Research Article

Outcomes of retrograde nailing of distal femoral fractures in Indian population: a prospective study

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Abstract

Background: Distal femur fractures are tough to handle, and the choice of implant for internal fixation remains controversial. One of the therapeutic principles that can be employed for the treatment of distal femoral fractures is retrograde intramedullary nailing, which follows the principle of biological osteosynthesis.

Objective: To investigate in a retrospective manner the results of retrograde nailing in distal femoral fractures and selected cases of femoral shaft fractures. Emphasis was posed on long-term functional outcome, especially in daily activities.

Materials and Methods: Retrograde femoral nailing was used from January 2010 to October 2015 in level 1 trauma center for the treatment of various types of femoral fractures (AO/ASIF-type 32/33) in 20 patients with 21 fractures. Patients were followed up till fracture healing and invited to a functional follow-up using Neer's knee scoring system.

Result: Osseous healing occurred in shaft fractures in 18.33 weeks on an average when compared with 15.25 weeks in supracondylar fractures. Stiffness was seen as only late postoperative complication in five of 19 (26.31%) patients beyond 1 year of postoperation. Two patients with pathological fracture died on follow-up owing to metastasis. After a mean 20.4 month follow-up, the mean scores were 85 in shaft and 74 in distal femoral fractures (I/A and E/A). Motion was better in shaft fractures (arc of motion—mean: 116.67°) than in distal femoral fractures (arc of motion—mean: 102.18°).

Conclusion: Retrograde nailing represents a reliable fixation method for extra-articular (33A) and intra-articular (33C) fractures of the supracondylar area. In femoral shaft fractures, retrograde inserted nails offer a valuable alternative, especially when the proximal femoral approach is obstructed. There is a need of methodologically sound clinical trials to generate high quality evidence for efficacy of retrograde nailing.

KEY WORDS: Retrograde nailing, femoral fractures, supracondylar femoral fractures, Neer's knee scoring

Introduction

Distal femur fracture accounts for 0.4% of adult fractures and observed mainly in elderly population.[1] The occurrence of distal femur fractures is around 37 of 100,000 patients per year.[2] In the geriatric age group with osteoporotic bone and vulnerable soft-tissue envelope, these fractures occur mostly owing to low-energy trauma often complicated by comorbidities. High-energy trauma causing complex injuries are responsible for comminuted and, sometimes, open fractures in young population, and, sometimes, these patients are polytraumatized. These fractures are getting more common because of increase in the incidence of osteoporosis.[3]

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Different types of femoral fractures require various operative treatments to avoid severe local and general sequelae. In particular, the operative treatment strategy in distal femoral fractures has different options. It has evaluated over period. Earlier, it was refrained to classic plate osteosynthesis (ORIF) procedures for a long period, but it was associated with very high complication rates.[4] After the evolution of biological plating, the rate of complications intra- and postoperation

has been reduced dramatically, and the requirement of bone grafting for nonunion has also much reduced. In the present time, two implants that are designed specifically for the distal femur and meant for less invasive procedures with minimum compromise of local biology—the plate/internal fixator system of LISS-DF (LCP-DF) for extramedullary use and retrograde nails for intramedullary fracture stabilization.[5] Retrograde intramedullary nailing is not only used for distal femoral area but also for femoral shaft nailing. This study is designed with the aim of analysis of functional outcome of retrograde femoral nailing.

Materials and Methods

This is a prospective observational study conducted at a tertiary-health center. This study is based on data of femoral fracture patients who were treated by retrograde nailing (RN) between January 2010 and October 2015. After taking permission from ethics committee, all the patients who were admitted for femur fracture surgery were followed up by an investigator. Various factors related to the patients and treatment were noted in the predesigned pro forma. Data related to these parameters were compiled and synthesized into frequency and percentages.

Operative Procedure

For RN, Indian made nails were used. This supracondylar nail (SCN) provides four distal interlocking screws and the possibility of compression and may be used for the stabilization of metaphyseal, distal femur fractures. Intraoperatively, patients were positioned supine on an operation table with the leg flexed at 40°–60° and the distal femur supported by a pillow to facilitate reduction of the distal fragment. For nail insertion, a medial para-ligamentous (15/21, 71.42%) or trans-ligamentous (6/21, 28.57%) incision was used. In extra-articular fractures, percutaneous insertion of the retrograde nail was possible, whereas, in comminuted intra-articular fractures, additional lateral arthrotomy was required. The insertion point was localized radiologically on the anteroposterior (AP) and lateral views in the intercondylar notch, anterior to Blumensaat's line and in projection of the femoral shaft axis. Clinically, the correct insertion point was verified by positioning the K-wire anterior to the femoral insertion of the posterior cruciate ligament (PCL) in the intercondylar notch. Following biplanar X-ray control, the K-wire was inserted into the medullary canal respecting a 7-degree valgus angle to the horizontal plane of the joint, and the cortex was opened using a 10-mm drill bit over the K-wire with a drill sleeve to protect from reaming debris. The K-wire was removed and replaced by a long guidewire. The latter was used to intubate the proximal fragment and positioned in the intramedullary canal proximal to the lesser trochanter. Limited reaming of the medullary canal was performed in 0.5 mm increments until cortical contact was appreciated. For final reaming, a reamer with a diameter of 2 mm larger than the selected nail diameter was used. The length of the nail was determined by measuring the guidewire, ensuring that the nail reaches proximally to the intertrochanteric region. The retrograde nail was inserted under fluoroscopic control. Final position of the distal end of the nail was below the chondral surface in the subchondral bone of the distal femur. The distal interlocking screws were inserted using the aiming device and trocar. In the SCN, four 5-mm interlocking screws were used (one proximal condyle screw: 5 mm, two oblique locking screws: 5 mm, one distal condyle screw: 5 mm). Whenever the dynamic compression option was utilized, the nail was inserted 1 cm deeper than the SCN. Insertion of an end cap locked the distal condyle interlocking screw and prevented screw loosening. Proximally, free-hand insertion of two interlocking screws in AP direction was performed.

Postoperative mobilization and physiotherapy were started after 24 h, and weight bearing was adapted to the fracture type, comorbidities, the estimated quality of osteosynthesis, and bone stock. Patients were followed up with regular clinic and radiographic evaluations till fracture healing. Osseous healing was defined radiographically as the presence of at least three of four healed cortices, with bridging callus formation and crossing trabeculae on AP and lateral radiographs. Clinical healing was defined as the absence of functional pain and local tenderness at the previous fracture site. All patients were evaluated using Neer's scoring system.

Result

From January 2010 until October 2015, 20 patients with 21 fractures of the femur were treated in our institution with a retrograde femoral intramedullary nail (IMN). Sixteen male (76.2%) and five female subjects (23.8%) with a mean age of 49.8 years (range: 21–80 years) were treated. Fourteen of 21 (66.67%) fractures were on the left side, five of 21 (23.8%) fractures on the right side, and one (4.77%) case was a bilateral fracture. In elderly patients with preexisting osteoporosis, the fracture was caused by trivial trauma-like slip and fall (n = 6/21, 28.57%). In young population, the fracture was seen owing to high-energy trauma such as road traffic accidents (n = 13/21, 61.9%) and fall from height (n = 2/21, 9.52%). Twelve fractures were seen as isolated injuries, one was bilateral, one was grade 3a open fracture, one was polytrauma patient with head injury and rib fracture, and five patients showed other fractures.

According to the AO/ASIF–fracture classification 18 of 21 (85.71%) belonged to type 33 (distal femur) and three of 21 (14.28%) to type 32 (femoral shaft). Two fractures (2/21, 9.52%) represented pathologic fractures (secondary to bronchial carcinoma and multiple myeloma) of the distal metaphysis. In distal femoral fractures (AO/ASIF type 33), the decision of use of retrograde IMN was left to the surgeon. In femoral shaft fractures (AO/ASIF type 32), the use was restricted to cases where the fracture line extended into the distal dia-metaphyseal area where distal nail insertion seemed

favorable owing to the injury pattern (e.g. floating knee injury) or a problematic proximal approach (e.g. inlying implant).

Preoperatively, the AP and lateral X-rays of the knee with distal femur were performed. Computed tomography (CT) scan was performed in patients with intra-articular extension to assess displacement of fragments, degree of comminution, and detection of coronal plane fractures that are difficult to identify on plane films. If impairment in perfusion or vascular injury is clinically diagnosed, diagnostic assessment using CT-angiography or conventional angiography is indicated and performed. In addition, X-ray view of the proximal femur and the hip joint (AP and lateral) was done to rule out a multilevel femur fracture in all cases as part of the diagnostic protocol.

Average time period between injury and surgery was 2.7 days (range: 0–9 days). Reduction in all cases with extra-articular fracture was indirectly accomplished (10/21, 47.61%) either manually, by traction, or external fixation. In 11 of 21 (52.39%) cases with intra-articular fractures, limited arthrotomy was used. Mean operation time lasted 62.47 min (range: 45–98 min.) and was found slightly shorter in femoral shaft fractures with 51 min than in distal fractures with 63 min. One case with bilateral fractures was nailed on both sides in same sitting. Average blood loss was 88 mL. Postoperative weight bearing was allowed according to individual fracture anatomy, quality of fixation, and concomitant injuries. It was started in femoral shaft fractures after 6 weeks on an average (range: 4–8 weeks) compared with distal fractures after 9.11 weeks (range: 6–12 weeks). Complete radiological healing in shaft fractures took slightly longer with 18.33 weeks (range: 17–20 weeks) than in supracondylar fractures with 15.25 weeks (range: 10–19 weeks). Adequate time for fracture healing was observed in 19 fractures (90.47%), while two (9.5%) patients died on follow-up before complete radiological union. No early or immediate postoperative complication was noted. As a late complication, back out of distal screw was seen in one case after complete osseous healing, and screw removal was done. Five cases with intra-articular fractures had stiffness in knee even after 1 year of surgery and treated with physiotherapy. Neither malalignment nor shortening was seen in any of cases. Eighteen of 20 patients with 19 of 21 fractures (90.47%) were evaluated using Neer's knee score with a mean follow-up time of 20.4 months (range: 13–28). Two patients had passed away owing to metastasis. Examination included X-rays of the affected limb and clinical evaluation of the patients according to Neer's scoring. Mean Neer's score was 79 suggestive of good results. Neer's score was 85 in shaft fractures showing excellent results and 73 in supracondylar fractures suggestive of good results. The mean arc of motion in shaft fractures was 116.67° (min.: 110°/max.: 125°), which was distinctly higher than results in distal fractures with 102.18° (min.: 80°/max.: 120°). Only a minority of patients had an unlimited ability of squatting (22.7%) and sitting cross-legged (27.8%). In contrast, all patients had unrestricted full weight bearing capacity requiring no support. Fifteen of 21 (71.42%) patients reported occasional pain episodes requiring analgesic tablet. Furthermore, all the knee joints were reported to be absolutely stable, and, upon clinical examination, no evidence of PCL compromise could be found. Radiological changes in follow-up examination were not conclusive, as intra-articular changes could not be directly related to nail implantation or the natural course of osteoarthritis.

Discussion

This was a retrospective, record-based, descriptive study to understand and describe the management of RN in fracture of femur. In this study, there was no immediate or early complications of RN observed, and, in five cases, knee stiffness was observed after 1 year. In many studies, it was observed that, in spite of knee stiffness, range of motion was not affected as majority of patients showed good range of motion postoperatively. Similar findings were observed in other studies also.[6] In such surgeries, chances of complications are always there because of the infection, nonunion, or malalignment. Use of "biological" osteosynthesis and minimum invasive approach can reduce the complications significantly.[7]

Complete radiological healing as per this study was around 4.5 months. Fracture healing time was less in the case of supracondylar fracture. This may be a chance finding as the sample size of overall study, especially supracondylar fracture was too less. There is no clear advantage of fracture healing time between anterograde and RN as per the published literatures. Various factors such as mechanical factors, fracture morphology, reaming of medullary canal, etc. play a role in fracture healing after intramedullary nailing.[8] As per the observation of Ostrum et al.,[9] longer healing time in the case of RN is mainly owing to fracture morphology and surrounding soft tissue injury than technique of insertion. In this study, better results are obtained in RN when compared with other studies. This may be because of the younger patients, favorable location, and absence of any other preexisting pathology.

This study has some very important limitations. The sampling was purpose; hence, patients were not chosen randomly. Sample size was also very less; hence, any comparison was between supracondylar and shaft fractures. There was no head-to-head comparison with the anterograde fracture; hence, comparison was done indirectly based on previous studies.

To us, RN represents an established stabilization method in distal femoral fractures. In femoral shaft fractures (AO/ASIF classification 32), the retrograde approach presents a dependable substitute to anterograde nailing and may even be beneficial, chiefly in the presence of hip pathologies/implants that are increasingly common in elderly patients. Chiefly, this age group benefits from retrograde IMN by early postoperative mobilization of the patients integrated with a minimal compromise of local vascularity and an almost complete submerging of the implant, which brings down soft tissue irritation and makes the implant suitable even in persons of poor general

status. Clinical outcome might mostly be based on surgical approach rather than on the option of implant. Multicenter studies with high numbers of patients are required to draw useful conclusions.

Conclusion

RN represents a reliable fixation method for extra-articular (33A) and intra-articular (33C) fractures of the supracondylar area. In femoral shaft fractures, retrograde inserted nails offer a valuable alternative, especially when the proximal femoral approach is obstructed. There is a need of methodologically sound clinical trials to generate high quality evidence for efficacy of RN.

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