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Management of distal femur fractures treated with distal femur nail

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Abstract

Background: Distal femur fractures were considered difficult to heal and often led to a degree of disability and deformity. The incidence of malunion, nonunion and infection are relatively high in many studies. The management goal of distal femur fractures are correction of axial alignment, length and rotation, restoration of range of movements and rapid union so as to return the patient to normal function. We present here result of retrograde nailing of extra-articular (AO 33A1 to A3) fractures of the distal femur using Distal Femoral Nail (DFN).

Methods: In Between 2019 to 2021 total 15 patients who underwent open reduction and internal fixation for distal femoral fracture in K.R. hospital. There were 11 male and 4 female patients, age range from 16 years to 83 years, mean age.

43.8 years. Average length of follow-up was 17.5months (12 months to 24 months).

Results: Total 15 patients was available for follow up. Regular fracture healing was observed in 14 cases. Delayed union in 1 case. Two patient had superficial infection, and two patients had leg shorting of 0.5 and 1 cm. Axial misalignment (Varus/valgus angulations) was found in two cases (5°-10°) there were no implant failures. On the bases of HSS score to measure functional outcome, 7 cases had excellent, 6 cases had good and 1 cases had fair result. Poor results were seen in one patient.

Conclusion: Distal Femoral Nail is a reasonably good tool to treat distal femoral fracture.

Keywords: Distal femur, fracture, distal femoral nail (DFN), internal fixation

Introduction

Fractures of the distal femur account for 4-6 percent of all femoral fractures^[1,2]. In the general population, distal femur fractures occur in two age groups: 15-50 years old, mostly in males who have sustained high-energy trauma, and 50+ years old, predominantly in females with osteoporosis who have had relatively low-energy trauma^[2].

The quadriceps, adductors, hamstrings, and gastrocnemius muscles can all produce fracture fragment displacement biomechanically^[3].

The gastrocnemius can generate posterior angulation of the distal segment, which can be overriden by the quadriceps and hamstrings working together.

Intercondylar fractures can also be rotated and propagated by the heads of the gastrocnemius.

Depending on the fracture configuration and its proximity to the adductors, they might create varus or valgus deformity. depending on the fracture configuration and its relationship to the adductor tubercle. For a long time they were considered difficult to heal and often led to a degree of disability. These difficulties become greater when they are associated with elderly patients who present with a high degree of osteopenia. So when considering fixation, fixation system needs to be strong enough to resist these deforming forces and yet adaptable enough to deal with the various fracture patterns.

The popliteal artery is relatively fixed and lies in close relation to distal femur and can be damaged by a posteriorly angulated fracture, but this is rare, with an incidence of approximately 0.2%^[3]. Another important consideration is regaining full knee motion and function which may be difficult because of the proximity of these fractures to the knee joint. The incidence of malunion, nonunion and infection are relatively high in many reported series^[4]. The goals of management of distal femur fractures are correction of axial alignment, length, and rotation, restoration of motion and rapid union so as to return the patient to normal

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Function [5]. The treatment of distal femoral fractures has undergone a substantial evaluation in the last three decades. Initial publication by Neer, Connolly, Mooney and Stewart and their colleagues conclude that non operative methods primarily traction alone or the combination with a cast, were superior to open reduction and internal fixation. But later work from AO (Arbeitsgemeinschaft für Osteosynthesefragen) group and others with better fixation device and soft tissue handling it was clearly demonstrated that operative treatment fur superior to non operative one and has been abandoned as treatment for fractures of the distal femur at the end of 1960ies [6]. For operative treatment many different fixation methods have been described, Angled Blade Plate (ABP) Dynamic Condylar Screw (DCS) Condylar Buttress Plate (CBP) antegrade intramedullary nail, retrograde nail, flexible nail, Minimally Invasive Skeletal Stabilization (LISS) plate, external fixation, total knee replacement [7]. We investigated the feasibility and functional outcome of retrograde nailing of extra-articular (AO 33A1 to A3) fractures of the distal femur using Distal Femoral Nail (DFN).

Materials and Methods

In this study, 15 distal femur fractures in 15 patients were treated at K.R. Hospital between 2019 and 2021. All fractures were surgically treated using DFN. The fractures included acute traumatic fractures, pathologic fractures, and non united fractures eleven patients were males and four were females, with average age of 43.8(16-83) year. The mechanism of

trauma was RTA in 11 patients (73%, Table 1), domestic fall in 4 patients (27%). We classified the fractures according to AO system. They consisted of 8 type A1, 7 type A2. There were 2 open (20%) fractures. Surgery was performed on the 2nd to 10th day following injury (mean time 6 days) under subarachnoid block anaesthesia.

We used titanium retrograde femoral nail system. Standard Pre-operative assessment carried out on radiographs (AP, lateral) to decide nail length, diameter and lengths of interlocking bolts. Transpatellar approach was used, with mid-line incision from the inferior pole of patella to tibial tuberosity. The entry point for the nail is in the axis of the medullary canal and in the intercondylar notch, just anterior and lateral to the femoral attachment of the PCL, determined on image intensifier. All 15 fractures were fixed using RFN with one locking proximal screw inserted in 13 fractures and 2 fractures were press fit proximally with no proximal screw.

Post-operatively, static quadriceps and active or assisted bedside knee mobilization was started from the 2nd post-operative day. Toe touch weight bearing was started after 6 weeks, followed by full weight bearing from 10th week with the help of a walker as radiographic evidence of healing (obliteration of fracture line) is noticed. Functional evaluation was done according to modified Hospital for Special Surgery knee rating scale (HSS). Relationship between clinical results and fracture type, surgical approach, and patient age were evaluated.



Fig 1: None required second surgery: one had deep infection treated with surgical debridement and IV antibiotics, two had loosening of proximal screws and backing out of distal bolt were removed after fractures became sticky

Results

All Fifteen patients were available for follow up for a mean period of 13 months (range 12 to 26 months). The average operating time was 85min±25min and for open approach than closed approach. Four patients developed superficial infection which was treated with IV antibiotics for 2 weeks. One patient (6.6%) had anterior knee pain of mild to moderate

severity which disappeared gradually with physiotherapy and weight bearing and ROM exercises. There were 4 patients (10.5%) with shortening of operated limb between 1 – 2 cm not affecting daily activities.

The mean time to union was 21 weeks (range 16 to 36 weeks). Delayed union (more than 42 weeks) was seen in one fracture (6.6%) and managed by dynamization. None required

second surgery: one had deep infection treated with surgical debridement and IV antibiotics, two had loosening of proximal screws and backing out of distal bolt were removed after fractures became sticky (Fig.1), one underwent revision surgery and changing of the nail because of fracture redisplacement. No breakage of screws or nail was seen. Functional outcome using modified HSS scale (Table 2) showed excellent results in seven (46.66%), good in six (40%), moderate in 1(6.6%), and poor in 1(6.6%) fractures. Knee range of flexion (Table 3) was normal in ten fractures (66.6%), 90°- 110° in two fractures (13.33%), 85° in two fractures(13.3%), and <85° in 1 fractures (6.6%). There were two fractures with varus deformity (13.33%, 5°-10°) were tolerated and asymptomatic, and two with posterior angulation (13.33%, 10°- 15°). Final knee flexion among fracture type and surgical approach showed almost similar result. Final knee arc was inversely correlated to patient age with patients younger than 55 years had very good knee ROM. Gait performance was satisfactory for isolated distal femur fractures. By the end of follow up period all fractures had united clinically and radio logically.

Discussion

The surgical treatment of distal femur fractures is challenging. The introduction of indirect fracture reduction techniques and less invasive approaches significantly reduced septic complications and nonunion rate, and provided specific biomechanical advantages. Seif Sawalha *et al.* in their series of 56 distal femur fractures in 54 elderly patients treated with RFN, concluded that RFN is good fixation method which allows immediate mobilization for elderly patients [29]. Arun K. N. *et al.* reported the results of 40 supracondylar and intercondylar fractures in 40 patients operated with RFN concluded that concept of biological fracture fixation is possible in these difficult and complex fractures with less operative time, minimal soft tissue stripping, minimal blood loss, decreased need for bone grafting and reasonably rigid fixation in osteoporotic bones. Post-operatively it helps in rapid mobilization and early functional rehabilitation [30]. Our current also study showed the same. Postoperative ROM in elderly patients was less compared to young due to preexisting conditions like osteoporosis, senile dementia, or osteoarthritis. There was no failure of the nail, while failure of distal interlocking screws and proximal screw was reported in one of the 15 patients, had screws removed. Generally the closed surgical approach has some advantage over open approach, shorter duration of surgery, minimal soft tissue invasion, and less blood loss.

The significant advantage of retrograde nail is early weight bearing which cannot be recommended with plates. RFN provides reliable fracture healing and good functional results, even in the old age group, or in extreme osteoporosis [13, 16, 31, 32, 33, 34, 35, 36]. Thus excellent and satisfactory results, according to Neer`s classification, are found in 72% to 85% of geriatric collectives [33, 35]. By the end of follow up period all fractures had united clinically and radiologically, in our study. El Kawy emphasized the advantage of early movement provided by IMN without decrease of mobility, though he observed in his collective a high rate (35%) of postoperative mal-alignment [13].

Handolin L *et al.* showed in their biomechanical study that IMN had higher construct stiffness and significantly lower micromotion at the fracture gap on cyclic axial compression compared to DCS or locked condylar plate. (1)So, early

mobilization can be ensued with IMN. However, in the patient with osteoporotic bone and severe fracture comminution, it is very difficult to get adequate implant purchase. In the fixation of distal femur fracture, distal locking has a major effect on the implant purchase in osteoporotic bone [37].

Several previous studies reported satisfactory results with RFN for fractures of distal femur [1, 32, 38, 39].

In the study of 15 distal femur fractures in 14 patients the rate of union was 93.33% with a mean time to union was 17.5 weeks [1]. In our study the mean union time was 23 weeks (16-40 weeks), and two fractures had delayed union (13.33%) of more than 42 weeks which were managed by dynamization. In a study by Gurkan *et al.* 16 distal femur fractures were treated with RFN, the mean union time was 25 weeks, and functional results were satisfactory using modified HSS scale; the knee ROM was 80° in 4 knees (24%) and below 80° in one knee (6%) [39]. A survey of the literature found an average mobility of the knee joints operated with RFN for fractures of distal femur to be 104°, which is close to our study results (Table 3) [35].

Bei *et al.* showed that many factors might affect restoration of function of knee joint following distal femur fracture like age, preoperative comorbidity, fracture pattern, reduction quality, whether or not continuous passive motion was used in rehabilitation, and postoperative complications [40]. However potential complications such as infection, knee septic arthritis, knee pain, and malunion might be seen following surgical treatment of distal femur fractures. Papadokostakis *et al.* in their meta-analysis reported the rate of infection as 1.1%, and knee septic arthritis as 0.18%, the rate of knee pain as 16.5%, and malunion rate as 5.2% [31]. The objective of this study was to assess clinical and functional outcomes of distal femur fracture stabilized with RFN. Our series was not consistent with that of Akib *et al.* which had a mean age of 63 years, against the mean age of 43.8years [41]. RTA accounted for the majority in young population, and male patients, while simple fall down was the second most common mode in our series, while in a study conducted by Elsoe *et al.*, they had a 61% incidence as a result of trivial trauma, this can be attributed to increased RTA in recent years [42]. Common complications encountered in our study were anterior knee pain and shortening. Less common complication was local symptoms at the distal bolt. Our results are consistent with Handolin *et al.*, i.e. RFN is a reliable tool in treatment of distal femur fracture with a low complication rate [1].

Table 1: Mechanism of trauma (n=43).

Mechanism of trauma	Number of patients	Percentage (%)
RTA	11	73.33
Domestic fall	4	26.66

Table 2: Functional outcome using modified HSS scale.

Results	No. of patients	Percentage (%)
Excellent	7	46.66
Good	6	40
moderate	1	6.6
poor	1	6.6

Table 3: Range of knee flexion.

Range of active flexion	>110°	90°-110°	85°	85°<
No. of patients	10	2	2	1
Percentage (%)	66.6	13.33	13.33	6.6

Conclusion

Retrograde intramedullary nailing using DFN is good operative procedure for stabilization of distal femur fractures including supracondylar fractures and intercondylar fractures. It provides a good stable fixation in the distal condylar segment where fracture fixation is potentially difficult because of wide canal, thin cortices, and frequently poor bone quality especially in osteoporotic patient. The minimally invasive surgery with less soft tissue disruption and stable fracture fixation, which allows early mobilization and weight bearing with good results and low complication rates.

Disclosure

All the authors declared no competing interest.

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