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Interlocking nailing for treating comminuted fractures of the shaft of femur

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ABSTRACT

Background: The fracture of the femoral shaft is one of the most frequent fractures seen in orthopaedic practise. The purpose of this study was to evaluate the operative procedure for managing communited fractures of the femoral shaft using interlocking fixation.
Methods: This prospective study was conducted in Pathankot, Punjab, with patients who presented to our emergency department as participants. We included all patients over the age of 18 who presented to our emergency department with a comminuted femoral shaft fracture. All patients underwent interlocking nailing.
Results: During the study period, 62 patients fulfilled our inclusion and exclusion criteria, 79% of which were males. In the present study, 50% of the patients demonstrated clinical union of the fracture in 12 to 14 weeks, 24% had clinical union in 10 to 12 weeks, while 26% had clinical union in 14 to 16 weeks. Similarly, majority of the patients showed radiological union of the fracture in 16 to 18 weeks (48%). Radiological union occurred in 23% in 14 to 16 weeks and in 29% in 18 to 20 weeks. Majority (77%) of the patients stayed in hospital for 10 to 14 days and the functional outcome as measured by Klemm and Borner criteria was excellent in 63% patients. Infection (5%) and limb length discrepancy less than 5 mm (3%) were the only complications observed in our patient population.
Conclusions: Our results show that Interlocking nailing results in good functional outcome with minimal complications.

Keywords: Femur, Fracture, Interlocking Nailing, Surgery, Outcome

INTRODUCTION

The fracture of the femoral shaft is one of the most frequent fractures seen in orthopaedic practise. Injuries are most prevalent among individuals younger than 25 and older than 65.[1] Comminuted shaft fractures of the femur are becoming more prevalent due to the rise in traffic accidents, pedestrian versus vehicle collisions, sports injuries, falls from height, and industrial accidents. In high velocity injuries, one must have a high index of suspicion for sequelae or other associated injuries when the bone is subjected to abrupt and violent force resulting in severe and extensive communition, putting the vascularity of bone and adjacent tissues at risk.[2] Fractures are typically caused by a bending strain applied to the femur, whereas comminution is caused by forces of greater magnitude. In contrast, torsion stresses produce a spiral fracture pattern. The fracture of the femoral shaft is a leading cause of morbidity and mortality in patients with high-energy trauma. The causes of morbidity are limb amputation, mal union, non-union, and so-called fracture disease. The muscle atrophies and becomes fibrosed, the hip and knee joints lose mobility, and chronic dependent edoema develops. Mortality is uncommon, but can result from an open wound, fat emboli, adult respiratory distress syndrome (ARDS), or multiple organ failure, particularly

in multiple injured patients, deep venous thrombosis (DVT), pneuomia development, long intensive care unit (ICU) stays, infection, haemorrhage nerve palsies, and compartment syndrome.[3] Currently, surgery is recommended for the majority of femur fractures due to the high rate of union, the low rate of complications, and the benefit of early fracture stabilisation, which reduces the morbidity and mortality rates in patients (particularly polytrauma patients) with these fractures. Interlocking nailing of communited fractures with proximal and distal locking fasteners provides rotational stability, and the nail functions as a load-sharing device as opposed to a load-bearing device.[4] It is encouraged to apply axial loading across fractures with a stable pattern, thereby fostering callus formation. If performed using a closed method, i.e., without disrupting the fracture hematoma, the fracture, appropriate instruments, and specialised knowledge are needed to perform the procedure.[5] The purpose of this study was to evaluate the operative procedure for managing communited fractures of the femoral shaft using interlocking fixation. This study examines the epidemiology of femur fracture patients presenting to a trauma centre in Pathankot. It involves a comprehensive analysis of comminuted fractures of the femoral shaft following internal fixation with closed interlocking nails, as well as an endeavour to manage these fractures with early ambulation and the least amount of disability.

METHODS

Study design

This prospective study was conducted at SKR Hospital and Trauma Centre Pvt Ltd, Pathankot, Punjab, with patients who presented to our emergency department as participants. The duration of the research was from January 1, 2022 to May 30, 2023. We included all patients over the age of 18 who presented to our emergency department with a comminuted femoral shaft fracture. Initial treatment consisted of fluid therapy, antibiotics, and analgesics. After initial stabilisation, either the patient or the patient's attendant provided informed consent. The patient was admitted and monitored throughout surgery and the post-operative period. Our inclusion criteria was comminuted femoral shaft fracture in patients aged 18 to 70 who were treated with interlocking fixation. We excluded patients with associated abdominal and thoracic injuries, epiphysis involvement, previously operated cases of non-union and mal-union fracture shaft femur, pelvic injuries, and neurovascular deficits. Before beginning this investigation, an institution's ethics evaluation was obtained.

Operative details and post-operative recovery

A femoral canal-aligned incision was made proximal to the greater trochanter. Either a large cannulated drill over a terminally threaded pin or an entry awl was used to create an entry point. A guidewire was inserted through the incision and into the femoral canal. The fracture was reduced using traction. Reaming was performed while reduction was kept constant. Introduced nail affixed on proximal frame. The C arm image confirmed that the fracture reduction and the position of the nail were adequate. The guide wire was then eliminated. Interlocking was performed proximally and distally, and the incision was closed in layers following the removal of the proximal jig and ASD. As tolerated, all patients were encouraged to perform static quadriceps exercises within 12 hours and isotonic exercises within 48 hours. In the case of unstable fractures (comminution >50%), partial weight-bearing was delayed until radiographically visible callus was observed, or for approximately 6 weeks. Fracture union was radiographically evaluated at 1 month, 2 months, 3 months, and 6 months. If radiographic evidence of fracture callus was observed after 10 to 12 weeks, full weight bearing was advised. We considered a fracture to be united if there was no pain on palpation or motion at the fracture site, no increase in temperature at the fracture site, no distress with full weight bearing, and serial radiographs showed bone trabeculae across the fracture site.

Data collection and analysis

We collected demographic information such as the patient's age and gender, as well as a comprehensive medical history. The patient's medical history included the mechanism of injury, extent of fracture, type of fracture, time of fracture presentation, and time of surgery after admittance. From the operative and post-operative notes of each patient, additional information was extracted. In addition, the type of anaesthesia administered, the clinical union of fracture, the radiological union of fracture, protected or partial weight bearing, full weight bearing, hospital stay duration, any complications encountered, and the functional outcome of surgery were gathered. Functional outcome at the final follow-up of the patients was assessed using the Klemm and Borner criteria.[6] The hospital-obtained information was encoded and input into Microsoft Excel sheets. The data were then imported into EpiInfo for descriptive analysis.

RESULTS

During the study period, 62 patients fulfilled our inclusion and exclusion criteria, 79% of which were males. 87% of the study population was aged 50 years or less. Road traffic accident was the most common mode of injury, accounting for 77% patients (Table 1). Majority of patients had fracture in the middle one-third femur. It was observed that 69% of the patients presented within 24 hours of injury. 47% of patients were taken in for surgery within 1 to 3 days. General anesthesia was the most common mode of anesthesia administered to patients, accounting for 73% of all patients. In the present study, 50% of the patients demonstrated clinical union of the fracture in 12 to 14 weeks, 24% had clinical union in 10 to 12 weeks, while 26% had clinical union in 14 to 16 weeks. Similarly, majority of the patients showed radiological union of the fracture in 16 to 18 weeks (48%).

Table 1: Baseline characteristics of patients.

Variables	N	%
Gender		
Male	49	79
Female	13	21
Age (years)		
18-30	20	32
31-40	20	32
41-50	14	23
51-60	8	13
Mode of injury		
Road traffic accident	48	77
Industrial accident	14	23
Level of fracture		
Upper 1/3rd	14	23
Middle 1/3rd	32	52
Lower 1/3rd	16	26
Type of fracture (Winquist-Hansen classification)		
Type I	15	24
Type II	18	29
Type III	17	27
Type IV	12	19
Time of presentation after injury		
0-1 day	43	69
Less than 1 week	11	18
More than 1 week	8	13
Time of surgery after admission		
Less than 24 hours	3	5
1-3 days	29	47
4-7 days	14	23
More than 7 days	6	10
Mode of anesthesia		
General anesthesia	45	73
Spinal anesthesia	17	27
Total	62	100

Radiological union occurred in 23% in 14 to 16 weeks and in 29% in 18 to 20 weeks. Partial weight bearing was started in 34% patients in 10 weeks and full weight bearing in 42% patients in 16 weeks. Majority (77%) of the patients stayed in hospital for 10 to 14 days and the functional outcome as measured by Klemm and Borner criteria was excellent in 63% patients. Infection (5%) and limb length discrepancy less than 5 mm (3%) were the only complications observed in our patient population.

DISCUSSION

Important components of initial care includes evaluating the patient for significant injuries and treating them as necessary, inserting an intravenous catheter and administering analgesia, and immobilising the affected limb. Antibiotics and tetanus prophylaxis are provided to patients with open fractures. There is little clinical evidence to support the use of traction in the preoperative management of fractures of the midshaft of the femur. Despite this, many orthopaedic surgeons advocate immobilising well-aligned fractures in a skin traction device, with or without neurovascular injury.

Table 2: Clinical progress shown by the patients.

Variable	N	%
Clinical union (weeks)		
10-12	15	24
12-14	31	50
14-16	16	26
Radiological union (weeks)		
14-16	14	23
16-18	30	48
18-20	18	29
Protected/ partial weight bearing		
8	19	31
10	21	34
12	22	35
Full weight bearing		
16	26	42
18	18	29
20	7	11
22	11	18
Length of hospital stay (days)		
6-9	7	11
10-14	48	77
15-20	7	11
Functional outcome (Klemm and Borner criteria)		
Excellent	39	63
Good	12	19
Fair	11	18
Poor	0	0
Total	62	100

Table 3: Complications among the patients at last follow up.

Complication	N	%
Infection	3	5
Limb length discrepancy (<5mm)	2	3
Delayed union and nonunion	0	0
Re-fracture	0	0
Fat embolism	0	0
Pulmonary embolism	0	0
Deep vein thrombosis	2	3
Total	62	100

Those in favour of traction assert that it reduces patient distress, enhances fracture alignment, and may resolve arterial flow issues. A systematic review of studies on traction for proximal femur (hip) fractures revealed no distinct benefit; comparable studies on midshaft femur fractures have yet to be conducted. Traction for open fractures of the femur is controversial.[7] There is concern that the use of traction in such situations may permit contaminated bone fragments to re-enter the incision. Stabilisation of the fracture site to prevent additional haemorrhage, neurovascular damage, or soft tissue injury

takes primacy over the theoretical danger of increased contamination. However, decisions regarding splinting and traction should ideally be made in consultation with the orthopaedic or trauma surgeon who will undertake patient care. Age, concomitant injuries, and underlying comorbidities must be considered when determining definitive treatment for femur fractures, along with resource availability and clinician experience. Among the few patients who are not surgically treated are those who are too unstable to withstand the procedure and, in some instances, infants. The standard treatment for a fracture of the femoral shaft is an antegrade reamed intramedullary nail.[8] Even when used on open fractures, antegrade intramedullary nailing is associated with a 98 to 99 percent union rate and a low risk of infection (1 to 2 percent). Although reamed intramedullary nailing is considered the standard of care, unreamed intramedullary nailing is also associated with minimal non-union and infection rates (approximately 1.9%).[9] If the patient is hemodynamically stable, the committee on trauma of the American college of Surgeons recommends that femoral shaft fractures in polytrauma patients be repaired within two to twelve hours of injury.[10] According to randomised and observational studies, performing operative fracture repair within the first 24 hours reduces mortality, respiratory complications, multisystem organ failure, and hospitalisation duration.[11] In the present study, partial weight bearing was started in 34% patients in 10 weeks and full weight bearing in 42% patients in 16 weeks. In the studies conducted by Sahu et al and Kurupati et al the average duration of PWB was 6 weeks and 4 weeks, respectively.[11,12] The average duration of full weight bearing was 10.15 weeks for femur fractures and 12.65 weeks for tibia fractures. Al-Algawy-Alla found similar results in his study, where the average duration of FWB was determined to be 13.2 weeks.[12] The average duration of radiological union was 18.65 weeks for femur fractures and 19.29 weeks for tibia fractures. Anastopoulos et al and Webb et al both discovered that the average duration of radiological union in cases of femur fracture was 18 weeks. Similar results were found in studies conducted on tibia fractures by Siebenrock et al and Chauhan et al in which the average duration of bone union was 21.5 weeks and 20.13 weeks, respectively.[9-12] Overall, femur fracture complication rates are modest. Infection, aberrant fracture healing, and discomfort are the most common complications. Hemorrhage, neurovascular injury, compartment syndrome, repeat fracture, and hardware failure are uncommon complications. Complications that are uncommon but life-threatening, such as mortality, multiorgan failure, and respiratory complications, are more common in patients with multiple traumas. These complications are typically caused by acute respiratory distress syndrome and pulmonary or adipose embolism.

Limitations

There are a few limitations of this study. First, this was a single centre study and the post-operative outcomes might be different at other surgical centres with less experienced surgeons. Second, the patients could not be followed for a longer time to assess for late complications.

CONCLUSION

Fractures of the femoral midshaft are common in young adults as a result of high-energy trauma and in older patients as a result of lower-energy falls. In this research article, we describe the characteristics of patients who presented with a femur fracture, as well as their clinical course and complications during treatment. Our patients exhibited outstanding functional outcomes following interlocking riveting.

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