

## Comparison of early versus delayed fixation after debridement of Open Type III-A Fracture of distal Femur: A Randomized Controlled Trial

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### ABSTRACT

**Objective:** To compare the rate of infection, knee range of motion and union in early versus delayed fixation of Gustilo and Anderson open type III A fracture of distal femur after initial debridement.

**Study Design:** A randomized controlled trial.

**Place and Duration:** Department of Orthopedic Surgery, Lahore General Hospital, Lahore from 1<sup>st</sup> September 2018 to 30<sup>th</sup> August 2019.

**Methodology:** A total of 70 patients of both genders aged 20 to 60 years with Gustilo Anderson open type III-A fracture were enrolled. After randomization, for patients in Group-A (n=35), fracture fixation was done within 72 hours of trauma (early fixation) while in Group-B (n=35), delayed fixation was done (fracture fixation after 72 hours of trauma). All patients underwent open reduction and internal fixation with dynamic condylar screw. Patients were periodically followed up to see the infection, knee range of motion and union.

**Results:** In a total of 70 patients, mean age was 35.81±11.31 years (ranging 18 to 58 years). In Group-A, duration of hospital stay was significantly less in comparison to patient in Group-B (7.60+2.26 vs. 15.85+6.33, p<0.0001). Overall infection rate was higher in Group-B as compared to Group-A till 8<sup>th</sup> week (p<0.05). Union was statistically different in both treatment groups from 8th week till 24th week follow up (p<0.05). It was observed that mean flexion was high in Group-A patients as compared to that of Group-B patients.

**Conclusions:** Early open reduction and internal fixation of open type IIIA fracture of distal femur is better than delayed open reduction and internal fixation after initial debridement in terms of infection, knee range of motion and union.

**Keywords:** Debridement, Femur, Fracture fixation, Knee, Infection, Range of motion.

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### INTRODUCTION

Fractures of the femur occur by applying great bending or twisting forces. Sufferers of these fractures are most often motor bike riders due to high velocity road traffic accidents or due to fall of the people working at the construction sites due to poor occupational skills and equipment. Different pathological conditions like osteoporosis, infections, or tumor can weaken the femur which could happen in fracture of this bone even due to a trivial trauma<sup>1</sup>. In older patients, the fractures of distal femur are often unstable and comminuted. Due to instability and osteoporosis, open reduction becomes difficult. Moreover traction for long time can cause risk for skin, urinary and respiratory systems<sup>2</sup>.

There are 6% distal femur fractures of total percentage of femur fractures. Fractures of distal femur in men are due to high velocity trauma at age of 15 to 50 years whereas in females these fractures are over age of 50 years in osteoporotic bones which are low energy trauma<sup>3</sup>. Open fractures, short distal femur segments, weak bones due to osteoporosis, geometry of fractures and factors affecting patients are the deciding elements to decide the management of patients<sup>4</sup>. Distal femur

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segment is the reason that intramedullary interlocking nailing cannot be done due to short space for interlocking.

The types of open fractures and presentation of patient are the deciding factors on which treatment plan is finalized. And accordingly, every fracture should be treated with external fixator or plate osteosynthesis and delayed closure or fixation and primary closure after immediate debridement and irrigation. However, in initial management, the condition of soft tissue around the fracture site should also be kept under observation. Studies suggest that damage control surgery with external fixator is necessary for early stabilization of skeleton. Surgeons can get help from these principles to provide better care to their patients<sup>5</sup>.

According to the latest studies, irrigation and debridement are of great importance and surgeons are opting earlier open reduction and internal fixation only if the wound has certain properties like, debridement done during first 12 hours, appropriate skin closure, intact vascular status and during closure approximation of skin should be without tension<sup>6</sup>. The early closure can also prevent the pseudomonas infections which are the most infective organism in open fractures<sup>7</sup>. The infection rate reduction and reduced bony union time may also be achieved with early closure of open fractures<sup>8</sup>. There is a scarcity of local data regarding outcomes of early versus delayed fixation of Gustilo and Anderson open type-III A fractures of distal femur after initial debridement. It was hypothesized that early open reduction and internal fixation of open type IIIA fracture of distal femur is better than delayed open reduction and internal fixation after initial debridement in terms of infection, knee range of motion, and union. This study was done with an objective to compare the rate of infection, knee range of motion and union in early versus delayed fixation of Gustilo and Anderson open type III A fracture of distal femur after initial debridement.

#### METHODOLOGY

This randomized controlled trial was carried out in the Department of Orthopedic Surgery, Lahore General Hospital, Lahore from 1<sup>st</sup> September 2018 to 30<sup>th</sup> August 2019. Approval from institutional ethical committee was acquired. Informed written consent was sought from all study participants.

A total of 70 patients of both genders aged 20 to 60 years with Gustilo Anderson open type III-A fracture were enrolled<sup>9</sup>. Patients having multiple fractures of pathological fractures were excluded. Randomization was done using computer generated numbers in both groups. There were thirty-five patients in each group. For patients in Group-A, fracture fixation was done within 72 hours of trauma (early fixation) while in Group-B, delayed fixation was done (fracture fixation after 72 hours of trauma).

A total of 70 patients (35 in each group) as per inclusion and exclusion criteria were enrolled from emergency or outpatient department. All patients underwent open reduction and internal fixation (ORIF) with dynamic condylar screw (DCS). Patients were followed up on 1<sup>st</sup>, 3<sup>rd</sup> and 7<sup>th</sup> days post-surgery. Then patients were periodically followed up on 2<sup>nd</sup>, 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup>, 16<sup>th</sup>, 20<sup>th</sup>, 24<sup>th</sup> and 36<sup>th</sup> post operative week to see the infection, knee range of motion, and union. Union was labeled as painless full weight

bearing on the affected limb with the evidence of bridging callus across the fracture sites and the mist of the fracture lines on both AP and lateral views on x-ray. Range of motion was defined as calculation of the degree of movement at knee joint, Normal full extension 0 degree and flexion of 135 degree and over is considered as normal according to Ronald Mcrae<sup>10</sup>. Occurrence of infection was monitored as per South Hampton surgical infection scoring<sup>11</sup>.

**Data Analysis:** All study data was recorded on a predesigned proforma specifically designed for this study. Data was analyzed using SPSS version 26.0. Quantitative variables like age, knee range of motion and hospital stay was calculated as mean and standard deviation (SD) while qualitative variables like gender, union and infection were represented as frequency and percentages. Both groups were compared by using t-test for quantitative variables and chi-square to compare qualitative variables. P-value $\leq$ 0.05 was considered as significant.

#### RESULTS

In a total of 70 patients, mean age was 35.81 $\pm$ 11.31 years (ranging 18 to 58 years). There were a total of 40 (57.1%) male and 15 (42.9%) female. In Group-B, 23 (65.7%) patients had RTA and 12 patients mode of injury was fall. In Group-A, duration of hospital stay was significantly less in comparison to patient in Group-B (7.60 $\pm$ 2.26 vs. 15.85 $\pm$ 6.33, p<0.0001). Table-I is showing comparison of characteristics among patients of both study groups.

**Table-I: Comparison of gender, age, mode of injury and duration of hospital stay in both study groups (N=70)**

Characteristics		Group-A (n=35)	Group-B (n=35)	P-value
Gender	Male	20 (57.1%)	20 (57.1%)	1
	Female	15 (42.9%)	15 (42.9%)	
Age in Years (Mean $\pm$ SD)		37.80 $\pm$ 11.13	33.82 $\pm$ 11.28	0.1419
Mode of Injury	Road Traffic Accident	24 (68.6%)	23 (65.7%)	0.7991
	Fall	11 (31.4%)	12 (34.3%)	
Duration of Hospital Stay (Mean $\pm$ SD)		7.60 $\pm$ 2.26	15.85 $\pm$ 6.33	<0.0001

At 3rd day, infection rate was high in Group-A patients while from 7th day onward till 4th week in Group-B patients' infection rate was high as compared to Group-A patients. In Group-A the infection was reported in 6 (17.1%) patients and 14 (40.0%) patients in Group-B from 3rd day to 2nd week while the infection rates decreased to 0% in Group-A and 20% in Group-B till 8th week. After 8th week there was no infection in either group. Overall infection rate was higher in Group-B as compared to Group-A till 8th week (p<0.05). Table-II is showing comparison of infection rates between patients of both study groups during follow ups.

**Table-II: Comparison of infection rates between patients of both study groups during follow ups (N=70)**

		South Hampton Surgical Infection Scoring <sup>11</sup>						p-value
		G-0	G-I	G-II	G-III	G-IV	G-V	
1 <sup>st</sup> Day	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	
3 <sup>rd</sup> Day	Group-A	29	0	6	0	0	0	0.010
	Group-B	35	0	0	0	0	0	
7 <sup>th</sup> Day	Group-A	29	0	6	0	0	0	0.015
	Group-B	21	7	7	0	0	0	
2 Weeks	Group-A	29	0	6	0	0	0	0.015
	Group-B	21	7	7	0	0	0	
4 Weeks	Group-A	35	0	0	0	0	0	0.005
	Group-B	28	0	0	7	0	0	
8 Weeks	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	
12 Weeks	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	
16 Weeks	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	
24 Weeks	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	
36 Weeks	Group-A	35	0	0	0	0	0	-
	Group-B	35	0	0	0	0	0	

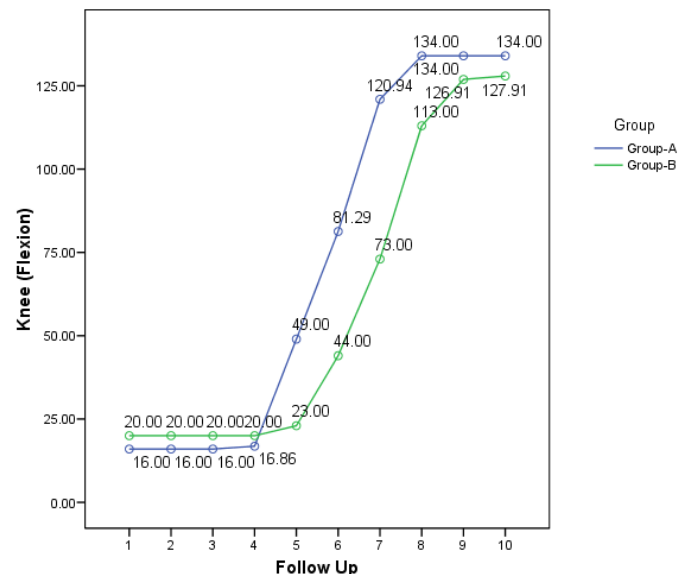
**Table-III: Comparison of Union during follow ups among patients of both Study Groups (N=70)**

		Hammer et al Criteria of Union <sup>12</sup>			p-value
		Not Achieved	Uncertain	Achieved	
1 <sup>st</sup> Day	Group-A	35	0	0	-
	Group-B	35	0	0	
3 <sup>rd</sup> Day	Group-A	35	0	0	-
	Group-B	35	0	0	
7 <sup>th</sup> Day	Group-A	35	0	0	-
	Group-B	35	0	0	
2 Weeks	Group-A	35	0	0	-
	Group-B	35	0	0	
4 Weeks	Group-A	35	0	0	-
	Group-B	35	0	0	
8 Weeks	Group-A	14	21	0	0.002
	Group-B	27	8	0	
12 Weeks	Group-A	2	20	13	0.000
	Group-B	13	20	2	
16 Weeks	Group-A	1	0	34	0.000
	Group-B	14	0	21	
24 Weeks	Group-A	0	0	35	0.020
	Group-B	5	0	30	
36 Weeks	Group-A	0	0	35	-
	Group-B	0	0	35	

Till 4th week, none of patients had nonunion in both treatment groups. At 8th week, 21 (60.0%) patients from Group-A and 8 (22.9%) patients from Group-B showed uncertain union. At 12th

week, 13 (37.1%) patients from Group-A and 2 (5.7%) patients from Group-B had union. At 16th week, 34 (97.1%) patients in Group-A and 21 (60.0%) patients in Group-B had union. At 24th week, 35 (100%) patients in Group-A and 30 (85.7%) patients in Group-B had union. At last follow up i.e. at 36th week all patients had union in both treatment groups. Union was statistically different in both treatment groups from 8th week till 24th week follow up. It was observed that significantly more patients in Group-A had achieved early union as compared to that of patients in Group-B as shown in Table-III.

Figure-1 is showing knee range of motion (Flexion) in both treatment groups from 1<sup>st</sup> day post operative till 36<sup>th</sup> week post operative respectively (10 follow ups). It was observed that mean flexion was high in Group-A patients as compared to that of Group-B patients.



**Figure-1: Comparison of Range of Motion between Patients of Both Study Groups (N=70)**

**DISCUSSION**

In this study, mean age of the patients with Gustilo and Anderson open type III A fracture of distal femur was noted to be 35.81±11.31 years. A recent study from India<sup>13</sup> evaluating 25 patients with open fractures of “Gustilo and Anderson” grade IIIa and IIIb found mean age to be 31.0±6.6 years which is close to what we noted. Another study from Nigeria<sup>14</sup> evaluating 59 cases of open tibial femoral fractures revealed that average age of the patients was 32 years.

Road traffic accidents were the commonest mode of injury responsible in 67.1% cases. Population based studies have pointed out towards road traffic accidents as the most common mode of injuries among patients with open distal femur fractures and our results were very aligned with the published literature<sup>15,16</sup>.

We noted that 57.1% of the patients were male in the present study. Male predominance among patients with Gustilo and Anderson open fractures of distal femur has been found by

many other authors from around the world<sup>13-15</sup>. As most cases of open type III A fracture of distal femur are caused by road-traffic accidents and males are predominantly involved in outdoor activities, this could be the main reason why male predominance is seen.

In this study, we noted that duration of hospital stay was significantly short among patients who had early open reduction and internal fixation of open type IIIA fracture of distal femur ( $7.60 \pm 2.26$  days versus  $15.85 \pm 6.33$  days,  $p < 0.0001$ ). A study from Tanzania by Nobert N et al<sup>17</sup> comparing early versus delayed surgical debridement of open long bone fractures revealed that duration of hospital stay was significantly low among patients who had early surgical debridement versus delayed as 6 (5-10) days versus 7 (6 to 11.5) days ( $p = 0.06$ ).

According to the results of our study infection rate was between 17-20% and patients who were treated after 72 hours among them infection rate was statistically high as that of those patients who were treated within 72 hours. Kreder et al<sup>18</sup> has treated 56 patients of open fractures, their results demonstrated a clear decline in infection rate from 25% to 12% provided the debridement was performed within 6 hours of injury. Similarly, in another research work by Kindsfater and colleagues,<sup>19</sup> observed that lower risk of infection was linked to early operation within 5 hours of injury. However this relationship of low infection rate and early operation within '6 hour' has come under interrogation as many recent researchers have found no association between timing of surgical debridement and rate of infection<sup>20</sup>. Harley et al<sup>21</sup> demonstrated no rise in infection and nonunion rates when debridement was performed within 13 hours of injury. The British Guidelines<sup>22</sup> have shown that debridement should be performed within 24-hour duration of injury. However, in case of highly contaminated wound or impending compartment syndrome, and open type-IIIC fractures very less literature favors internal fixation<sup>23</sup>.

In the present study, results regarding union were assessed based on Hammer et al criteria.<sup>12</sup> According to results significant difference was present in union of fracture in relation to early and delayed fixation of fractures. In early group, 97.1% patients had union at 16th week and in delayed group only 60% patients had union. By comparing our study with the literature<sup>24,25</sup>, researchers have shown satisfactory union rate in relation to early fixation of fracture in comparison to delayed fixation.

Internal fixation can be safely undertaken within 24h of injury in open Type III fractures. Metallic internal fixation, if judiciously performed gives parallel or superior results than external fixator device or delayed internal fixation after removal of external fixator system. This hypothesis is substantial with our results as infection [4th week: Group-A=Infection: Grade-0=35, Group-B=Infection: Grade-0=28,  $p$ -value<0.05], union [24th week: Group-A: Union=35, Group-B=Union=21,  $p$ -value<0.05] and knee range of motion respectively. i.e. [36th week: Group-A=134, Group-B=127.91,  $P$ -value<0.05].

### CONCLUSION

Early open reduction and internal fixation of open type IIIA fracture of distal femur (within 72 hours) is better than delayed

open reduction and internal fixation in terms of infection, knee range of motion, and union.

### AUTHOR'S CONTRIBUTION

**Hussain R:** Conceived Idea, Designed Research Methodology

**Basit MA:** Literature Search, Manuscript Writing

**Ijaz A:** Data Collection, Data Interpretation

**Shakeel M:** Statistical Analysis

**Jalal SF:** Literature Review

**Hanif MM:** Manuscript final reading and approval

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