

## Functional Outcome Of Ankle Fractures Treated With Internal Fixation.

Dr. Raju H Kulkarni<sup>1</sup>, Dr.V V Patil<sup>2</sup>,

<sup>1</sup>(Associate Professor, Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi, India)

<sup>2</sup>(Junior Resident, Department of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi, India)

### Abstract

**Background:** Ankle fractures are among the most common injuries treated by orthopaedic surgeon. This is because it is relatively mobile and bear much of the stresses associated with weight bearing. Anatomic restoration of the joint is the goal of management in ankle fractures. The purpose of this study is to analyse the cause and the patterns of ankle fractures as well as functional outcomes of surgically treated ankle fractures.

**Materials and Methods:** This is a prospective study done in Mahadevappa Rampure medical college Kalaburagi from 1<sup>st</sup> October 2019 to 31<sup>st</sup> October 2021. We studied 25 patients who underwent surgery for ankle fractures. Olerud and molandar ankle scoring system was used during follow-up.. Classification used are Lauge-Hansen classification and Danis-Weber classification. 4mm Cannulated cancellous screws, locked compression plates, Tension Band Wiring used for medial malleolus. Semi tubular plate, 4mm cannulated cancellous screw, TENS (Titanium Elastic Nailing System) and Tension Band Wiring used for lateral malleolus. 4mm cannulated cancellous screw used for posterior malleolus are common mode of fixation.

**Results:** 25 patients were identified and reviewed. There were 20 male patients (80%) and 5 female patients (20%) with age ranging from 19 years to 75 years old (mean, 35.12 years). Common causes of ankle fractures were trauma (especially motor vehicle accidents followed by twisting injury). Weber B (44.0%) was the most common pattern of fracture at presentation. Excellent and good outcomes were achieved in 84% of cases when measured using the Olerud and Molander scoring system for foot and ankle. In conclusion, operative treatment for ankle fractures restores sufficient stability and allowed mobility of the ankle joint.

**Key Word:** Ankle fractures, Lauge-Hansen, Danis-Weber, Olerud and Molander scoring, functional outcome.

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### I. Introduction

Fractures involving the ankle mortise are one of the most common injuries in lower extremity. It has an incidence rate of 107 fractures per 1,00,000 person years<sup>1</sup>. The ankle injuries gained importance because body weight is transmitted through it and the locomotion depends upon the stability of this joint. The ankle joint supports more weight per unit area than any other joint in the body<sup>2</sup>. The most congruous joint in the lower extremity is The Ankle joint which bears up to five times the body weight<sup>3</sup>.

Sir Robert Jones said-Ankle is the most injured joint of the body but the least well treated<sup>4</sup>. Sir Percival Pott (1714-1788), Tillauz (1872) (described fracture of anterolateral margin of tibia implicating the anterior syndesmotom ligaments), Baron Dupuytren, J.G. Maisonneuve have all greatly contributed to understanding of ankle injuries. In 1922 Ashurst and Bromer understood exact mechanism and classified ankle injuries<sup>5</sup>. In 1948-1954, Lauge-Hansen recognized four patterns based on pure injury sequences and taken into account at the time of Ankle injury, deforming force direction and position of the foot.

Though malleolar fractures are discussed extensively, the opinions in the treatment of these fractures varies widely because of differences in classification reduction techniques and subjective symptoms at follow up studies.

To avoid complications as in all intra articular fractures it is necessary to achieve anatomical reduction by open method and internal fixation of ankle fracture. The results of ankle fractures are better with emphasis on anatomical reduction of fracture, stable internal fixation, regaining full fibular length and early active pain free mobilization, since the advent of A.O principles of management.

### II. Materials and Methods

The study was conducted on 25 patients between age group of 18 to 80 years who were enrolled after detailed clinical and appropriate radiological evaluation in Department of Orthopedics, Mahadevappa Rampure Medical College, Kalaburagi and other Private Hospitals in Kalaburagi. It was conducted between October 2019

to October 2021. Patients were evaluated pre-op and post-op with serial radiography and Olerud and Molander's scoring system was used for functional assessment.

**Study Design :** A Prospective interventional study.

**Study Duration** – 18 months (1 October 2019 to 31 March 2021).

**Sample size** – 25.

**Study population** – Clinically and radiologically diagnosed cases of ankle fracture & clinically evaluating postoperatively at 6 weeks, 3 months, 6 months intervals using appropriate tools.

**Source** – The study was conducted on patients who underwent internal fixation for ankle fracture in the Department of Orthopedics, Basaveshwara Teaching and General Hospital, Kalaburagi. and other Private Hospitals in Kalaburagi

**Statistical analysis** – Statistical analysis will be done using software version IBM SPSS 20.00. Collected data were spread on excel sheet and master chart was prepared. Through the master chart, tables, graphs and diagrams were prepared. For quantitative data analysis, paired and unpaired t-tests were applied and for qualitative data analysis, chi-square test and Fisher exact test were applied for statistical significance. If P-value was less than 0.05, it is considered as significant.

**Inclusion criteria:**

1. Closed ankle fractures and Open ankle fractures of Grade I, Grade II and Grade IIIA
2. Ankle fracture associated with subluxation & dislocation of the ankle joint.
3. Age above 18 years, either sex.

**Exclusion Criteria:**

1. Patients below 18 yrs.
2. Ankle fractures associated with lower limb fractures.
3. Grade IIIB and IIIC Open ankle fractures.
4. Pregnant woman

**Method:**

A careful history was taken from the patient and patient attenders to know the mechanism and severity of injury. The patients were then assessed for general condition and to rule out vital injuries. An informed written consent was taken from patient.

On examination of patient ankle, observe for swelling of the ankle joint, deformity around joint, soft tissue injuries and distal neurovascular status. Lower ends of tibia and fibula were palpated and look for bony tenderness, displacement if any fracture, bony crepitus and stability of joint. Dorsalis pedis artery and posterior tibial artery pulsations were checked and noted. Syndesmotic instability was conformed with the squeeze test and stress test. Radiological evaluation with plain radiographs in antero-posterior, lateral and mortise views. The fractures were classified according to Lauge–Hansen classification<sup>6</sup> and anatomical types<sup>7</sup>.

**Operative Technique:**

The surgical management (Internal fixation) and the aim of our treatment was to obtain good functional outcome by assessing the accuracy of reduction<sup>8,9</sup>

They are

1. To restore full length of fibula
2. Anatomical positioning of talus beneath the tibial plafond
3. Restoration of medial joint space to its normal width
4. Correction of tibiofibular diastasis.

Under spinal anaesthesia the patient was placed in supine position. Lateral malleolus fractures were reduced and fixed with either a TENS or a lag screw or K wire. Rigid Fixation was achieved with one third semi-tubular plate and screws. Medial malleolus fractures were fixed with K- wire or 4 mm cancellous screw or malleolar screw or locked compression plate. Posterior malleolus fractures were fixed with screw or plate and screws. The syndesmotic screw was used based on the type of fracture and location of the fibular injury.

**Choice And Planning Of fixation:** A satisfactory fixation technique must have a low risk of failure, must resist the forces that are likely to cause re-displacement of the fracture and must not increase comminution or cause displacement during its application.

**Lateral Malleolus**

Weber Type A: The fracture is reduced, held with a reduction forceps and stabilized either by tension band wiring or a cannulated cancellous screw.

Weber type B: After reduction, the fracture is fixed with one or two lag screws placed perpendicular to the line of fracture. More commonly a plate is used to neutralize the rotational and axial forces on the fibula. One-third tubular plate conforms to the curvature of the fibula and has a lower profile than the thicker DCP. The fibular plate can also be placed posteriorly as an antiglide plate to resist posterior migration and rotation of the distal fragment.

Weber type C: Transverse fibular fractures are reduced and fixed with a one-third tubular plate, Reconstruction plate or narrow 3.5 mm DCP to resist migration and rotation of the distal fragment. Anatomic reduction of the fibula will usually restore the mortise and additional fixation of the syndesmosis may not be needed, especially if the fibular fracture is within 3 to 4 cm of the joint. Fractures of the proximal fibula need not be internally fixed.

**Medial Malleolus:** Avulsion fractures of the medial malleolus are reduced and fixed with either a tension band technique or cancellous screws. A fracture above the deltoid attachment is reduced and provisionally stabilized with K wires placed perpendicular to the fracture. Each wire is then removed and replaced with a 4mm partially threaded cancellous screw. Two points of fixation are needed to control rotation of the medial malleolar fragment and either two screws or a combination of a screw and a K-wire are used.

**Posterior Malleolus:** Open reduction and internal fixation has been recommended when more than 25% of the posterior articular surface is involved or the fracture is displaced more than 2mm. The decision to fix the posterior fragment is based on the amount of residual displacement after reduction of the fibula. A partially threaded 4 mm cannulated cancellous screw with or without washer is used by with anterior or posterior approach

**Post – operative protocol:** Intravenous antibiotic was given in the post-op period. Sutures were removed after 10 – 12 days. Below knee POP cast were applied for four weeks. Non-weight bearing walking was advised from second postoperative day. Partial weight bearing walking was started after four weeks. Ankle weight bearing was delayed in cases with syndesmotomic screw fixation. Follow up was done for a period of 6 months at regular 6 weeks interval. Olerud and Molandar`s scoring system<sup>10</sup> was used for the present study. In this scoring system patients were questioned and assessed with pain, analgesics use, stiffness of joint, swelling around joint, daily living activities, walking aids usage, and return to normal routine work and activities. Olerud and Molandar`s scoring system

	parameter	DEGREE	SCORE
1	pain	None	25
		While walking on uneven surface	20
		While walking on even surface outdoors	10
		While walking indoors	5
		Constant and severe	0
2	stiffness	None	10
		Stiffness	0
3	swelling	None	10
		Only in 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	No problem	5
		Impossible	0
8	supports	None	10
		Taping, wrapping	5
		Stick or crutch walking	0
9	Work, Activities of daily life	Same as before injury	20
		Loss of tempo	15
		Change to simpler job	15
		Severely impaired work capacity	0

poor <60    2. Fair 60-80    3. Good 81-90    4. Excellent >90

### III. Observation and Results

In our study, twenty five cases of ankle fractures were treated by surgical management (internal fixation) at Mahadevappa Rampure Medical College Kalaburagi, and other private hospitals in Kalaburagi, Karnataka from October 2019 to October 2021 were analyzed. In our study, most of the patient's i.e. 9 (36%) were within the age group of 21-30 years, followed by 8 (32%) cases within the age group 31-40 years. Young patient was 19 years and eldest patient was 75 years. The mean age was 35.12 years [Table 1].

20 cases (80%) were males and 5 (20%) were females [Table 2]. Right side ankle was affected in 16 (64%) cases and left ankle in 9 (36%) [Table 3]. 16 cases (64%) affected were because of road traffic accident, 9 cases (36%) were because of twisting injury. The most common mode of injury was Road traffic accident [Table 4].

In our study, majority of the cases i.e. 10 (40%) had Supination-external rotation injury, followed by 7 (28%) cases had Pronation-abduction injury, 5 (20%) cases had Pronation-External Rotation injury and 3 (12%) cases had Supination-adduction injuries [Table 6].

Out of 25 sample cases 19 (76.0%) of cases were comes under Danis Weber classification. Among them 3 (12.0%) of cases were **type A** pattern according to Danis Weber classification, 11 (44.0%) of cases were **type B** pattern and 5 (20.0%) of cases were in **type C** pattern [Table 7]

In the present series, bimalleolar fracture was seen in 12 (48%) patients, followed by 6 (24%) patients had isolated medial malleolar fracture, 4 (16%) patients had trimalleolar fracture and 3 (12%) had isolated lateral malleolar fracture [Table 5].

Most of the medial malleolar fractures were stabilized with cannulated cancellous screw i.e. 15 cases (68.18%). Tension band wiring (TBW), and plate were used in the rest of the cases. Majority of the lateral malleolar fractures i.e. 9 cases (47.36%) were fixed with plate and screws. Cancellous screw was used in 2 cases, TENS in 7 cases and TBW in 1 case. 4 patients (16%) had posterior malleolar fracture all were treated with cancellous screw [Table 10].

In our series all fractures showed union between 10 – 14 weeks with average of 12 weeks. 3 (12%) patients had complications. All 3 patients had superficial skin infection. All superficial infection resolved with local dressing and systemic antibiotics. [Table 9].

Excellent results were found in 10 cases (40%), good in 11 cases (44%), fair results in four cases (16%) according to Olerud and Molander's scoring system [Table 8].

**Table No.1: Age wise distribution of ankle fracture cases**

Age in years	Number of cases	Percentage
≤ 20	2	8.0
21-30	9	36.0
31-40	8	32.0
41-50	3	12.0
>50	3	12.0
<b>Total</b>	25	100.0
<b>Mean ± SD</b>	35.12± 13.25	-----

**Table No.2: Gender wise distribution of ankle fracture cases**

Gender	Number of cases	Percentage
Males	20	80.0
Females	5	20.0
<b>Total</b>	25	100.0

**Table No.3: Side of injury wise distribution of ankle fracture cases**

Side of injury	Number of cases	Percentage
Right	16	64.0
Left	9	36.0
<b>Total</b>	25	100.0

**Table 4: Mode of injury wise distribution of ankle fracture cases**

Mode of injury	Number of cases	Percentage
Road Traffic accidents (RTA)	16	64.0
Twisting injury	9	36.0
<b>Total</b>	25	100.0

**Table No.5: Malleolar type wise distribution of ankle fracture cases**

Malleolar types	Number of cases	Percentage
Bi malleolar	12	48.0
Tri malleolar	4	16.0
Lateral malleolus	3	12.0

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Medial malleolus	6	24.0
<b>Total</b>	25	100.0

**Table No.6: Lauge Hansen’s classification wise distribution of ankle fracture cases**

Lauge Hansen’s classification	Number of cases	Percentage
Pronation external rotation	5	20.0
Supination adduction	3	12.0
Pronation abduction	7	28.0
Supination external rotation	10	40.0
<b>Total</b>	25	100.0

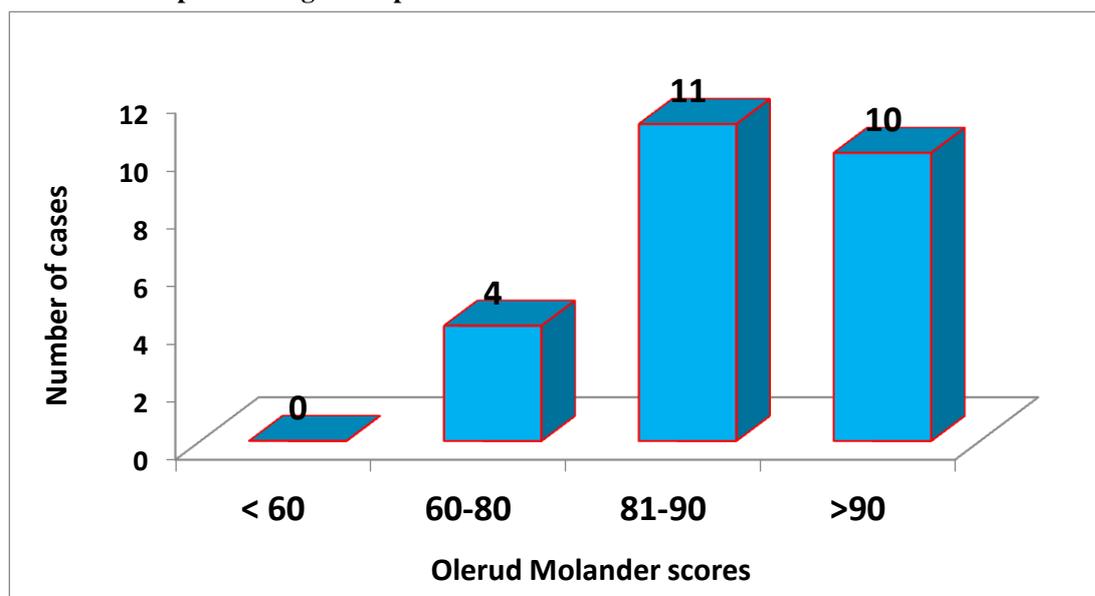
**Table No.7: Danis Weber classification wise distribution of ankle fracture cases**

Danis Weber classification	Number of cases	Percentage
Type A	3	12.0
Type B	11	44.0
Type C	5	20.0
<b>Total</b>	19	76.0

**Table No.8: Olerud Molander score wise distribution of cases**

Olerud Molander score	Number of cases	Percentage
< 60	0	0.0
60-80	4	16.0
81-90	11	44.0
>90	10	40.0
<b>Total</b>	25	100.0

Simple bar diagram represents OlerudMolander score wise distribution of cases



**Table No.9: Complications wise distribution of ankle fracture cases**

Complications	Number of cases	Percentage
No complications	22	88.0
Surgical wound infection	3	12.0
<b>Total</b>	25	100.0

**Table No.10: Mode of fixation wise distribution of ankle fracture cases**

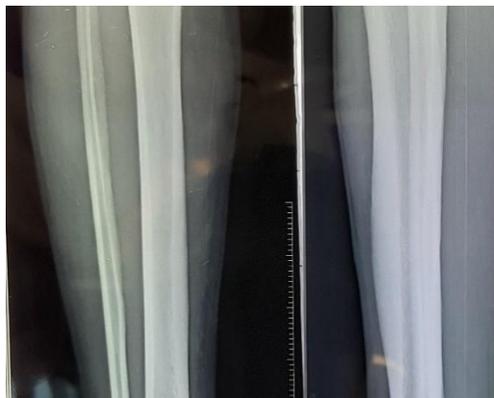
Mode of fixation		Number of cases	Percentage
Lateral malleolus	Cannulated cancellous screw (cc screw)	2	8.0
	Plating	9	36.0
	Tension band wiring (TBW)	1	4.0
	TENS	7	28.0
Medial malleolus	Cannulated cancellous screw (cc screw)	15	60.0

	<b>Plating</b>	4	16.0
	<b>Tension band wiring (TBW)</b>	3	12.0
<b>Posterior malleolus</b>	<b>Cannulated cancellous screw (cc screw)</b>	4	16.0
	<b>Plating</b>	0	0.0

**FIGURES**

**CASE 1**

Name: siddanna. Age 36yrs. Mode of injury: road traffic accident. Type: supination external rotation Olerudmolandar`s score: 90



Preoperative xray in AP and Lateral view



Postoperative xray in AP and Lateral view

**Case 2**

Name: Naseer age:22yrs. Mode of injury: Road traffic accident.  
Type: pronation external rotation. Olerud and molandar`s score:95



Preoperative xray in AP and Lateral view



Postoperative xray in AP and Lateral view

Name: Siddarooda. Age:26yrs. Mode of injury: twisting injury  
Type:supination external rotation. Olerud and molandar`s score:95



Preoperative xray in AP and Lateral view



Postoperative xray in AP and Lateral view

**Case no 4**

Name: Basavaraj. Age:35yrs. Mode of injury: Road traffic accident.

Type: Supination and External rotation. Olerud and Molandar's score: 95



Preoperative xray in AP and Lateral view



Postoperative xray in AP and Lateral view

**IV. Discussion**

Ankle fracture is certainly a challenge to all orthopaedic surgeons, but literature doesn't provide any consensus or appropriate treatment for ankle fractures especially associated with ligament tears

**Age Distribution:** In our study, 11(44%) cases were from 18-30 yrs of age group, 8(32%) in 31-40 yrs of age group, 3(12%) in 41-50 yrs of age group and 3(12%) in 51 and above age group. Regarding age incidence most of the patients were aged between 18 to 30 years, so the young and active individuals are more prone for ankle

injuries. The mean age of the cases in our study is 35.12yrs, Similar results were observed in Beris et al<sup>11</sup>, Lee et al.<sup>12</sup>, Roberts SR<sup>13</sup>.

**Table 2: Mean age distribution in various studies**

STUDY	NUMBER OF PATIENTS	MEAN AGE
Beriset <i>al</i> <sup>11</sup>	144	30
Roberts SR <sup>13</sup>	25	40
Mohapatra A, Raj K <sup>14</sup>	84	43.8
Present study	25	35.12

**Sex Distribution**

In our study Males were more commonly involved. Males 20(80%) cases and Females 5(20%) cases. In a study by ROBERT SR<sup>13</sup> on 25 patients of ankle fractures the male: female ratio was 11:14 and male percentage was found to be 44%. Beris et al<sup>11</sup> in his study on 144 patients of ankle fractures the male: female ratio was 56:88 and male percentage was 38.8%

**Table 1: Sex distribution in various studies**

Study	Number of patients	Male : Female	% Males
Motwani GN <sup>15</sup>	40	5:1	82.5
Maruthi CV <sup>16</sup>	40	7:3	70
Beriset <i>al</i> <sup>11</sup>	144	8:11	38.8
Robert SR <sup>13</sup>	25	11:14	44
Present study	25	4:1	60

**Mode of Injury**

Most common mode of injury is Road Traffic Accidents-16 patients (64%) which were in accordance with study by Mohapatra A, Raj K<sup>14</sup> and Lee et al.<sup>12</sup>

**Table 3: Mode of Injury in various studies**

Study	Number of patients	Common mode of injury
Lee <i>et al</i> <sup>12</sup>	168	Road traffic accidents
Mohapatra A, Raj k <sup>14</sup>	84	Road traffic accidents
Present study	25	Road traffic accidents

**Mechanism of Injury**

In our study, we noticed that supination-external rotation injury (40%) are more common followed by pronation Abduction injury (28%), and are compared with studies by Roberts et al<sup>13</sup>, Beris et al<sup>11</sup>

**Table 4 : mechanism of injury in various study**

Study	Number of patients	Most common type	Percentage
Roberts RS <sup>13</sup>	25	SER	34
Beriset <i>al</i> <sup>11</sup>	144	SER	45
Parvataneni Prathap <sup>17</sup>	30	SER	46.6
Present study	25	SER	40

**FUNCTIONAL OUTCOME:**

Functional outcome was assessed by Olerud and Molandar`s scoring system at the end of 6months, Out of 25 patients we studied 10 (40%) patients had excellent, 11 (44%) patients had good, 4 (16%) patients had fair and 0 (0%) patient had poor results, similar results was observed in other study like Shah ZA, Arif U [18], De souza et al<sup>19</sup>, Beris et al.<sup>11</sup>, Motwani GN<sup>15</sup>

**TABLE 5: FUNCTIONAL OUTCOME IN VARIOUS STUDIES**

Study	Number of Patients	Good to Excellent	Fair	Poor
Beriset <i>al</i> <sup>11</sup>	142	105(74.3%)	21(14.6%)	16(11.1%)
Shah ZA, Arif U <sup>18</sup>	40	33(82.5%)	5(12.5%)	2(5%)
Motwani GN <sup>15</sup>	40	33(82.5%)	5(12.5%)	2(5%)
De souzaet <i>al</i> <sup>19</sup>	150	135(90%)	9(6%)	6(4%)
Present study	25	21(84%)	4(16%)	0

**COMPLICATIONS:**

In the present study; 3 (12.0%) of ankle fracture cases had the complication of Surgical wound infection and In 22 (88.0%) of ankle fracture cases don't observed any complications. All superficial infection resolved with local dressing and systemic antibiotics.

**COMPARISON OF STUDY OUTCOME WITH THE PARAMETERS**

In our study, Gender, Age of the patients, Mechanism of Injury (According to Lauge-Hansen classification) and Types of Fracture (According to Danis-Weber classification) was not found to be statistically significant associated with the functional outcome.

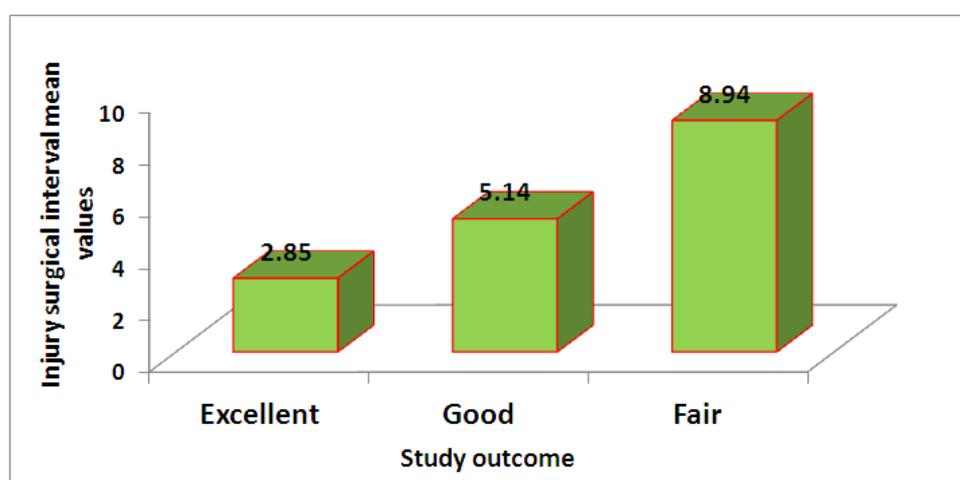
In our study it is concluded that early operative intervention can improves the functional outcome of ankle fractures

**Table No.15: Comparison of Study outcome with Injury surgery interval**

Injury Surgery Interval	Injury Surgery Interval	ANOVA-test value and P-value
	Mean ± SD	
Excellent	2.85 ± 2.31	F = 7.15 P = 0.005 HS
Good	5.14 ± 3.75	
Fair	8.94 ± 2.54	

**HS-HIGHLY SIGNIFICANT**

There was statistically highly significant difference of mean injury surgical interval with study outcome (P<0.01)



**V. Conclusions**

In this study it was observed that ankle fracture treated with Internal fixation gain Excellent to Good Ankle function after 6 months by using olerud and molandar`s scoring system. Ankle fractures occur most commonly due to road traffic accident in adults. Right sided ankle is most commonly involved. Immediate open Reduction and Internal Fixation in ankle fractures yield good results in terms of anatomical reduction, stability and Post Op functional return. Supination External Rotation injury is the commonest mechanism of injury in our study. Patient operated early, only if soft tissue was good, in order to have good functional outcome in closed ankle fractures. Delay in surgery tended to give a poorer result.

Weight bearing should be delayed upto 2 months as it may lead to implant failure. Post-operative immobilization in a plaster slab or cast for 6 weeks will not affect final outcome of ankle movements and would gain full range motion by end of 12 weeks.

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