of lateral malleolar fractures and medial malleolar fractures fixation with cannulated cancellous screw give better results when compare ORIF with plate and screw fixation of lateral malleolar fractures and medial malleolar fractures with malleolar screw fixation.

CONCLUSION

In comparison with open reduction and internal fixation of medial malleolar fractures with malleolar screw and fibular plate and screw fixation for lateral malleolar fractures, this is a time-consuming surgery due to opening of the fracture fragment. Loss of fracture hematoma, more chances of skin infection and skin necrosis due to wider incision, and subcutaneous nature of the bone, hardware problems due plate and screw fixation and with more union time, and higher chances of ankle stiffness.

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