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To determine functional and radiological outcome of various surgical modalities for treating malleolar fractures: Observational study

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Abstract

Purpose: To determine functional and radiological outcome of various surgical modalities for treating malleolar fractures.

Materials and Methods: The present prospective observational study was conducted among 40 admitted in the department of Orthopedics, Sir T Hospital, Bhavnagar with Ankle Fracture. Standardized clinical and functional evaluation at 2 weeks (suture removal), 3 months and 6 months were done. Surgical technique used were open reduction and internal fixation of the lateral malleolus with semi tubular plate; medial malleolus with cancellous screws or tension band wiring ; posterior malleolus with cancellous screws. Radiological assessment of each patient was done. The outcome measures were calculated using the Karlsson and Peterson functional scoring system at 3 and 6 months postoperatively. Similarly radiological outcome was calculated using Kristenson's Radiological criteria at 6 month.

Results: In our series, most of the patient affected by the fracture belongs to age group of 41- 50 years which was 16 (40%). The commonest mode of injury is fall (50%) and road traffic accident (32.5%). 23 were male patients (57%) and 17 were female patients (43%). 23 cases involved the right ankle and 17 cases involved the left ankle. The mean duration of stay was 4.5 days. In the present study out of 40 patients, 5 patients presented with persistent swelling, 8 patients presented with residual pain while 9 patients presented with both of the complaints. In our study of 40 cases, 29 cases (72.5%) achieved good results and 7 cases (17.5%) achieved fair results and 4 cases (10%) achieved poor results at 6 months follow up. 1 patient develops superficial infection postoperatively and treated by dressing and antibiotics.

Conclusion: Ankle fractures are among the most common injuries treated and these are best managed by open reduction and internal fixation. Anatomical reduction is essential in all Tri-malleolar fracture to achieve good functional outcome and to avoid complications like arthritis and loss of range of movements. Immobilization for 6 weeks doesn't reduce the final functional outcome. Good physiotherapy is recommended for adequate range.

Keywords: outcome, ankle fractures, surgical management

Introduction

Ankle fractures are the third most common orthopaedic injuries in geriatric patients and the most common intra-articular fractures of a weight bearing joint.¹ They contribute to 9% of all fractures and surgical correction is required otherwise it may lead to post-traumatic painful restriction of movements and osteoarthritis^[1-3]. About 15-20% of patients with ankle fractures are clinically significant and vary from unimalleolar, bimalleolar and trimalleolar fractures^[4]. A more stable but least invasive osteosynthesis is required to enable early functional outcome. Some studies say upto 53% of ankle fractures are unstable and require surgery^[5]. Both bimalleolar and trimalleolar fractures affect gait pattern and clinical symptoms to an equal extent in short term studies^[6].

In eighty percent of ankle joints, normal motion is a simple rotation around the axis passing inferior and posterior to a line joining the medial and lateral malleoli. Malleolar fractures occur as a result of a rotator force as opposed to an axial force. Up to one sixth of the weight of the lower limb is carried by the fibula and rest by the tibia^[7].

Internal fixation is an acceptable choice for ankle fractures in active patients. The reconstruction of the fibula is taken initially followed by the medial malleoli. Fractures of the posterior malleolus and syndesmosis are assessed and fixed accordingly. In the event of a delay the ankle is supported in a pressure dressing and elevated followed by fixation at an elective date. Fractures involving lateral malleoli can be fixed with AO one third tubular plates. Other options include 3.5mm cortical or 4mm cancellous AO screws supported with neutralization or tubular plates or kirschner wires. Syndesmotic diastasis is fixed with 4.5mm cortical screws inserted through the fibula into the tibia. The posterior malleoli is fixed with one or two 4 mm cancellous screws. The medial malleoli is fixed with two 4 mm AO cancellous screws or even tension band wiring, smaller fragments are fixed with combination of screw with a kirschner wire [8].

Prospective studies have shown good outcome in fixation of lateral malleoli by one third tubular plates over hook plates [9]. The clinical outcome of fixation was excellent for medial and posterior malleoli fractures by cancellous screws [10]. However, some trials show fixation of the medial malleoli by plating having good union at 8 weeks when compared with percutaneous screw fixation [11].

To date very few investigators have examined the functional recovery following operative treatment of ankle fractures or mentioned about the suitable period advisable for full weight bearing [12]. Limitations in functionality and physical capacity represent main threat to health related quality of life in these patients [13]. However in today's age, when different implants and different modalities are available for the treatment of malleolar fractures, no method is perfect and each one has its pros and cons. It is important to individualize treatment modality for every patient and not to be restricted by rigid protocols.

The purpose of this study is to determine functional and radiological outcome of various surgical modalities for treating malleolar fractures, which will allow us to practice more efficiently.

Methodology

The present prospective observational study was conducted among 40 admitted in the department of Orthopedics, Sir T Hospital, Bhavnagar with Ankle Fracture.

Inclusion criteria

1. All patients with malleolar fractures of ankle
2. Age groups from 20 to 60 years of either sex
3. Simple close and open injuries (up to Gustilo-Anderson classification grade 2)

Exclusion criteria

1. Fractures in below 20 and above 60 years of age
2. Fracture operated after 4 weeks
3. Pathological fractures
4. Undisplaced fractures
5. Polytrauma patient with head injury
6. Bilateral malleolar fracture
7. Patients with previous surgeries around ankle joint
8. Open fractures (Gustilo Anderson grade 3)
9. Fracture associate with neurovascular injuries
10. Pilon and talus fractures

Features Suggestive Of Malleolar Fracture

Positive clinical history of malleolar fractures includes-

1. h/o injury

2. Bruises around the ankle joint
3. Pain
4. Swelling
5. Deformity
6. Crepitus
7. Painfully Restricted ROM

Assessment

Standardized clinical and functional evaluation at 2 weeks (suture removal), 3 months and 6 months were done. Radiological assessment of each patient was done.

Methodology

For this prospective study, all patients fitting into the inclusion criteria were selected and details were noted down according to the study proforma. Informed written consent was obtained from the patients participating in the study.

The Following protocol was followed:

- A. Thorough history and clinical examination was done to rule out head / chest /abdominal spinal or pelvic injury.
- B. General and local examination of the patient.
- C. Examination to rule out associated fractures

Inspection

Relation on ankle to foot either normal , equinus, calcaneus, valgus or varus. Inter-relation of malleoli and fossa in the front of malleoli. Prominence of tendoachillis, fossa on both sided of tendo Achilles, pattern position and size of heel for broadening.

Palpation

All bones forming the ankle joint i.e. lower end of tibia and fibula including malleoli, calcaneus and talus are looked for: local bony tenderness and bony irregularities, displacements, unnatural mobility, crepitus, inter-relation of malleoli, springing of fibula. Dorsalis pedis and posterior artery pulsation were checked and noted.

-ROM

-No attempt was made to check range of movement

- D. Stabilization of the patient with intravenous fluids, oxygen and blood transfusion.
- E. Careful assessment of neurovascular status.
- F. Primary immobilization of the involved ankle in slab or compression dressing along with limb elevation and ice pack application.

Pre-Operative evaluation

1. The general condition and vital signs were recorded.
2. The condition of skin, amount of swelling and neurovascular status.
3. Medical evaluation (clinically, ECG, etc).
4. Lab investigations (complete haemogram, blood sugar level, LFT, RFT, HIV 1&2, HBsAG, HCV, serum electorlytes, PT, INR BT/CT urine routine andmicroscopy).
5. Radiograph of the ankle was taken and classified according to Lauge Hansen classification.
6. Obtaining Physician fitness towards surgery.
7. The consent for surgery was taken from the patient and the attendants after explaining the procedure and possible complications.

Intra-operative protocol

1. Anaesthesia -All patients were given spinal anesthesia.
2. The limb and ankle to be operated was prepared before the scheduled surgery

3. Antibiotic Prophylaxis - Pre-operative antibiotic combination of 3rd generation Cephalosporin (Ceftriaxone + sulbactam 1.5gm) and aminoglycoside (Amikacin 500mg) was given intravenously half hour prior to surgery
4. Patient positioning -Patient was placed in supine position on table with sand bag underneath the affected side buttock Pneumatic tourniquet was applied to the proximal thigh.
5. The operative site was cleaned with thorough betadine soap scrub and painted with betadine.
6. Draping done covering the operative site with sterile drapes.

Instruments

1. Stainless steel and titanium plates- one third semi-tubular plate and distal fibular plates.
2. Cannulated-Cancellous screws with washer, cortical screws, cancellous screws, locking head screws and Tension bandwiring.
3. GE C-arm and orthopedic surgical instruments.
4. O Ttable.
5. Digital Radiographyunit.
6. Conventional X-raymachine.

Surgical Procedure

Internal fixation of the lateral malleolus

The lateral malleolus is approached through a postero-lateral incision. The incision is placed up to 12cm proximal to the tip of lateral malleolus and extended distally along the posterior margin of the fibula to the tip of malleolus and curved anteriorly for 2.5cm in line of peroneal tendons. The fibula is exposed sub-periosteally and full thickness flaps are retracted. The foot is externally rotated to freshen the fracture edges, and the fracture will be fixed with a one-third tubular plate with or without a lagscrew.

Fixation of the Medial malleolus

A medial longitudinal incision of 8cm is put over the medial malleolus between its anterior and posterior borders with the lower end curving anteriorly at the tip of medial malleolus. Deep dissection is done fracture ends freshened. The fragments to be held with a towel clip and is fixed with 4 mm cannulated cancellous screws with washer, or by tension band wiring.

Posterior malleolus fixation

These fractures are approached either from posteromedial or posterolateral incisions. Posterior malleolar fragments of size more than 25% of the articular surface will require fixation. Fixation is achieved with lag screws which glide through the fragment adjacent to their head and be threaded only into the opposite fragment, placed from posterior to anterior direction.

Syndesmotic injury

Syndesmosis stability was checked by laterally displacing the distal fibula from the tibia while observing the relationship of the two bones. If more than 3 to 4 mm of lateral shift of talus occurs, instability is present and is to be fixed by cancellous screws.

Postoperative protocol

In the immediate postoperative period care was given to the general condition, fluid balance, IV antibiotic and analgesics as per the protocol. The limb was immobilized in a POP slab, and immediate post-operative radiographs were taken to determine the bone alignment and maintenance of reduction. Limb was elevated over two pillows to decrease swelling. This will help us to rehabilitate the patient faster.

Antibiotic prophylaxis

The same combination of Ceftriaxone + Sulbactam 1.5gm was given for 3 doses. If there was any haematoma or oozing from the wound, then antibiotics was continued for two more days along with repeat blood count or according to clinical improvement.

Wound care

Wound was inspected after 3 days along with dressing. Patient was called to change the dressing at 1week. And then follow up directly after 15 days of surgery for sutureremoval.

Follow up

The first follow up was usually at 1 week followed by 2 weeks and 3 months and 6 months. The course of fracture healing was documented radiologically with minimum 12 weeks interval. Functional and Radiological outcome was assessed at follow up period. Evaluation range of motion achieved and any possible loss of reduction was done at each follow-up.

Mobilization

Initial non-weight bearing mobilization was advocated followed by partial and complete weight bearing once fracture union has been documented clinically and radiologically.

Outcome measures

The outcome measures were calculated using the Karlsson and Peterson functional scoring system ^[14] at 3 and 6 months postoperatively. Similarly radiological outcome was calculated using Kristenson's Radiological criteria ^[15] at 6month.

Statistical Data Analysis

The data on categorical variables will be presented as n (% of cases) and the values on continuous variables will be presented as Mean \pm Standard deviation (SD). The significance of difference of distribution of incidence of outcome measures across various groups of interest (such as age, sex groups etc) will be tested using Chi-Square test. Independent sample 't' test or analysis of variance (ANOVA) will be used to test the significance of difference in the continuous variables across two or more groups. The underlying assumption of normality will be tested before subjecting the study variables to t test or ANOVA. P-values less than 0.05 will be considered to be statistically significant. All the hypotheses will be formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data will be statistically analyzed using Statistical Package for Social Sciences (SPSS ver 21.0, IBM Corporation; NY, USA) for MS Windows.

Table 1: Demographic details of the study population

Age (yrs)	No of cases	Percentage
20-30	9	22.5
31 – 40	5	12.5
41 – 50	16	40
51 – 60	10	25
Gender		
Male	23	57
Female	17	43
Total	40	100
Hospital stay		
≤ 5	35	87.5
> 5	5	12.5
Total	40	100

Table 2: distribution according to mode of injury, associated injuries, laterality and wound type

Mode of injury	No of cases	Percentage
RTA	13	32.5
Fall at home	20	50
Sports injury	2	5
Work place injury	5	12.5
Associated injury		
Head injury	2	5
CLW	1	2.5
No	37	92.5
Side of involvement		
Left	17	42.5
Right	23	57.5
Type of wound		
Abrasion	5	12.5
Laceration	3	7.5
Nil	32	80
Total	40	100

Table 3: Lauge-Hansen classification wise distribution of cases

Lauge-Hansen classification	No of cases	Percentage
Supination-Adduction	7	17.5
Pronation-Abduction	7	17.5
Pronation-External Rotation	10	25
Supination-External rotation	15	37.5
Pronation-Dorsiflexion	1	2.5
Total	40	100

Table 4: Outcome at 3 months and 6 months follow-up

Outcome	At 3 months (%)	At 6 months (%)
Total Karlsson functional Score		
Poor	5 (12.5%)	4(10%)
Fair	29 (72.5%)	7(17.5%)
Good	6 (15%)	29 (82.5%)
Total	40 (100.0%)	40 (100.0%)
Kristenson's radiological criteria		
Good	33	82.5%
Fair	6	15%
Poor	1	2.5%
Total	40	100.0%

Table 5: Late complications

Complications	No. of Patients	% of Patients
Persistent Swelling	5	12.5
Residual Pain	8	20
Both	9	22.5
Infection	1	2.5
Nonunion	2	5
Implant failure	1	2.5

Discussion

The aim of operative treatment for fractures of the ankle is to allow early movement after stable internal fixation. Overall, open reduction and internal fixation has yielded satisfactory results. The best results are obtained when the fracture is adequately reduced and planned rehabilitation program is followed. The present study was conducted to assess the outcome of ankle fractures treated by open reduction internal fixation.

In this prospective, observational study we have used both subjective and objective methods to assess the functional outcome of the operative treatment of these injuries.

In our study majority of the patients i.e. 16 (40%) were from age Group of 41 to 50 years, followed by 10 (25%) patients in the

age group 51-60 years and 9 (22.5%) of patients in the age group of 20-30 years. The study consisted of 40 patients aged between 20-60 years. Studies by Nilsson *et al.*,^[16] in 2003 on 54 patients, aged 17-64 years showed similar outcomes when compared to our study.

In our study, the incidence of fracture is more common in male patients as compared to females. The gender ratio of male to female in our study is 1.35:1.00. The higher ratio can explain by increasing cases of road traffic accidents. These fractures have bimodal distribution with adolescents and younger middle age that are more prone for high velocity injuries most common in males and later these fractures are seen in elderly patients due to osteoporosis. Our study consisted of 40 patients of which 17 were females and 23 were males.

The incidence of fracture is more common in male patients as compared to females

Studies	Sex incidence
Nilsson <i>et al.</i> 2003 ^[16]	M > F
Shivarthre DG <i>et al.</i> 2011 ^[17]	F > M
Beckenkamp PR <i>et al.</i> 2016 ^[18]	F > M
Our study	M > F

In our study the most common modes of injury seen was road traffic accident and fall, of about 13 cases (32.5%) and 20 (50%) respectively. Followed by work place injury 5 (12.5%) and sports injury 2 (5%) respectively. These observations were found to be consistent with studies in literature.(19) 17 patients had left ankle fracture (42.5%), 23 had right ankle fracture (57.5%).

In our study the most common modes of injury seen was road traffic accident and fall

Studies	Mode of injury
Shivarthre DG <i>et al.</i> 2011 ^[17]	FALL
Hong <i>et al.</i> 2013 ^[19]	RTA
Hong <i>et al.</i> 2014 ^[20]	RTA
Korim <i>et al.</i> 2014 ^[21]	FALL
Our study	FALL AND RTA

In the present study, the most common fracture pattern seen was supination-external rotation type of injury 15 cases (37.5%) followed by pronation external rotation type of injury 10 cases (25%). This is in concordance with observations given by Stufkens *et al.*,^[22] with good functional outcome. Weening *et al.*,^[23] of about 425 ankle fractures demonstrated 30% of fractures to be due to supination external rotation type of injury. The least common being pronation dorsiflexion type of injury. The most common modality of fixation for the lateral malleolus was 1/3rd tubular plate, and for the medial malleolus was with 4 mm cannulated cancellous screws with washers. Fixation of the lateral malleolus with one third tubular plates showed good functional outcome and similar results have been reported by sanders *et al.*,^[24] Syndesmotic screws were used in 3 of the cases. Weening *et al.*,^[23] conducted study in 2005 on the predictors of functional outcome following trans-syndesmotic screw fixation of ankle fractures. Of the 425 ankle fractures that were studied 30% were supination external rotation injuries.

In our study 12.5% of cases presented with minor abrasions and lacerations. Korim *et al.*,^[21] stated that both superficial and deep infections result in lower functional scores. On follow up at 6 weeks, 9 out of 40 patients had persistent swelling and residual pain, 8 patients had only residual pain and 5 patients had only

persistent swelling. This is in concordance with a similar study done by Hong *et al.*,^[20] in 2014 in which he reported residual pain, swelling and ankle stiffness as the most common complications at 1 year follow up. Studies by Reagan *et al.*,^[25] showed good functional outcome despite patients evaluated to have residual pain and restricted movements.

The mean Karlsson functional score at 3rd month post op was 52.35 and at 6th month post op was 88.45. Comparison of present study to other previous study has been given below in tabulated form. The study had the following limitations: The study group was relatively small, with a shorter duration of follow up. Variations in surgical techniques and experience could not be accounted for in this study. According to Kristenson's Radiological criteria out of 40; 33(82.5%) patients have good result, 6 (15%) patients have fair result and 1 (2.5%) patient has poor result.

Comparison of present study to other previous study has been given below in tabulated form

Authors	Good	Fair	Poor
Burwell & Charnley ^[26]	102 (77.3%)	22 (16.7%)	8(6%)
Colton ^[27]	18 (70%)	4(15%)	4(15%)
Beris <i>et al.</i> ^[28]	105 (74.3%)	21(14.6%)	16(11.1%)
Desouza ^[29]	135 (90%)	9(6%)	6 (4%)
Present Study	29 (72.5%)	7 (17.5%)	4(10%)

Conclusion

In the review of 40 patients with ankle fractures that were unstable, displaced or both treated surgically by open reduction and internal fixation in accordance with AO principles. Ankle fractures are among the most common injuries treated and these are best managed by open reduction and internal fixation. Anatomical reduction is essential in all Tri-malleolar fracture to achieve good functional outcome and to avoid complications like arthritis and loss of range of movements. Immobilization for 6 weeks doesn't reduce the final functional outcome. Good physiotherapy is recommended for adequate range. Good outcome was noted following anatomical reduction of fractures. Guided weight bearing and physiotherapy rehabilitation is required for better functional outcome.

Recommendations

- We used Karlsson's functional criteria for functional assessment of operated patient. We recommend use of Karlsson's functional score as it is easier to reproduce and quite precise.
- We recommend early operative intervention as soon as swelling disappears as it reduces hospital stay and improves final outcome.
- As the duration of our study is short, we could not comment on long term complications like degenerative osteoarthritis. A longer study would be worthwhile to conduct to assess such longterm outcome and complication.

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