

## A comparative study on Early versus Delayed Operative Treatment of Closed Ankle fracture in Adults

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### Abstract:

**Background:** Ankle fractures are one of the most common lower limb fractures; they account for 9% of all fractures, representing a significant portion of the trauma workload. Ankle fractures usually affect young men and older women, however, below the age of 50; ankle fractures are the commonest in men. Timely treatment intervention is a crucial factor for appropriate wound healing and early rehabilitations. Sometimes due to lack of hospital facility in far flung area or some other reasons patient come to hospital late. So for orthopaedic surgeon it has become important to know the outcome of operative treatment done late. **Materials and method:** It is a Hospital based Quasi-experimental study conducted on 30 patients for a period of 2 years from September 2017 to October 2019 in the Department of Orthopaedics RIMS, Imphal, Manipur to compare the outcome of early versus delayed operative treatment of closed ankle fracture in terms of infection, post operative hospital stay, fracture union, range of motion, weight bearing and functional outcome of the limb. Patients fulfilling the inclusion criteria and willing to take part in the study were included and divided by purposive sampling into 15 each in two groups namely early group: where the patients were treated within one week of injury, and delayed group: where the patients were treated after one week of injury. Post operative evaluations of functional and radiological outcome was done using Olerud C and Molander H functional score system on the basis of poor, fair, good and excellent. And the two groups were compared using Independent t<sub>test</sub> and Chi-square test. Difference was considered statistically significant when the value was < 0.05. **Results:** In early group there was excellent functional outcome in 9 cases ( 60 %), good in 3 cases (20%), fair in 2 cases (13.3%) and poor in 1 case (6.6%). In delayed group there was excellent functional outcome in 8 cases (53.3%), good in 3 cases (20%), fair in 3 cases (20%) and poor in 1 case (6.6%). Both the groups was comparable as the p value was >0.05. **Discussion:** In this comparative study, the differences between the results of early and late operative treatment of closed ankle fracture in adults were insignificant in terms of fracture union, range of motion, weight bearing, operative time and functional outcome. Both groups had 100% union rate without any failure. There were statistically significant difference in terms of post operative hospital stay and wound infections which showed lesser complication in early group leading to lesser post operative hospital stay. **Conclusion:** In this study the overall functional outcome was 80 % excellent to good results in early group and 73.3 % excellent to good results in delayed group. Thus when immediate fixation is not possible, delayed fixation of displaced ankle fracture is a reasonable option.

**Keywords:** Ankle fracture, comparative, Functional outcome, Purposive sampling, Olerud C and Molander H functional score system.

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### I. Introduction

Ankle fractures are one of the most common lower limb fractures<sup>1</sup>; they account for 9% of all fractures<sup>2</sup>, representing significant portion of the trauma workload.<sup>3</sup> The annual incidence of ankle fracture is between 107 and 184 per 100,000 persons.<sup>4,6</sup> Ankle fractures usually affect young men and older women<sup>7</sup>, however, below the age of 50; ankle fractures are the commonest in men. The most common causes of ankle fractures are twisting injuries and falls, followed by sports injuries.<sup>4,5</sup> The ankle injuries gained importance because body weight is transmitted through it and the locomotion depends upon the stability of this joint.

Timely treatment intervention is a crucial factor for appropriate wound healing and early rehabilitations. Sometimes due to lack of hospital facility in far flung area or some other reasons patient come to hospital late. So for orthopaedic surgeon it has become important to know the outcome if operative treatment done late. Since there is scarcity of similar research work on treating within one week versus after one week, there is little knowledge about which one is better. So it has become important to do an experimental study to know better about the outcomes of different intervention time. So this study is to compare the outcome of early versus delayed operative treatment of closed ankle fracture in terms of infection, post operative hospital stay, fracture union, range of motion, weight bearing and functional outcome of the limb.

## **II. Materials And Methods**

It is a Quasi-experimental study conducted in the Department of Orthopaedics at our institute. Patients were enrolled for the study from September 2017 to October 2019. Thirty patients were enrolled in the study and due written consent was obtained.

### **2.1 Inclusion Criteria:**

All closed displaced ankle fractures in adult above 18 yrs of age and ankle fractures with late presentation, with nonunion or malunion.

### **2.2 Exclusion criteria:**

Undisplaced fractures and fractures treated by closed reduction, multiple fractures, severe soft tissue injury with blister and medically unfit for surgery.

### **2.3 Study Group:**

Patients fulfilling the inclusion criteria and willing to take part in the study were divided by purposive sampling into 15 each in two groups namely,

**2.3.1 Early group:** where the patients are treated within one week of injury, and

**2.3.2 Delayed group:** where the patients are treated after one week of injury.

### **2.4 Management in Casualty/OPD:**

On arriving in the Casualty/OPD, the patients were thoroughly assessed clinically. The cause of injury was inquired; vitals parameters were checked; associated head, neck, chest, abdominal injuries, etc were looked for. On local examination skin condition including fracture blisters, haemarthrosis, open or closed, distal neurovascular compromise and any sign of compartment syndrome were noted. Any other associated limb injury or bony injury was noted and the patient was sent for x-ray anteroposterior view and lateral view of the involved extremity. According to the general condition and vital parameters intravenous access was sought for and intravenous fluids given accordingly. Other bony injuries were immobilized and appropriately treated. A below knee posterior slab was applied for temporary immobilization of the ankle fracture.

On admission the patients were again thoroughly assessed clinically. All the routine investigations were sent and the patients were prepared for operation.

### **2.5 Operative procedures:**

Patients were subjected to operative procedures by open reduction and internal fixation and fixed with either partial threaded screw and one third tubular plate or tension band wiring with one third tubular plate. Operation was under anaesthesia (spinal or general).

#### **2.5.1 Positioning**

Patient was kept in supine position and the affected limb was kept in extended and externally rotated on the operating table. A tourniquet was applied to the thigh as per requirement.

#### **2.5.2 Draping**

The skin over the ankle region with leg and foot was prepared by soap scrub and application of the povidine iodine (10%) solutions. The operative field was draped with sterile sheets and placing the towel clips so that they were not superimposed on the fracture on subsequent imaging.

#### **2.5.3 Fixation of the fibula with one third tubular plate**

Skin incision was given as j shaped incision behind the malleolus for exposure of lateral malleolus as all the bimalleolar case the fibula is fixed first. Incision started about 5 cm above the tip of malleolus and will extend downward and forwards 2.5 cm to 3.5 cm below it. The incision was subjected to extended proximally

when required. After exposing the fracture site the haematoma and interposed soft tissue if any was removed and fracture surface was cleaned with a curette. The fracture was reduced and held in alignment with the help of bone holding forceps. A one third tubular plate either 5 or 6 holes, depending upon the type of fracture was applied. The bone was drilled with a 2.8mm drill bit using a drill guide and will tap with a 3.5 mm cortical bone tap. 3.5 mm cortical screws was then be used to fix the fracture.

#### **2.5.4 Fixation of medial malleolus with partially threaded screws<sup>15</sup>**

An anteromedial incision was made over the medial malleolus that begins approximately 2 cm proximal to the fracture line, extends distally and slightly posteriorly, and ends approximately 2 cm distal to the tip of the medial malleolus. The skin with its underlying subcutaneous tissue was retracted anterior and posteriorly. The great saphenous vein and its accompanying nerve were retracted anteriorly.

The fracture site was exposed and the fracture fragments were curetted to remove any loosed osseous or chondral fragments. With a bone-holding clamp or towel clip, the detached fragments were brought into normal position and internally fixed with two 1.5mm smooth Kirschner wires drilled across the fracture site as temporary fixation devices. If the reduction was satisfactory, a 2.8mm drill bit was drilled across the fracture fragments and a 4mm partially threaded screw was inserted using a 4mm screw driver and one of the Kirschner wires was removed. A second screw was then placed in a similar fashion and the second K-wire was removed.

After fixation had been confirmed, the wound was irrigated and closed atraumatically, usually with interrupted non absorbable skin sutures. A posterior below knee plaster slab was applied after skin closure.

#### **2.5.5 Fixation of medial malleolus by tension band wiring**

A similar incision was made on the medial malleolus to expose the medial malleolus, and after reducing the fragment a towel clip was used to hold it in position and two k-wires was passed parallel to each other through the fragments. Then a through and through antero posterior drill hole was made on the tibia above 3 cm proximal to fracture and a length 20 or 22 gauge stain less steel was passed through the hole. The end was crossed over, with one end passing under the 2 k- wires and ends was tightened and twisted in a figure of eight fashion. After through irrigation the wound was closed in layers and below knee plaster of paris was applied.

#### **2.5.6 Post-operative management:**

Postoperatively, the ankle was immobilized in a posterior plaster splint with the ankle in neutral position and elevated. A cephalosporin antibiotic was administered prior to the operation and then 12 hourly for 24 to 48 hours after surgery and continued with oral antibiotics for another 5 days. Suture removal was done on the 10<sup>th</sup> day and then patients were discharged or the patients were discharged and called for suture removal on the 10<sup>th</sup> day after surgery in the OPD. Regular OPD check up was done at monthly intervals thereafter for 1 year and AP and lateral radiographs were obtained. Range-of-motion exercises were begun once the wound was healed. Weight bearing was restricted for 6 weeks, after which partial weight bearing was started when the fracture was healing well. Full weight bearing was allowed depending on radiographic evidence of fracture consolidation.<sup>43</sup>

#### **2.5.6 Functional assessment:**

The results were evaluated using Olerud C and Molander H functional score system.<sup>44</sup> C. Olerud and H. Molander: A scoring scale for symptoms evaluation after ankle fracture as given below:

Parameters	Degree	score
1. pain	None	25
	While walking on uneven surface	20
	While walking on even surface	10
	While walking indoors	5
	Constant and severe	0
2. Stiffness	None	10
	Stiffness	0
3. Swelling	None	10
	Only evening	5
	Constant	0
4. Stair Climbing	No problem	10
	Impaired	5
	Impossible	0
5. Running	Possible	5
	Impossible	0

6. Jumping	Possible	5
	Impossible	0
7. Squatting	Possible	5
	Impossible	0
8. Supports	None	10
	Taping, Wrapping	5
	Stick or Crutch	0
9. Work, Activities of daily life	Same as before injury	20
	Loss of tempo	15
	Change to a simple job/ part-time job	10
	Severely impaired work capacity	0

Total Score = 180

Poor : 0% - 30%.  
 Fair : 31% - 60%.  
 Good : 61% - 90%.  
 Excellent : 91% - 100%.

### 3.7 Statistical analysis

Data was checked for completeness and consistency. Data as age, sex, fracture side, mode of injury, age of fracture, operating time, weight bearing, time of union and functional outcomes were entered and analysed by using SPSS V.21 for windows (IBM Inc). The data were compared between the two groups under study by using Independent t-test and Chi-Square test. Difference was considered significant when the p value was < 0.05.

## III. Results

Thirty patients who fulfilled the inclusion criteria were analysed using Olerud C and Molander H functional score system<sup>44</sup> and Schmits<sup>43</sup> evaluation system.<sup>45</sup> Of total 30 cases included in our study, 17 were males and 13 were female (M:F= 1.3:1 ).

The average age of patients in early group was 37.13 years (S.D  $\pm$ 13.303) with range being 18-65 years and in delayed group, average age of the patient was 37.40 years (S.D  $\pm$ 12.822) with the range being 18–65 year. There were 17 fractures on the right side and 13 fractures on the left side.

The road traffic accident was the most common mode of injury seen in 16 cases followed by slipping/stumbling from steps in 8 cases and work accident in 6 cases in both

The mean age of fracture in early group was 1.6 days ( $\pm$ 0.667) days ranging from 1-4 days while it was 13.13 ( $\pm$ 3.29) days ranging from 8-18 days in delayed group.

The operating time in both the groups were ranged from 30-45 minutes with mean operating time was 37.00 minutes and standard deviation of 4.140. Operating time was found to be statistically insignificant ( $p > 0.05$ ).

In this study the early group has average postoperative hospital stay of 6.07 ( $\pm$  1.5) days ranging from 4 to 11 days and in delayed group the average stay was 8.40 ( $\pm$  2.501) days, ranging from 5 to 12 days. In our study there was shorter median post operative hospital stay in early group. The comparison was statistically significant ( $p < 0.05$ ).

In the early group the minor post operative wound infection was found in one case 6.6 % ( $\pm$  1.5) and in delayed group the minor post operative wound infection was found in two cases 13 % ( $\pm$  2.501). In this study there was lesser post operative wound infection in early group.

There was no deep infection in both the group. The comparison was statistically significant ( $p < 0.05$ ).

Clinically, the mean time for union in early group was 7.47 weeks (range 5-10 weeks) with standard deviation of 1.302 while in delayed group was 8.00 weeks (range 6-12 weeks) with standard deviation of 1.558. The difference between the two groups was insignificant ( $p > 0.05$ ).

Radiologically, the mean time for union in early group was 11.80 weeks (range 8-15 weeks) with standard deviation of 2.210 while in delayed group was 12.93 weeks (range 9-18 weeks) with standard deviation of 2.251. Bone union takes lesser time in early group but the difference between the two groups was statistically insignificant ( $p > 0.05$ ).

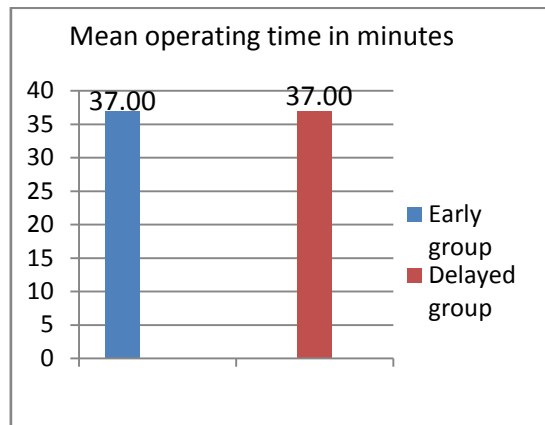
The mean time for restricted weight bearing in early group was 7.47 weeks (range 5-10 weeks) with standard deviation of 1.302 while in delayed group was 8.00 weeks (range 6-12 weeks) with standard deviation of 1.558. Unrestricted weight bearing was allowed after the fracture had united radiologically. The mean time

for unrestricted weight bearing in early group was 11.80 weeks (range 8-15 weeks) with standard deviation of 2.210 while in delayed group it was 12.93 weeks (range 9-18 weeks) with standard deviation of 2.251.

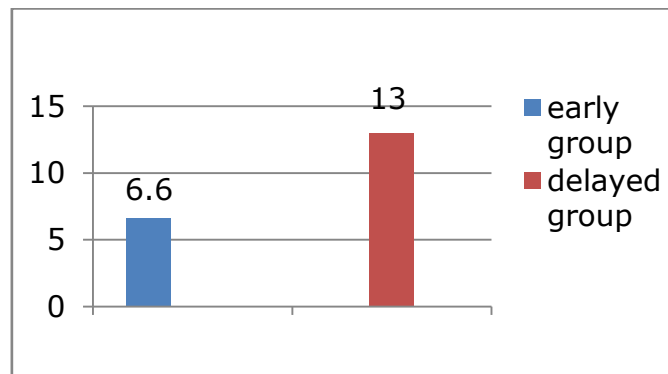
The range of motion in early group was 100% in 0-20° dorsiflexion, 93.3% in 0-50° planter flexion, 80% in 0-20° pronation and 86.3% in 0-40° supination while in delayed group was 100% in 0-20° dorsiflexion, 86.6% in 0-50° planter flexion, 80% in 0-20° pronation and 86.3% in 0-40° supination.

In early group there was excellent functional outcome in 9 cases (60%), good in 3 cases (20%), fair in 2 cases (13.3%) and poor in 1 case (6.6%). . In delayed group there was excellent functional outcome in 8 cases (53.3%), good in 3 cases (20%), fair in 3 case (20%) and poor in 1 case (6.6%).

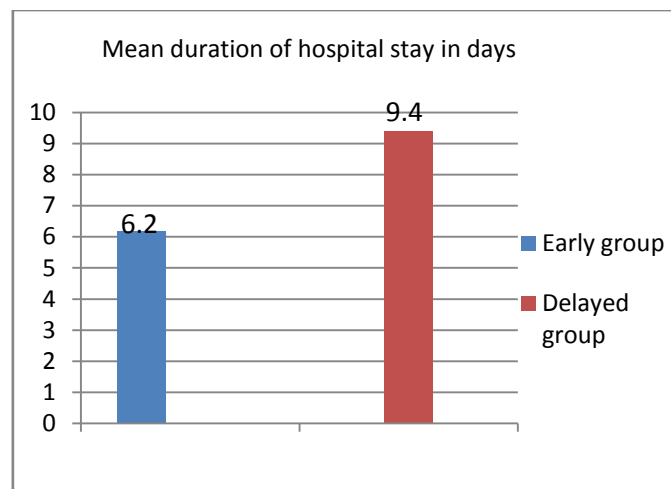
**IV. Tables**



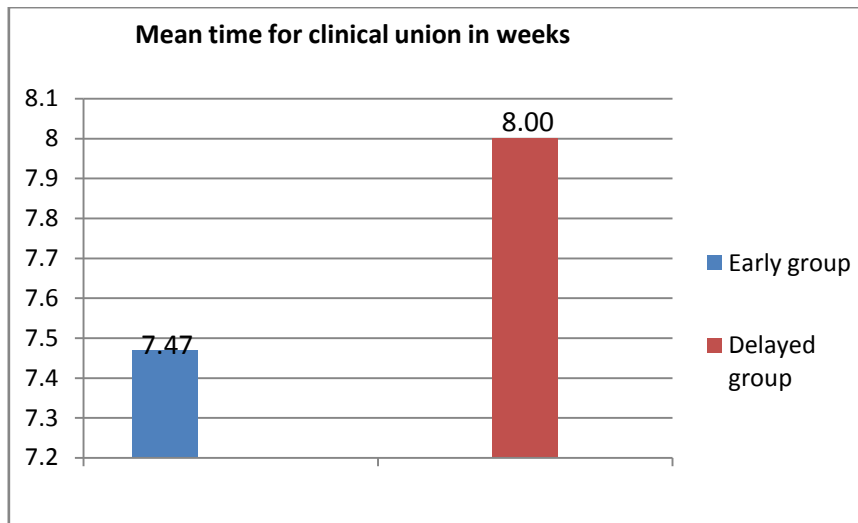
**Table 1:** Bar diagram showing mean operating time (in mins).



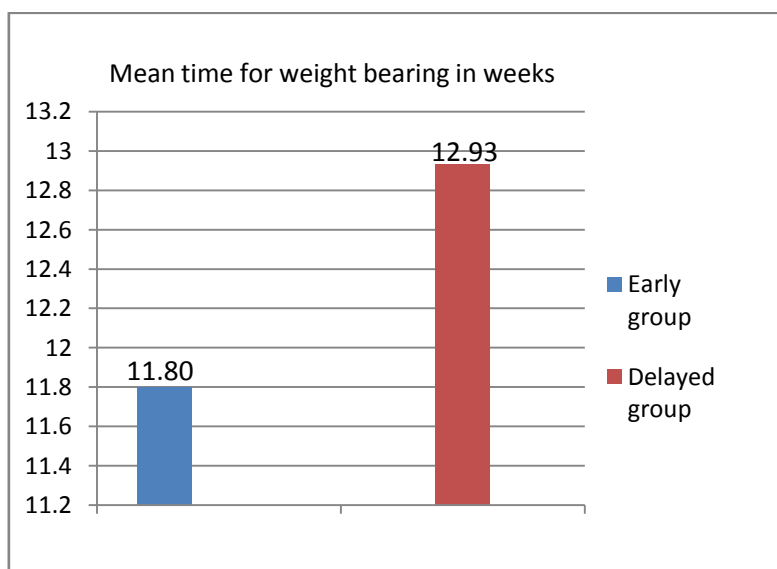
**Table 2:** Bar diagram showing mean postoperative infection (in %).



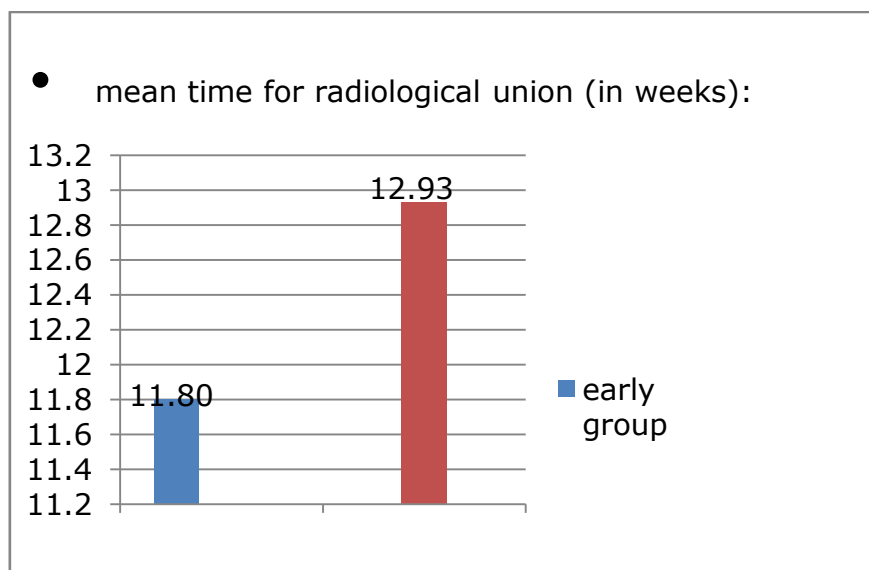
**Table 3:** Bar diagram showing mean duration of hospital stay (in days)



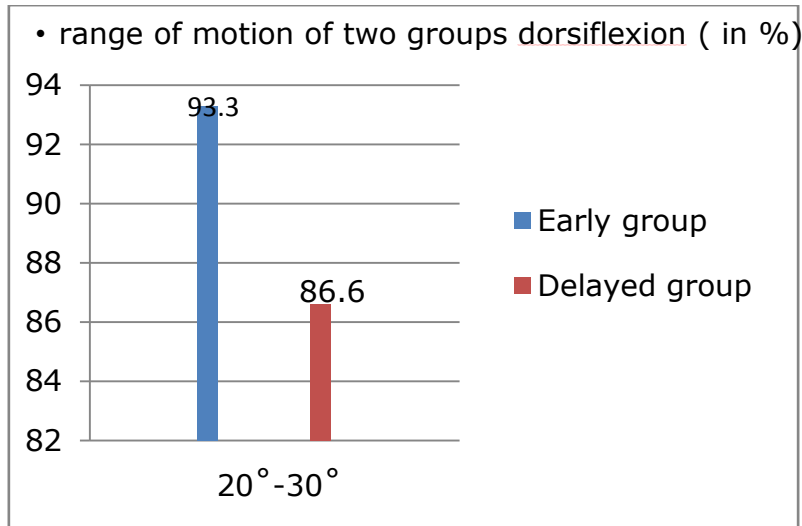
**Table 4:** Bar diagram showing mean time for clinical union (in weeks)



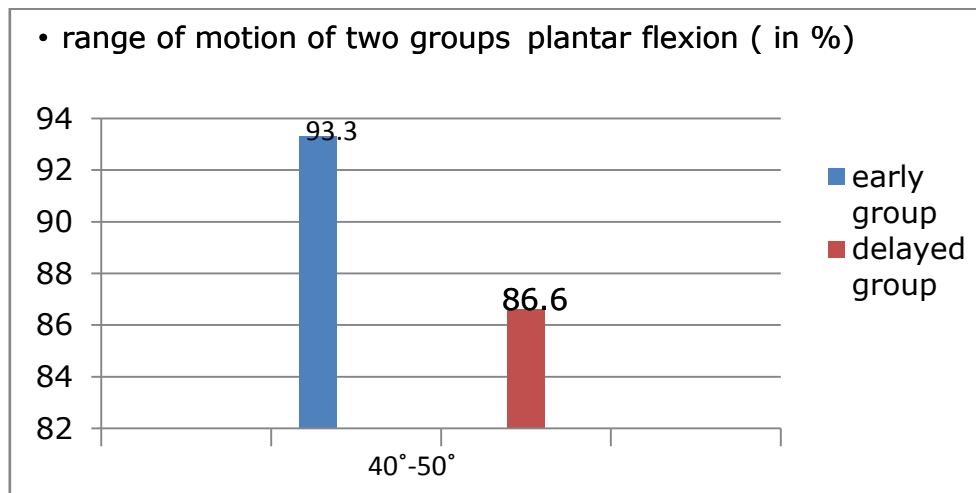
**Table5:** Bar diagram showing mean time for weight bearing (in weeks).



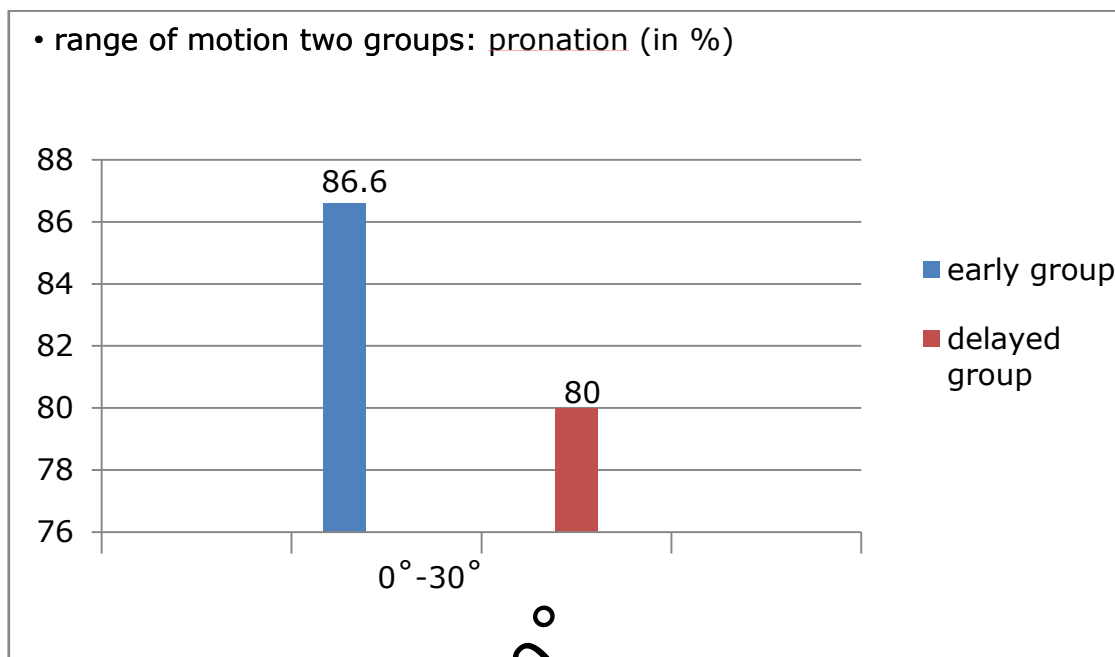
**Table 6:** Bar diagram showing mean time for radiological union (in weeks).



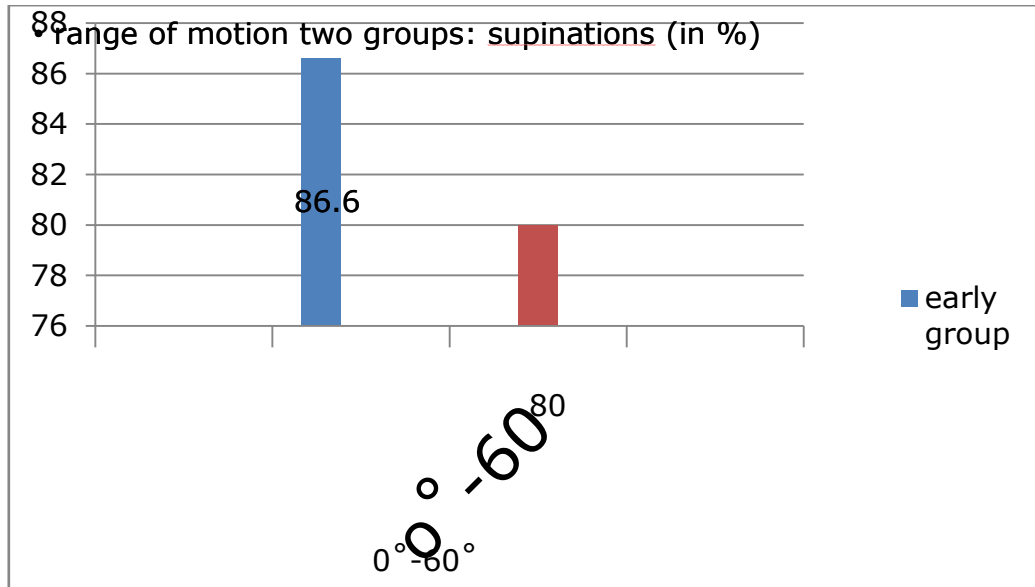
**Table 8:** Bar diagram showing range of motion dorsiflexion (in %).



**Table 9:** Bar diagram showing range of motion plantar flexion (in %).



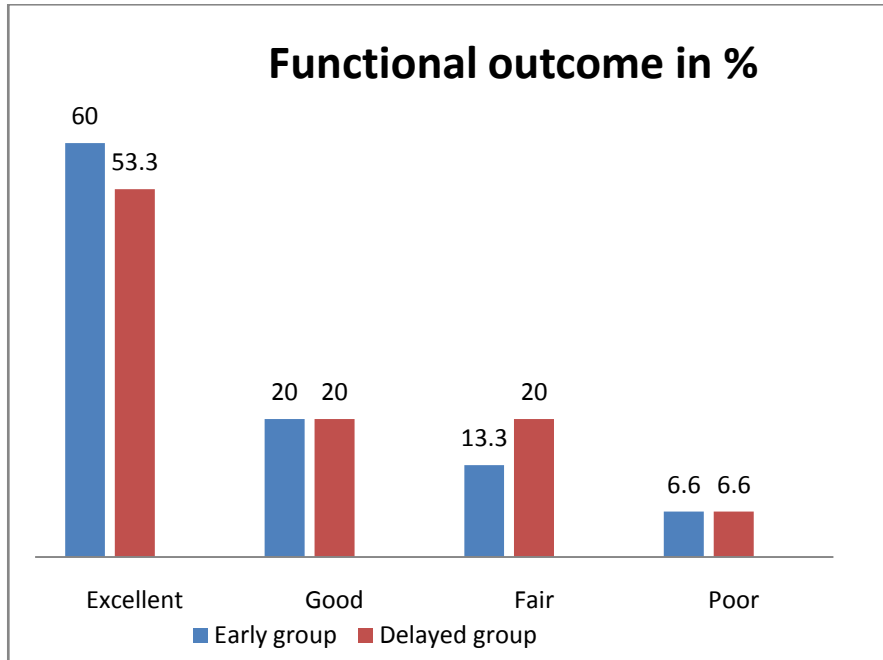
**Table 10:** Bar diagram showing range of motion pronation (in %).



**Table 11:** Bar diagram showing range of motion supination (in %).

**Table 1:** Showing functional outcome.

Rating	Early group		Delayed group		p-value
	No.=15	%	No.=15	%	
Excellent	9	60	8	53.3	0.152
Good	3	20	3	20	
Fair	2	13.3	3	20	
Poor	1	6.6	1	6.6	



**Table 12:** Bar diagram showing Functional outcome (in %)





**Fig 1 :** Pre-operative x-ray



**A**



**B**

**Fig 2 :** A- Tourniquet application and B- Betadine solution application

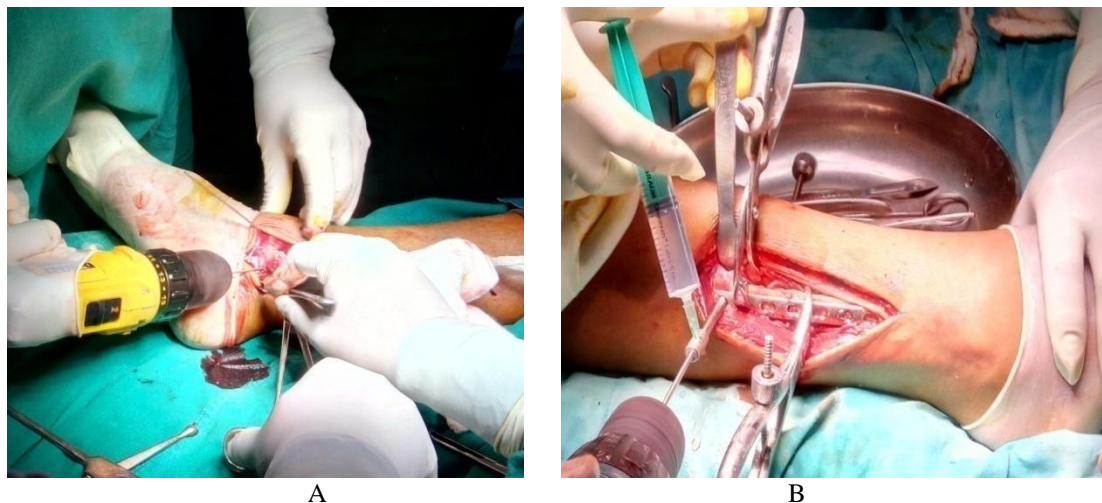


**A**



**B**

**Fig 3 :** Skin incision and B- fracture site exposed



**Fig 2:** A- fracture stabilization with K- wire and B- Fracture fixed with screw and plate



**Fig 3:** Early group : Post operative x- rays

**13 : Range of motion (A B C D )**





**C- Pronation**



**D- Supination**

### **V. Discussion**

The ankle fractures are increasing day by day. Ankle joint is one of the main weights bearing joint and fractures around the ankle joint are of paramount importance as they would result in significant morbidity and quality of life.

Timely treatment intervention is a crucial factor for appropriate wound healing and early rehabilitations. This study is an experimental study conducted on patients with closed ankle fracture above 18 years of age. A total of 30 patients were operated, 15 of them were operated within 1 week of injury by open reduction and internal fixation either by threaded screws or tension bend wiring with one third tubular plate and 15 were operated after 1 one week of injury by open reduction and internal fixation either by threaded screws or tension bend wiring with one third tubular plate.

In this study the average postoperative hospital stay was early 6.07 days and in delayed group the average postoperative hospital stay was 8.40 days. In our study there was shorter median post operative hospital stay in early group. The comparison was statistically significant ( $p < 0.05$ ). In our study there was shorter median post operative hospital stay in early group. The comparison was statistically significant ( $p < 0.05$ ). This shorter post operative hospital stay in early group was reported with other study by Breederveld RS et al<sup>33</sup> Singh RA et al<sup>34</sup> Pietzik P et al<sup>35</sup> Kamhieh Y et al<sup>36</sup> and James LA et al.<sup>37</sup>

In the early group the minor post operative wound infection was found in one case ( 6.6 %) and in delayed group the minor post operative wound infection was found in two cases (13%). In our study there was lesser post operative wound infection in early group. There was no deep infection in both the group. The comparison was statistically significant ( $p < 0.05$ ). We feel that operating upon first week after the injury has more advantages considering the lesser infection rate and lesser post operative hospital stay leading to minimization of hospital costs.

The mean operating time in early group was 37 minutes while in delayed group was 37 minutes. It took equal time to operate with both the groups and the difference in the duration of operating time was found to be statistically insignificant ( $p > 0.05$ ). We feel that the operating upon the two groups are technically the same with no superiority. This study was comparable to other study by Konrath et al.<sup>32</sup>

Radiologically, the mean time for union in early group was 11.80 weeks while in delayed group was 12.93 weeks but the difference between the two groups was statistically insignificant ( $p > 0.05$ ). so we feel that delayed open reduction and internal fixation is an alternative when soft tissue swelling, fracture blisters, or abrasions are present that offer an undesirable environment for surgical incisions.

Unrestricted weight bearing was allowed after the fracture had united radiologically. The mean time for unrestricted weight bearing in early group was 11.80 weeks and in delayed group it was 12.93 weeks. It took less time to allow the patient for unrestricted weight bearing after the operation in early group comparing to delayed group.

In early group there was excellent functional outcome in 9 cases (60%), good in 3 cases (20%), fair in 2 case (13.3%) and poor in 1 case (6.6%). In delayed group there was excellent functional outcome in 8 cases (53.3%), good in 3 cases (20%), fair in 3 case (20%) and poor in 1 case (6.6%). The functional outcome was better in early group comparing to patients in delayed group but the difference between the two groups was statistically insignificant ( $p > 0.05$ ).

We are of the opinion that both the operative timing used in our study provide excellent functional results in term of union rate as well as functional outcome. The limitation of our study was small sample size in both groups and absence of long term follow-up.

A randomized control trial, preferably triple blinded even double blinded, involving a large number of patients with long term follow-up is clearly indicated to bring out significant differences between early and delayed operative treatment of of ankle fractures.

## VI. Conclusion

In this comparative study, the differences between the results of early and late operative treatment of closed ankle fracture in adults were insignificant in terms of fracture union, range of motion, weight bearing, operative time and functional outcome.. Both groups had 100% union rate without any failure. There were statistically significant difference in terms of post operative hospital stay and wound infections which showed lesser complication in early group leading to lesser post operative hospital stay.

In this study the overall functional outcome was 80 % excellent to good results in early group and 73.3 % excellent to good results in delayed group. Thus we felt when immediate fixation is not possible, delayed fixation of displaced ankle fracture is a reasonable options.

### Research involving human participants:

All procedures were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

### Informed consent:

Informed consent was obtained from all individual participants included in the study.

### Declaration of patient consent:

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have given his/her consent for his/her images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

### Financial support and sponsorship:

Nil.

### Conflicts of Interest

There is no conflicts of interest.

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