

A Comparative Study between Intramedullary Fixation and External Fixation of Femur Shaft Fracture in Polytrauma Patients in Jharkhand

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ABSTRACT

BACKGROUND

Femoral shaft fractures result from high energy trauma and maybe associated with life threatening conditions. Typical in younger people is associated with polytrauma. Though intramedullary nailing (IMN) is the gold standard option of treatment, external fixation (EF) can also be used temporarily or definitively, in such cases. The aim of this study was to compare the functional outcome of these two procedures.

METHODS

This prospective comparative study was conducted at our centre over a period of 6 years. Age, sex of the patients, laterality, type of fracture with mean follow up, union time, and complications such as delayed union, angular deformities, and limb length discrepancies were tabulated and compared.

RESULTS

There were more cases of open fractures in the EF group compared to IMN group. In the IMN group the average surgery duration was 95.76 minutes and it was 69.4 minutes in the EF group. The average time for bone union was 25.66 weeks in IMF group and 28.22 weeks in EF group. Complication rate was higher in EF group with 11 complications (7 major & 4 minor) compared to IMN group with only 6 cases presenting with complications (3 each of major & minor).

CONCLUSIONS

Though IMN is the gold standard in treatment of femoral shaft fractures, EF in polytrauma is an alternative method for definitive fracture stabilization, with minimal additional operative trauma and an acceptable complication rate.

KEYWORDS

Femoral Shaft Fractures, Intramedullary Nailing, External Fixation, Polytrauma, Definitive Treatment

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BACKGROUND

Femoral shaft fracture resulting from high energy injury has an incidence of 0.01% and often presents with polytrauma, comminuted fractures, and open fractures, and is commonly seen in younger people.¹ Causes of this include vehicular accidents, fall from heights, gunshot injuries, animal attack among others.² Over last few years several treatment procedures have been followed to treat femoral shaft fractures. Before the introduction of use of plates and screws, treatment of these was done by various types of trans-skeletal traction.³

Groves and Kuntcher introduced intramedullary nailing (IMN) for the treatment of femoral shaft fractures in United Kingdom and Germany, respectively.^{1,4} As of today, the gold standard for fracture of femur shaft is reduction and fixation with IMN.¹⁻⁵ However many a times, IMN cannot be done due to general condition of the patient precluding major surgery or in those with severe soft tissue damage. In these conditions, EF is mainly indicated to temporarily stabilize fracture⁶ which can be later converted into intramedullary nailing.⁷ This intermediate procedure reduces complication rates and costs.⁸ Also in countries like India, due to financial constraints it is often used as definitive treatment. Monolateral EF though not widely in treatment of femoral shaft fractures and is generally reserved for initial stabilization of polytrauma patients, or for open fractures,⁹ however carries the advantage of being rapid comparatively which plays an important role in critical patients and those with damaged vascular supply to the bone.¹⁰ This approach constitutes the 'Damage Control Orthopaedics' (DCO) concept devised to contain and stabilize orthopaedic injuries, especially long bones, so that overall physiology of the patient can be improved and avoid deterioration of the patient's condition by the 'second hit' of a major surgery. Hence this delays definitive fracture repair until general condition of the patient improves. The primary goal of DCO is to do as little as possible so as to avoid added damage from the non-life saving procedure. Decreased morbidity and mortality, forestalling pulmonary complications, including pneumonia, fat embolism and acute respiratory failure has been documented.¹¹ Also benefits such as improved patient mobility, decreased pain and reduced need of analgesics has been reported.¹² Severe comminution of bone is commonly seen at fracture site with bone loss in open type of fractures and hence EF is chosen as it along with stabilizing the fracture, it allows treatment of soft tissue wound.

Objective

The objective of this study is to compare the best and worst of the both procedures in treatment of femoral shaft fractures.

METHODS

Between January 2015 and December 2020, this comparative prospective study was conducted at our institution in Jharkhand by Department of Orthopaedics with

an aim to include at least 30 patients in each study group. Type of procedure employed depended on the general condition of the patient.

Cases with motor vehicle accidents were included in the study. Those patients in the age group 15 – 75 years were include in the study. Patients who did not attend follow-ups or who died for reasons unrelated to the fracture were ruled out. Monolateral external fixator (EF) group and Intramedullary Nailing with interlocking nail (IMN) group were the intervention used in this study.

Follow-ups were carried out for a minimum period of 9 months or until bone union occurred. Age at surgery, gender, injured side, laterality, location of fracture, duration of surgery, mean follow-up time, average weight bearing period time, average union time, and post-operative complications were recorded. Bone union was evaluated both clinically and radiographically according to common criteria.¹³

Fractures were considered united in the absence of movement and pain on stress at the fracture site and by radiographical evidence showing uniform and continuous ossification of the callus, with consolidation and development of trabeculae. Presence of abnormal movement at the fracture site at least 9 months after the injury and with no progressive signs of healing for at least 3 months was termed non-union. A Malunion criterion was shortening > 2.5 cm, angulation of more than 10°, or rotational malalignment of more than 5°. All other complications if occurred were noted. Patients were followed up 3, 6, and 8 months post-operatively.

Ethical Clearance

Institutional ethical committee clearance was obtained.

Statistical Analysis

The IMN group and the EF group data was summarized using percentage and compared on Microsoft Excel.

RESULTS

The average of patient age in IMN group was 39.4 years (ranging from 18 to 72) while the EF group had a mean age of 45.4 years (ranging from 16 to 74) (Table 1). There were 27 men (72.9 %) and 10 women (27.1 %) in IMN group whereas the EF group had 26 males (81.3 %) and 6 females (18.7 %) (Table 1). Two patients (5.4 %) had a bilateral femur fracture in IMN group while there were three patients (9.4 %) with bilateral femoral fracture in EF group. There were 35 patients (94.6 %) and 29 patients (90.6 %) with unilateral femur fracture in IMN and EF groups, respectively. (Table 1)

In IMN group, 15 patients (42.8 %) had right sided fracture while 20 patients (57.2 %) had left sided one, among the unilateral fractures. While in EF group, 16 patients (55.2 %) had right sided fracture and 13 patients (44.8 %) had left sided one, among the unilateral fractures (Table 1). In 8 cases (21.6 %) the fracture occurred at the

proximal third of the femoral shaft, in 20 cases (54 %) at the middle third and in 9 (24.4 %) at the distal third, in IMF group. While in the EF group, 6 cases (18.8 %) had fracture at the proximal third of the femoral shaft, 16 cases (50 %) had at the middle third and in 10 cases (31.2 %) fracture was seen in the distal third. (Table 1)

	IMN Group 39.4			EF Group 45.4		
Mean Age						
Gender	Male	Female		Male	Female	
	27	10		26	6	
Fracture Laterality	Unilateral	Bilateral		Unilateral	Bilateral	
	35	2		29	3	
Side Involved	Right	Left		Right	Left	
	15	20		16	13	
Type of Fracture	Open	Closed		Open	Closed	
	7	30		16	16	
Site of Fracture	Proximal	Middle	Distal	Proximal	Middle	Distal
	8	20	9	6	16	10

Table 1. IMN & EF Group Comparison

The mean operating time in the EF group was 69.4 minutes (range 42 - 100) and it was 95.76 minutes (range 67 - 147) in IMN group. The average time before post-operative weight bearing was started in IMN group was 31.27 days (range 28 - 35) and was 32.81 days (range 30 - 40) in EF group. The average time for bone union was 25.66 weeks (range 17 - 56) in IMF group and 28.22 weeks (range 20 - 48) in EF group. In the IMN group, 7 (18.92 %) patients had their nail removed at a mean time of 35.57 months (range 28 - 50).

Complications	Intra Medullary Nailing	External Fixation
Major		
Infection	1	2
Re-Fracture	0	1
Malunion	1	1
Loss of Reduction	0	2
Delayed Union	1	1
Minor		
Pin Point Infection	0	2
Knee Stiffness / Pain	2	2
Screw Rupture	1	0
Total	6	11

Table 2. Comparison of Post-Operative Complications

In the IMN group, there were a total of 6 complications (16.22 %), out of which 3 (8.11 %) were major and other 3 (8.11 %) were minor. 2 cases (5.4 %) - each of infection and malunion required re-surgery. In the EF group, there were a total of 11 complications (34.38 %), out of which 7 (21.88 %) were major and other 4 (12.5 %) were minor. 4 cases (12.5 %) - 1 of infection, 1 re-fracture and with loss of reduction) required re-surgery. Rest of the cases in both groups were conservatively managed. (Table 2)

In the IMN group the average follow-up duration was 46.46 months (range 34 - 61) and was 43.34 (range 34 - 53) in EF group.

DISCUSSION

High energy trauma such as road traffic accidents are the common cause of fracture of femoral shafts. They may be closed, (overlying tissues are intact) or open (bone is exposed). Femur fractures are usually classified according to the morphology of fracture line as transverse, oblique, spiral and comminuted. Femur fractures can result in severe and

permanent disability for instance limb shortening, rotational deformity and other complications such as infection, delayed union and non-union.

Such high energy / velocity traumas also result in accompanying injuries of trunk and head & neck placing the patient at high risk of mortality. These polytrauma (multiple injuries in three or more parts of the body) injuries can be life-threatening and time is of essence in management.

IMN is the ideal method for treating femoral shaft fractures. The nailing can be antegrade or retrograde. Both have relative advantages and disadvantages. Also IMN type of fracture fixation is associated with higher union rates and lower complication rates.

The monofixator (monolateral external fixator) provides reliable and enduring fixation in lower limb fractures with associated soft tissue trauma. Satisfactory reduction and stabilisation can be achieved in quick time. Monolateral EF is a system by which manipulation of bone segments through bone anchorage consisting of pins secured to an external frame support. They have the advantage of using half-pins so as to avoid damage to the nearby neurovascular structures. And also the simple structure allows brisk application reducing operative time and simplifies preoperative planning so as to allow attention of the treating polytrauma team towards life threatening complications, which is duly appreciated in traumatology.

Our prospective study compared two definitive treatment options used in treatment of femoral shaft fractures - intramedullary nailing (IMN) and external fixation (EF).

The demographic variables were comparable. Closed fractures accounted to 81% in the IMN group while in the EF group open fractures equalled closed fractures. This mirrors the fact that not only the general condition in a polytrauma case mattered in selection of type of procedure but also the nature of fracture - open / closed. Polytrauma patients require an early and rapid approach management and also most of the open fracture cases mandate the need for EF. Benefits of early reduction and fixation include decreased risk of fat embolism caused by fracture movements, pain relief and shortened hospital stay with early recovery. Rogers et al.¹⁴ in their study showed an increased risk of infections and pulmonary complications in patients who were treated 72 hours after the injury. That's where the need of utilizing EF when IMN cannot be employed.

The shorter the surgical time lesser would be the peri/post-operative complications in patients who are in a critical state due to high energy trauma.¹⁰ The average surgical duration was 95.76 minutes in the IMN group and 69.4 minutes in the EF group which is longer than those published in other literature, 60 & 40 minutes respectively.^{1,8} In both our and compared study EF took relatively lesser time to be performed.

Early stabilization of fractures, haemostasis, and management of accompanying intracranial / thoracic / abdominal conditions is the principle in treatment of polytrauma patients. The weight bearing protocol at our institution was to be allowed at a mean time of 5 weeks. The average time before post-operative weight bearing was started in IMN group was 31.27 days (range 28 - 35) and

was 32.81 days (range 30 - 40) in EF group. In a study by Testa et al,⁸ the mean non weight bearing weight was 25.82±27.66 days for the monoaxial EF. And it was same in both groups of our study as of the protocol. EF group was mostly delayed due to accompanying trauma to trunk / head & neck. Unequal post-operative weight-bearing in the groups also might have influenced different union times in the two groups which was 25.66 weeks (range 17 - 56) in IMF group and bone union took 28.22 weeks (range 20 - 48) in the EF group. However technically, weight bearing can be started earlier in those with EF.^{15,16}

However the major difference between the 2 groups was seen in complications recorded which was relatively higher in EF group compared to IMN group. In the IMN group, there were a total of 6 complications (16.22 %) while in EF group there were a total of 11 complications (34.38 %), which was almost the double of the former. In the study by Testa⁸, reported complications were 9.19% of delayed union, 8.05% cases of loss of reduction, 5.75% of malunion and 1.15% of septic non-union.

Pin-tract infection and knee stiffness seen in EF, though minor complications can largely be avoided with better hygiene, antibiotic therapy, and knee joint mobilization.¹⁷ In our study pin-tract infection was 6.25% in EF group with no cases in IMN group. Knee stiffness was seen in 2 patients in each group. 4 cases (12.5 %) in EF group and 2 cases (5.4 %) in IMN group needed to be operated on for the complications – such as corticocancellous bone graft, resetting of external fixation. In the EF group, loss of reduction was a frequent complication with 2 cases and they being treated with a new reduction and / or resetting of the external fixator.

Delayed union was treated conservatively in both groups having each one case. Infections were treated with toilette, and antibiotics. The IMN group had a relatively longer average follow-up duration of 46.46 months than EF which had 43.34 months. 7 (18.92 %) patients had their nail removed at a mean time of 35.57 months while all the EF cases had their fixators removed at 32 – 34 weeks.

IM nailing is an effective method in treatment of femoral shaft fractures yielding high union rates and low complication rates. With the current available techniques and implants at the disposal of Orthopaedician, excellent results can be obtained by this procedure.

Conversion of temporary EF done as an emergency procedure to an IMN is standard practice. But in certain regions of our country where private medical centres are (relatively) expensive and government facilities are inadequate those patients with financial constraints are often treated with EF as definitive procedure. However satisfactory results can be obtained with definitive EF if stable fixation is achieved during procedure. Compared to IMN though the complication rate is relatively high, predictable results can be obtained in treatment of complex and severe femur fracture. Staged removal of EF, early ambulation & physical therapy involving post-operative protocol if followed, outcome of this is satisfactory. Plaguing pin tract infections can be treated by local wound care and antibiotic therapy. However, other problems of EF such as decrease in knee range motion should be effectively tackled.

CONCLUSIONS

To conclude, surgical management of femoral shaft fractures has several options to be considered and need to be tailored to the patient individually. Though IMN is the gold standard, with good outcomes and low rates of complications, EF has its advantages too. In comminuted fractures or associated injuries, EF has been proven to be an ideal method for definitive fixation, because of minimal invasiveness, decreased blood loss and thromboembolism risk, shorter operative duration and earlier weight-bearing. But it is associated with more complications and lesser patient compliance. Hence assessment of the patient condition and selection of procedure accordingly is imperative on part of the treating surgeon.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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REFERENCES

- [1] Li AB, Zhang WJ, Guo WJ, et al. Reamed versus unreamed intramedullary nailing for the treatment of femoral fractures: a meta-analysis of prospective randomized controlled trials. *Medicine (Baltimore)* 2016;95(29):e4248.
- [2] Jurkovich JG, Carrico CJ. Trauma-management of acutely injured patients. In: Sabiston D, edr. *Textbook of surgery: the biological basis of modern surgical practice*. 15th edn. W.B. Saunders Company, 1997: p. 296-340.
- [3] Scannell BP, Waldrop NE, Sasser HC, et al. Skeletal traction versus external fixation in the initial temporization of femoral shaft fractures in severely injured patients. *J Trauma* 2010;68(3):633-640.
- [4] Babalola OM, Ibraheem GH, Ahmed BA, et al. Open intramedullary nailing for segmental long bone fractures: an effective alternative in a resource-restricted environment. *Niger J Surg* 2016;22(2):90-95.
- [5] Winkquist RA, Hansen ST Jr, Clawson DK. Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases. *J Bone Joint Surg Am* 1984;66(4):529-539.
- [6] Rokkanen P, Slätis P, Vanka E. Closed or open intramedullary nailing of femoral shaft fractures? A comparison with conservatively treated cases. *J Bone Joint Surg Br* 1969;51(2):313-323.
- [7] Nowotarski PJ, Turen CH, Brumback RJ, et al. Conversion of external fixation to intramedullary nailing for fractures of the shaft of the femur in multiply injured patients. *J Bone Joint Surg Am* 2000;82(6):781-788.
- [8] Testa G, Aloj D, Ghirri A, et al. Treatment of femoral shaft fractures with monoaxial external fixation in polytrauma patients. *F1000Research* 2017;6:1333.

- [9] Stojiljković P, Golubović Z, Mladenović D, et al. External skeletal fixation of femoral shaft fractures in polytrauma patients. *Med Pregl* 2008;61(9-10):497-502.
- [10] Sabharwal S, Kishan S, Behrens F. Principles of external fixation of the femur. *Am J Orthop (Belle Mead NJ)* 2005;34(5):218-223.
- [11] Richards JE, Matuszewski PE, Griffin SM, et al. the role of elevated lactate as a risk factor for pulmonary morbidity after early fixation of femoral shaft fractures. *J Orthop Trauma* 2016;30(6):312-318.
- [12] Kobbe P, Micansky F, Lichte P, et al. Increased morbidity and mortality after bilateral femoral shaft fractures: myth or reality in the era of damage control? *Injury* 2013;44(2):221-225.
- [13] Kessel L. Clinical and radiographic diagnosis of Watson-Jones' Fractures and joint injuries. Edinburgh: Elsevier 1992: p. 258-259.
- [14] Rogers FB, Shackford SR, Vane DW, et al. Prompt fixation of isolated femur fractures in a rural trauma center: a study examining the timing of fixation and resource allocation. *J Trauma* 1994;36(6):774-777.
- [15] Arazı M, Oğün TC, Oktar MN, et al. Early weight-bearing after statically locked reamed intramedullary nailing of comminuted femoral fractures: Is it a safe procedure? *J Trauma* 2001;50(4):711-716.
- [16] Kubiak EN, Beebe MJ, North K, et al. Early weight bearing after lower extremity fractures in adults. *J Am Acad Orthop Surg* 2013;21(12):727-738.
- [17] Babar IU. External fixation in close comminuted femoral shaft fractures in adults. *J Coll Phys Surg Pak* 2004;14(9):553-555.