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Original Article

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Outcomes of diaphyseal femoral fractures treatment in relation to fracture union and full weight bearing among adults

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ABSTRACT

BACKGROUND & OBJECTIVE: The femoral shaft fractures constitute 50% of all femoral fractures. The objective is to observe the outcome of diaphyseal femur fracture treatment of femur shaft with the union and full weight bearing by bridge plate osteosynthesis among adults.

METHODOLOGY: A Prospective observational study was conducted in the department of Orthopaedic Surgery, Postgraduate Medical Institute/Lahore General Hospital. A sample of 30 patients was calculated using WHO calculator. Convenient sampling was used for patient selection. After reducing the fracture (indirectly), the other end of the plate was also fixed with screws. Data was collected at 6th months post-operatively to see radiological union and weight-bearing status. Data analysis was done using SPSS version 25. Fisher exact test was applied. p-value≤0.05 was considered significant.

RESULTS: Mean age of the patients was 34.66±9.22 years. Gender distribution of patients shows that 17% of the patients were females, and 83% of the patients were male. At the 6th month follow-up, all 30 (100%) patients had achieved bony union. At the 5th month, 14(46.7%) of the operated cases were allowed to bear 36-45 Kg weight (p=0.024), and in the 6th month, there were 20(66.7%) operated cases were allowed to bear full weight after the radiological union (p=0.013).

CONCLUSION: Bridge plating technique is a safe, easy, and effective method of fixation for comminuted diaphyseal fractures of long bones in terms of bony union and weight bearing. It has a high rate of union with fewer complications.

KEYWORDS: Biological Bridge Plate Osteosynthesis, Fracture Healing, Complete Weight Bearing.

INTRODUCTION

The longest and strongest bone in the body is femur which has many important functions like walking and standing. The femur is also exposed to many forces like weight bearing and torsional forces. The muscles surrounding the femur account for most of the forces during muscle contraction [1]. The femoral shaft fractures are the most common, with the incidence of 1520 fractures per 100,000 persons in a year. The femoral shaft fractures constitute 50% of all femoral fractures. Mostly the shaft of femur fractures result due to high velocity injuries and is associated with lot of surrounding muscles injuries and associated with other organ injuries which causes more mortality and morbidity rates [2].

Therefore, the basis of surgery in such fractures comprises early mobility with anatomic reduction. The surgery is demanding with tissue damage and compensation of vascularity of bone fragments [3].

There are several methods to treat comminuted fractures

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of femoral diaphysis, which can be an intramedullary nail, plate osteosynthesis, and external fixators.

There are different pros and cons of different procedures and can be decided according to the patient's situation and type of fractures [4]. Interlocking intramedullary nailing is the best treatment option in comminution as well, but there are limitations. For instance, this technique may end up in non- union due to interlocking causing less chances of compression, and it requires to dynamize it to achieve compression [5,6]. Other advantages of biological reduction by bridge plate osteosynthesis are; **i)** Protection of soft tissue, **ii)** helps to maintain length, rotation, and angulation of femoral shaft, **iii)** bridge plating osteosynthesis provides mobility at the fracture site, which helps in early callus formation **iv)** bridge plating helps in maintaining the length and rotation with mechanical axis[7].

Data available on this topic is not enough to reach any conclusion. Present study aims to observe the outcome of comminuted fracture of shaft of femur with union and full weight bearing by bridge plate osteosynthesis among adults.

METHODOLOGY

It was a prospective study carried out in the department of Orthopaedics of Postgraduate Medical Institute/Lahore General Hospital, Lahore. The study duration was one year and 5 months (September 2018-February 2020). A sample size of 30 patients was calculated using WHO calculator (95% confidence interval, 5% margin of error, and 4% prevalence) [8]. A convenient sampling technique was used. Patients of either sex with comminuted closed fractures of the shaft of the femur with age between 20 and 50 years were included in this study.

Ethical approval was taken from the respective institute (AMC/PGMI/LGH/Research No/036/18). Consent was taken from all participants.

Patients with pathological fractures and Gustillo Anderson Type III open fractures were not included, as were patients with chronic medical illnesses. All surgeries were performed under General /Spinal anesthesia. Two small incisions were made in the skin above or below the fracture site, and the plate was passed above the periosteum (sub muscularly) with blunt dissection. The plate was fixed from one side, either proximally or distally. And after reducing the fracture (indirectly), the other end of the plate was also fixed with screws. At least three screws were applied on either side of the fracture. Data was collected after 3, 4, 5, and 6th months post-operatively. However, final outcomes were seen at 6 months to see radiological union and weight-bearing status. Data analysis was done using SPSS version 24. Mean, standard deviation, frequency, and percentage were calculated. Fisher exact test was applied. We reported a p-value ≤0.05 as a significant finding.

RESULTS

A total of 30 patients were included in the study. The mean age of the patients was 34.66±9.22 years. We found that 5(17%) of the patients were females and 25(83%) of the patients were male. We found 3% of patients presented with falls from height, whereas 97% of patients presented with a road traffic accident. There were 10(33.33%) patients who presented with grade-2, 15(50%) with grade-3, and 5(16.66%) with grade-4 fracture as per Winquest & Hansen Classification as shown in (Table-I). In 1st month only 1(3.33%) patient achieved bony union. At 3rd month follow-up, only 3(10%) patients, at 4th month 5(16.67%) patients, at 5th month 5(83.33%) patients, and on 6th month follow up, all 30 (100%) patients had achieved bony union (Table-II).

At 1 month, only 2(6.7%) patients were able to bear weight <10 kg, at 3 month 4(13.3%) patients were able to bear the weight of 20Kg, and at 4 month 5(16.7%) patients were able to bear the weight of 30 Kg, and at 6 month 19(66.7%) patients were able to bear full weight p-value=0.01 shows significant association as shown in Table-III.

Table-I: Demographic characteristics.

Demographic characteristics		Frequency (n=30)	Percentage (%)
Gender	Male	25	83
	Female	5	17
Causes of trauma	Fall from height	1	3
	Road Traffic Accident	29	97
Fracture	Grade-2	10	33.33
	Grade-3	15	50
	Grade-4	5	16.66

Table-II: Bony Union Different follow-up time Interval.

Time		Bone union		p-value
		Not Achieved	Achieved	
1 Month	≤2 weeks	21(70%)	0(0%)	0.300
	3-4 weeks	8(26.67%)	1(3.33%)	
3 Months	≤9 weeks	12(40%)	1(3.33%)	1.000
	10-12 weeks	15(50%)	2(6.67%)	
4 Months	≤13 weeks	12(40%)	3(10%)	1.00
	14-16 weeks	13(43.33%)	2(6.67%)	
5 Months	≤17 weeks	4(13.33%)	8(26.67%)	0.128
	18-30 weeks	1(3.33%)	17(56.7%)	
6 Months	≤22 weeks	0(0%)	9(30%)	-
	23-24 weeks	0(0%)	21(70%)	

DISCUSSION

It is noted that the patients' mean age was 34.66±9.22 years. The ratio was 5:1 of male to female. It shows male were 83% while females were 17%. The patients' age ranges from 20 to 50 years. Various other studies have almost the same results.

Table-III: Weight-bearing at different follow up time intervals.

Time		Weight bearing		Total	p-value
		No	< 10 Kg		
1 Month	≤2 weeks	21(70%)	0(0%)	21(70%)	0.083
	3-4 weeks	7(23.3%)	2(6.7%)	9(30%)	
		10-15 Kg	20 Kg		
3 Months	≤9 weeks	12(40%)	0(0%)	12(40%)	0.130
	10-12 weeks	14(46.7%)	4(13.3%)	18(60%)	
		20-25 Kg	26-30 Kg		
4 Months	≤13 weeks	15(50%)	0(0%)	15(50%)	0.42
	14-16 weeks	10(33.3%)	5(16.7%)	15(50%)	
		30-35 Kg	36-45 Kg		
5 Months	≤17 weeks	3(10%)	9(30%)	12(40%)	0.024
	18-30 weeks	13(43.3%)	5(16.7%)	18(60%)	
		46-50 kg	Full bearing		
6 Months	≤22 weeks	0(0%)	9(30%)	9(30%)	0.013
	23-24 weeks	10(33.3%)	11(36.7%)	21(70%)	

In our study, the male minimum age was 20 years, and it was 25 years of females. There were 97% of patients had road traffic accidents, and only 3 % had high falls. Patients were treated by bridge plate osteosynthesis, intramedullary nailing or external fixators. The age range of 20-39 years was recorded there was 4: 1 ratio of male to female, and the youngest was 20 years, similar to our study [9].

There were 15 patients treated through biological fixation of closed comminution fractures of the femur or tibia. Femur fractures were united with mean 6.1 weeks, and tibia fractures were united at 8.3 weeks in the study of Ibrahim et al. the study recorded no malunion, non-union or complication [10]. As suggested, biological fixation is an appropriate method for closed fractures but not in open fractures due to the high rate of fixation [11] .

Various studies reported femoral bony union of comminuted fracture range from 18 weeks to 20.6 weeks[12,13]. A study reported a fracture union in 18 weeks [14]. Another study showed the duration of fracture union was 18 weeks, while Ricci et al. reported 19.7 weeks duration for fracture healing [15], Wenda et al study showed fracture union was 4 months[16], and Hanif documented 20.6 weeks union duration after the surgery which was from Mayo hospital Lahore Pakistan respectively [17].

Jhangir study showed duration ranging from 6 to 16 weeks with biological plate osteosynthesis in femoral comminution fractures[18]. The study showed bone healing in 93% of cases at the fourth, fifth, and sixth months all cases had bone healing. It was observed that bony union was almost the same as compare other studies with respect to bony union and complete weight bearing. A study documented that partial and complete weight bearing were started at 3.3±1.1 months and 4.8±1 months, respectively [19].

The operated cases were not permitted to put weight until one month after surgery in this study. Twenty-eight patients were allowed to bear partial weight bearing of about twenty to thirty Kg at the third and fourth months after the surgery if they could tolerate it. A fifth month after the surgery, complete weight bearing was permitted, which was after the radiological union achieved of each patient. Operated cases follow-up was continued for six months after the surgery till the healing of bone.

The comminuted diaphyseal femoral fractures were operated with bridge plate osteosynthesis of 31 patients. This study provided the results in favour of bridge plating. Hence according to the study 71% of cases had excellent results, 25 % had a satisfactory outcome, and 3 % of cases were end up in failure. It is also documented that bony union were achieved in all cases with a mean time of 8.7 weeks[20].

Hence the results of the study concluded that biological bridge plate osteosynthesis provided a good option for the management of comminuted fractures of the shaft of the femur, which provided excellent results of bone union and weight bearing with radiological and clinical outcomes.

CONCLUSION

The bridge plating technique is a safe, easy, and effective method of fixation for comminuted diaphyseal fractures of long bones in terms of bony union and weight bearing. This study found bridge plate osteosynthesis to be a cost-effective and technically easy procedure. This method can be successfully used in treating all comminuted diaphyseal fractures of the femur.

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Author's Contribution:

Muhammad Atif: Substantial contributions to the conception or design of the work

Muhammad Abdul Basit: Concept, design and interpretation of data.

Muhammad Zaman Khan: Acquisition, analysis, or interpretation of data for the work.

Muhammad Ali Usman: Acquisition of data for the work.

Syed Shaharyar Shah: Final approval of the version to be published.

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