

Research Article

Bimalleolar Fracture of Ankle Joint Managed By Tension Band Wiring Technique: A Prospective Study

Dr. Maruthi CV¹, Dr. Venugopal N², Dr. Nanjundappa HC², Dr. Siddalinga swamy MK²

¹Assistant Professor, Department of Orthopaedics, MVJ MC and RH, Hoskote, Bangalore, India

²Professor, Dept of Orthopaedics, MVJ MC and RH, Hoskote, Bangalore, India

³MVJ Medical College & Research Hospital, Hoskote, Bangalore -562 114, India

***Corresponding author**

Dr. Maruthi CV

Email: cvm.aruthi@sifv.com

Abstract: Ankle fractures are the most commonly encountered by most of the orthopaedic surgeons. According to the Lauge Hansen's classification five different types can be seen. The surgical treatment of adduction, abduction and supination external rotation type of injuries leading to bimalleolar fractures can be fixed with either tension band technique or cancellous screws. Here we are done a study to evaluate the benefits of tension band wiring technique in the management of bimalleolar fractures of the ankle. In our study, 40 cases of bimalleolar fracture of ankle joint of above mentioned types were admitted in Department of Orthopaedics, between February 2009 and November 2013 was included. We included patients above 20 and below 58 years. We excluded patients with pronation external rotation, vertical compression and trimalleolar fractures, pathological fractures, compound fractures and who are medically unfit and at extremely high anaesthesia risk. All the patients, operated by open reduction and internal fixation using tension band wiring technique. And follow up done at intervals of 4, 8, 12 and 24 weeks. And the clinic radiological outcome was assessed at 24 weeks using Baird and Jackson scoring system. And we conclude that bimalleolar fractures are the most commonly encountered by orthopaedic surgeon in his practice. Abduction types of injuries are the most common type to be seen. By Tension band wiring technique, we can achieve stable fixation and early mobilization of the ankle joint, which limits the complications of pseudotumors osteodystrophy and ankle stiffness. And by the above mentioned technique, we achieved good to excellent results of 90 percent.

Keywords: Bimalleolar fracture, Tension band wiring, Abduction, Lauge Hansen's, Baird and Jackson score

INTRODUCTION

Ankle fractures are the most commonly encountered fracture by most of the orthopaedic surgeons. According to the Lauge Hansen's classification five different types can be seen. The surgical treatment of adduction, abduction and supination external rotation type of injuries leading to bimalleolar fractures can be fixed with either tension band technique or cancellous screws. Here we are done a study to evaluate the benefits of tension band wiring technique in the management of bimalleolar fractures of the ankle.

MATERIALS AND METHODS

The study was conducted on 40 cases of bimalleolar fracture of ankle joint classified according to the Lauge Hansen's classification (Table 1) who were admitted in Department of Orthopaedics, between February 2009 and November 2013. We included patients above 20 and below 58 years. We excluded patients with pronation external rotation, vertical compression and trimalleolar fractures, pathological

fractures, compound fractures and who are medically unfit and at extremely high anaesthesia risk. All the patients were operated by open reduction and internal fixation using tension band wiring technique. And follow up done at intervals of 4, 8, 12 and 24 weeks. And the clinic radiological outcome was assessed at 24 weeks using Baird and Jackson scoring system (Table 2).

RESULTS

Forty patients with bimalleolar fractures admitted in our institution during February 2009 and November 2013 were selected and studied. Patients were in the age group of 20 to 58 years with a mean of 28.8 years. 28(70%) cases were males and 12(30%) were females. Among the 40 cases, 60% of the patients had sustained the fracture on right side and 40% on left. 70% of the patients sustained fracture due to fall and the rest in road traffic accidents. Most of the patients in our study were in abduction type of Lauge Hansen's classification.

Table 1: Lauge Hansen’s classification

<p><u>Supination-Adduction (SA)</u></p> <ul style="list-style-type: none"> • Transverse avulsion-type fracture of the fibula below the level of the joint or tear of the lateral collateral ligaments • Vertical fracture of the medial malleolus
<p><u>Supination-Eversion (External Rotation) (SER)</u></p> <ul style="list-style-type: none"> • Disruption of the anterior tibiofibular ligament • Spiral oblique fracture of the distal fibula • Disruption of the posterior tibiofibular ligament or fracture of the posterior malleolus • Fracture of the medial malleolus or rupture of the deltoid ligament
<p><u>Pronation-Abduction (PA)</u></p> <ul style="list-style-type: none"> • Transverse fracture of the medial malleolus or rupture of the deltoid ligament • Rupture of the syndesmotoc ligaments or avulsion fracture of their insertions • Short, horizontal, oblique fracture of the fibula above the level of the joint
<p><u>Pronation-Eversion (External Rotation) (PER)</u></p> <ul style="list-style-type: none"> • Transverse fracture of the medial malleolus or disruption of the deltoid ligament • Disruption of the anterior tibiofibular ligament • Short oblique fracture of the fibula above the level of the joint • Rupture of posterior tibiofibular ligament or avulsion fracture of the posterolateral tibia
<p><u>Pronation-Dorsiflexion (PD)</u></p> <ul style="list-style-type: none"> • Fracture of the medial malleolus • Fracture of the anterior margin of the tibia • Supramalleolar fracture of the fibula • Transverse fracture of the posterior tibial surface

Table 2: Baird and Jackson scoring system

Pain	Score
No Pain	15
Mild pain with strenuous activity	12
Mild pain with activities of daily living	8
Pain with weightbearing	4
Pain at rest	0
Stability of ankle	
No clinical instability	15
Instability with sports activites	5
Instability with activites 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 25 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

Table 3: Scores according to the Baird and Jackson scoring system

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

Maximum possible score-100

Table 4: Type of Bimalleolar fracture

	No. of Patients	%
Adduction	6	15
Abduction	26	65
Supination external rotation	8	20
Total	40	100

Pre-operative

Patients with above mentioned bimalleolar fractures were admitted and below knee slab was applied routinely in all cases. Oral and parenteral analgesics were given to relieve pain. Following investigations were done in all the cases: Haemoglobin level, urine routine, bleeding and clotting time, blood urea, serum creatinine, random blood sugar, Electro cardiograph (ECG), and chest X-rays were obtained routinely.

Pre anaesthetic evaluation was done for all cases and American society of Anaesthesiologist (A.S.A) grading system used prior to surgery. Parenteral 2nd generation cephalosporin was administered 1 hour prior to surgery. Shaving and scrubbing was done morning of surgery else before shifting patient out of waiting room to the operation theatre.

Surgical technique

Under tourniquet control, lateral malleolus was fixed first. By lateral approach (Fig. 1) the lateral malleolus fracture site is exposed, after clearing the soft tissue from the fracture site, temporarily held with towel clip and stabilized with two number 1.8mm k wires passed from the tip of malleolus to the medial cortex of the proximal fragment of fibula under image intensifier guidance and by figure of eight method the

18 gauze stainless wire is passed around the k wires at the tip of malleolus and four centimetres proximal to the fracture site through the lateral cortex of the fibula in anteroposterior direction. The stainless steel wire is tightened till the maximum compression is achieved at the fracture site. After through wash wound was closed.



Fig. 1: Lateral approach

By anteromedial approach (Fig. 2) the medial malleolus fracture site is exposed, after clearing the soft tissue from the fracture site, temporarily held with towel clip and stabilized with two number 1.8mm k wires passed from the tip of malleolus to the lateral cortex of the tibia under image intensifier guidance and by figure of eight method the 18 gauze stainless wire is passed around the k wires at the tip of malleolus and four centimetres proximal to the fracture site through

the medial cortex of the tibia in anteroposterior direction. The stainless steel wire is tightened till the maximum compression is achieved at the fracture site (Fig. 3). After through wash wound was closed and compression dressing applied.



Fig. 2: Medial approach



Fig. 3: Fracture fixed with tension band wiring

Intraoperative

Total duration of the surgery ranged from 45 minutes to 70 minutes.

Post-operative care

Immediately after the surgery check X-ray were taken. Parenteral antibiotics were given till second postoperative day and then oral antibiotics till fifth day. On the second day wound inspected and suture removal done on fourteenth day. Range of motion exercises at the ankle joint was started on the second day at the ankle joint. Patient was allowed to nonweight bearing ambulation using axillary crutches from the second day. Patient was followed at 4, 8, 12 and 24weeks for clinic radiological evaluation and final results at the end of 24 (Fig. 4) weeks by using Baird and Jackson scoring system.



Fig. 4: Six months follow up X-ray

Physiotherapy

Range of motion exercises at the ankle joint was started on the second day at the ankle joint. Patients were allowed to nonweight bearing ambulation using axillary crutches from the second day. Partial weight bearing started in all by four weeks and full weight bearing by eight weeks.

Complications

In one case postoperative superficial infection was noted and treated conservatively with antibiotics and regular dressings.

Distribution of patients according to the Baird and Jackson scoring system

All patients after fracture union or after 24weeks were grouped and clinical and radiological results evaluated as follows.

Table 5: Baird and Jackson scoring system

Result	Scores in our study
Excellent	100-6
	98-2
Good	94-8
	92-11
	93-9
Fair	84-1
	81-1
	87-1
	86-1
Poor	-
Total	40

Results according to the Baird and Jackson scoring system

Table 6: Results according to the Baird and Jackson scoring system

Result	No. of Patients	Percentage
Excellent	8	20%
Good	28	70%
Fair	4	10%
Poor	0	-
Total	40	100%

DISCUSSION

Ankle injuries are usually caused by simple twisting injury to high energy injuries [1-3]. The incidence is highest in elderly women. Two third of the ankle injuries are isolated medial malleolar fractures one fourth constitutes bimalleolar fractures and 7% is trimalleolar. Open fractures accounting for 2% [4]. Four major fracture types were described by Lauge-Hansen, supination-adduction, supination-external rotation (SER), pronation-abduction, and pronation-external rotation (PER) fractures. The most common injury mechanism is SER, which accounts for the majority of all patterns [5]. In our study abduction type of injury was most common. Usual presentation is pain, swelling and inability to walk. Examination reveals tenderness, swelling instability and antalgic gait. According to OARs ankle roentgenograms are done if there is pain near the malleoli, age above 55years or older, inability to bear weight, bone tenderness at the posterior edge or tip of either malleolus [6, 7]. In the acute trauma setting; mortice, anteroposterior and lateral nonweight bearing views to be done. If the patient is able to stand comfortably weight bearing views are done to check for alignment and stability [8, 9]. Plain x-rays show a discontinuity in condensed subchondral bone line around the talus that extends from the subchondral bone of the distal tibia to the medial aspect of the fibula. Disruption of this line indicates shortening, rotation, or displacement of the fibula. Other measures that help to determine non alignment after ankle injury include (a) measuring the talocrural angle, (b) determining the medial clear space, and (c) assessment of syndesmotic widening. The mortise view is probably the best for making all of these measurements. Bimalleolar ankle fractures disrupt the medial and lateral stabilizing structures of the ankle joint. Displacement reduces the tibiotalar contact area and alters joint kinematics. Closed reduction often can be accomplished, but not maintained in anatomical position as swelling subsides. Nonunion has been reported in approximately 10% of bimalleolar fractures treated by closed methods, although these are not always symptomatic. Twenty percent of bimalleolar fractures involve intraarticular injuries to the talus and tibia; these injuries go untreated when closed methods are used. Tile and the AO group recommended open reduction and internal fixation of both malleoli for almost all bimalleolar fractures. The medial malleolar fractures are treated by tension-band wire around two parallel K-wires. The proximal tension-band wire is placed through a drill hole or around a horizontally placed screw. This construct directly resists the bending forces that are partially responsible for the fracture and has been shown to have greater strength than two partially threaded screws [10-12]. Lateral malleolus fracture can be fixed with cancellous screw, rush pin, tension band wiring. In our study in all tension band wiring was used. The ankle is immobilized in a posterior plaster splint with the ankle in neutral position and elevated. If the bone quality is good, and the fixation is secure, the splint can be removed in 2 to 4 days and replaced with a removable

splint or fracture boot. Range-of-motion exercises are begun. Weight bearing is restricted for 6 weeks, after which partial weight bearing can be started if the fracture is healing well. Full weight bearing is allowed after 12 weeks. In our study posterior splint was not put in any of our patients and mobilization was started on the second day after surgery. Radiological union will be achieved by six to twelve weeks and full weight bearing by eight to twelve weeks. In our study radiological union was achieved in all by eight weeks and full weight bearing started by eight weeks in all of our patients. The results are comparable to the standard studies and we achieved 90 percent good to excellent outcome [11, 12].

CONCLUSION

Bimalleolar fractures are the most commonly encountered by orthopaedic surgeon in his practice. Abduction types of injuries are the most common type to be seen. By Tension band wiring technique, we can achieve stable fixation and early mobilization of the ankle joint, which limits the complications of pseudotumors, osteodystrophy and ankle stiffness. And by the above mentioned technique, we achieved good to excellent results of 90 percent.

REFERENCES

1. Bauer M, Bergström B, Hemborg A, Sandegård J; Malleolar fractures: nonoperative versus operative treatment. A controlled study. *Clin Orthop Relat Res.*, 1985; 199: 17-27.
2. Bauer M, Jonsson K, Nilsson B; Thirty-year follow-up of ankle fractures. *Acta Orthop Scand.*, 1985; 56(2):103-106.
3. Kristensen KD, Hansen T; Closed treatment of ankle fractures. Stage II supination-eversion fractures followed for 20 years. *Acta Orthop Scand.*, 1985; 56(2):107-109.
4. Court-Brown CM, McBirnie J, Wilson G; Adult ankle fractures an increasing problem? *Acta Orthop Scand.*, 1998; 69(1): 43-47.
5. Lauge-Hansen N; Fractures of the ankle. Combined experimental-surgical and experimental roentgenologic investigations. *Arch Surg.*, 1950; 60: 957-985.
6. Stiell IG, McKnight RD, Greenberg GH, McDowell I, Nair RC, Wells GA *et al.*; Implementation of the Ottawa ankle rules. *JAMA*, 1994; 271(11): 827-832.
7. Stiell IJ, Wells G, Laupacis A, Brison R, Verbeek R, Vandemheen K *et al.*; Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. *Br Med J.*, 1995; 311(7005):594-7.
8. Brage ME1, Rockett M, Vraney R, Anderson R, Toledano A *et al.*; Ankle fracture classification: a comparison of reliability of three X-ray views versus two. *Foot Ankle Int.*, 1998; 19(8): 555-562.
9. Cockshott WP, Jenkin JK, Pui M; Limiting the use of routine radiography for acute ankle injuries. *Can Med Assoc J.*, 1983; 129(2):129-131.

10. Johnson BA, Fallat LM; Comparison of tension band wire and cancellous bone screw fixation for medial malleolar fractures. *J Foot Ankle Surg.*, 1997; 36(4): 284-289.
11. Kabukcuoglu Y, Kucukkaya M, Eren T; The ANK device: a new approach in the treatment of the fractures of the lateral malleolus associated with the rupture of the syndesmosis. *Foot Ankle Int.*, 2000; 21(9):753-758.
12. Ostrum RF, Litsky AS; Tension band fixation of medial malleolus fractures. *J Orthop Trauma*, 1992; 6(4): 464-468.