STUDY OF SURGICAL MANAGEMENT OF MALLEOLAR ANKLE FRACTURES

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ABSTRACT

BACKGROUND

Malleolar ankle fractures, including uni, bi and trimalleolar variants have become common due to road traffic accidents and sporting injuries. These fractures require fixation in most cases, as the entire weight of the lower limb transmits to the ankle and a sound and stable ankle is a prerequisite for normal gait. Open reduction and internal fixation with cc screws, TBW and semitubular plates, has been the mainstay of treatment for tri and bimalleolar fractures, increasingly unimalleolar fractures and syndesmotic injuries are also being treated with ORIF.

Objectives- To study the functional outcome of surgically managed bimalleolar fractures of ankle in adults.

MATERIALS AND METHODS

A prospective study of 30 cases of malleolar fractures of ankle in adults, managed surgically by various techniques, in MediCiti Institute of Medical Sciences from June 2013 to Nov. 2015, satisfying the inclusion and exclusion criteria were studied. The functional outcome was evaluated using the Burwell and Charnley criteria.

RESULTS

Majority of the patients (76.7%) had good results in the current study, similar to what was observed in other series like Burwell & Charnley, Colton, De Souza et al, Beris et al.

CONCLUSION

Unstable malleolar ankle fractures are common due to road traffic accidents. Majority of them were caused by pronation-abduction (30%) and supination- external rotation forces (27%). Anatomical reduction with restoration of the articular congruence is essential in all intra-articular fractures.¹ The operative results were satisfactory in 85% cases, with good to excellent functional outcome. Cancellous screws or malleolar screws are better in internal fixation of medial malleolus compared to Kirschner wire fixation and lateral plating was the best for fibular fractures. Functional results improve when the normal bend of the lateral malleolus is restored while plating.²

KEYWORDS

Malleolar Ankle Fractures.

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BACKGROUND

Operative treatment of ankle fractures has become more common as it restores the anatomy and contact-loading characteristics.^{3,4}

The purpose of this study is to evaluate the functional outcome and results obtained after surgical management by various methods of internal fixation.⁵

Aims and Objectives

- To estimate the proportion of unimalleolar, bimalleolar and trimalleolar fractures in ankle fractures.
- To evaluate various surgical modalities available for malleolar fractures.
- To assess functional outcome and range of motion of ankle postoperatively.

Mechanism of Injury

The malleolar fractures are caused predominantly by rotational forces whereas axial loading causes tibial plafond fractures, predominantly.⁶ Most malleolar fractures occur when the part, including the talus, is fixed on the ground by the body's weight.

The type of malleolar fracture that occurs depends on two factors: the position of the foot at the time of injury, either supination or pronation, and the deforming forces, which are external rotation, abduction or adduction.⁶

Classification

Several different classification systems of ankle injuries exist, but those in current use are Anatomical types, Lauge-Hansen system, Danis-Weber system and the AO/Orthopaedic Trauma Association (AO/OTA) system.⁷

Lauge-Hansen Classification [Figure 4, 5]^{8,6}

A. Supination - Adduction (SA)

1. Transverse avulsion-type fracture of the fibula below the level of the joint or tear of the lateral collateral ligaments.
2. Vertical fracture of the medial malleolus.

B. Supination - Everson (External Rotation) (SER)

1. Disruption of the anterior tibiofibular ligament.

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2. Spiral oblique fracture of the distal fibula.
3. Disruption of the posterior tibiofibular ligament or fracture of the posterior malleolus.
4. Fracture of the medial malleolus or rupture of the deltoid ligament.

C. Pronation - Abduction (PA)

1. Transverse fracture of the medial malleolus or rupture of the deltoid ligament.
2. Rupture of the syndesmotric ligaments or avulsion fracture of their insertions.
3. Short, horizontal, oblique fracture of the fibula above the level of the joint.

D. Pronation-Eversion (External Rotation) (PER)

1. Transverse fracture of the medial malleolus or disruption of the deltoid ligament.
2. Disruption of the anterior tibiofibular ligament.
3. Short oblique fracture of the fibula above the level of the joint.
4. Rupture of posterior tibiofibular ligament or avulsion fracture of the posterolateral tibia.

Danis-Weber System

There are three types of fractures in this classification system. The fractures are categorised into types A, B and C, based on the level of the fibular fracture. Type "A" fractures are below the level of distal tibiofibular syndesmosis, "B" fractures at the level of the syndesmosis and "C" fractures above the syndesmosis.⁹

Management

Physical Examination

Examinations for range of motion and stability should be deferred if an obvious injury is present on the basis of either physical examination or radiographs. The average range of motion is about 30° dorsiflexion and about 30° to 45° plantarflexion.

Stress testing is often difficult in the acute setting, and analgesic premedication and local or regional anaesthesia may be needed.

Radiographic Measurements of Alignment and Stability

After an injury or reduction, x-ray studies are used to determine the adequacy of alignment and to infer the degree of stability.

The Parameters that Typically can be obtained are as follows

- Tibiofibular Line.
- Talocrural Angle.
- Talar Tilt.
- Medial Clear Space.
- Syndesmotric Integrity.

Treatment

The goals of treatment are to obtain an anatomical reduction, maintain this reduction until the fracture heals, and return the patient to his or her pre-injury level of function with a painless, mobile ankle.⁶

As a part of the initial evaluation, the ankle should be gently reduced and immobilised in a padded splint to

prevent further soft tissue injury and decrease the swelling. Application of ice packs, elevation of the extremity, and compression are used to reduce swelling.

Non-operative Treatment

Closed reduction is done for stable fractures and open reduction and internal fixation for the unstable fractures. Successful closed reduction requires an understanding of the mechanism of injury and an assessment of the inherent stability of the injury.¹⁰

- Supination adduction fracture is reduced by abducting (everting) the hind foot.
- External rotation fractures at that level of the syndesmosis are reduced by gentle distraction, internal rotation and varus stress.
- Pronation-abduction fractures are reduced by distraction and adduction.

In unstable fractures, the talus is displaced medially or laterally 2 mm or more from its anatomical position. Fractures associated with syndesmotric disruption, Pronation - external rotation, Abduction-external rotation, are usually unstable and often require operative stabilisation.

With regard to the talus, the criteria set forth by Yablon et al¹¹ are as follows:

Good reduction: talar displacement <0.5 mm and talar tilt <0.5 mm.

Fair reduction: talar displacement <2 mm and talar tilt <1 mm.

Poor reduction: talar displacement >2 mm and talar tilt >1 mm.

Operative Treatment

The goals of operative treatment are to obtain an anatomical reduction that is maintained by stable fixation, resulting in a healed fracture and recovery of normal function. This goal is more relevant in the young, active, healthy individual, but slight deviations from an anatomic alignment are acceptable in an elderly patient.⁶

Operative method has now become the method of choice in all unstable and complex ankle fractures. It offers the best outlook for optimal results.¹² Other indications are⁶:

- Failure of closed reduction,
- For displaced or unstable fractures that result in displacement of the talus or widening of the mortise greater than 1 to 2 mm and
- Open fractures.

Surgery is carried out as early as possible to avoid subsequent swelling and skin problems. Ankle swelling may peak in 1 to 7 days, and operative treatment is best done before the period of maximal swelling or after the initial swelling has resolved. If significant soft tissue injury with marked swelling and blisters is evident, surgery should be delayed until the skin has healed as it is associated with a reduced likelihood of anatomic reduction, with poorer results.⁶

The reconstruction of the fibula takes priority and therefore the lateral side is dealt before the medial side. It may sometimes be necessary to fix the medial side first, as in complex fractures with comminution and discontinuity of the fibula.^{13,12}

Fracture Fixation^{6,12,10}

1. Avulsion fractures of the medial malleolus were best reduced after exposing both the anterior and the medial aspects of the fracture by sharply turning back the periosteum and attached fascia.
2. For intermediate-sized fragments, one wire and 2.0 or 2.5 mm drill bit was used to prepare a hole for a 4.0 mm partially threaded cancellous screw or malleolar screw.
3. For larger fragments, two such drills are used for provisional fixation and replaced one at a time with the 4.0 mm partially threaded screws. To obtain a lag effect, their threads must not cross the fracture and they should be oriented perpendicular to plane of the fracture.
4. When the medial malleolar fragment was too small for screws or if comminuted, K-Wires with a figure-of-eight tension band was used for fixation.

Technique of Fixation of Posterior Malleolus

A posteromedial or posterolateral approach is used to expose the fracture. The posterolateral approach is claimed to offer better visualisation of articular surface of the posterior malleolus. The posterior malleolus should be fixed preferably with two screws, passed in the anteroposterior direction, with lag effect as there is a tendency for the large fragment to rotate as well as displace proximally.

Syndesmosis Transfixation

Obvious distal tibiofibular diastasis on initial or subsequent radiographs or gross mechanical instability of the syndesmosis signals the possible need for syndesmosis transfixation. The greater the degree of syndesmotic injury and the more unstable the ankle injury, the greater will be the need to fix the syndesmosis. The purpose of transfixing the syndesmosis with a screw is to maintain the distal tibiofibular relationship until the syndesmotic ligaments have healed.^{6,9}

Anatomical reduction of the syndesmosis is necessary and the talus must be reduced in the mortise.

The fixation screw is a position screw, its function is to hold the syndesmosis in the reduced position. The screw is used independently or in conjunction with a plate, depending on the type and location of the fibular injury. The screw is inserted at the top of the fibular sulcus in the tibia, usually about three to four centimetres proximal and parallel to the ankle joint, and was angled approximately 30° anteriorly so that it is perpendicular to the tibiofibular joint and will not miss the tibia. Fixation is usually obtained by placing one or two screws from posterolaterally in the fibula to anteromedially in the tibia about 1.5 to 3.0 cm above the plafond. Fixation of the syndesmosis was done with the ankle in full dorsiflexion to avoid over tightening of the mortise and loss of dorsiflexion postoperatively.

Postoperative Protocol

Non-weightbearing walking started from first or the second postoperative day. Partial weightbearing was started after the removal of the cast (after clinical and radiological signs of union become evident). Active exercises of the ankle was advised.

In patients with syndesmotic screw fixation, weightbearing was delayed till screw removal.

Complications

Most complications of ankle injuries relate to one of three basic areas⁶: infection, soft tissue problems, or malunion and arthrosis (Osteoarthritis).

MATERIALS AND METHODS

All the cases were those attending MediCiti Institute of Medical Sciences during the period of June 2013 to July 2015. This is a descriptive study with a sample size of 30 patients, who were followed up for 3 to 6 months.

Inclusion Criteria

All patients with acute (<14 days) Malleolar Ankle fractures, patients above the age of 16 years and below 65 years, both males & females will be included, closed fractures.

Exclusion Criteria

Patients with existing deformities of lower third leg, ankle and foot, with polytrauma, with significant comorbid conditions who are a poor risk for surgery, with fractured lower 1/3rd tibia and fibula, and tibial plafond fractures.

Management - Conservative vs. Surgical

Undisplaced fractures were treated conservatively.

All displaced fractures were treated surgically with open reduction and internal fixation. Malleolar screw was most commonly used for fixation of medial malleolus. Lateral malleolus was fixed with 1/3 tubular plate or rush nails. Another method used for fixation was Tension Band Wiring. Most of the patients were operated on emergency basis within 24 hours of injury. The average time of surgery was 2.75 days.

All cases were operated under spinal anaesthesia and tourniquet control. Standard anteromedial, posteromedial or lateral approaches were used.

Postoperatively below-knee POP slab was given until the 10th postoperative day, when suture removal was done. Non-weightbearing mobilisation of the ankle was done when fixation was found to be stable.

Below-knee cast was removed after 6 weeks and the ankle joint was mobilised. The patients were advised to come for followup once in 10 days initially for the first month and thereafter monthly until fracture union and good recovery occurred. Patients in whom, the fixation was stable, cast was removed and the ankle joint was mobilised at the end of the second week. The surgical results were evaluated based on the subjective and objective evaluation. The criteria used in our study were that of Burwell and Charnley (1965).

Objective Criteria**Good**

- Ankle movements at least three quarters of normal.
- Trivial swelling.
- Normal gait.

Fair

- Ankle movements at least half of normal.
- Moderate swelling.
- Normal gait.

Poor

- Ankle movements less than half of the normal.
- Severe swelling with visible deformity of ankle.
- Patient walking with limp.

Subjective Criteria

All patients were questioned as to the presence of pain, sensation of stiffness and any disability. The grading is given below.

Good

Complete recovery.

Fair

Aching during use, with slight stiffness.
Ability to walk not seriously impaired.

Poor

Serious impairment of ability to walk or work.

RESULTS

In our series of 30 cases of malleolar ankle fractures, treated by surgical method, during the period of June 2013 to July 2015. The following are the observations

Age in years	16 - 20	21 - 30	31 - 40	41 - 50	51 - 60
No. of cases	1	9	6	11	3
Percentage %	3.3	30	20	36.7	10

Table 1. Age Incidence

In the current study, the majority of cases i.e. 11 (36.7%) were in the 41 - 50 yrs. age group followed by 9 cases (30%) in the 21 - 30 yrs. age group. The youngest in the group is 20 yrs. old whereas the oldest is 56 yrs. the mean age in the study was 37.5 yrs.

Sex	No. of Cases	Percentage %
Males	17	56.7%
Females	13	43.3%

Table 2. Sex Incidence

In the present study, males were more commonly involved (17 cases, 56.7%) as compared to females (13 cases, 43.3%). The male: female (M:F) ratio is 1.3: 1.

Side	No. of Cases	Percentage
Right	13	43.3%
Left	17	56.7%

Table 3. Side Involvement

The right side was found to be less involved i.e. 13 cases (43.3%) as compared to the left side i.e. 17 cases (56.7%).

Mode of Injury

The most common mode of injury was due to RTA, 23 cases i.e. 77%; slip and fall either in the area of work or at home is the next cause of injury, 7 cases, i.e. 23%.

Mode of Injury	No. of Cases	Percentage
Road Traffic Accident	23	76.7%
Slip and Fall	7	23.3%

Table 4. Mode of Injury

Fracture Classification

PA type of injuries were most common i.e. 30% (9 cases) followed by SER injuries i.e. 26.7% (8 cases). There were 7 cases of SA type of injuries i.e. 23.3% and remaining 6 cases were PER type (20%).

Lauge Hansen Classification	No. of Cases	Percentage
SER	8	26.7%
SA	7	23.3 %
PA	9	30 %
PER	6	20 %

Table 5. Fracture Classification

Fixation of Individual Fractures

A. Medial Malleolus Fixation

Implants Used	Malleolar Screws	CC Screws	TBW	K Wires	Total
No. of Cases	12	12	5	1	30
Percentage	40%	40%	16.7%	3.3%	100%

Table 6. Medial Malleolus Fixation

Of the 30 patients operated in the current study malleolar screws and CC screws were used in equal number, 12 cases each i.e. 40 %. TBW was performed in 5 cases i.e. 16.7%, in 1 case k wires were used i.e. 3.3%.

B. Lateral Malleolus Fixation

Implant Used	1/3 Semitubular Plate	Rush Pin	CC Screw	Cortical Screw	Total
No. of Cases	14	9	1	1	25
Percentage	56%	36%	4%	4%	100%

Table 7. Lateral Malleolus Fixation

In the study undertaken, 1/3 semitubular plate was used in the majority of cases (14 cases) i.e. 56% followed by 9 cases of Rush pin i.e. 36% and 1 case each of isolated CC screw and cortical screw i.e. 4% respectively, out of 30 cases only 24 had a lateral malleolus# rest being unimalleolar specifically medial malleolus#.

C. Posterior Malleolus Fixation

Posterior Malleolus	Fixed with CC Screws	Not Fixed	Total
No. of Cases	2	7	9
Percentage	22.2 %	77.8%	100 %

Table 8. Posterior Malleolus Fixation

In the current study, there were no isolated posterior malleolus fractures. Of the 9 trimalleolar fractures, 7 were not fixed as the posterior malleolus was undisplaced or fell back into place after fixation of medial and lateral malleolar fixation. 2 cases, however, were fixed due to large fragment of the posterior malleolus, fixation was done with CC screws.

Time for Signs of Union to be Noted

No. of Weeks	6 Wks.	8 Wks.	10 Wks.	12 Wks.	16 Wks.	Total
No. of Cases	4	15	5	2	3	29

Time for Signs of Union to be Noted

Chart showing Signs of Union in Weeks

In the current study, most of the fracture showed signs of union as early as 8 weeks. i.e. 15 cases, average time for union was 9.2 weeks. There was 1 case of non-union.

Day of Surgery

In the current study, most of the cases were operated between day 2 and day 4. Average time to surgery was 2.6 days.

Complications

In the present study, 2 cases showed complications. 1 case was affected with superficial wound infection and another showed delayed union. Complication rate was 6.7%.

Complications	No. of Cases	Percentage
Superficial Infection	1	3.3 %
Delayed Union of Medial Malleolus	1	3.3 %
Complications

Chart Showing Distribution of Complications

DISCUSSION

30 patients of Malleolar ankle fractures were operated at the current centre from June 2013 to July 2015. All the patients were evaluated with a followup period of 6 - 18 months.

1. Thirty cases of unstable malleolar fractures of the ankle, managed surgically by various techniques were studied.
2. The anatomy, classification, clinical features, review of literature, and methods of surgical management have been detailed out.

3. The age distributions were 22 to 63 years (Average – 37.5 years), majority of them i.e. 36.7% of the cases were in the age- group 41-50 years.
4. More common in male (56.7%), compared to females (43.3%).
5. Right ankle was more commonly affected (56.7%).
6. Most common mode of injury was Road traffic accident (76.7%).
7. According to Lauge-Hansen's classification, Pronation-abduction injuries were commonest (30%) in our series, followed by supination-external rotation (27%).
8. Method of fixation of medial malleolus: majority of cases were treated with malleolar and cancellous screw fixation (40% each).
9. Most of patients with fibular fracture underwent fixation by one-third tubular plate (56%).
10. Most of the cases (77.5%) were operated between the second and fifth days of injury.

CONCLUSION

This study supports these conclusions and was comparable with those in other studies.

1. Unstable Malleolar ankle fractures are common due to road traffic accidents. Age groups between 31-40 years were most commonly injured. Malleolar fractures more common in male than female.
2. Majority of them were caused by pronation-abduction (30%) and supination-external rotation (27%).
3. Fibular alignment (length, rotation) has to be maintained for lateral stability of the ankle.
4. Anatomical reduction with restoration of the articular congruence is essential in all intra-articular fractures.
5. The operative results were satisfactory in 85% cases, with good to excellent functional outcome.
6. Functional results were much better in younger age groups and men. Fair-to-poor results were seen in wound infection and those with unsatisfactory reduction of fracture fragments.
7. Excellent results are obtained with stable fixation of fracture. Cancellous screws or malleolar screws are better in internal fixation of medial malleolus compared to Kirschner-wire fixation and lateral plating was the best for fibular fractures.
8. TBW done for many PER and PA injuries showed promising results comparable to that with screw fixation and also lesser reports of skin irritation at the wound site. It is the method preferred for small transverse fragments and osteoporotic bones of both malleoli especially in the elderly.
9. Functional results improve when the normal bend of the lateral malleolus is restored while plating.
10. Chances of non-union due to soft tissue interposition were avoided by surgical treatment. Delayed union in 1 case, was possibly due to unsatisfactory reduction at the time of surgery.
11. Rehabilitation is quick because immobilisation is for a relatively short duration and is followed by weightbearing.
12. Hence, we conclude that surgical management of Malleolar ankle fractures provides good functional outcome.

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