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# COMMINUTED FRACTURES OF SHAFT OF FEMUR;
## BRIDGE PLATE VERSUS INTERLOCKING NAIL IN LOW VELOCITY GUN SHOT INJURIES

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**ABSTRACT..** Comminuted fracture shaft of the femur is a common entity faced by orthopaedic surgeon. Road traffic accidents are the major cause of these comminuted fractures. But with increase in violence, gun shots are also causing these fractures frequently. **Objectives:** To see and compare the result of intramedullary interlocking nailing and biological plating in terms of infection rate, union rate and to assess the other complications. **Design:** Prospective study **Setting:** Department of Orthopedic Surgery Allied Hospital Faisalabad. **Period:** From Sept 2001 to Sept 2003. **Patients & Methods:** Forty comminuted fractures of femur were managed ,twenty by bridge plating and twenty by interlocking nailing. **Results:** Results were compared with reference to healing time, infection rate, operating time and hospital stay and was comparable to other studies. **Conclusions:** Closed interlocked intra-medullary nailing is an excellent method for treating comminuted femoral shaft fracture. But requires expensive equipment and more expertise. Bridge plating require no special instrumentations and can be done at periphery with less facilities available.

**Key words:** Bridging plating, Interlocking nailing.

## INTRODUCTION

In our country the number of people suffering from comminuted femoral shaft fractures has increased with the increase of road traffic accidents and fire arms injuries. Most of these patients are either treated with closed interlocking intramedullary nailing and some time with bridge plating or some cases are treated by external fixator or by skeletal traction.

Closed interlocking nailing require expensive equipments like special fracture operating table, image intensifier and a wide array of special instruments. Bridge plating require less expensive equipment than needed for closed nailing.

The two most important general concepts in the biomechanics of fixation of femoral fractures are mechanical stability and tissue conservation. The implant functions as a mechanical stabilizer to prevent deformity and to provide a stable skeleton to allow functional reactivation and restoration. Tissue conservation maximizes the bone regeneration capacity of the body[1].

Bridge plate osteosynthesis is advantageous, especially

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in multiple injured patients[2]. Maini[3] described bridge plating as biological fixation due to the fact of conservation of soft tissues and blood supply.

In comminuted femoral shaft fractures where internal fixation is indicated, static interlocking nail is the treatment of choice, but where this facility is not available, biological fixation with the bridge plate can provide a good alternative.

Biological fixation technique decrease the soft tissue dissection about the fracture site. Despite the belief that soft tissues should be preserved during the open reduction of fractures, surgeons traditionally have sought to achieve maximal mechanical stability regardless of the impact it might have on the soft tissues. The conflict between the need for absolute anatomical reduction and the desire for soft tissue preservation is analogous to the saying 'wash me but don't get me wet'. The slow progress towards improved soft tissue handling is evidenced by the way plating techniques are taught in bridging plate technique above and below the fracture with the use of plate inserted deep to the muscles[4].

Bridge-plating with its advantages in terms of vascularity and bone healing is a well established procedure today in the treatment of comminuted fermoral fractures[5].

Miclau and Martin[6] used wave plate with the advantage of avoiding plate contact to the bone, allowing for the application of corticocancellous bone graft at the fracture site altering the load of the plate to provide pure tension forces on the plate.

## AIMS AND OBJECTIVES

The aim of the study is to see and compare the result of intramedullary interlocking nailing and biological plating in term of infection rate, union rate and to assess the other complications.

Comparison was made in the following aspects.

1. Time taken for operative procedure.
2. Intra-operative complications.

### Intra-operative

Additional comminution of fractures.

Iatrogenic femoral neck fracture.
Others if any
Post-operative: Neuropraxia/nerve palsy.
Leg length discrepancy/rotational deformity.
Others.

3. Duration of hospital stay.
4. Wound infection-superficial/deep
5. Complications in follow-up

- Shortening of limb
- Delayed union
- Malunion
- Non union
- Mal-alignment of fracture
- Residual joint stiffness
- Implant failure:
- Bent or broken nail or screw
- Bent or broken plate

Time taken for fracture healing and full weight bearing.

## MATERIALS AND METHODS

A total of 40 patients were treated, 20 with interlocked intramedullary nailing and 20 with biological fixation with bridge plate.

The study was conducted on patients admitted in Allied Hospital, Faisalabad from September, 2001 to September, 2003. Written consent was taken regarding the type of surgery to be performed.

**Table-I. Mechanism of injury**

| Mechanism | No. of pts | %age |
|---|---|---|
| Low velocity fire arm injury | 20 | 50% |
| Road Traffic accident | 18 | 45% |
| Fall from Height | 2 | 5% |
| Total | 40 | 100% |

| Table-II. Extent of comminution | | | | | | |
|---|---|---|---|---|---|---|
| Type | Nailing | | Bridge plating | | Total | |
| | No | %age | No | %age | No | %age |
| Type II | 2 | 5% | 3 | 7.5% | 5 | 12.5% |
| Type III | 8 | 20% | 12 | 30% | 20 | 50% |
| Type IV | 10 | 25% | 5 | 12.5% | 15 | 37.5% |
| Total | 20 | 50% | 20 | 50% | 40 | 100% |
| *Winquist & Hansen Classification* | | | | | | |

| Table-III. Open Versus Close Fracture | | | | | | |
|---|---|---|---|---|---|---|
| Type | Nailing | | Bridge plating | | Total | |
| | No | %age | No | %age | No | %age |
| Open | 15 | 37.50 | 10 | 25% | 25 | 62.50% |
| Close | 5 | 12.5% | 10 | 25% | 15 | 37.50% |
| Total | 20 | 50% | 20 | 50% | 40 | 100% |

Open Fracture Classification (Gustilo et al)
Taken regarding the type of surgery to be performed.

## Inclusions criteria

1. Comminuted femoral shaft fractures of type II, III and type IV.(Winquist and Hansen Classification)

2. Open femoral shaft fractures type I and Type III-A ( only low velocity fire arm injuries )

## Exclusion criteria

1. Comminuted femoral shaft fractures of type I
2. Open femoral shaft fractures type II and Type III (except low velocity fire arm injuries).
3. Segmental femoral shaft fractures
4. Fracture in age group below 14 years.

Proforma was filled, history/clinical examination. X-rays of the pelvis (AP view), the injured femur (AP and lateral views) and the knee (AP and lateral views) were taken to provide estimation of correct diameter and length of nail or bridge plate. Patients were put on proximal tibial skeletal traction from the day of injury and weight for traction 1/5$^{th}$of the body weight was applied. Routine investigations including complete blood count, hemoglobin, blood sugar, blood urea, ECG and X-ray chest were performed. Winquist and Hansen classification was used to classify the fracture comminution and for open fracture Gustilo et al classification used. Nail length was estimated by clinical measurement of the contralateral uninjured femur from the tip of the greater trochanter to lateral aspect of the knee joint minus 2 to 3 cm (AO manual). The diameter of the nail was estimated from the X-rays. Nails of longer and shorter lengths and larger and smaller diameters were prepared for the operation.

In the case of bridge plating, the length of the bridge plate was such that 4-5 screws engaging both cortices could be inserted in the proximal and distal fragments.

The patients were operated on elective operating list. A.O

local made interlocking nail were used in all nailing cases. Broad bridge plate made by Synthes were used in all plating cases.

Fracture table and image intensifier was used for close intramedullary nailing in supine position. Bridge plate was done on ordinary fracture table in supine position. Plate was inserted using two stab wound across the fracture and sliding the plate across the fracture . Minimum four to five screw were used across the fracture for fixation.

Postoperatively injectable first generation cephalosporine and aminoglycoside were used for five days. Early ROM exercises were started and cruch walk allowed. Partial weight bearing allowed when callus was evident radiologically Full weight bearing recommended when there was good callus formation.

## RESULTS

We had a total of 40 cases, 20 of biological plating and 20 cases of interlocked intramedullary nailing. We have reported the follow-up study upto one year.

**Table-IV. Fracture Healing time**

| Healing time (Wks) | Nailing | Bridge Plating |
|---|---|---|
| Within 12-16 weeks | 10 | 7 |
| Within 17-24 weeks | 4 | 6 |
| Within 25-28 weeks | 2 | 1 |
| Within 29-32 weeks | 1 | 2 |
| Within 33-36 weeks | 1 | 1 |
| Within 37-40 weeks | 1 | 1 |
| Non union | 1 | 2 |
| Total | 20 | 20 |

| MEAN HEALING TIME | |
|---|---|
| Nailing | 16.2 weeks |
| Bridge Plating | 17.5 weeks |

**Table-V. Postoperative Complications**

| Complications | Nailing (n=20) | Bridge plating (n=20) |
|---|---|---|
| Wound infection | 2 | 2 |
| Knee Stiffness | 2 | 2 |
| External rotation of femur 10° | 1 | - |
| Shortening of the femur 1 cm | 1 | - |
| Implant failure | 1 | 2 |
| Delayed union | 8 | 5 |
| Nonunion | 1 | 2 |
| Total | 16 | 13 |

There were 32 (80%) males and 8 (20%) females with the male: female ratio of 4:1 (Table I). The youngest patient was 20 years old and the oldest was 60 years. The mean age was 32 years.

Most of the fractures were encountered in the age range of 20-39 years. There were 24 (60%) patients in the age group 20-29 years, and 9 (22.5%) in 30-39 age range (Table II). This distribution was almost similar in both groups (Table III).

The most common site of the femoral shaft fracture was the middle third in 22 cases (55%) followed by upper third in 10 cases (25%) and distal third in 8 cases (20%) (Table IV).

The most common causes of the femoral shaft fracture in our study were fire arm injury (low velocity) and road traffic accident (RTA). There were 20 (50%)cases of the femoral shaft fractures caused by the low velocity fire arm injuries and 18 (45%)patients, who got fractures of femur by road traffic accident. The most common cause in RTA was motorcycle accidents in 14 (35%) patients followed by auto-pedestrians accident in 2 (5%) patients and motor vehicle accidents in 2(5%) patients (Table V). Other cause in 2 (5%) patients were fall from height.

## DISCUSSION

After reviewing the articles on both closed interlocked intramedullary nailing and biological plating, it is not surprising that we do not find any article in English literature on a prospective study comparing the two methods of treatments. In this regard this study can be considered to be unique. The present study showed the most common causes of the femoral shaft fracture being fire arm injury (low velocity) and road traffic accident (RTA). There were 20 (50%)cases of the femoral shaft fractures by the low velocity firearm injuries, 18 (45%)patients, who got fractures of femur by road traffic accident.

In the case of bridge plating attempts were made of indirect reduction of fracture and length was achieved. No attempt was made to perfectly reduce the medial cortex. Every attempt was made to disturb the intervening fragments as little as possible. Technically, it was observed that it was easier to operate on higher grades of comminutions.

In the case of nailing, the type of comminutions, in addition to the location of the fracture, has an important bearing on the type of locking used. We used static interlocking in all the cases because we included only type II, III and IV comminutions in our study. Dynamic interlocking is only recommended for transverse or short oblique less comminuted fractures[7]

In our study the mean duration of postoperative hospital stay in the interlocking group was 7.1 days. In the bridge plating group, it was 9.45 days. In both the groups patients were generally discharged on the 8$^{th}$ postoperative day. The main reason for the longer mean duration of hospital stay in the bridge plating group was the one case, that developed infection had to be admitted 2 times to control the infection and later on for bone grafting. . In the present study, the mean anaesthesia time for nailing was 114 minutes and that for bridge plating was 103.5 minutes.

The number of cases with re-admissions in closed nailing group were two (10%), whereas in bridge plating group were three (15%). One case in nailing group developed wound infection , nail was removed and NA fixator was applied after six month. Two bridge plates were broken for which implants were removed and interlocking nailing done. In one case of bridge plating bone grafting was done.

Intra-operative difficulties of significance were not encountered when correct principles were followed in the bridge plating group. We could not find any intra-operative difficulties mentioned in literature concerning bridge plate fixation. But we, as beginners did have some difficulties in correct alignment and length restoration as we did not use image intensifier. In one case drill bit was broken during surgery again because of technical error.

We were unable to put the distal screws properly in one case of nailing group and in postoperative radiographs it was detected that the screws were not passing through the nail. De-rotation boot cast was applied afterward.

There were a total of 16 postoperative complications in the closed nailing group and 13 in the bridge plating group.

We had no superficial infection in nailing group but four ((10%) of our patients developed deep infections. One of them developed severe infection, nail was removed and external fixator was applied. Rest of three cases were treated conservatively with antibiotics and wound wash. It is observed that the infection rate in nailing group and in plating group is same. Therefore, no significant difference was seen.

There were three patients in the nailing group who could not flex their knee more than 110 degrees at one year postoperative time and same complication in two patients in the bridge plating group at the end of one year. There was one patient of shortening of 1 cm in nailing group. One patient was fixed in external rotation of 10 degree in nailing group but he had no problem in walking. We had one case of screw breakage that was found on postoperative follow up radiographs due to delayed union and early weight bearing by patient in nailing group.

Two bridge plates were broken. The cause in one case was delayed union and the other was nonunion. There were 13 (32.5%) cases with delayed union, eight in nailing group and five in bridge plating group. Ten cases

united within 36 weeks without any further surgical intervention and in three cases bone grafting done and fracture got united within 40 weeks.

Three cases of nonunion were detected two in bridge plating group and one in nailing group. Cause of non-union in nailing group was infection, nail was removed and external fixator was applied. Fracture was united after one year. Causes of non-union in bridge plating were implant failure. Broken bridge plates were removed interlocking nailing and bone grafting done. Fractures were uniting after one year. In our study malunion was not a significant problem. There was one patient with 10 degrees external rotation of his leg and one with shortening of 1 cm in the nailing group and two with shortening of 1 cm in bridge plating groups. External rotation and shortening were due to incorrect positioning of the limb during the procedure.

The mean healing time for nailing group was 16.2 weeks whereas that of bridge plating was 17.5 weeks. The range of healing time is 12-40 weeks.

There are several studies on nailing in which the healing time vary from 12 weeks to 32 weeks. But there are few studies on bridge plating and healing time vary from 12-23 weeks.

In our study, it is observed that weight bearing is early in nailing group than bridge plating group. The earlier weight bearing in the nailing group was an important advantage over the bridge plating group.

## CONCLUSION

Closed interlocked intramedullary nailing is an excellent method of treating comminuted femoral shaft fracture with the advantage that full weight bearing can be done significantly earlier in the patients treated with closed interlocked nailing.

Bridge plating of comminuted femoral shaft fracture is also excellent method of treatment comparable to closed interlocked nailing with the following advantages.

Less expensive equipment is required than is needed for closed nailing.

No special fracture table is required and no image intensifier is required.
It is more suitable for patients with polytrauma where stressful positioning required for closed nailing may not be suitable.

There is less chances of fracture heamatoma disturbance.
The disadvantage of nailing is that it requires special fracture or operating table, image intensifier and a wide array of special instruments and hence not feasible in all parts of the world.

The disadvantage of bridge plating is that it takes a little more time for full weight bearing.
No significant difference was found regarding infection in both groups.



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