International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 04-02-2021, Accepted: 20-02-2021, Published: 26-03-2021
www.medicalsciencejournal.com
Volume 7, Issue 3, 2021, Page No. 70-76

A prospective analysis of reduction and internal fixation of closed ankle fractures

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Abstract
Background: Ankle fractures are a very common type of fractures encountered by orthopaedicians. There has been an increased prevalence of such fractures over the last two decades both in young, active patients and in the elderly[1,2]. Increase in the road traffic accidents, sports injury, fall from heights, industrial accidents etc are the cause for increased incidence of these fractures. The ankle injuries have potential to produce significant long-term disability and complications[3]. The goal of treatment of these fractures is both a healed fracture and an ankle that moves and functions normally without pain. This can be achieved by anatomical reduction which includes restoration of normal tibio-fibular relationship, restoration of articular congruence, restoration of length, rotation and obliquity of distal fibula.
Materials and Methods: The study is a clinical prospective and observational study conducted at KBNTGH, Kalaburagi The material comprises of 30 adults patients of either sex with closed displaced ankle fracture treated with open reduction and internal fixation using different surgical procedure and implants in the department of Orthopaedics, KBNTGH, Kalaburagi during the period of July 2017 to June 2019.
Results: 30 patients with unstable fracture of ankle joint treated with open reduction and internal fixation Age of the patients ranged from 21 to 72 years. Majority of the patients were males. The mode of injury in maximum patients was road traffic accidents. Bimalleolar fracture was most common type observed in 18 patients. According to Lauge-Hansen classification Supination external rotation injury was most common type seen in 12 patients.
All patients were operatively treated immediately after swelling subsided using appropriate implant for fracture pattern. Average rate of clinical union was observed between 16-18 weeks. The rate of radiological union in majority of patients was around 18-20 weeks.
Most patients were given well padded below knee slab in full dorsiflexion for six weeks. During this period partial weight bearing was allowed using crutches. After six weeks progressive unrestricted weight bearing and range of motion exercises were started and patients were reviewed every month till union.There was 1 case of non-union.3 cases developed superficial to deep infection which responded well to antibiotics.
Most of the patients were discharged on post-operative day 14 after suture removal.
Functional outcome was satisfactory as 90% patients had excellent to fair outcome.
Conclusion: The conclusion of our study is:
- Ankle injuries commonly result from road traffic accidents and twisting injuries.
- Young, active and mobile patients are at greater risk for sustaining ankle injuries.
- A good reduction and fixation requires a thorough knowledge of mechanism of injury of ankle.
- Displaced and unstable ankle injuries often require early operative treatment for early and better functional outcome.
- The choice of implant is crucial to neutralize the deforming forces to obtain optimal results.
- Early intervention, good aseptic precautions and good general condition of patient will reduce the chances of infection.
- Good results can be expected even if the time for union is longer.

Hence we conclude that a pre-operatively well defined fracture pattern in each patient aids in implant and technique selection for optimal reduction and fixation which in turn leads to early restoration of patient to his routine activities.

Keywords: ankle fractures; medial malleolus; lateral malleolus; TBW; platting; C-C screws

Introduction

Ankle fractures are one of the commonest fractures encountered by orthopaedicians in routine practice. There has been an increased prevalence of such fractures over the last two decades both in young, active patients and in the elderly [1, 2]. Sports injuries, road traffic accidents, domestic injuries are the common causes for ankle fractures.
Ankle is a complex joint. It manifests great strength and stability. The stability is secured by stong ligaments and also the insertion of talus into the deep socket between medial and lateral malleoli. The ankle fractures are complex injuries that are a challenge to manage and its important as the whole body weight is transmitted through them and locomotion depends on stability of these joint. The ankle injuries have high potential to produce significant long-term disability and complications [3].
The aim of the treatment of these fractures is just not healing but securing a pain-free joint with complete range of movements. This can be achieved by proper anatomical reduction which includes restoration of normal tibio-fibular relationship, restoration of articular congruence, restoration of length, rotation and obliquity of distal fibula. The

development of strategies for treatment of various patterns of ankle injuries revolves around whether these goals can be achieved more predictably with operative or non- operative means. The ultimate goal is to return the patient to the pre-injury level with painless and mobile ankle.

Though ankle fractures have traditionally considered as non controversial with respect to the indications for operative intervention, the recent advances in understanding of the bio-mechanics of the complex ankle joint haven given birth to a particular areas of uncertainty clinically.

These include the indications for the operative treatment of isolated fractures of the lateral malleolus, the operative technique for and post-operative management of injuries of the syndesmosis and the reliability of radiographic assessment of fractures about the ankle.

Materials and Methods

The study is a clinical prospective and observational study

The material comprises of 30 adults patients of either sex with closed displaced ankle fracture treated with open reduction and internal fixation using different surgical procedure and implants in the department of Orthopaedics, KBNTGH, Kalaburagi during the period of July 2017 to June 2019.

After obtaining a detailed history, complete general physical, systemic and local examination, the patients were subjected for relevant investigation. On admission to the hospital appropriate first aid in the form of below knee plaster slab, ice packs, fluid therapy, and analgesics were given. Any associated injuries were treated appropriately. X-ray of the ankle joint in three views Antero posterior, lateral and Mortise were taken including full length of Tibia/Fibula and foot. Before subjecting the patient for surgical procedures written/informed consent was obtained from patient/legal guardian. Post operatively cases were followed initially every 15 days for 6 weeks then monthly till union. Consent was taken for participation in the study and only those patients were included.

The data collected was transferred into a master chart which was subjected to statistical analysis.

Inclusion criteria

a. Patients with unstable fracture of ankle joint.
b. Fracture disturbing the ankle mortise.
c. Patients of any sex & in age groups of 18years and above
d. Patients who are fit for surgery

Exclusion criteria

a. Open ankle fractures.
b. Ankle fracture in children.
c. An undisplaced fracture of ankle.
d. Patient is unfit for surgery or anaesthesia
e. Patient not giving written consent for surgery.
f. Fracture in which satisfactory reduction was achieved by closed methods.

Salient Findings

30 patients with unstable fracture of ankle joint treated with open reduction and internal fixation in the department of orthopaedics, KBNTGH, Kalaburagi during the period of July 2017 to June 2019 were evaluated in a prospective study. This was found to be a standard procedure resulting in good to excellent results.

Age of the patients ranged from 21 to 72 years.

Majority of the patients were males.

The mode of injury in maximum patients was road traffic accidents.

Bimalleolar fracture was most common type observed in 18 patients.

According to Lauge-Hansen classification Supination external rotation injury was most common type seen in 12 patients.

All patients were operatively treated immediately after swelling subsided using appropriate implant for fracture pattern. Average rate of clinical union was observed between 16-18 weeks. The rate of radiological union in majority of patients was around 18-20 weeks.

Most patients were given well padded below knee slab in full dorsiflexion for six weeks. During this period partial weight bearing was allowed using crutches. After six weeks progressive unrestricted weight bearing and range of motion exercises were started and patients were reviewed every month till union. There was 1 case of non-union.3 cases developed superficial to deep infection which responded well to antibiotics.

Most of the patients were discharged on post-operative day 14 after suture removal.

Functional outcome was satisfactory as 90% patients had excellent to fair outcome.

Results

During period between July 2017 to June 2019, 30 patients who underwent surgery for ankle fractures in department of orthopaedics, KBNTGH, Kalaburagi were taken up for study.

Age Distribution

The age incidence between 20-40 yrs was the commonest in this study with an incidence of 70% representing active population in society.

Sex Distribution

In the present study majority of cases were males with an incidence of 60% and male to female ratio being 1.5:1

Side Preponderance

In our study of twenty cases, 18 cases of ankle fractures occurred on the right side and the remaining nine cases occurred on left side.

Mode of Injury

In the present study, road traffic accident [RTA] was the commonest cause of ankle fractures accounting to fifty percent of the cases followed by twisting injury and fall from height.

Table 1: Mode of Injury

Mode of injury	Number of Cases	Percentage
R.T.A	15	50
T.I	09	30
F.F.H	06	20
Total	30	100

Type of Fracture and Treatment Availed

All the fractures were classified according to Henderson's, Lauge-Hansen and Danis-Weber classification.

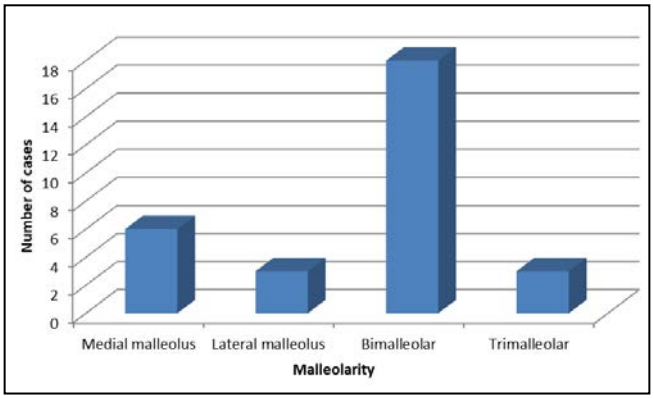
Bimalleolar fractures were the commonest in our study and

trimalleolar fractures were of least occurrence. The isolated fractures of lateral and medial malleolus occurred with nearly same frequency in our study.

Classification based on malleolarity

Table 2: Classification of Malleolarity

Malleolarity	Number of Cases	Percentage
Medial malleolus	06	20
Lateral malleolus	03	10
Bimalleolar	18	60
Trimalleolar	03	10



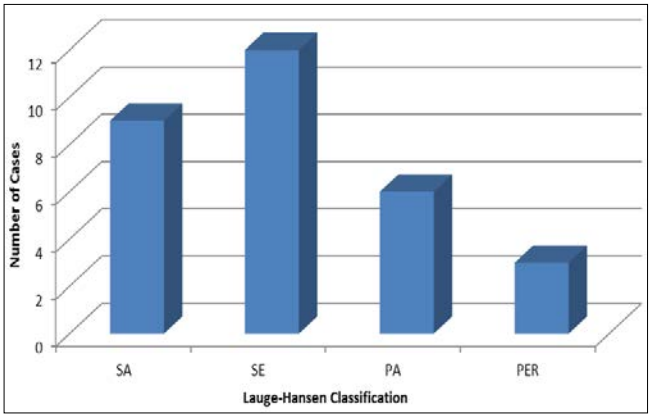
Graph 1: Classification of Malleolarity

Fractures classified according to Lauge-Hansen classification

When classified according to Lauge-Hansen classification, supination external rotation type injury was of the commonest occurrence. The occurrence of Pronation abduction was less then Supination adduction in our study. Pronation external rotation is the least common injury in our study.

Table 3: Fractures classified according to Lauge-Hansen classification

Type	Number of Cases	Percentage
SAD	9	30
SER	12	40
PAB	6	20
PER	3	10



Graph 2: Fractures classified according to Lauge-Hansen classification

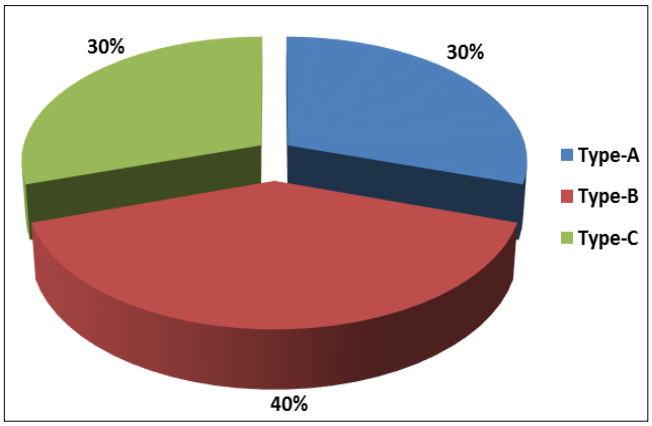
Fracture Classification according to Danis-Weber

When Danis-Weber classification was used to classify the fractures, type-B fractures occurred more frequently.

Table 4: Danis Weber Classification of Cases

Classification Type	Number of Cases	Percentage
Type-A	9	30
Type-B	12	40
Type-C	9	30

Type A occurred in 9 cases, Type B in 12 cases and Type C in 9 cases.



Graph 3: Danis Weber Classification of Cases

Implants Used

Fibular fractures were fixed using one- third tubular plate and screws [16 cases], reconstruction plate [4 case], 3.5 mm lag screws [2], and K-wires [2 cases], while, medial malleolar fractures were fixed using 3.5 mm malleolar screw [7 cases], 3.5 mm lag screws [12 cases] or K-wires alone [1 case], TBW [7 case]. Posterior malleolus (3 cases) was fixed with 3.5mm cancellous screws.

Lateral Malleolus Fixation with Different Implants and Results

Table 5: Lateral malleolus fixation

Implant used	Results				Total	Satisfactory Outcome (%)
	Excellent	Good	Fair	Poor		
STP & S	2	10	3	1	16	75
CS/MS	1	1	0	0	02	100
K-wire	0	0	0	2	03	00
RP & S	0	1	3	0	04	00

Satisfactory outcome included both excellent and good results. We found that 1/3rd semitubular plate were better implants for fixing lateral malleolar fracture of various fracture patterns. Also TWO cases lateral malleolar fracture fixation, fixed with CS showed satisfactory outcome.

Medial Malleolus Fixation with Different Implants and Results

Table 6: Medial Malleolus Fixation

Implant used	Results				Total	Satisfactory Outcome (%)
	Excellent	Good	Fair	Poor		
MS	1	3	2	1	7	57.14
CS	2	7	2	1	12	75
K-wire alone	0	0	0	1	1	00
TBW	0	6	1	0	7	85.7

Satisfactory outcome included both excellent and good results. Cancellous screws because of their lag effect gave a better fixation with better functional outcome in majority of cases compared to malleolar screws. Also six cases of medial malleolar fracture fixation, fixed with Tension Band Wiring (TBW) showed satisfactory outcome.

Posterior Malleolar Fixation with Cancellous Screw

In this study, we fixed 1 case of posterior malleolar fractures with cancellous screw whereas two cases were not fixed. We had satisfactory result for one case while other had fair to poor result.

Hospital Stay and Discharge

The hospital stay varied with each patient from 8-15 days with an average of 11 days. Sutures were removed at 12-14 days post-operatively and in all patients a below knee plaster was used with partial weight bearing allowed till 6 weeks. Till 6 weeks they were reviewed every 15 days. After this, they were reviewed every month till fracture union.

Complications

The complications encountered in our study were pin tract infection, superficial wound infection, malunion. and nonunion. In a case where K wire was used, developed pin tract infection which was controlled by removing wires at 6 weeks and after treating with appropriate antibiotics. Two cases of superficial wound infection occurred which healed with regular dressing and appropriate antibiotics.

Malunion was seen in two fracture cases one of which was trimalleor fracture.

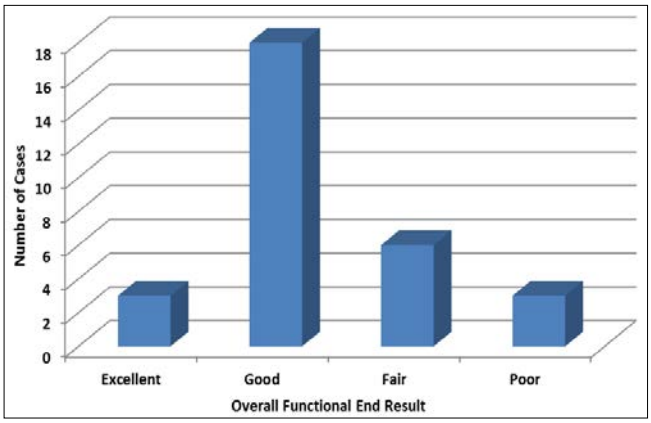
One case of nonunion was encountered in our study where the medial malleoli was fixed with K wires. Patient had gross restriction of movements with poor outcome.

Overall Functional End Result

The overall functional end results based on the assessment criteria described earlier, is in the table below.

Table 7: Overall Functional End Result

Functional outcome	Number of Cases	Percentage
Excellent	3	10
Good	18	60
Fair	6	20
Poor	3	10



Graph 4: Overall Functional End Result

29 cases united at an average of 17.65 weeks with a range of 10-23 weeks. Patients were followed at regular intervals for thirty weeks. Excellent and good functional outcome was considered satisfactory result, which was achieved in 21 cases. Moderate outcome was seen in 6 cases and 3 cases had poor outcome.

We opine that the important factors in the outcome of results are the type of fracture, the time of presentation after injury. The adequacy of reduction and the experience of the surgeon are also very important

Case 1

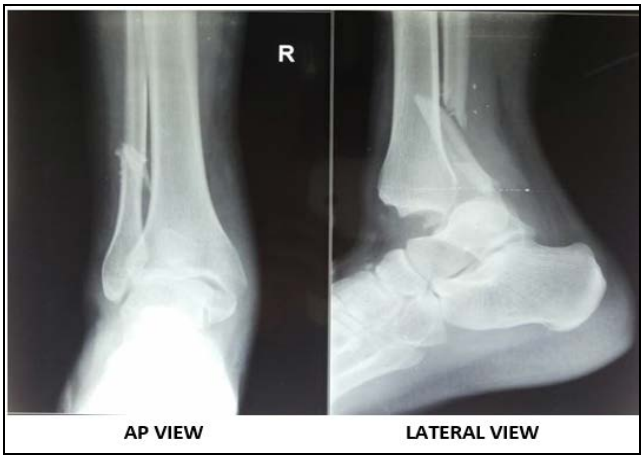


Fig 1

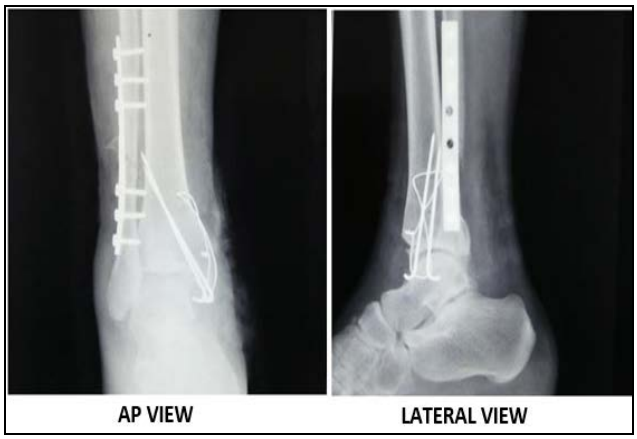
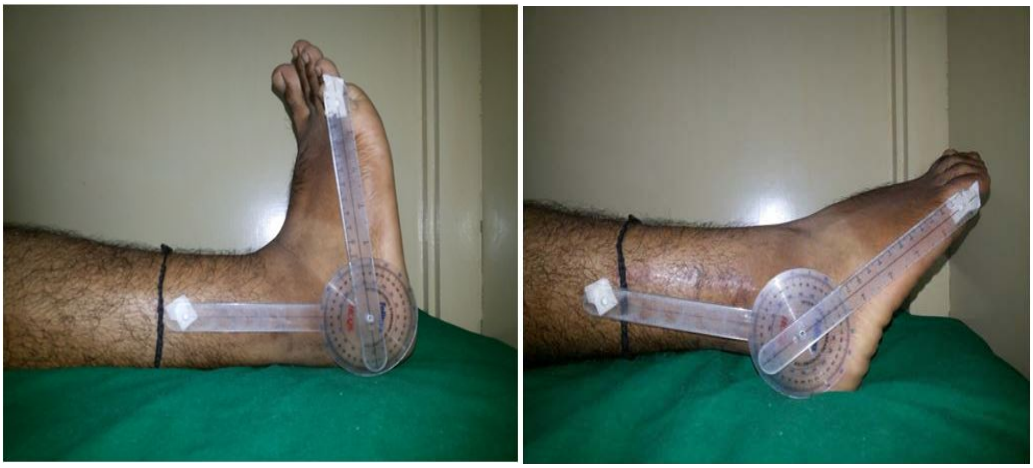


Fig 2: Post Op XRAY

Fig 3: Squatting



Dorsi-flexion Plantar-flexion

Fig 4

Case 2

Fig 5: Pre Op XRAY

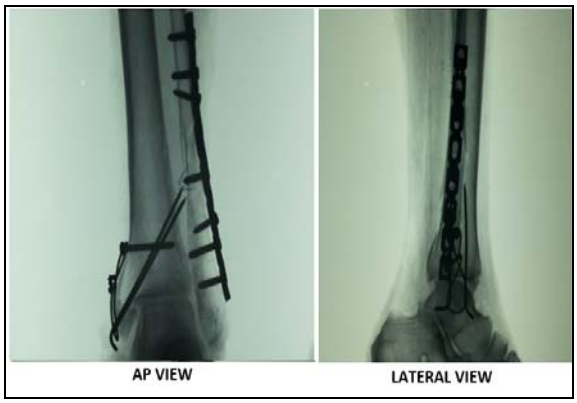


Fig 6: Post Op XRAY

Fig 7

Discussion

Over a period of two years from July 2017 to June 2019, thirty patients who were operated for ankle fractures in department of Orthopaedics, KBNTGH, Kalaburagi were taken up for study.

Even though closed reduction is an accepted method of treatment of ankle fractures, it might not be possible in all cases. Many authors have pointed out that satisfactory anatomical reduction cannot be expected in all cases as there will be periosteal interposition at the fracture site [4, 5, 6]. Hence the current opinion has increasingly favored primary operative intervention for displaced or unstable fractures of ankle.

The population in the present series, was similar to population studied by other authors [7]. They occurred more frequently in males in 2nd to 4th decade which reflects more physical activity of working men.

Authors in other studies have shown road traffic accidents as the commonest mode of injury, our series supports this finding. This might be attributed to the improving economy of our nation, per capita income along with improved roads that have compelled for more vehicular population on road.

Presence of innumerable classification systems in the literature itself signifies that not one system can be relied upon completely. We opine that even though Lauge Hansen classification helps us in understanding the mechanism of injury it will also help in open reduction. In the present series supination-extemal rotation injuries occurred most frequently amounting to 40% of cases [8, 9, 10].

However Weber [11] classification introduced in. 1949 is simpler and more relevant when operative reduction is considered.

Fracture fixation of fibula can be achieved in number of ways. Burwell and Chamley and many authors have used axial screw to stabilize fibula but lateral plate as advocated by AO group [12, 13] has become widely accepted for the same. We have mostly used plate osteosynthesis for fibular fractures in our study. We have always reduced the fibula first and the medial malleolus fell into position easily.

McDaniel and Wilson [14] showed that closed reduction of fractures involving less than 25 percent of the posterior tibial surface led to a good or excellent result even in the presence of residual displacement of more than two millimeters. But those bigger than this size should be fixed. In our, series we encountered three such posterior malleolar fractures out of which one was fixed with cancellous screw.

There is always a controversy whether the deltoid ligament should be repaired or not. Many authors have recommended operative repair in association with stabilization of associated fractures [Connrad and Tannin [15, 16], Hamilton [17], Yablon [18]] others, however believe that non-operative treatment is satisfactory [De Souza, Gustilo and Meyer [19] 1985, Staples [20] 1960]. We have not seen any late instability in our cases where the deltoid was not repaired.

Burwell and Charnley [4, 6] doubted whether internal fixation of the syndesmosis is necessary and considered that to be a method not without grave disadvantages. In our series we have not used syndesmotic screws.

Perioperatively, image intensifier was used to asses the reduction and fixation of the fracture and we found it to be extremely useful. Post-operative immobilization of ankle fractures has been considered less favourable by some authors like Olerud *et al* [21] and some authors like Weber[11] do not advocate plaster immobilization at all; but Meyer & Kumbler [13], have used it initially and some have used it after an initial period of free movement without weight bearing like Burwell and Charnley [4, 6]. Yde and Iristensen [22] have used continuous immobilization in the post operative period. According to Sondenaa[23] plaster cast immobilizations for 6 weeks did not diminish the strength of ankle motion. We have used POP till 6 weeks. Only in badly comminuted fractures and in non-cooperative patients we have continued POP after this period.

In our series we had satisfactory results in 70% [excellent + good] and 20% cases had fair outcome while 10% had poor results. We had got poor results in SER type IV fractures.

Our present study results were compared with results of Ulf lindsjo *et a1* [26]. In prospective study of 321 consecutive cases of dislocation ankle fractures operatively treated according to the AO (ASIF) principles, 306 cases (95%) were followed up two to six years after surgery. The infection rate was 1.8% with no septic arthritis. The clinical results were “excellent and good” in 82% “acceptable” in 8%, and “poor” in 10%. Posttraumatic arthritis occurred in 14%. The most decisive factors influencing the clinical result were the type of fracture, and the accuracy of the reduction. Exact reduction, rigid internal fixation, early postoperative joint exercises, and subsequent full weight-bearing in a below-the-knee walking plaster are essential for a good end result of fracture-dislocations of the ankle joint. Compared to other series Infection rate in present series is comparatively high. However the infection occurred in only 3 cases which responded to appropriate treatment. Infection rate is high in the preset study because compared to other series number of patients are less in our series. Patients come late after native treatment in form of massage and native plasters with in duration & edema which is also a cause for wound dehiscence and infection. Patients are poor and of low socioeconomic status and their personal hygiene are poor which can also be a contributory factor. Being poor, they cannot also afford sterile drapes and stockinet for surgery especially of the foot and ankle which can also be a factor for high infection rate.

Conclusion

The conclusion of our study is:

- Ankle injuries commonly result from road traffic accidents and twisting injuries.
- Young, active and mobile patients are at greater risk for sustaining ankle injuries.
- A good reduction and fixation requires a thorough knowledge of mechanism of injury of ankle.
- Displaced and unstable ankle injuries often require early operative treatment for early and better functional outcome.
- The choice of implant is crucial to neutralize the deforming forces to obtain optimal results.
- Early intervention, good aseptic precautions and good general condition of patient will reduce the chances of infection.
- Good results can be expected even if the time for union is longer.

Hence we conclude that a pre-operatively well defined fracture pattern in each patient aids in implant and technique selection for optimal reduction and fixation which in turn leads to early restoration of patient to his routine activities.

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