

# Outcome of Delayed Minimally Invasive Plate Osteosynthesis in Firearm Injuries of Femoral Shaft

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**Objectives:** To evaluate the results of bridge plating in comminuted femoral shaft fractures in adults due to high velocity firearm injuries.

**Study Design:** A cross-sectional observational study.

**Patients & Subjects:** A total of 30 Patients with fracture of femoral shaft from high velocity firearm injury were studied, who met the inclusion criteria.

**Methods:** The patients were admitted through Emergency Department after completing the initial protocol. Multiple debridements were done if needed and subsequent fixation was done in 02 to 03 weeks of initial injury.

**Results:** We achieved union in all the cases. The average time to union was 20 weeks and 6 days. Male to female ratio was 4:1. There were 02 cases (6.7%) of delayed union & 01 case (3.31%) of nonunion.

Infection occurred in 04 pts (13.4%), 02(6.7%) with superficial and 02 (6.7%) with deep infection. Hardware pain was experienced by 03 patients (10%).

**Conclusion:** The comminuted fracture of the femoral shaft due to high velocity firearm injuries can be managed with excellent results using the minimally invasive plate (biological) fixation. The key to success is debridement of devitalized tissue and hence eradication of infection before fixation.

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## Introduction

Open fractures caused by bullets have been a difficult problem since the invention of firearm<sup>1</sup>. Energy dissipated laterally from high velocity missile produces damage far beyond its trajectory causing tissues to lose their vitality<sup>2</sup>.

The treatment of such open fractures with severe comminution is still a major problem in treatment of such fractures. The superiority of bridge plating compared to anatomical reduction is now undisputed. Heitemyer et al performed Multiple wedge osteotomies in animal studies and found superior bone healing and better stability after bridge plating at 08 weeks than after anatomical reduction and fixation.<sup>2,3</sup>

This biological fixation and indirect reduction decreases the incidence of infection and refracture; it also reduces the need for bone grafting. It also preserves the soft tissues about the fracture and is associated with early fracture consolidation due to lessening of overall surgical trauma.<sup>4-6</sup>

## Materials and Methods

33 patients of Comminuted fracture shaft of the femur due to firearm injury, treated in Orthopaedic department Unit – I Mayo Hospital Lahore between Aug 2003 to 2005, who met the inclusion criteria, were included in the study. The Patients with vascular injury, chronic debilitating illness and both of extreme age groups were excluded from the study.

All data was retrieved from hospital record and supplemented by continuing follow up. 03 patients were lost during follow-up leaving behind 30 patients for the study.

The study group included 06 females and 27 males who had an average age of 35 years (range: 18 – 47 years). The mechanism of injury was high velocity firearm injuries. Classification of initial fracture type and the Gustilo Grade of the open injury was III A.

## Procedure

After initial resuscitation, the wound was examined and grading was done after giving Prophylaxis of 1st generation cephalosporin and Aminoglycoside antibiotics.

Thorough wide debridement and copious irrigation with N/Saline was done in Emergency O.T. on the same day, followed by reexamination and multiple debridements if needed after 48 hrs, till the wounds were closed, or clinically clear of infection. Fixation was done in two to three weeks of initial injury.

## Surgical Technique of Bridge Plating

The upper and lower limits of the fracture site were marked. Two incisions were made in a straight line slightly posterior to the line joining the greater trochanter and the lateral femoral condyle without opening the fracture site. After skin, the fascia lata was incised along the anterior border of the iliotibial band. The vastus lateralis was retracted anteriorly and the dissection continued down to bone along the anterior surface of lateral intermuscular septum, which is attached to the linea aspera. Long broad dynamic compression plate was used with a maximum of 3-5 screws in each proximal and distal fragment after indirect reduction.

**Comparison of Study**

Study Name	No. of Patients	Delayed/ Non Union	Infection	Fracture Healing Time
Kinast et al 1989 <sup>8</sup>	23	0	0	18 weeks
Riemer 1994 <sup>9</sup>				18 weeks
John P Chriosvitsinos et al 1997 <sup>10</sup>	20	0	0	19.7 weeks
K Wenda et al 1997 <sup>11</sup>	17	1	0	4 months
Present Study	30	4	4	20.6 weeks from fixation

Suction drains were removed usually after 48 hours. Follow-up visits were done at 3-weeks' intervals with radiological and clinical assessment.

The patients were mobilized from the 3<sup>rd</sup> post-operative day. Weight bearing was started when there was sufficient callus formation on radiographs, usually after the third post-operative month.

**Results**

We eventually achieved union in all the cases. 26 of 30 Patients had union in 20 weeks 6 days (range: 15.4 to 27 weeks), excluding the cases of delayed union.

**Functional Out Come**

Using Nicolas & McCoy<sup>7</sup> criteria, 19 patients (63.3%) had excellent results, 07 patients (23.3%) good and 04 patients (13.3%) were found to have poor results, regarding union, shortening, rotation and flexion of knee & hip.

**Complications**

01 patient (3.3%) had non-union and 02 patients (6.7%) had delayed union. Infection occurred in 04 patients (13.3%), with superficial in 02 and deep in 02 patients. Hardware pain was experienced by 03 patients (10%).

**Additional Surgery**

A total of 07 patients (23.3%) underwent additional surgery cancellous bone grafting was done in 01, Bone marrow injection in two patients and union achieved at 30<sup>th</sup> week.

Incision drainage was done in two patients with superficial infection and irrigation & drainage was done in one patient with deep infection.

Hardware removal was done in 03 patients, 02 with infection and 01 with persistent pain due to hard ware.

**Discussion**

The biological fixation with minimally invasive technique in the management of comminuted femoral shaft fractures combines the beneficial effects of stable fixation while not interfering with the fracture hematoma and blood supply of small fracture fragments.

We achieved union in all the cases. In 03 cases of delayed union and non-union, cancellous bone grafting & bone marrow injection was given at 12<sup>th</sup> and 24<sup>th</sup> week respectively. These showed union at 30<sup>th</sup> week.

The high velocity firearm injuries because of their deleterious effects on blood supply of fracture fragments and soft tissue leads to more devitalization and infection at fracture site. This needs debridement and eradication of infection.

04 patients were graded having poor outcome because of shortening of limb and stiffness.

**Conclusion**

Comminuted fractures of the femoral shaft due to high velocity firearm injuries can be managed with excellent results using minimally invasive plate (biological) fixation. The key to success is debridement of devitalized tissue and hence eradication of infection before fixation. Through this study it may be suggested that clinical assessment should be combined with laboratory investigations (ie ESR, TLC, DLC, CRP) before fixation to reduce the higher chances of infection.

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