National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2020; 4(3): 42-45
Received: 22-05-2020
Accepted: 24-06-2020

Dr. Dhrumil S Dave
(Assistant Professor Department of Orthopedics) SMT NHL MMC, Ahmedabad, Gujarat, India

Dr. Harsh N Patel
Resident Doctor Department of Othopeadics, SMT NHL MMC, Ahmedabad, Gujarat, India

Dr. Krishna Kumar Ashwin
Resident Doctor Department of Othopeadics, SMT NHL MMC, Ahmedabad, Gujarat, India

Dr. Kaushal Upadhyay
Resident Doctor Department of Othopeadics, SMT NHL MMC, Ahmedabad, Gujarat, India

Corresponding Author:
Dr. Dhrumil S Dave
(Assistant Professor Department of Orthopedics) SMT NHL MMC, Ahmedabad, Gujarat, India

Study of results of intramedullary nailing in segmental fracture femur

Dr. Dhrumil S Dave, Dr. Harsh N Patel, Dr. Krishna Kumar Ashwin and Dr. Kaushal Upadhyay

DOI: https://doi.org/10.33545/orthor.2020.v4.i3a.235

Abstract
Orthopaedic surgeons often encounter segmental femur fractures, because these fracture most often result from high-energy trauma, one must have high index of suspicion for complications. Currently surgery is indicated for most femur fractures because of high rate of union, low rate of complications and advantage of early stabilization which decreases the morbidity and mortality rate in patients. While the main stay of the treatment has been reamed intramedullary nailing.
Methods: We studied a total of 50 patients of segmental fracture femur admitted in the orthopaedic department, treated with intramedullary nailing. The common age group was ranging from 20 to 41 yrs with average age group of 35.85 yrs. 22 patients were males, 8 were females. 23 patients had closed fracture, 7 had open fractures. 12 patients were operated by open nail and other 18 by closed technique using C-arm.
Results: Mean time for union was more in patients treated by open procedure (20 weeks) as compared to closed technique (18.35 weeks). We found 2 patient developed superficial infection, which healed completely and 2 had deep infection with nonunion. In our series of 30 patients, 21 patients had excellent results, 9 patients had good results and 1 had fair result.
Conclusions: Intramedullary nailing is a very effective and successful method of definitive primary treatment, in most types of segmental fractures of the femur. It is effective in controlling rotational and longitudinal forces that act across the fracture site. Nail provides strong fixation, rotational stability and earliest return to functional status, as the rate of healing is good with this method. It allows early weight bearing and reduce rehabilitation.

Keywords: Segmental femoral fractures; intramedullary nailing

Introduction
Long bone fractures are often a result of high-energy trauma which may result into comminuted or segmental fractures. Fractures following high-energy trauma are often associated with extensive soft tissue injuries [1].
The average annual incidence of femoral fractures has been quoted to range from 0.1 to 3% (up to 37 per 100000 patient years), with peak incidence in young adult males and a second peak in incidence, with low energy mechanisms is seen in the elderly population [2]
Segmental femoral fracture is a unique fracture type characterized by a completely isolated intermediate fragment separated by distinct fractures at two or more levels. This fracture is rare in adults, most commonly occur in young patients who often result from high energy mechanism such as motor vehicle crash or fall from height. [3] These fractures most commonly occur in the young males. Infection rates are higher as majority of these are open fractures with more severe soft tissue injury [4]
Segmental fractures of the femur are commonly encountered in routine orthopaedic practice. As femur is the longest weight bearing bone in the body and is surrounded by soft tissue envelope. Femur fracture usually occurs due to high- energy trauma and fracture may result in prolonged morbidity and extensive disability unless treated appropriately. This often leads to nonunion or delayed union. Segmental fractures are characterized by circumferential loss of cortical contact even after the reduction.[5] The state of the surrounding soft tissues and the local blood supply to the bone are the most important factors determining the tendency of the fracture to heal.[6] This is usually compromised in segmental fractures because of injury to the

surrounding soft tissues in addition to the compromised blood supply to the middle segment. This often leads to nonunion or delayed union [7]

Treatment method depends on the type and location of fracture, degree of comminution, age of the patient and patient's social and economic demands. The technique chosen should focus on minimal soft tissue and bone damage. The goal should be to achieve anatomic alignment and early mobilization with functional rehabilitation of limb. Many modalities of treatment have evolved over the years for this fracture.

The method studied here is Intramedullary nailing either antegrade nailing or retrograde nailing.

Since most patients are polytraumatized, it has become essential to treat these patients surgically unless and until it is contraindicated. The surgical treatment has gone into revolutionary changes over the period of time and with advent of new antibiotics and better surgical procedures, even open fractures can be fixed internally. Internal fixation is done by different methods like: dynamic compression plate and screws and intramedullary nailing with or without interlocking. It is generally accepted that closed reduction and internal fixation with an intramedullary nailing (IMN) is an effective method for the treatment of segmental femoral fracture with the benefit of minimization of soft-tissue injury. However, closed reduction of severely displaced fracture is difficult to achieve and maintain, usually at the cost of operation time [3]

Among all different methods of internal fixation, intramedullary fixation has become popular during the last few decades, due to the following attributes:-

1)The nail provides internal stabilization along the axial line of forces; as nail lies in the axis of femur,2) predictable realignment of bone, 3) prevention of excess dissection of fracture site and protection of surrounding soft tissue envelope when done biologically, resulting in abundant callus with less need for bone grafting, 4) minimal potential for contamination, 5) rapid regeneration of bone and union of fracture allows intermittent dynamic axial compression with weight bearing, which promotes fracture consolidation, 6) less chances of stress shielding being a load sharing implant and early functional use of limb [8]

The interlocking nail system combines the best of both i.e. not only does it offers axial and rotational stability in comminuted and unstable fractures, but also involves minimal interference with soft tissue around the bone especially when introduced in a closed manner [9]

Intramedullary Interlocking nailing of femur has now become the treatment of choice in almost all fractures regardless of the fracture pattern and degree of comminution. The focus of this study is to restore alignment, rotation and length, preservation of blood supply to aid union, prevention of infection and early rehabilitation of the patient with femoral fracture with the aim to evaluate post-operative alignment of fracture fragments, time for radiological union at fracture site and the post-operative complications in long term follow-up (1 Year).

Materials and Methods

Data of 50 patients was collected having segmental fracture of femur. The inclusion criteria of the study were closed segmental femoral fracture, open segmental fracture with wound size <1 cm and Intertrochanteric fracture and Fracture shaft femur and the exclusion criteria of the study were open segmental fracture with wound size >1 cm , Intracapsular neck femur fracture and Fracture shaft femur. The patients falling into the inclusion criteria were informed about the nature of the surgery and written informed consent was taken.

These cases of segmental fracture shaft femur were treated either by femur nail or proximal femoral nail (PFN) or Intramedullary Supracondylar Nail (IMSC), which is locally available and is based on AO design nail with proximal locking jig and two proximal and distal holes and one oblique proximal locking hole.

Fracture union was taken as the absence of tenderness at the fracture site during weight bearing with callus bridging at least three cortices on two different views of the fracture radiologically. Nonunion is defined as ―A fracture that, in the opinion of the treating physician, has no possibility of healing without further intervention.

In ward patients detailed history, through clinical exam and the general condition was assessed. Associated orthopaedic and other systemic injuries were assessed and managed accordingly. X-rays are taken in 2 planes, AP and lateral including x-ray of ipsilateral hip and knee joint.

Surgical Procedure

Antegrade Nailing

For Antegrade nailing patient was shifted to Jacksons fracture table, oblique incision from the proximal tip of the Greater trochanter continuing it proximally for 6-8 cm was used. Entery was made through the piriformis fossa with the help of curved pointed awl.

Percutaneous pins were used to reduce the segmental fracture followed by reaming and guide wire insertion. The position of the guide wire was confirmed under the image intensifier and tip of guide wire was passed into the sub chondral bone in the central direction, after which the nail was inserted with the help of the jig under the guidance of image intensifier and the guide wire was removed. Then proximal locking was done with the help of proximal jig followed by distal locking after removal of the jig. Closure was done. When closed technique failed to reduced fracture fragments or inability to pass the guide wire in the distal fragment or the cases operated more than three weeks after injury were operated by open techniques.

Image 1: Showing pre-operative, immediate post-operative and 15 months followup Xray of patient operated by Antegrade nailing

Retrograde Nailing

For retrograde nailing approximately 5 cm incision was kept from inferior pole of patella to patellar tendon followed by incising subcutaneous tissue, patellar tendon is cut and infra patellar fat pad is retracted. Fracture reduction was achieved by manual traction pulling to the upper tibia. Direct reduction can also be achieved with the help of bone hook in securing the anatomic alignment. Then guide wire was gently slide through the soft tissue into the pre drilled entry portal, advanced into the proximal fragment under the image intensifier guidance.

Appropriate sized nail were inserted after the sequential reaming and both proximal and distal locking was done followed by

through irrigation of the wound and wound closure was performed.

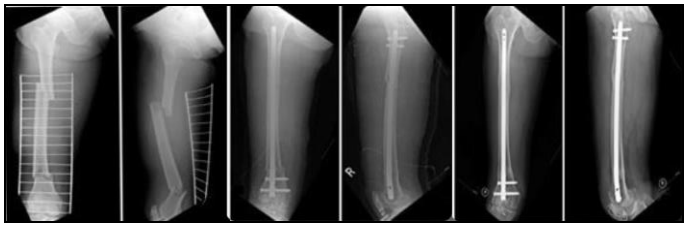

Image 2: Showing pre-operative, immediate post-operative and 12 months followup Xray of patient operated by retrograde nailing

Results

This is study of 50 cases of segmental fracture femur treated with intramedullary nail. It was found that fracture of femur is most common in 3rdand 4th decade of life, with mean age of 35.85 years.

Table 1: Age Distribution

Age in years	No. of patients (n)	Percentage (%)
11-20	0	0
21-30	13	26
31-40	29	58
41-50	8	16
51-60	0	0
61 & above	0	0
Total	50	100

Table 2: Sex Distribution

Sex	No. of patients (n)	Percentage (%)
Male	37	74
Female	13	26
Total	50	100

Road Traffic accident in 43 patients out of 50 patients was observed to be the main cause of fracture in our study. (86%)

Our study shows that 76% of our segmental fracture femur was of closed variety whereas 24% of rest was of open type. According to Gustilo- Anderson classification all open segmental fracture are considered to be open grade type III.

Open nailing was done in 11 patients and closed nailing in all other 39 patients. Average healing time of union in open procedure was 20 wks and in closed procedure it was 18.35wks.

Most common post-operative complication was found to be non-union in 18% of total cases. Non-union was commonly seen at one fracture site. Both site non-union was not seen frequently.

In our study of 50 patients 8 patients had post-operative shortening of <2 cm which was negligible. 6 patients had 2-5 cm shortening. No patient our study had gross shortening of >5 cm.

According to Harris hip score 54% of our patients had excellent result, 22% had good results, 20% had fair results and only 4% had poor results. Total 76% patients had excellent to good results which are statistically significant. ($p< 0.05$)

Table 3: Harris Hip Score

Score	No of patients (n)	Percentage (%)
91 – 100 (Excellent)	27	54
81 – 90 (Good)	11	22
71 – 80 (Fair)	10	20
< 70 (Poor)	02	04
Total	50	100

According to Knee society score, 54% patients had excellent results, 20% patients had good results, 16% had fair results and 10% had poor results. Total 74% patients had excellent to good results which are statistically significant. ($p< 0.05$)

Table 4: Knee Society Score (KSS)

Score	No of patients (n)	Percentage (%)
81 – 100 (Excellent)	27	54
71 – 80 (Good)	10	20
61 – 70 (Fair)	08	16
< 60 (Poor)	05	10
Total	50	100

Discussion

Road traffic crashes account for 87% of all segmental femoral fractures. It is estimated that for every road traffic injury (RTIs)-related death, there are up to 50 times more survivors with some type of disability. This incidence relates to increased no. of two-wheelers and four-wheelers in our country leading to high energy trauma.

Male patients in the first four decades of life with mean age of 35.85 years have often been shown to be largely affected by trauma. Male: Female ratio being 2.7:1 depicting higher incidence of fracture in driving population.

Segmental fractures have always been associated with high-energy trauma. It is, therefore, not surprising that 68% (34) of our patients had associated injuries ranging from other long bone fractures to head injuries. This is accounted for the prolonged hospital stay, since there are no support facilities for proper hospice care outside the hospital. Other studies on segmental fractures also report prolonged hospital stay due to the associated injuries.

Various methods of management of segmental long bone fractures have been documented. These range from conservative or nonoperative management to locked intramedullary nailing, locked plating, dynamic compression plates, rush nail, ender nails, and external fixation. Nonoperative management has been found to be associated with nonunion rates as high as 27.2%. Even when union does occur, it is often delayed and malunited with a significant loss of muscle bulk and consequent difficulty in rehabilitating the patient. A multicenter study in the UK compared the outcome of segmental fractures managed with compression plating, intramedullary nails, and external fixators. The study showed that the use of intramedullary nailing had the best outcome. Intramedullary nailing has the benefit of soft tissue protection, load-sharing capacity of the implant, closed method of application, and preservation of extramedullary blood supply. We have no records of management outcomes using other methods of fixation of segmental fractures in our center.

Though antegrade nailing is usually favored for femoral fractures, we were guided by the standard indication for the retrograde approach, which in our study were mainly fractures located close to the distal femoral condyles.

It is important in open nailing to ensure that soft tissue exposure and dissection are minimal to ensure the preservation of periosteal blood flow to the middle segment which we tried to achieve in this study. Despite that there is slight increase in healing time (about 2 wks) when compared with closed method.

Closed nailing ensures that the original fracture hematoma is preserved at the fracture site, thereby promoting union. Closed reaming of the intramedullary canal also deposits useful graft material around the fracture site. On the other hand, open nailing technique often results in extensive soft tissue damage and increased blood loss, raising concerns about nonunion and

infection. Nonetheless, because it requires no special equipment and achieves quick stabilization, some authors advocate open nailing for polytrauma patients. The technique is also particularly useful in resource- poor environments because it requires less training and minimally expensive equipment. Liao *et al.*[10] described a mini-open method of reduction and nailing for femoral fractures, a variation of which was used in our study, where a small incision was made at the fracture site and reduction was achieved using one or two fingers passed through the incision. Their study demonstrated a comparable union rate (97.3%) to that of closed nailing. However, their study was performed on simple or minimally comminuted fractures. The proximal and distal segments were reamed leaving the middle segment except when there was a long middle segment. This helped us to avoid devitalizing the blood supply to the middle segment while attempting to stabilize it for reaming.

Despite the open method of reduction, our overall union rate of 82% at 4 months is comparable to other reports of nailing. Delayed union and nonunion are the known complications of segmental fractures. Among the patients studied, there were 7 cases of one nonunion which involved the fracture between the middle and distal segments and 2 cases of both nonunion. We concluded the reason for nonunion being massive soft tissue disruption at the time of injury, extensive displacement of fracture fragments both resulting into severe damage to blood supply to bone. Cancellous bone grafting was done at the site of nonunion on latter aspect. This was followed with dynamization, and union was eventually achieved. However, various studies have reported inconsistent results with dynamization, preferring only bone grafting for delayed union.

The other complications recorded were two superficial wound infections which were managed with antibiotics and wound dressings, and they resolved in a few days.

The prolonged hospital stay was mainly due to delayed mobilization as a result of the multiple injuries sustained by the patients. The patients with more severe additional injuries had longer periods of admission compared with those with the segmental fractures alone. These made mobilization difficult and sometimes necessitated procurement of wheelchairs before discharge to home.

In our study, approximately 75% patients had excellent to good results according to Harris hip score and Knee society score which are statistically significant ($p < 0.05$). These patients had minimal pain, subtle limp, excellent range of motion imparting them independent walking and minimal interference in daily routine activities leading to a better quality of life. The rest 25% patients had fair to poor Harris hip score and Knee society score. These patients had improvement in pain with time but due to nonunion and other factors like malalignment, implant failure etc; patients were having limited range of motion at hip and particularly at knee impairing them to bear weight on the fractured limb.

Conclusion

Intramedullary nailing provides strong fixation, rotational stability, early weight bearing, reduced rehabilitation and earliest return to functional status. It allows resumption of knee range of movement exercises at early stage; so it is possible to give good knee range of movement at the end. Though few cases required secondary procedures either in the form of bone grafting and dynamization or in the form of plating; intramedullary nailing is a very effective and successful method of definitive primary treatment, in most types of segmental fractures of the femur.

Intramedullary nailing being a load-sharing implant induces periosteal callus formation and secondary bone healing. Also, the fact that procedure been done in a closed manner, it causes minimal iatrogenic soft tissue disruption, decreased blood loss during surgery and preservation of fracture haematoma leading to a more biological fixation. Thus, uncovers the superiority of intramedullary nailing over plating. This observation runs parallel to the previous similar studies done.

Thus, intramedullary nailing is still the most cost-effective, reliable and preferred treatment of modality for segmental fracture femur.

References

1. Babalola OM, Ibraheem GH, Ahmed BA, Olawepo A, Agaja SB, Adeniyi A. Open intramedullary nailing for segmental long bone fractures: an effective alternative in a resource restricted environment. Nigerian Journal of Surgery 2016;22(2):90-5.
2. Memarzadeh A, Tissingh EK, Hull P, Trompeter A. Intramedullary nailing of femoral shaft fractures in adults. Orthopaedics and Trauma 2017;1;31(2):86-92.
3. Liu H, Wu J, Lin D, Lian K, Luo D. Results of combining intramedullary nailing and plate fixation for treating segmental femoral fractures. ANZ journal of surgery 2019;89(4):325-8.
4. Ramkishan D, Narsimulu SY. A Study of Management of Segmental Fractures of the Long Bones. Journal of Contemporary Medical Research 2016;3(9):2672-5.
5. Kempf I, Grosse A, Beck G. Closed locked intramedullary nailing. Its application to comminuted fractures of the femur. JBJS 1985;1;67(5):709-20.
6. Nayagam S. Principles of fractures. In: Solomon L, Warwick D, Nagayam S, editors. Apley's System of Orthopaedics and Fractures. 9th ed.. London: Hodder Arnold 2010, 695p.
7. Lin J, Hou SM. Locked nailing of severely comminuted or segmental humeral fractures. Clinical Orthopaedics and Related Research® 2003;1;406(1):195-204.
8. Brumback RJ, Uwagie-Ero S, Lakatos RP, Poka A, Bathon GH, Burgess AR. Intramedullary nailing of femoral shaft fractures. Part II: Fracture-healing with static interlocking fixation. The Journal of bone and joint surgery. American volume 1988;1;70(10):1453-62.
9. Anastopoulos G, Asimakopoulos A, Exarchou E, Pantazopoulos T. Closed interlocked nailing in comminuted and segmental femoral shaft fractures. The Journal of trauma 1993;35(5):772-5.
10. Liao JC, Hsieh PH, Chuang TY, Su JY, Chen CH, Chen YJ. Mini-open intramedullary nailing of acute femoral shaft fracture: reduction through a small incision without a fracture table. Chang Gung medical journal 2003;26(9):660-8.