VOLUME-7, ISSUE-4, APRIL-2018 • PRINT ISSN No 2277 - 8160

Original Research Paper

Orthopaedics

SURGICAL MANAGEMENT OF BIMALLEOLAR FRACTURES OF ANKLE IN ADULTS

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ABSTRACT

Background: Malleolar fractures are the most common lower extremity fractures. These injuries are important, because the whole body weight is transmitted through then ankle, and locomotion depends on the stability of the ankle. Open reduction and internal fixation have become the mainstay of treatment for most of the bimalleolar fractures, as these operative procedures restores the anatomy, biomechanics and contact loading characteristics of the ankle.

Objectives: To study the functional outcome of surgically treated bimalleolar fractures of ankle in adults.

Methods:A prospective study of 40 cases of bimalleolar fractures of ankle in adults, managed surgically by various techniques in IGIMS, Patna, Bihar, satisfying the inclusion and exclusion criteria were studied. The functional outcome was evaluated using the Biard and Jackson's ankle scoring system.

Results: In our study we achieved 82.5% excellent to good results, 12.5% fair results, 5% poor results. The results were comparable to other studies.

KEYWORDS :

INTRODUCTION

Ankle fractures are the most common type of fractures treated by orthopaedician. There has been an increase in the prevalence of such fractures over the last two decades both in the young, active patients and in the elderly.[1,2] Most ankle fractures are complex injuries that are difficult to manage. These injuries are important because the whole body weight is transmitted through the ankle and locomotion depends upon the stability of the ankle joint. They have the potential to produce significant long-term disability and complications in the form of pain, instability and early degenerative arthiritis.[3] As a result of a better understanding of the biomechanics of the ankle, improvements in fixation techniques and findings of outcome studies, there has been a gradual evolution in the effective strategies for the treatment of ankle fractures. The goals of treatment include achieving sound union of fracture and an ankle that moves and functions normally without pain.This obviously shows the need for perfect anatomical reduction, which could be better, achieved by open reduction and better maintained by internal fixation. The operative method restores the anatomy and contact-loading characteristic of the ankle. Other advantages include early rehabilitation without a cast, early mobilization and earlier weight bearing. Although fractures about the ankle have traditionally been considered noncontroversial with respect to the indications for operative intervention, recent advances in the understanding of the biomechanics of the ankle have given rise to particular areas of clinical uncertainty. These include the indications for the operative treatment of isolated fractures of the lateral malleolus, the operative techniques for syndesmotic injury and its post-operative management and the reliability of radiographic assessment of fractures about the ankle.

The purpose of this study, on Bimalleolar fractures of ankle is to evaluate the functional outcome and results obtained after surgical management by various methods of internal fixation.

OBJECTIVES

1. To study the functional outcome of surgically managed bimalleolar fractures of ankle in adults.
2. To restore the anatomy of malleoli and ankle perfectly by operative treatment with internal fixation.
3. To assess the union of fractures after surgical management.
4. To achieve stable fixation and early mobilization of the ankle.
5. To compare the results of the present study with those in literature.

METHODOLOGY

40 cases of bimalleolar fractures of ankle in adults were treated at IGIMS, Patna, Bihar by surgical intervention and studied for a period of 6 – 18months.

CRITERIA FOR SELECTION OF THE CASES:

***INCLUSION CRITERIA*:**

1. Patients having unstable bimalleolar fractures of ankle, treated surgically were considered for the study.
2. Patients who are above the age of 20 years.
3. Closed type of fractures.
4. Patients who are medically fit for surgery.

EXCLUSION CRITERIA:

1. Open fractures of the ankle.
2. Those patients who are below 20 years and above 65 years were excluded.
3. Stable malleolar ankle fractures (treated conservatively).
4. Patients which were treated by non-operative methods were excluded.
5. Patients who are medically unfit for surgery.

40 patients with bimalleolar fractures of ankle who were admitted and operated at Indira Gandhi Institute of medical sciences, PATNA, were included in the present study. All the patients were explained about the aims of the study, the methods involved and an informed written consent was obtained before being included in study. On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and a complete survey was done to rule out significant injuries. Careful examination was done to rule out fractures at other sites. Local examination of injured ankle and following clinical signs were looked for Swelling of the ankle, any deformity, skin condition, neurovascular status.

Inspection:
Swelling of the ankle, any deformity, skin condition, neurovascular status.

Palpation:
Skeletal components of the ankle i.e., lower ends of tibia/fibula and the malleolar parts were palpated and looked for bony tenderness, displacements, any abnormal painful mobility and crepitus. The inter-relation of the malleoli was also noted. Dorsalis pedis artery and posterior tibial artery pulsations were checked and noted. Distal neural status was also examined and noted. Instability of the syndesmosis was identified on the basis of the mechanism of injury and the fracture pattern. Pain elicited with the squeeze test (manual medial-lateral compression across the syndesmosis) and the external rotation stress test was considered as indicative of clinical syndesmotic instability. Radiologically, tibiofibular clear space of more than six millimeters and widening of the medial clear space of more than four millimeters were considered as indications of syndesmotic instability. Intraoperatively, the stability was checked by laterally displacing the distal fibula from the tibia, if >3 or 4 mm of lateral shift of talus occurs, it suggests instability (Cotton test)37. Fractures of the ankle were evaluated using plain radiographs in anteroposterior, lateral and mortise views. The fractures were classified using the Lauge–Hansen, AO/OTA classification system and anatomical types. Closed reduction and a below knee posterior POP slab was applied. Routine investigations were done. The patients were taken for surgery as early as possible once the general condition is stable and fit for surgery. The routine investigations were as follows: Complete blood count, Routine Urine examination, RBS, LFT, KFT, HIV, HbSAg, Anti HCV, Chest X-ray and ECG.

PREOPERATIVE PREPARATION OF PATIENTS:
- Patients were kept nil orally for eight hours before surgery.
- Intravenous fluids as per need.
- Adequate amount of compatible blood was kept reserved, for any eventuality.
- Preparation of whole extremity.
- Tetanus toxoid 0.5 ml IM., and lignocaine test dose.
- Tranquilizers if needed.
- A written and informed consent for surgery.
- Parenteral antibiotics, given at the time of induction of anaesthesia.

OPERATIVE TECHNIQUE:
Under spinal, the patient was placed in supine position. The ipsilateral buttock was raised on a sandbag to improve the exposure of the lateral side. Pneumatic tourniquet was applied in all cases. The procedure was performed in a bloodless field, which facilitates good visibility to describe the fracture pattern and thus facilitating anatomical reduction.

SURGICAL APPROACHES & FRACTURE FIXATION:
Lateral malleolus: A secure anatomic repair of a displaced lateral malleolus fracture is one of the most important steps in operative management of a malleolar fracture because of the role this structure plays in maintaining tibiotalar alignment.

Approach: A direct lateral approach over the fibula was standard for reducing and internally fixing distal fibula fractures. The dissection plane was between the peroneus tertius anteriorly and the peroneus longus and brevis posteriorly. The incision was moved slightly anterior when the need to fix the anterior syndesmosis.

Fracture Fixation:
1. Avulsion fractures of the distal fibula were reduced, held with a reduction forceps, and stabilized by either a tension band technique or a lag screw. A larger avulsed fragment of the distal lateral malleolus, typical of *AO type A injuries*, is best fixed with either a tension band wire or a small oblique screw.
2. *AO type B fracture* was fixed with one or two lag screws placed perpendicular to the line of the fracture.
3. More secure fixation was achieved with one third semi-tubular plate contoured to fit the concave, slightly spiral, lateral surface of the fibula. Compressing the fracture site with an anterio-posterior interfragmentary lag screw was used to augment the strength of the fixation.
4. *AO type C fractures* were reduced and fixed with a one-third tubular plate. The position of the plate was dependent on the level of the fracture, the condition of the overlying soft tissues, and the extent of the communition.

Medial malleolar fixation:
Approach: The medial approach to the ankle was centered on the medial malleolus itself and was shifted either anteriorly for better access to the joint or posteriorly to expose the back of the tibia. The incision used was longitudinal or curvilinear, depending on the exposure needed

Fracture fixation:
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 -mm partially threaded screws. To obtain a lag effect, their threads must 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.

SYNDESMOSIS TRANSFIXATION:
Talus must be reduced in the mortise. Any associated medial or lateral malleolar fractures were fixed. The reduction of the tibiofibular joint must be maintained during placement trans-syndesmotic fixation. The fixation screw or position screw (fully threaded) was used independently or in conjunction with a plate, depending on the type and location of the fibular injury. The screw was inserted at the top of the fibular sulcus in the tibia, fixation is usually obtained by placing one or two screws from posterolaterally in the fibula to antero-medially 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. Removal of the screw was done after at least 4 to 8 weeks, weight-bearing was delayed till screw removal.

POST – OPERATIVE PROTOCOL:
Parenteral antibiotics were given in the post-op period. After 10 to 12 days, the sutures were removed and a below knee cast was applied for 4 weeks. Non-weight bearing gait was started from first or the second postoperative day. Partial weight bearing 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, weight bearing was delayed till screw removal.

Follow up of cases was done at regular intervals of 6 weeks for minimum of 6 months. At each assessment, all patients were questioned with regard to pain, use of analgesics, stiffness, swelling, activities of daily living, use of walking aids, and return to work and participation in sports. At examination, the gait, any thickening, swelling, tenderness of the ankle and the range of motion of the ankle were evaluated. Anteroposterior, lateral and mortise radiographs of ankle were made at the time of examination. Baird and Jackson's ankle scoring system of subjective, objective and radiographic criteria was used for the study. All the patients were evaluated and scores were given.

BAIRD AND JACKSON'S SCORING SYSTEM50:

SCORING SYSTEM FOR SUBJECTIVE, OBJECTIVE AND RADIOGRAPHIC CRITERIA :

CRITERIA POINTS

I. Pain:

A. No Pain 15
B. Mild pain with strenuous activity 12
C. Mild pain with activities of daily living 8
D. Pain on weight bearing 4
E. Pain at rest 0

II. Stability of ankle:

A. No clinical instability 15
B. Instability with sports activities 5
C. Instability with activities of daily living 0

III. Ability to walk:

A. Able to walk desired distances without limp or pain 15
B. Able to walk desired distances with mild limp or pain 12
C. Moderately restricted in ability to walk 8
D. Able to walk short distances only 4
E. Unable to walk 0

IV. Ability to run:

A. Able to run desired distances without pain 10
B. Able to run desired distances with slight pain 8
C. Moderate restriction in ability to run, with mild pain 6
D. Able to run short distances only 3
E. Unable to run 0

V. Ability to work:

A. Able to perform usual occupation without restrictions 10
B. Able to perform usual occupation with restrictions 8
in some strenuous activities .
C. Able to perform usual occupation with substantial 6
restrictions.
D. Partially disabled; selected jobs only 3
E. Unable to work 0

VI. Motion of the ankle:

A. Within 100 of uninjured ankle 10
B. Within 150of uninjured ankle 7
C. Within 200 of uninjured ankle 4
D. < 50% of uninjured ankle, or dorsiflexion < 5 degrees 0

VII. Radiographic result:

A. Anatomic with intact mortise 25 (normal medial clear space, normal superior joint space, no talar tilt)
B. Same as A with mild reactive changes at the joint margins 15
C. Measurable narrowing of superior joint space, with 10 superior joint space>2mm, or talar tilt >2mm
D. Moderate narrowing of superior joint space, with 5 superior joint space between 2 mm and 1 mm .
E. Severe narrowing of superior joint space, with superior 0 joint space <1mm, widening of medial clear space, severe reactive changes (sclerotic subchondral bone and osteophtye formation)

MAXIMAL POSSIBLE SCORE 100

FUNCTIONAL GRADING SCORE

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

RESULTS

40 patients of Bimalleolar ankle fractures were operated at IGIMS, Patna, Bihar. All the patients were evaluated with follow up period 6-18 months.

1. Forty cases of unstable bimalleolar 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 – 37.4 years), majority of them i.e, 37.5% of the cases were in the age- group 31-40 years.
4. More common in male (60%), compared to females (40%)
5. Right ankle was more commonly affected (62.5%)
6. Most common mode of injury was Road traffic accident (45%), followed by fall from height (35%) and twisting injury (20%).
7. According to Lauge-Hansen's classification, Supination - external rotation injuries were commonest (37.5%) in our series, followed by Pronation – external rotation (30%), pronation abduction (20%) and supination-adduction (12.5%) injuries.
8. According to AO classification, most common types were B (50%), type C (37.5%). Type A (12.5%) was least common.
9. Method of fixation of medial malleolus: majority of cases were treated with malleolar and cancellous screw fixation (70%). Most of patients with fibular fracture underwent fixation by one-third tubular plate (60%). Most of the cases (77.5%) were operated between the second and fifth days of injury.
10. Two cases of syndemosis injury were reduced and fixed with screw. Weight bearing was delayed till screw removal. No incidence screw break out were encountered.
11. Average time taken for fracture healing was 10.4 weeks.
12. Superficial infection of the wound was the most common complication in our study.
13. We had good to excellent functional outcome results in 82.5% of the cases. Fair results in 12.5% and poor in 5%.

DISCUSSION

The goal of treatment in bimalleolar fracture patients is to provide fracture union with a painless full range of motion of the ankle and with an anatomical restoration of the injured ankle joint. There has been an increase in the prevalence of bimalleolar fractures over the last two decades both in the young, active as well as in elderly patients [2]. Studies support the ORIF for the restoration of the normal anatomy of the joint for better results [3,4,5,6]. The treatment of malleolar fractures with accurate open reduction and stable internal fixation using AO method and principles has yielded a higher percentage of excellent and good results [7]. Motwani et al. [8] reported the mean age of their study population as 39.28 years. Available reports show male preponderance as in a study by Baird and Jackson (70.0%) [9] and studies by Indian authors [3,8,10,11]; our study population showed mean age 37.4 years and male preponderance (60%). Road traffic injuries are the frequent cause of ankle fracture [3,8,10,12], and this is again proven in our study(45%). In contrast, Maruthi et al. [11] report fall as the main cause of fracture, which was the second common cause in our study (35%) and in other previous studies [3,8,10,12]. Right ankle(62.5%) was the most commonly involved joint in our study similar to the previous reports [2,3,8,11,13,] while; there are reports where in left side was the most commonly involved joint [9,10]. Lauge–Hansen classification system considers the position of the foot and the deforming force that resulted in injury for assessment. The most common type of injury was SER (37.5%), followed by pronation-abduction injury (30%), and our observation is in accordance with previous reports [3,9,11,13,15] According to Hughes, fixation of the lateral malleolus first, often results in minimal post-operative immobilization and associated with rapid improvement in functions [17]. Burwell and Charnley showed that anatomical reduction and rigid fixation lead to the early return to function [4]. Mean time for the union was 10.4 weeks in our study population with a range of 8-14 weeks, which was similar to the study by Motwani et al. [8]. Baird and Jackson grading system to describe the outcome is a well-accepted, adopted method and we categorized the outcome in our patients using this grading system. Greater proportion of our patients had good to excellent (82.5%) outcome compared to reports by Cotton (70.0%),[11] Beris et al. (74.3%) [7], but lesser than Maruthi et al. (90.0%) [11]. Fair outcome varied

between 14 and 17% [4,7] we too report a lower rate of fair outcome (12.5%). Poor outcome was reported in considerably lesser percentage (5%) than Burwell and Charnley (6.0%); [4]. Fair to poor results in our patients can be attributed to wound infection and syndesmotic injury , and those with unsatisfactory reduction of fracture fragments. We too report infections and delayed union; former were managed with appropriate antibiotic. Complications that we observed are part of any surgical intervention and we managed successfully without much discomfort to the patients. We immobilized our patients for 3-4 weeks. We advised partial weight bearing with an observance of early signs of union radiologically and with complete signs of union, full weight bearing was advised. In those with syndesmotic screw weight bearing was delayed till screw removal . The result of our study is in accordance with a similar previous study. ORIF has become the mainstay of treatment for most of the unstable bimalleolar fractures, as these operative methods restores the anatomy, biomechanics, and contact loading characteristics of the ankle.

CONCLUSION

Understanding the mechanism of injury is essential for anatomical reduction and fixation. Fibular alignment (length, rotation) has to be maintained for lateral stability of the ankle. Anatomical reduction with restoration of the articular congruence is essential in all intra articular fractures. Open reduction and internal fixation restores the articular congruity of the ankle joint. Functional results were much better in younger age groups and men. Excellent results are obtained with stable fixation of fracture. Chances of non-union due to soft tissue interposition were avoided by surgical treatment. Plaster cast or slab applied for a period of 3-4 weeks does not reduce the final outcome. Rehabilitation is quick because immobilization is for a relatively short duration and is followed by weight bearing. Hence we conclude that, surgical management of bimalleolar ankle fractures provides good functional outcome. By stable surgical fixation of fracture, early mobilization can be done with good functional outcome.

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