

# COMPARATIVE STUDY OF MANAGEMENT OF CLOSED COMMINUTED FEMORAL SHAFT FRACTURES WITH CLOSED INTERLOCKING INTRAMEDULLARY NAIL AND OPEN REDUCTION AND DYNAMIC COMPRESSION BRIDGE PLATING

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## ABSTRACT

Fracture shaft of the femur are life-threatening injuries and can cause severe permanent disability. Nowadays the interlocking nailing is regarded as the operative technique of choice for fracture shaft of femur. However, the advantages and disadvantages have rarely been compared with plate osteosynthesis. This is prospective study to compare the two methods of treatments in terms of time to union, hospital stay (including readmission), wound infection, shortening of limb, delayed union, malunion, joint stiffness and implant failure. 54 patients, age (16 to 66) years, were treated by DCP (22), and interlocking nail (24). Eight patients were lost to follow up. The study was conducted in Services Hospital, Department of Orthopaedics and Ittefaq Hospital, Lahore, Pakistan from June 1996 to Dec 1997. Written consent was taken regarding the type of surgery to be performed. Open fractures of Gustilo Grade II or III, femoral shaft fractures associated with other fractures of the same femur, fractures in immature skeleton and segmental fracture were excluded. Winquist and Hansen classification was used to classify fracture comminution. Patients were alternately allocated. In the plating group, primary bone grafting was done in all cases. Time to union in nailing group was  $16.43 \pm 2.48$  weeks and in plating  $19.88 \pm 3.46$  weeks,  $p$ -value  $< 0.05$ . Mean hospital stay in nailing group was  $12.8 \pm 2.75$  day and plating group  $21.1 \pm 2.73$  days,  $p > 0.05$ . There were 2 deep infections in the plating group and none in nailing group. There was no shortening of limb in the plating group but 2 patients in the nailing group had shortening of 2 cms. Delayed union occurred in 2 patients in nailing group but 5 in plating group. One patient in the nailing group had external rotation of at least 10 degrees and none in plating group. Two patients in the nailing group had knee stiffness and 6 patients in the plating group. One patient in the nailing group had a broken interlocking screw 2 patients in the plating group had bent plates. Closed interlocking intramedullary nailing as a method of treating closed comminuted femoral shaft fracture is better than plating in terms of rate of postoperative complication including infection.

**Key Words:** *Comminuted fractures shaft of femur, static interlocking nailing and bridge plating.*

## INTRODUCTION

Fractures of the shaft of the femur are the result of high-energy trauma and therefore can be life-threatening injuries and can cause severe permanent disability. Shortening of the limb and malalignment, along with contracture of knee due to prolonged immobilization have traditionally plagued the orthopaedists'

management of patients who have these injuries.<sup>2</sup>

Comminution is a sign of even higher energy injury and its presence traditionally has complicated the decision making on preferred treatment. The risk of shortening, rotation and malalignment are clearly higher in comminuted fractures.

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Closed Comminuted fracture of the femoral shaft may be treated operatively by closed static interlocking nailing or by Dynamic Compression Plate (DCP) across the comminution as a bridge plate.<sup>3</sup> Intramedullary nailing has many theoretic and practical advantages over the other forms of external and internal fixation. Nails are inserted with relatively less exposures and dissection as compared to that needed for plate fixation. Because the fracture hematoma is not evacuated with closed nailing, the early action of local cellular and humoral agents critical to normal fracture healing is not disturbed. The most accurate reduction of comminuted fractures of the femoral shaft can be obtained with interfragmentary compression and plate fixation.<sup>14</sup> Magerl *et al*<sup>7</sup> recommended primary bone grafting in fractures with suboptimal fixation, devascularization of fragments or cortical deficiency. Nowadays the interlocking nailing is regarded as the operative technique of choice for patients with a fracture of the femoral shaft.<sup>13</sup> However, the advantages and disadvantages of the techniques have rarely been compared with plate osteosynthesis in clinical studies.<sup>13</sup>

## AIMS AND OBJECTIVE

To compare the following aspects amongst patients treated by IM nailing and DCP fixation of comminuted femoral shaft fractures

1. Time to Union
2. Hospital stay (including readmission)
3. Wound infection
4. Shortening of limb
5. Delayed union
6. Malunion
7. Joint stiffness
8. Implant failure-bent or broken (nail and plate)

## MATERIAL AND METHODS

In a prospective study a total of 54 patients, age (16 to 66) years, having closed comminuted fracture shaft of femur were treated by DCP - 22 patients, and interlocking nail-24 patients. Eight patients were lost to follow up. The study was conducted on patients admitted in Service Hospital, Department of Orthopaedics and Ittefaq Hospital, Lahore, Pakistan from June 1996 to Dec 1997. Written consent was taken regarding the type of surgery to be performed. Grade n or HI open fracture, shaft fracture associated with other fractures of the same femur, fracture in immature skeleton and segmental fracture and fractures in which external fixation had been applied were excluded. Winquist and Hansen classification was used to classify the fracture comminution. We have considered delayed union to be present if clinical union of fracture did not take

place within 24 weeks of the operation.<sup>1</sup>

Initial assessment and necessary resuscitation were earned out. Thereafter the patients were put on proximal tibial skeletal traction. Patients were alternately allocated to the two treatment groups.

After interlocking nailing, on the first postoperative day, gentle range of motion exercise of the knee and hip was started. Toe touch crutch walking was started as early as possible (second or third day), and quadriceps strengthening exercise within limits of pain tolerance. Partial weight bearing with crutches was started when early callus formation was evident. Full weight bearing was allowed when callus formation bridged the fracture gap. Routine dynamization was not attempted.

In the plating group, primary bone grafting was done. On the first postoperative day, gentle ROM exercise of knee and hip were started. Quadriceps strengthening exercises were not encouraged at this stage. Non-weight bearing ambulation was started as early as possible. When radiological fracture union occurred, partial weight bearing was allowed and aggressive quadriceps strengthening exercise were begun and continued for one month. After one month of partial weight bearing, full weight bearing was started.

In both the groups sutures were removed on the 10<sup>th</sup> postoperative day. The second follow up visit was 6 weeks from the date of surgery. Further visits were at 6 weeks intervals.

## RESULTS

The most common cause of the fracture shaft of femur in our study was RTA (76%). Table I shows the modes of injury encountered in our study.

The most common type and site of fractures were as mentioned in (table II and III) respectively.

### *Time to union*

Time to union in nailing group was  $16.43 \pm 2.48$  weeks and in plating group was  $19.88 \pm 3.46$  weeks,  $p$ -value  $< 0.05$ .

### *Postoperative Hospital stay (Including readmissions)*

Postoperative mean hospital stay in nailing group was  $12.8 \pm 2.75$  day and  $21.1 \pm 2.73$  days,  $p > 0.05$  in plating group.

### *Wound infection*

There was no deep infection in the nailing group but 2 in the plating group.

**Table I : Mode of Injury**

Mode	No. of Patients	%
Road Traffic Accidents		
? Motor vehicle accidents	6	13
? Auto-pedestrians accidents	12	26.1
? Motorcycle accidents	17	37
Fall from height	6	13
Fall at ground level	3	6.5
Hit by heavy object	2	4.3
<b>Total</b>	<b>46</b>	<b>100</b>

**Table II : Comminution classification (Winqvist - Hansen) n=46**

Type	Nailing		Plating		Total	%
	Number	%	Number	%		
Type I	6	13	7	15.2	13	28.2
Type II	9	19.6	9	19.6	19	39.2
Type III	7	15.2	4	8.7	11	23.9
Type IV	2	4.3	2	4.3	4	8.7
<b>Total</b>	<b>24</b>	<b>52.2</b>	<b>22</b>	<b>47.8</b>	<b>46</b>	<b>100</b>

**Table III : Location of fractures**

Location	No. of Patients	Percentage
Proximal third	12	26.1
Middle third	25	54.3
Distal third	9	19.6
<b>Total</b>	<b>46</b>	<b>100</b>

**Table IV : Postoperative complications**

Complication	Nailing (24)	Plating (22)
Deep infection	0	2
Knee stiffness		
Flexion 100-120°	2	4
< 100°	0	2
Implant failure		
Broken interlocking screw	1	-
Broken plate	-	2
Loosening of screws	-	1
External rotation 10°	1	0
Delayed union	2	5
Shortening 2 cm	2	0
<b>Total</b>	<b>8</b>	<b>16</b>

**Shortening of limb**

One case had shortening of 2cm in the nailing group but none in the plating group.

**Delayed union**

There was 2 case of delayed union in the nailing group but 5 in the plating group.

**Malunion**

There was one case of more than 10 degrees of external rotation in the nailing group and none in the plating group.

**Joint stiffness**

Two patients in the nailing group had knee stiffness and 6 in the plating group.

**Implant failure**

There was one case of broken interlocking screw in the nailing group and 2 cases of bent plate in the plating group.

Postoperative complication were as mentioned in (Table IV). Intraoperative difficulties of significance were not encountered.

**Table V : Comparison of treatments of femoral shaft fracture : Closed nailing and plating with present study**

Authors and year	No. of patients	Delayed union	infection	ROM knee <120°	Implant failure	Time to union	Hospitalization
Magerl et al (plate) 1979	67		3%		7 (10.4%)		7 weeks
Reudi et al (plate) 1979	131		6%		9 (6.9%)		
Cheng et al (plate) 1985	32		0%		2 (6.3%)	22 weeks	4.5 weeks
Thoresen 1985 Nailing	48		0%			16 weeks	
Wiss (nailing) 1966	112		0%				
Johnson and Greenberg 1987 Nailing	179			0%		14 weeks	
Christe et al (nailing) 1988	117	2 (1.7%)			2 (1.7%)	17 weeks	
Bostman et al (plating) 1989	102	5 (4.9%)	7 (6.86%)		5 (4.9%)		
Niekerk and Schoots 1992 plate	20	0	0				
Niekerk and Schoots 1992 nailing	19	15%	10%				
Mahnood et al (nailing) 1993	50	6%		1 (2%)			
Riemer et al 1994 Plating	150		0	1%	7%	18 weeks	
Ghaloo et al 1997 Plating	29	17 (58.6%)	8 (27.5%)	15 (52%)	3 (10.3%)		
Preset study (plating)	22	5 (22.7%)	2 (9%)	6 (27.3%)	2 (9%)	19.9 weeks	27 days
Present study (nailing)	24	1 (4.2%)	0	2 (8.3%)	1 (4.2%)	16.4 weeks	12 days

## DISCUSSION

After reviewing the articles, (Table V) on the treatment of comminuted femoral shaft fracture by closed interlocking nailing and plating we did not find any prospective study comparing the two methods of treatments. In this regard this study can be considered to be the first of its kind. Before the advent of interlocking nailing, plating was considered appropriate for comminuted fracture of the femur, especially for those distal to the isthmus, where simple nailing was inadequate.<sup>11</sup> Wherever, facilities for interlocked nailing became available, most Orthopaedic surgeons started treating fractures of the shaft of femur by interlocked nailing rather than plating. In the case of plating, in type I and type II comminution, attempts were made to anatomically reduce the fracture and compression was achieved. In type III and type IV, only those butterfly fragments were replaced which were necessary to determine anatomic length, axis and cortex. No attempt was made to perfectly reduce the medial cortex. Every attempt was

made to disturb the intervening fragments as little as possible. Fixation of comminuted fracture without opening the fracture site has been advocated, a method that has been termed as "Biological fixation".<sup>8</sup> Technically, it was observed in our study that it was easier to operate on higher grade of comminution than on type I or type II. It is well recognized that fracture comminution may increase during reaming or nail insertion. The preoperative radiography may fail to detect non-displaced fracture line.<sup>6</sup> It is important that the starting point for nail insertion be correct.<sup>6</sup> The successful closed reduction of femoral shaft fractures may be impossible when there is soft tissue interposition at the fracture site. Mahaisavariya et al reported this in a retrospective study comparing the sonographic finding in soft tissue interposition with those in a control series of 40 other fractures.

On an average, the time to union in the case of plating was 3.5 weeks later than in the case of nailing group. We have considered delayed union to be present if clinical union of

fracture did not occur within 24 weeks of the operation!. Higher incidence of delayed union was a significant disadvantage in the plating group. Since our study of individual cases extended for a period of 6 months follow-up, we are not in a position to comment on non-union. So for the purposes of calculation, we have excluded those cases which had not united in 6 months, when considering time to union. At the end of 6 months we had 2 cases in the nailing group, which had not united, and 5 cases from the plating group. If we had included these cases also, the differences in the time to union would have been much more.

The main reason for the longer duration of hospital stay in the plating group (21.1 days) as compared to nailing (12.8 days) was that the 2 cases that developed deep infection had to be admitted 4 times each to control the infection.

There was no deep infection in nailing group but in case of plating 2(9%) infections were noted. This rate is much more than that reported by Magerl et al<sup>7</sup> (3%) and Reudi et al<sup>11</sup> (6%) but similar to that reported by Ghaloo et al<sup>4</sup> (8%) and Bostman et al<sup>1</sup> (7%). Higher rate of infection again was a significant disadvantage in the plating group.

In contrast to nailing group in which we had 2 cases of shortening of at least 2 cm, there was no shortening in plating group. No other study mentions about shortening.

The fracture was fixed in at least 10 degrees of external rotation in the case of nailing, which was not seen in the case of plating.

One another important disadvantage of plating was the higher rate of knee stiffness. The other studies about plating have not mentioned about knee stiffness but Ghaloo et al<sup>4</sup> have reported 52% of cases in which knee flexion was less than 120 degrees.

We had one case of broken interlocking screw, which is not a major complication, but the bent plates in the plating group are major complications.

## CONCLUSION

Plating of shaft of femur was associated with more (16) complications as compared to nailing (8). Closed static interlocking intramedullary nailing as a method of treating closed comminuted femoral shaft fracture is better than plating in terms of rate of postoperative complication including infection. But because closed interlocking nailing requires image intensifier and fracture table, which is still not available in most of the hospitals, orthopaedic surgeons still need to know the techniques of plating comminuted femoral shaft fractures.

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