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Original Research Article

Prospective study of functional outcome of distal femur fracture managed by distal femur nailing

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ABSTRACT

Background: The purpose of the present study was to assess the functional outcome of distal third femur fracture managed by retrograde intramedullary nailing.
Methods: 25 patients with closed distal third femur fracture were enrolled in the study satisfying the inclusion criteria and underwent surgical management with distal femur nailing. Follow up of all the patients was done at 1, 3, 6 and 12 months. The functional outcome of all the operated patients was evaluated by using Lysholm knee scoring system.
Results: In present study 25 cases underwent surgical management with distal femur nailing. After the clinical sign and radiological sign of union, cases were trained with active and passive joint mobilization exercises and functional outcome was evaluated by Lysholm knee scoring system (component-limp, support, pain, instability, locking, swelling, stair climbing, and squatting). The scores were further graded as excellent (>90), good (84-90), fair (65-83) and poor (<65). Out of 25 patient, functional outcome was excellent in 13 (52%), good in 4(13%), fair in 6 (24%) and poor in 2 (8%).
Conclusions: The retrograde intramedullary nailing can be considered as a successful, safe reliable, effective and useful technique which should find a place in the armamentarium of every orthop**a**edic surgeon who deals with distal third femoral fractures.

Keywords: Retrograde nailing, Distal femur fractures, Union, Functional outcome

INTRODUCTION

The distal femur fractures accounts for an incidence of around 37/100,000 patients per year. Generally, two different mechanisms of injury cause distal femur fractures. In the old age population as the bone is osteoporotic and soft-tissue has vulnerable envelope, distal femoral fractures occur predominately after low-energy trauma, e.g., falls and sprain injuries complicated by a high rate of co morbidity (60% female, older than 60 years). In young patients (60% male, younger than 40 years), high-energy trauma causes complex injury with comminuted and open fracture pattern.[1] Despite affecting the same anatomical location as young patients, fractures in the elderly pose different challenges due to osteoporotic bone and the overall patients' medical condition.[2]

During early 1960s, there was a great resistance towards operative management because of inadequate fixation, high incidence of infection, non-union, malunion and lack of proper instruments, implants, as well as antibiotics. Then, the traditional management of displaced supracondylar fracture of femur was according the principle of Watson Jones and John Charnley, which comprised of skeletal traction, manipulation of fracture and external immobilization like casts or cast bracings.[3,4] These methods had complications like malunion, deformity, prolonged bed rest, shortening, knee stiffness,

angulations, joint incongruity, quadriceps wasting, post-traumatic osteoarthritis and knee instability.

The management of distal femoral third fracture consists of the use of AO blade plate, dynamic condylar screw (DCS) and implant systems like intramedullary supracondylar nails/retrograde intramedullary femor nail. Supracondylar fractures have tendency to collapse into the varus. The use of DCS or AO blade plate, leads to lateral pulling of the shaft of femur, thus displacing the line of weight bearing which is lateral to the anatomic axis of condyle. This leads to rotational movements at the fracture site that pulls off the blade plate or condylar screws causing fatigue fracture of the plates.

Moreover, the presence of osteoporotic bone leads to fixation failures with screws and plates cutting off the soft bone.

The intramedullary femur nail act as a load sharing device which helps to give good results with good stability and less soft tissue dissection. The benefits of nailing are that it aligns the femoral shaft with condyles thus decreasing the tendency to place varus mal-alignment at the fracture site. As bending movement of an intramedullary device is substantially decreased failure of fixation in osteoporotic bone is less. A retrograde intramedullary femur nail has got other advantages like of fracture hematoma preservation, blood loss reduction, indirect fracture reduction, minimal soft tissue dissection, reduced operative time, less rate of infection, benefit in osteoporotic bone and also they result in high healing rates in fractures of the distal femur.[5] There are biomechanical advantages of intramedullary nailing system over screws and plates because of their intramedullary location which results in less stress on the implant, also they have the potential for load sharing and less stripping of soft tissue is seen when they are inserted.

The controversy still exists regarding the optimum device for distal third femur fracture fixation. Hence, the present study was confined to analyse prospectively the functional outcome of distal femur/retrograde nailing in distal femur/supracondylar femur fractures.

METHODS

The present prospective study included 25 patients with closed distal third femur fracture.

Study period

The duration of the study was from January 2020 to December 2021.

Study place

The study was conducted at Vilasrao Deshmukh Government Medical College, Latur.

Statistical tool

Statistical package for the social sciences (SPSS) 27.0 version and Graph prism 7.0 version was used for statistical analysis.

The selection of patients was carried out according to the following inclusion and exclusion criteria.

Inclusion criteria

Patients admitted to orthopaedics department of tertiary care centre with: age in the range of 18 to 70 years; clinically and radiologically confirmed cases of distal third femur fractures of AO types A1, A2, A3; closed fracture of distal third femur; patients of both the gender; patients medically fit for surgery; and patients who have given written consent for treatment as per protocol included in our study.[6]

Exclusion criteria

Patient age less than 18 years; patients with proximal and middle third femur fractures; type 1, 2, 3a, 3b and 3c compound fractures according to Gustilo Anderson classification for open fractures; patients with distal third femoral fractures of AO types B and C; patients having pathological fracture at distal third femoral region; patient who are medically unfit; and patient who has not given written consent for treatment as per the protocol were excluded from the study.

After getting approval from institutional ethical committee and informed and written consent from the patient, the patient selected in the study were subjected for thorough clinical examination. The baseline investigations and radiographic analysis of the affected femur were analyzed and was classified radiologically according to the AO classification.

All the cases were managed surgically with distal femoral nailing and were followed up according to the study protocol.

Surgical procedure

Preoperative planning

Preoperative calculation was done on radiographs to confirm the length and diameter of implant.

Patient position

After induction of patient with either spinal anesthesia or epidural anesthesia, patient was placed supine with knee flexed at 30 degrees. Roll was used to provide knee flexion so as to reduce pull of gastrocnemius muscles on the distal fragment. This also permitted easy lateral imaging of distal femur.

Operative procedure

Preparation

The limb was scrubbed, prepared and draped. Prophylactic IV antibiotics and tetanus toxoid was given 30 min prior to incision.

Approach

A midline incision of 4 cm was taken from inferior pole of patella up to tibial tuberosity. The paratenon over patellar tendon was sharply incised and patellar tendon was split in the midline along the direction of its fibres.

Entry point and insertion of guide wire

The entry point for the nail was in line with the axis of the medullary canal, just below crest of intercondylar notch. With the bone awl, posterior cruciate ligament was identified and 1 cm anterior to it, entry was taken that is confirmed under C-arm guidance. Under C-arm guidance, the guide wire was then inserted into the medullary canal through the entry point.

Reaming

Using cannulated reamer in an increment of 0.5 mm, the reaming of the medullary cavity was done for about 1 mm more than the planned nail diameter.

Insertion of intramedullary nail

The predetermined nail was loaded over the jig. The nail was then inserted over the guide wire through the entry point which was made previously, first through the distal and then proximal fragment after appropriate reduction which was confirmed on image intensifier and then depending on the length of the nail, the proximal holes of the nail were locked prior to distal holes.

The required length of interlocking bolt was measured with the help of depth gauge and self-tapping interlocking bolt of 4.9 mm thread diameter passed from lateral to medial cortex engaging the locking hole in the nail. The jig was then disengaged to remove the debris,

Closure

The joint was washed thoroughly. Haemostasis was achieved and incision was closed in layers, repair of paratenon of patellar tendon was done precisely.

Postoperative

In the wards, limb elevation was done with injectable analgesics and antibiotics were prescribed for 5-10 days. Patients were shifted on static quadriceps and active or active assisted bedside knee mobilization and continuous passive mobilization machine and knee was flexed passively till 80 degrees on second post-operative day. Suture removal was done on 14th postoperative day**.**

Patients were discharged on postoperative day 15. Patients were given crutch training and were made ambulatory on bilateral axillary crutches without weight bearing. Toe touch walking was allowed by the 6th week as the patient gained confidence on crutches. Further, weight bearing was allowed depending on the clinical and radiological picture. The initial fracture geometry, intraarticular communition, stability of fixation were the major factors considered while advising progressive weight bearing.

Follow up

All patients were followed up at the end of 1, 3, 6, 12. At each follow-up patient was assessed as regards clinico-radiological union in the form of pain, thickening, warmth at fractures site, radiographic alignment, evidence of callus seen, knee range of motion, extensor lag and shortening (Figures 1 and 2).

Figure 1: X-ray (AP, lateral) (a) preoperative, (b) post op, and (c) 12 months follow up.

Unprotected weight bearing was avoided till there was good clinical and radiological evidence of progressive fracture healing. For each fracture type, the long-term results were evaluated using Tegner Lysholm knee scoring scale rating system which assigns points for pain, working and walking capacity, range of movement, and radiological appearance.[7]

Figure 2: Clinical outcome in a patient with retrograde distal femoral nailing at 12 months post-surgical procedure.

RESULTS

The descriptive statistics were reported as mean (SD) for continuous variables, frequencies (percentage) for categorical variables and software used in the analysis were statistical package for the social sciences (SPSS) 27.0 version and Graph Pad Prism 7.0 version.

Demography

Among 25 cases 18 cases (72%) were males and 7 cases (28%) were females (Table 1). The maximum number of cases belonged to 21 to 30 years age group i.e. 7 cases (28%) followed by 41-50 years and 51 to 60 years age group i.e. 6 cases (24%) respectively. Mean age of the patients was 37.92±12.69 (19-60 years**)** (Table 1).

Table 1: Demographic detail.

Age group in years	Male (%)	Female (%)
≤20	2 (8)	0 (0)
21-30	6 (24)	1 (4)
31-40	2 (8)	2 (8)
41-50	4 (16)	2 (8)
51-60	4 (16)	2 (8)
Total	18 (72)	7 (28)
Mean±SD	35.83±12.87	43.28±11.33
Range (years)	19-56	30-60

Mode of injury

Among 25 cases 20 patient (80%) sustained an injury due to road traffic accident, 3 cases (12%) had a self-fall and 2 cases (8%) due physical assault (Figure 3).

Fracture type: AO classification

According to AO classification, in our study among 25 cases, 15 cases (60%) were of A1 type, 7 cases (28%) were A2 and 25 cases (12%) were A3 type of distal third femur fracture (Table 2).

Table 2: Distribution of patients according to fracture type: AO classification.

AO classification	No. of patients	Percentage
A1	15	60
A2	7	28
A3	3	12
Total	25	100

Radiological union

In the study 20% of the cases had union in 12-14 weeks 48% in 15-17 weeks, 24% of them in 18-20 weeks and 8% of the patients had radiological union in 21-24 weeks. Mean radiological union was seen at 16.56±2.69 weeks (Table 3).

Table 3: Distribution of patients according to radiological union.

Radiological union (weeks)	No. of patients	Percentage
12-14	5	20
15-17	12	48
18-20	6	24
21-24	2	8
Total	25	100
Mean±SD	16.56±2.69 (12-24 weeks)	

Weight bearing

In 36% of the patients full-weight bearing was 8 to 11, in 56% of the patients it was 12 to 15 and in 8% of the patients full weight bearing was 16 to 20 and mean full weight bearing was 12.64±2.65 (8 to 20) (Table 4).

Table 4: Distribution of patients according to weight bearing.

Weight bearing	No. of patients	Percentage
8 to 11	9	36
12 to 15	14	56
16 to 20	2	8
Total	25	100
Mean±SD	12.64±2.65 (8 to 20)	

Knee flexion

In 2 patient (8%) knee flexion was 70-80 degree, in each 6 patient (24%) knee flexion was 80.1-90 degrees, 100.1-110 degrees and 110.1-120 degrees and in5 patient (20%)

knee flexion was 90.1-100 degrees. Mean knee flexion was 100.60±13.33 (Table 5).

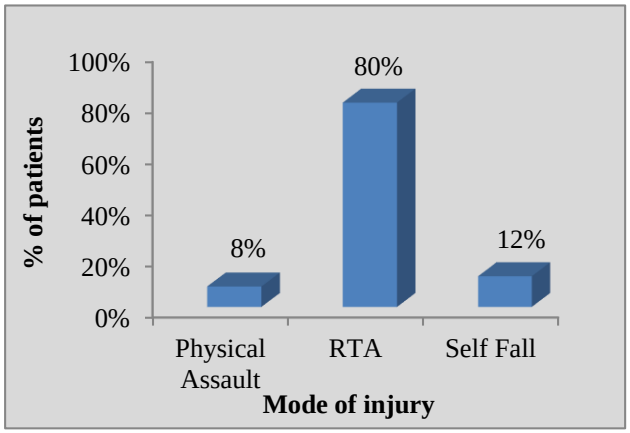

Figure 3: Mode of injury.

Table 5: Distribution of patients according to knee flexion.

Knee flexion (degree)	No. of patients	Percentage
70-80	2	8
80.1-90	6	24
90.1-100	5	20
100.1-110	6	24
110.1-120	6	24
Total	25	100
Mean±SD	100.60±13.33 (70-120 degrees)	

Complications

Out of 25 cases in our study most common complication encountered was knee pain in 5 patient (20%) of the patient, followed by shortening in 3 patient (12%), there is 1 patient (4%) each with screw backout, superficial infection and varus degree alignment (Table 6).

Table 6: Distribution of patients according to complications.

Complications	No. of patients	Percentage
Knee pain	5	20
Screw backout	1	4
Shortening	3	12
Superficial infection	1	4
Varus angulation	1	4
Not any	14	56
Total	25	100

Functional outcome

After the clinical sign and radiological sign of union, cases were trained with active and passive joint mobilization exercises and function assessment were made using Lysholm score system (component-limp, support, pain, instability, locking, swelling, stair climbing, and squatting). The score was further graded as excellent (>90), good (84-90), fair (65-83) and poor (<65). Out of 25 patient, functional outcome was excellent in 12 patient (52%), good and fair in 5 patients each (20%) and poor in 2 patients (8%) (Table 7).

Table 7: Distribution of patients according to functional outcome.

Lysholm score	Functional outcome	No. of patients	Percentage
<65	Poor	2	8
65 to 83	Fair	5	20
84 to 90	Good	5	20
>90	Excellent	12	52

DISCUSSION

Of all femoral fractures, distal femur fracture comprises of 4-6%.[8] In general population, bimodal distribution of distal femur fracture is seen. It is predominantly seen in 15-50 years of age males, sustaining high-energy trauma, and above age 50 years predominantly in females, with osteoporosis, sustaining relatively low energy trauma. Intramedullary nailing and bridge plating are commonly used treatment modalities for fractures of distal femur. As they need less soft-tissue dissection and devitalisation, they are considered as biologic methods of fixation. Complications such as non-union and infection are less compared to traditional methods of open reduction and plating since fracture hematoma is preserved in these methods of fixation. Compared to plating, intramedullary nails are load sharing devices that allows early weight-bearing post-operatively.[9] The treatment modality used in this study was distal femur nailing.

Retrograde intramedullary nailing was developed in an attempt to overcome the limitations of antegrade nailing. The management of distal femur fracture by retrograde nailing technique and its outcome in 25 patients was evaluated in our study. Interlocking Intramedullary nailing was found to be a safe and effective means of fracture fixation. The early mobilization of neighbouring soft tissues and joint is a proof of the amount of stability provided by the fixation. This is a biological means of fixation and aims at providing early useful movements of the extremity.

In present study, age distribution was from 18 to 70 years with a high incidence in the 21-30 years age group, accounting for 28% (7 out of 25) of study population. The mean age of all patients was 37.92±12.69 years. Comparable results were obtained by Shah et al where the mean age of the patients was 35.20 years with minimum age patient of 20 years and maximum of 50 years.[10] Jahangir et al had a mean age of 42.75 years in their study with minimum age being 18 years, maximum age being 70 years.[8]

Duration of union of fracture in our study was from 12-24 weeks with an average of 16.56 weeks. This was comparable with the study conducted by Loya et al, Jahangir et al where mean duration of fracture union was 16 weeks and 15.81 weeks respectively.[5, 8] 100 percent of the fractures were healed in our study. Similar findings were seen in series of Gellman et al, Jahangir et al, Loya et al and Dileep et al.[5,8,9,11] But in the series of Handolin et al 95% of the fractures were healed in regular healing time (less than 24 weeks).[12] No non-union occurred in present series. Similar finding was found in the series of Gellman et al, Jahangir et al, and Loya et al.[5,8,11] But Anaberu et al, Handolin et al found non-union of 2.65% and 4.7% cases respectively in their series.[12,13] A study by Dileep et al showed 3 (14.3%) cases of delayed union.[9] In present study, no delayed union was seen.

Road traffic accident was the most common mode of injury observed in present study accounted for 20 out of 25 (80%) followed by self-fall accounted for 3 out of 25 (12%) of total patients and 2 patients had a history of physical assault (8%). In a study conducted by Dileep et al, most common mode of trauma was RTA 13 (62%), fall from height in 5 (28.50%).[9] In study conducted by Shah et al, motor vehicle accident had caused fracture in 68 (70.1%) patients while 29 (30.2%) patients sustained fractures due to fall on ground.[10]

Regarding range of knee motion, at the latest follow-up examination was 70-80 degree in 2 case, 80.1-90 degree in 6 cases, 90.1-100 degree in 5 cases, 100.1-110 degree in 6 cases and 110.1-120 degree in 6 cases. The mean range was 100.60 degree. This was comparable with the result of Jahangir et al and Gellman et al where the mean range was found to be 115º and 106º respectively.[8,11]

Full weight bearing in the present series was observed at an average 12.64 (8 to 20) weeks. This was closely comparable with the series by Loya et al where full weight bearing was achieved on an average in 11.68 weeks.[5]

In our study, maximum number of the patients had their healing in excellent alignment without shortening. The 2-2.5 cm shortening that occurred in 3 patients did not affect their function. All of them could do well with shoe raise. The common reason for pain in the post-operative period were distal end protruding in the knee joint, prolonged knee stiffness, loosening of locking bolts impinging over the skin, improper insertion of nail and superficial infection at the site of locking bolts. All the patients were comfortable with simple analgesics. This was positively correlated with other studies Anaberu et al.[13]

In our study only superficial infection was seen in one patients who responded very well to the antibiotics similar to other studies Shah et al, and Anaberu et al.[10,13] IV antibiotics was given for 5 days followed by oral antibiotics for 5 days with regular dressings. The anterior knee pain cases were managed conservatively with oral analgesics. Cases with varus angulation were advised for the nail removal which can lead to its correction in due course of bony remodeling. The screw backout case was advised screw removal.

All cases in our study were trained with active and passive joint mobilization exercises after the clinical sign of fraction union. Different types of rating scales are used to get the functional outcome after surgical treatment of supracondylar fracture of femur. Neer, HSS, Karlstrom and Olerud, Leung, Schatzker, Sanders, Lysholm knee score are some of the scales. The functional assessments in present study were made with Lysholm knee scores (components-Limp, support, pain, instability, locking, swelling, stair climbing, and squatting).[7] These scores were graded as excellent (>90), good (84-90), fair (65-83) and poor (<65). The results of present study show poor functional outcome in 8% (2 cases), fair in 20% (5 cases), good in 20% (5 cases) and excellent in 52% (13 cases).

The results were comparable with the study by Anaberu et al in which functional assessment was made with Lysholm knee scoring, the study showed excellent in 48.77% (55 patients), good in 34.51% (39 cases) fair in 9.73% (11 cases) and poor in 7.07% (8 cases).[7]

However, long terms follow up and large-scale study is needed to evaluate the final effect of this procedure as little is known about the longer effects of retrograde intramedullary nailing.

CONCLUSION

Retrograde intramedullary nailing shows excellent functional outcome for distal third femur fracture. It provides stable fracture fixation, less soft tissue disruption with decrease in blood loss and good purchase of the distal bone fragment which allows early joint mobilization and weight bearing. There is less difference in individual fracture type healing and weight bearing. Retrograde intramedullary nailing has higher rate of union, with a low incidence of complications. This can be considered as a successful, safe, reliable, effective and useful technique which should find a place in the armamentarium of every orthopaedic surgeon who deals with distal third femoral fractures that initially requires attention to details of the technique to prevent any complication.

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