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INTRAMEDULLARY SCREW FIXATION OF LATERAL MALLEOLI IN BIMALLEOLAR FRACTURES-A STUDY OF CLINICAL, FUNCTIONAL AND RADIOLOGICAL OUTCOME

Orthopaedics

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ABSTRACT

Objective: To study the results of 20 patients with syndesmotically stable bimalleolar fractures of the ankle treated surgically with intramedullary malleolar screw fixation of the lateral malleoli.

Methods and result: The patients were reviewed every four weeks postoperatively to assess the clinical,radiological and functional improvement.All except one patient showed signs of complete union with good to excellent functional outcome.

Conclusion: We conclude that Intramedullary screw fixation of lateral malleoli in bimalleolar fractures is a reliable and stable technique with very minimal chances of failure and wound complications.

KEYWORDS

INTRODUCTION

Ankle fractures are one of the most common fractures among orthopaedic trauma patients especially the elderly and the incidence is on the rise(1,2).Though females are more affected,often such fractures have a bimodal distribution peaking in young men and elderly women(3,4).The treatment of these fractures depends on the extent of bone injury and the damage to the soft tissues.For a successful functional outcome, detailed medical history, physical examination, and appropriate radiographic examination should be done before going for anatomic restoration of tibiotalar joint(3).Though operative treatment dominates the literature on ankle fractures, conservative treatment of stable ankle fractures is gaining more interest because of increasing rate of wound dehiscence(5).Lateral malleoli fracture may occur alone or in conjunction with fractures of the tibia or as a component of malleolar fracture of the ankle.Isolated distal fibula fractures without associated ligamentous injury are usually treated with a splint or brace and mobilised as early as possible(6).But if combined with medial malleoli fracture,it is better to consider surgical fixation to avoid non/malunion(7).Though surgical management is found not superior to non-surgical management of isolated lateral malleoli fracture at the level of syndesmosis with minimal talar shift, it is not so in case of bimalleolar fractures(8).

Better understanding of the biomechanics and pathoanatomy of the ankle due to extensive research in the recent past has allowed more accurate evaluation of all elements and characteristics of injuries to bone and soft tissues associated with malleolar fractures.Stability of ankle joint is attained by its 'ring' nature produced by bones and ligaments placed all around, which if broken at one site retains the stability;but if broken at two or more sites loses its stability.So technically speaking bi- and trimalleolar fractures are most likely unstable as the 'ankle ring' has broken in at least two places.The medial column with its strong deltoid ligament has proved to be the key element in providing stability to ankle fractures especially while fixing isolated lateral malleoli fracture and it determines the long term functional outcome(9,10).If not treated properly,young patients are at risk of developing post-traumatic osteoarthritis, with a significant impact on quality of life due to pain and impaired function.On the other hand, elderly patients especially with poorly controlled diabetes and osteoporosis are at increased risk of wound complications, infection and failure of fixation(11).Even though there is insufficient evidence for changing the practice of plating,intramedullary fixation of simple oblique or spiral distal fibular fractures give excellent results that are comparable with modern plating techniques because of less soft tissue dissection, less prominent, symptomatic and palpable hardware and a reduced requirement for its removal (12,13). A certain subset of patients with unstable ankle fractures treated with open reduction internal fixation can be made weight bearing as tolerated immediately without jeopardising the operative fixation or clinical outcome (14).This is applicable especially in patients who has undergone intramedullary fixation.Modified Knowles pin, which looks similar to malleolar screw, when used in lateral malleoli fracture fixation was found to be very secure even in quite osteopenic patients and permits very early full weight bearing provided talus is anatomically reduced within the ankle mortise(15).

Ankle fractures in the elderly are challenging to treat and prone to complications.They often present with multiple co-morbid conditions that make surgical management challenging and place them at an increased risk for both peri and post-operative complications(Tab.1). Treatment decision is made depending on bone quality, skin conditions, comorbidities, and functional demand of the patient(2). Post operative infection after fixation of ankle fractures is a challenging and limb-threatening complication, especially in patients with comorbidities such as diabetes mellitus and so adequate preventive measures should be taken in such patients(16). Low-energy ankle fractures often found in the elderly are not the result of their inevitably weaker bones but rather their predisposition to falls and a worsening obesity epidemic.In such patients,intramedullary fixation allows for smaller incisions that may be beneficial in decreasing complications such as wound breakdown and infection.Also intramedullary fixation has better functional results compared to those with plate fixation because they act as weight sharing devices and small incisions used decreases the aforementioned risks of wound complications(17). The general indications for surgery in elderly patients should not differ from those in younger patients because results are equally poor in them if treated non-operatively(2).It may be entirely reasonable to treat a fracture conservatively and to accept healing in an imperfect position in an elderly or multi-morbid patient, if the risk of surgery is expected to be high.If relevant comorbidities are present, the treatment regimen may be adapted accordingly so as to prevent wound complications.Surgery is often difficult for patients with diabetes and peripheral artery occlusive disease (PAOD), as well as for elderly patients with osteoporosis or parchment skin where rate of wound infection is as much as 10%.Often it is difficult to anchor a serviceable osteosynthesis in “soft” bones of the elderly.In such patients,complications can be prevented to a great extend by opting intramedullary fixation(18).Involvement of medial malleolus, female gender, older age, higher American Society of Anaesthesiologists grade, smoking, and lower educational level negatively influenced general health outcome, physical function, and pain(19).Although there are many classifications available for ankle fractures, those by Lauge-Hansen, Danis-Weber, and AO-OTA are often used by Orthopaedic surgeons and among those, the one with the highest reproducibility rate is the Danis-Webber (3).In ankle fractures,open reduction and internal fixation (ORIF) represents the gold standard for the treatment which helps to restore anatomical alignment and articular congruity of ankle mortise thus avoiding altered loading of the tibiotalar joint and subsequent poor functional outcomes. Though poor bone quality and associated co-morbidity can present technical difficulties when managing patients surgically, considerable

improvement in anatomical reduction can be achieved with internal fixation in eligible patients, irrespective of age or gender(20).Impaired wound healing which presents as dehiscence, edge necrosis, and blistering of wound is the most common complication associated with ankle fracture surgeries(21).Patients with fibular fractures associated with higher energy injuries, such as fractures of the distal tibia plafond, have high occurrences of wound complications especially when treated with plating.Minimally invasive approach allows for minimal soft tissue dissection and thus decreased wound healing complications (22) An alternative in such cases is the use of an intramedullary implant which requires only a small incision that too at malleolar tip(23). In open ankle fractures,rigid internal fixation should be carried out with the aim of restoring anatomy of the ankle mortise and preventing long-term secondary degenerative changes resulting in pain and stiffness(24).

According to expanded Danis-Weber classification, lateral malleolar fracture below the syndesmosis is called a type A injury; a fracture at the level of the syndesmosis, a type B injury; and a fracture above the syndesmosis, a type C injury.Decision regarding timing of definitive surgical treatment depends mainly on the soft-tissue findings. Widening of the tibio-fibular cleft or of the talo-tibial joint space medially implies a biomechanically relevant syndesmotic rupture leading to instability.If so fibula has to be positioned into the fibular notch and fixed with a tricortical positioning screw.Combined policies of early operative fixation and pro- active discharge planning minimise the financial implications of bimalleolar fracture, with no increase in the complication rate(25). In stable ankle fractures,direct postoperative weight bearing and early mobilization has the potential benefit of earlier functional recovery especially if opted for intramedullary fixation(26).

The aim of this study was to determinate the radiological and functional outcome of screw fixation of lateral malleoli in syndesmotic-stable bimalleolar fractures.

MATERIALS AND METHOD

We retrospectively reviewed 20 bimalleolar fracture patients which falls in types B and C of expanded Danis-Weber classification(Table.2) who had undergone operation at our institution with mini incision malleolar screw fixation for lateral malleoli.Majority were of type B wherein fracture of lateral malleoli is at the level of syndesmosis. According to Lauge-Hansen classification,all patients had abduction factor in common with 10 having external rotation force in addition (Fig.1). All patients with 18 years of age or older, unilateral, isolated closed ankle fracture/ankle fracture dislocation, and all patients who had to be definitively treated with ORIF were included in the study. Exclusion criteria were: associated fractures of the shafts of fibula/tibia, or talus and also polytrauma.All surgeries were conducted under spinal anaesthesia. All operations were performed under tourniquet control and were operated using the same approach and surgical technique. Through one to two centimetre long vertical incision at the tip,lateral malleoli was fixed using 4 mm size malleolar screw of adequate length passed retrograde and ensuring that the threads cross the fracture site. Medial malleoli was fixed in all cases by malleolar screws with or without K wireImage intensifier was used to perform the surgical procedure and to evaluate on table fracture reduction and the stability of fixation in all cases. Wound was closed using vicryl to subcutaneous tissue and staples to the skin.

We followed a standard postoperative care protocol as a rule. In the initial four weeks time, a posterior short leg splint with the foot at 90° was applied and no weight-bearing was permitted to improve wound healing. Sutures were removed after 10-12 postoperative days. Depending on the fracture patterns and wound state, a rehabilitation program with passive and active range of motion (ROM) exercises and partial weight-bearing of up to 10 to 15 kg was allowed to favour fracture healing. Full weight-bearing and full normal activity was allowed once the bone and ligamentous healing was assured (usually 4-6 weeks postoperatively), depending on the fracture pattern and follow-up X-ray findings.Outpatient records were analysed to collect postoperative details including functional outcome measurement, clinical fracture healing, residual pain, ROM, and wound inspection. Radiological union of the fractures were assessed by comparing callus strength and fracture gap in anteroposterior and lateral view X-rays taken every three to four weeks.All patients were assessed every four weeks for development of complications like surgical site infection,deformity or need for re-operation.

RESULTS

Out of the 20 patients studied, 16 (80%) were female and 4 (20%) were male, and their average age was 50 years (range 26–70 years). According to Danis-Weber classification, eighteen fractures were of type-B (90%) and two were of type-C(10%).No fracture could be included in type-A.None of the fracture showed signs of syndesmotic injury during examination under anaesthesia. One obese patient with type C fracture who started full weight bearing at two weeks postoperative and against medical advice developed implant failure with cut through of lateral malleolar screw.All patients had intraoperative post-fixation radiographs that displayed symmetric joint space around the talus.Average fracture union time was 10 weeks (range 6-12 weeks)which was calculated depending on the fracture gap and callus strength in the follow up radiographs(Table1). On clinical evaluation two patients (10%) had peri-incisional erythema at two weeks that resolved with a short course of oral antibiotics. No wound issues were noted at the end of one month.During the final review, two patients had persistent ankle stiffness with minimal limping of the affected limb.Radiographic evaluation at every 2 weeks displayed no loss of reduction in 19 patients (95%) and one loss of reduction (5%) and that too because of patient cause.That patient later underwent dynamic compression plate fixation of lateral malleoli and fracture went for union in 8 weeks.

DISCUSSION

Postoperative wound infection being one of the most common complications of ankle fracture surgery is reported upto 10% in the literature. Many studies have concluded quoting that intramedullary fixation is an ideal technique for managing long bone fractures.Though extramedullary plating of distal fibular fracture achieves acceptable and consistent union,it has been associated with wound infection, wound breakdown and hardware prominence,with reported complication rates of up to 30% (14,21,25) .With the advantage of mini-incision technique and low-profile implants associated with intramedullary fixation of distal fibular fractures, there is a theoretical reduction in the risk of patients developing wound complications and soft-tissue irritation due to hardware prominence. In a 17 studies review literature by Sameer Jain and others,the authors has substantiated that excellent union rates and satisfactory functional outcomes can be expected with intramedullary fixation(21). In another review study by Rishin J Kadakia and others,they found that intramedullary fixation of fibula in elderly patients with displaced ankle fractures had better functional results compared to those with plate fixation(16). In an original study by Paul B. McKenna and others,the authors have proved that in simple oblique or spiral fracture of the lateral malleolus with good bone quality, lag screw only fixation is preferable to plate osteosynthesis(25). In a 20 patients study by George A. Brown, intramedullary modified Knowles pin was found to be a successful device for internal fixation of the lateral malleolus and allowed early return to full function(23). In another study by Tyner Gonzalez and others the authors reported that minimally invasive technique in fibular fracture fixation allows for minimal soft tissue dissection with decreased wound healing complications(17).

The sole purpose of our study was to evaluate the results of intramedullary fixation with regards to union, functional outcome and complications.Even though limited fixation is biomechanically weaker than standard plate osteosynthesis (25), the presence of loss of fracture reduction in only one non-compliant patient of the present series suggests that while not absolutely rigid, fracture fixation is clearly stable. We have found no evidence to suggest that this less rigid fixation compromises fracture healing or clinical outcome.

CONCLUSION

In all patients, except one, fracture united without a measurable change in fibular alignment or position of the intramedullary device.Union rate was found to be without any obvious complication.Our study has proved that malleolar screw appears to be a successful device for internal fixation of the lateral malleolus in bimalleolar fractures and allows early return to full function.Since sample size is not large enough and follow up period was short, we recommend a large sample study that evaluates long term results of the same procedure.

Conflict of interest

Both authors declare that there is no conflict of interest.

Treatment	Timing	Diagnosis	Possible management
Conservative	short-term	compartment syndrome	fasciotomy
		dislocation	osteosynthesis
		inner pressure ulceration	osteosynthesis, arthrodesis, plastic surgical coverage
		CRPS	pain therapy, plexus block
	long-term	pain	arthrodesis, ankle prosthesis
		limited range of motion	arthrodesis, ankle prosthesis
Surgical	short-term	compartment syndrome	fasciotomy
		wound hematoma	wound revision
		impaired wound healing, infection	wound revision
		dislocation	reoperation
		malpositioned screw(s)	reoperation
		inadequate reduction	reoperation
		CRPS	pain therapy, plexus block
	long-term	non-union	resection and bone grafting
		malposition	correction osteotomy, arthrodesis, ankle prosthesis
		impingement syndrome	arthroscopy
		limited range of motion	arthrodesis, ankle prosthesis
		arthrosis	arthrodesis, ankle prosthesis

Table 1. Showing operative and non-operative complications of bimalleolar fractures and its management

Fibular fracture	Danis-Weber	Lauge-Hansen (stages)	AO/OTA
Infra-syndesmotic	Type A	Supination adduction (SAD) 1. Transverse fracture of lateral malleolus 2. Vertical fracture of medial malleolus	44-A1 (isolated lateral) 44-A2 (lateral, medial) 44-A3 (lateral, medial, posterior)
Trans-syndesmotic	Type B	Supination external rotation (SER) 1. Injury of AITFL 2. Low oblique/short spiral fracture of lateral malleolus 3. Injury of PITFL or fracture of posterior malleolus 4. Deltoid ligament injury or fracture of medial malleolus	44-B1 (lateral) 44-B2 (lateral, medial) 44-B3 (lateral, medial, posterior)
Supra-syndesmotic	Type C	Pronation external rotation (PER) 1. Deltoid ligament injury or fracture of medial malleolus 2. Injury of AITFL 3. High oblique/spiral fracture of distal fibula 4. Injury of PITFL or fracture of posterior malleolus Pronation abduction (PAB) 1. Deltoid ligament injury or fracture of medial malleolus 2. Injury of AITFL 3. Transverse or comminuted fracture of distal fibula	44-C1 (simple diaphyseal) 44-C2 (multifragmentary) 44-C3 (proximal)

Note. AITFL, anterior inferior tibiofibular ligament; AO, Arbeitsgemeinschaft für Osteosynthesefragen; OTA, ; PITFL, posterior inferior tibiofibular ligament

Table 2. Showing various classifications for bimalleolar ankle fracture

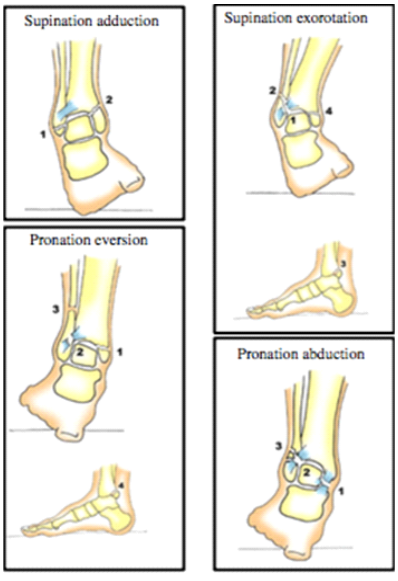

Figure 1. Lauge-Hansen classification with Trauma mechanism of ankle fractures. Supination abduction: 1. Talo-fibular ligament sprain or fibular avulsion; 2. Vertical medial malleolus fracture. Supination eversion: 1. anterior tibiofibular ligament sprain; 2. Lateral oblique fibular fracture; 3. Avulsion of posterior malleolus or ligament rupture; 4. Transverse medial malleolus fracture or disruption of deltoid ligament. Pronation abduction: 1. Transverse medial malleolus fracture or deltoid ligament; 2. Anterior tibiofibular ligament sprain; 3. Transverse comminuted fracture of the fibula. Pronation ext.rotation: 1. Transverse medial malleolus fracture or deltoid ligament disruption; 2. Anterior tibiofibular ligament disruption; 3. Oblique or spiral fracture of the fibula; 4. Avulsion of posterior malleolus of posterior tibiofibular ligament.

No.(n=20)	Age in yrs/Sex	Danis-Weber type	Union time in weeks
1	39/F	B	8
2	40/F	B	8
3	48/M	B	12
4	47/F	B	12
5	48/F	B	8
6	50/F	B	6
7	70/M	B	Implant failure at 2 weeks
8	60/F	B	12
9	62/F	B	8
10	65/F	C	8
11	43/F	B	8
12	54/F	B	8
13	26/F	C	8
14	66/M	B	12
15	49/F	B	8
16	46/F	B	12
17	48/F	B	12
18	60/F	B	8
19	53/F	B	8
20	47/F	B	12

Table 3. Showing details of patients who underwent malleolar screw fixation for lateral malleoli component of bimalleolar fracture

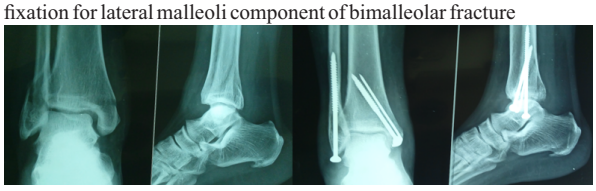

Fig.2 Showing pre-operative(a) and post healing(b) X-rays of a Danis-Weber Type B bimalleolar fracture

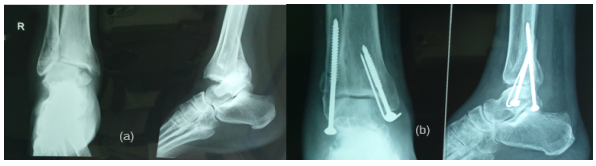

Fig.3 Showing pre-operative(a) and post healing(b) X-rays of a Danis-Weber Type C bimalleolar fracture

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