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A prospective study of osteosynthesis of malleolar fractures of ankle in adults

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Abstract

Introduction: In this age of road traffic accidents and sports activities the occurrence of malleolar fractures of the ankle are common. Malleolar fractures account for nearly 2% of all the fractures.

Methods: During the period of July 2015 to July 2016, thirty adults with malleolar fractures of the ankle were operated at Sapthagiri Institute of Medical Science And Research Center, Bangalore. They were treated by open reduction and internal fixation by one-third tubular plate or dynamic compression plate, tension band wiring, malleolar screws or a combination of these. The rating was done as per Weber's protocol.

Results: Acceptable results were obtained in twenty- five out of thirty patients, with 83.3 % of the patients having excellent to good rating. Five patients (16.6%) results were poor, because of pain on activity, restriction of range of motion at the ankle and subtalar joint, and restriction of activity.

Conclusion: Surgical management of malleolar fractures of the ankle by open reduction and internal fixation remains the treatment of choice, to ensure anatomical joint restoration, union, and good function of the ankle joint.

Keywords: Tubular plate, dynamic compression plate, tension band wiring, malleolar screws, weber's

Introduction

In this age of road traffic accidents and sports activities the occurrence of malleolar fractures of the ankle are common. Malleolar fractures account for nearly 2% of all the fractures^[1]

In order to obtain anatomical joint restoration, malleolar fractures can be managed both conservatively and surgically. For most fractures surgical management by open reduction and internal fixation ensures anatomical joint restoration and union.

The advantages of open reduction and internal fixation (ORIF) are

- The normal relationship of ankle mortise can be restored^[1]
- Weight bearing alignment of the ankle at right angle to the longitudinal axis of the leg is achieved^[1]
- The contours of the articular surface can be achieved^[1]
- Prevents malunion, nonunion, post traumatic arthritis and alteration of joint kinetics.^[1, 2]

Injuries about the ankle joint cause destruction of not only the bony architecture but also often of the ligamentous and soft tissue components¹. Only slight variation from normal is compatible with good joint function.

Randomized, prospective studies have shown that better results are obtained with operative than non-operative treatment^[3]. The present study is done to assess the functional outcome and complications following open reduction and internal fixation of malleolar fractures in adults and to compare with the previous studies.

Methodology

The clinical material for the study of surgical management of malleolar fractures of ankle in adults consists of 30 cases of fresh fractures of traumatic etiology meeting the inclusion and exclusion criteria, admitted to SAPTHAGIRI INSTITUTE OF MEDICAL SCIENCE AND RESEARCH CENTER, Bangalore Hospital, from July 2015 to July 2016.

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Inclusion Criteria

1. Patients 18 years and above
2. Fresh fractures
3. Simple and compound fractures
4. Undisplaced fracture of medial malleolus in patients with high functional demands [1].
5. Displaced fracture of medial malleolus [1].
6. Fracture of lateral malleolus with more than 5 mm displacement [1].
7. Danis- Weber Type B and Type C Fractures [1].
8. Displaced bimalleolar fractures [1].
9. Posterior malleolus fragment involving more than 25% of articular surface [1].
10. Trimalleolar fractures [1].

Exclusion Criteria

1. Children
2. Epiphyseal injuries
3. Pathological fracture
4. Malunion
5. Non-union
6. Associated fractures of the tarsal bones and pilon fractures.

Preoperative Planning

- Patients were kept fasting over night before surgery.
- Adequate amount of compatible blood was kept ready for any eventuality.
- The whole of the extremity below the umbilicus, including the genitalia was prepared when required
- A systemic antibiotic, usually a 3rd generation cephalosporin was administered 1 hour before surgery.

Implant Selection

Type A: Transverse fracture of the lateral malleolus below the syndesmosis with oblique fracture of medial malleolus

Implants

1. Kirschner wires 1.6mm diameter, and figure of eight tension band wires 1.2mm diameter, for lateral malleolus with poor bone quality. For a larger fragment of lateral malleolus, one – third tubular plate
2. 4.5 mm intramedullary lag screw if the bone stock is good.
3. 4.0 mm cancellous bone screws, or 4.5mm cannulated screws as malleolar screws for medial malleolus. If fragment is small and comminuted tension band wiring is done.

Type B: Transsyndesmotoc oblique fracture of lateral malleolus and fracture of the medial malleolus and rupture of tibiofibular or deltoid ligament

Implants:

1. Contoured one third tubular plate for lateral malleolus. Preferably posterolateral plating (anti – glide technique) is done
2. Oblique lateral malleolus fracture without comminution - 2 lag screws 1 cms apart
3. If the fracture is transverse intramedullary nailing device done
4. 4.5 mm intramedullary lag screw if the bone stock is good.
5. 3.5mm cortical screw as syndesmotoc screw if necessary
6. 4mm cancellous screw or 4.5 mm cannulated screws or tension band wiring for medial malleolus.

Type C: Suprasyndesmotoc fibular fracture with medial malleolar fracture and disruption of the interosseous membrane or deltoid ligament rupture Implants:

1. One – third tubular plate, 8-12 holes for fibular fracture if plate extends below the plafond unicortical cancellous screws put 3.5mm dynamic compression plate in case of larger individuals.
2. 3.5 cortical screw as syndesmotoc screw
3. 4.0 mm cancellous bone screws or 4.5 mm cannulated screws for the medial malleolar fracture
4. Kirschner wires. 1.6mm diameter, and figure of eight tension band wire 1.2 mm diameter, for medial malleolar fracture when the fragment is small and comminuted.

Results

Table 1: Age distribution of patients studied

Age in years	Number	%
21-30	8	26.7
31-40	9	30.0
41-50	9	30.0
>50	4	13.3
Total	30	100.0
Mean ± SD	39.30±11.72	

Table 2: Mode of injury

Mode of Injury	Number	%
Fall	11	36.7
RTA	19	63.3
Total	30	100.0

Table 3: Type of Fracture

Simple/Compound	Number	%
Simple	23	76.7
Compound	7	23.3
Total	30	100.0

Table 4: Mechanism of Injury

Mechanism of Injury	Number	%
Abduction	3	10.0
Adduction	-	-
Ab External rotation	3	10.0
Add Internal Rotation	9	30.0
External Rotation	15	50.0
Total	30	100.0

Table 5: Surgical management

Surgical management	Number	%
1.lm-1/3tp, mm-ms	8	26.7
2.mm-tbw	6	20.0
3.lm-1/3tp, mm-tbw	3	10.0
4.mm-ms	2	6.7
5.mm-ms, pm-ms	1	3.3
6.fib-1/3 tp, dl repair	1	3.3
7.fib-1/3 tp,mm-ms pm-ms	1	3.3
8.lm-1/3tp, mm- ms	1	3.3
9.lm-1/3tp, mm- tbw	1	3.3
10.lm-1/3tp, mm-ms, sy-ss	1	3.3
11.lm-1/3tp, sy-ss	1	3.3
12.lm-1/3tp,mm-ms	1	3.3
13lm-1/3tp,mm-ms,	1	3.3
14.lm-1/3tp,mm-ms,pm-ms	1	3.3
15.lm-dcp, pm-ms	1	3.3

Table 6: Fracture union in weeks

Fracture union in weeks	Number (n=30)	%	90%CI
≤ 10 weeks	18	60.0	45.09-73.29
>10 weeks	12	40.0	26.71-54.94
Mean ± SD	10.90 ± 2.33		-

Table 7: Range of motion

Range of motion	Number (n=30)	%	90%CI
Full range	19	63.3	48.33-76.13
Slight diminution	10	33.3	21.08-48.34
Limitation <1/2 of sound side	-	-	-
Limitation >1/2 of sound side	1	3.3	0.8-13.64
Stiff foot	-	-	-

Table 8: Complications

Complications	Number (n=30)	%	90%CI
Absent	29	96.67	86.67-99.25
Present	1	3.3	0.8-13.64
Infection	1	3.3	0.8-13.64
Swelling	-	-	-
Deformity	-	-	-

Table 9: Ratings of management outcome

Ratings of management outcome	Number (n=30)	%
Excellent	13	43.3
Good	12	40
Poor	5	16.6
Inference	83.3% of the patients have been rated as Excellent – Good rating with 90%CI (73.40-93.87) Which is statistically significant.	

Table 10: Final outcome

Final outcome	Excellent-Good (%)	Poor (%)
Type A	88.8	11.1
Type B	80.0	20.0
Type C	83.3	16.6

Discussion

During our study, we learnt that accurate anatomical reduction of ankle fracture is not sufficient, it was also necessary to maintain reduction till complete union occurs. This was best achieved by internal fixation. This is supported by the study of Mitchell where he said anatomical reduction of displaced malleolar fractures, especially restoration of the length of the fibula and maintaining reduction is almost impossible by closed methods [5].

Danis emphasized that the internal fixation should be so complete and rigid that the injured joint can be exercised in the early postoperative period. The AO principles for the treatment of ankle fractures were based on Danis recommendations and on biomechanical studies of the importance of the lateral malleolus and the syndesmosis for the stability of the ankle [6]. Increased knowledge about the normal and post traumatic anatomy, function of the ankle joint has led to demands for exact reduction and rigid internal fixation of ankle fractures. It is difficult to satisfy these demands with closed, non-operative methods of treatment. Open reduction and internal fixation is therefore the standard treatment for displaced and unstable fractures about the ankle [4]. Cedell, Cotton C. L. and many other authors have reported better results after operative treatment as compared with closed methods [7].

The surgical technique used in this present series contributes a

precise method of open reduction and internal fixation by using dynamic compression plate or semi tubular plate and screws, malleolar screws, tension band wiring or a combination of these. Our experience of this method of fixation has given favourable results.

In the present study, thirty patients were operated for malleolar fracture of the ankle by semi tubular plate or dynamic compression plate and screws, malleolar screws, tension band wiring or combination of these. The data collected in the study are assessed and analyzed. The results are evaluated based on pain, range of movement at the ankle and subtalar joint, radiograph, activity and complications as per Weber's protocol [4]. The rating as per the protocol was excellent, good or poor.

Of the 30 patients there were 13 patients (43.3%) with excellent results, 12 patients (40%) with good results, 5 patients (16.6%) had poor results.

The 13 patients fulfilled the criteria as per Weber's protocol and had a score of 0. Taking this into consideration they were rated as excellent.

In 12 patients, slight pain with excess activity (+), slight diminution of range of movements at ankle and subtalar joint (SD), had normal work with restriction of strenuous activity (NW RSA) and there were no complications. 5 patients had a score of 1 and 7 patients had a score of 2. Taking all these criteria into consideration this group was rated as good.

Of the 5 poor results, one case was a compound fracture. The surgery was delayed in this patient due to the compound injury. At the 6 months, he had pain with normal activity, range of movement at ankle and subtalar joint was limited >1/2 of sound side. The fracture united by 16 weeks. Patient had normal work, but limited in his activity. This patient had infection as a complication and had a score of 10 and rated poor as per Weber's protocol. Compound injury, infection, delay in the treatment were the reasons for poor result.

One case was a 50 year old male with ankle dislocation. The surgery was delayed in this case. At the end of follow up, this patient had slight pain on excess activity (+), slight diminution of range of movements at the ankle and subtalar joint. Fracture united in 14 weeks and normal work with restriction of strenuous activity was present. The score was 4 and rated poor as per Weber's Protocol. Age of the patient, delay in the treatment and severe soft tissue injury were considered for the poor result.

Another case was a 45 year old female. The patient at the end of 6 months had mild pain on excess activity, slight diminution of ankle and subtalar joint movements. The fracture united in 12 weeks. Patient had normal work with restriction of strenuous activity. The score was 3 and rated poor as per Weber's protocol. Age and being a female patient with tendency for osteoporosis were attributed for the poor result.

Another case was a compound fracture. The surgery was delayed in this case. At the end of the follow up, the patient had mild pain on excess activity, fracture united in 14 weeks. Slight diminution of ankle and subtalar joint movements was present, and had normal work with restriction of strenuous activity. The case was given a score of 4 and rated poor as per Weber's protocol. Fracture being compound and delay in the treatment were the reasons for the poor result.

Another case was a compound Tri malleolar fracture. The surgery was delayed in this case too. At the end of 6 months, the patient had mild pain on excess activity. Slight diminution of ankle and subtalar joint movements. Fracture united in 16 weeks. Patient had normal work with restriction of strenuous activity. This case had a score of 4 and was rated as poor as per Weber's protocol. Age of the patient, compound fracture,

delay in the treatment and poor cooperation by the patient are attributed for the poor result.

The present study is based upon treatment for malleolar fractures and their results in 30 cases with a follow up of 6 months as shown in table 11.

Table 11: Comparison with other studies

Series	Follow up
Johanne's Yde	78 months
ULF Lindsjo ^[8]	48 months
Richeerd S. Limbird ^[9]	34 months
Childress	24 months
Listal ^[4]	96 months
Frieberg ^[4]	60 months
Gallen ^[4]	67.5 months
Bostman ^[10]	12 months
Yoblan ^[11]	66 months
Our study	6 months

ULF Lindsjo has found in his series that osteoarthritis following ankle fracture were more common among the female patient and showed poor clinical results of treatment attributed to greater tendency to osteoporosis in menopausal women ^[8].

Kristensen, Cedell, Danis *et al.* have emphasized the significance of accurate reduction for a good result ^[7]. With the exact restoration of the anatomy of the ankle joint, the biomechanical pre requisites for good function will be fulfilled. The best method of treatment for attaining the goal is an accurate open reduction and rigid interval fixation.

Conclusion

Surgical management of malleolar fractures of ankle is simple, effective and economical which can be carried out in a minimal basic orthopaedic set up. It ensures restoration of anatomy and good function of the ankle joint

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