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Original Article

Outcome of Retrograde Interlocking Intramedullary Nailing for Fracture Shaft of Femur and Extra-articular Distal Femur

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Abstract

Introduction: Retrograde nailing represents an established fixation method for fractures of the distal femur and offers in femoral shaft fractures an alternative to the existing technique of antegrade nailing. The aim of this study was to investigate in a prospective analysis the results of retrograde nailing in extra-articular distal femoral fractures and femoral shaft fractures. Emphasis was posed on the long-term functional outcome, especially in daily activities.

Materials and Methods: Retrograde femoral nailing was used from November 2015 to December 2016 in Government Medical College Hospital for the treatment of selected distal femoral (AO/ASIF-type 33) and femoral shaft fractures (AO/ASIF - type 32) in 20 patients with 20 fractures. The mean age of patients was 42.7 years (minimum: 21/maximum: 103) and 70, 7% presented with ipsilateral local pathologies or associated entities.

Results: Osseous healing occurred in 13.7 weeks on an average. Post-operative complications requiring reintervention were seen in 2/20 (14.6%) fractures. All patients were evaluated with a mean follow-up period of 6 months using the functional score of the modified knee-rating system based on knee-rating scale of "The Hospital for Special Surgery." Results of study were graded as excellent, good, fair, and poor according to the criteria of knee-rating scale of "The Hospital for Special Surgery." There were 7 (35%) excellent, 11(55%) good, 1(5%) fair, and 1 (5%) poor results.

Conclusion: Retrograde nailing represents a reliable fixation method for extra-articular (33-A1-3) fractures of the supracondylar area. In femoral shaft fractures, retrograde inserted nails offer a valuable alternative, especially when the proximal femoral approach is obstructed.

Key words: Distal femoral fractures, Femoral fractures, Functional outcome, Retrograde nailing

INTRODUCTION

Femoral fractures usually require operative treatment to avoid severe local and general adverse sequelae. While in the treatment of femoral shaft fractures, intramedullary nailing (IMN) early became the golden standard, operative strategies in distal femoral fractures refrained to classic plate osteosynthesis (open reduction and internal fixation [ORIF] procedures) for a long period, though it was associated with high complication rates.[1-3] The introduction of so-called biological plating - techniques decreased complication rates and the need for bone grafting dramatically even when conventional implants were used.[4-6] In the recent years, two implants were specially designed for the distal femur and specially adapted for minimally invasive procedures with less compromise of local vascularity: The plate/fixator system of less invasive stabilization system- distal femoral (LISS-DF), locking compression plate-DF for extramedullary, and retrograde nails for intramedullary fracture stabilization.[7-9] However, the technique of retrograde IMN is not only restricted to the supracondylar area but also represents an attractive alternative in femoral shaft fractures.[10-13] Prospective analysis of the results of retrograde femoral nailing technique in our institute was done with special regard to the functional outcome.

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MATERIALS AND METHODS

From 11/2015 until 12/2016, 20 patients with 20 fractures of the femur have been treated in our institutions with a retrograde femoral IMN. Gender distribution was male predominant representing 16 males (80%) and 4 females (20%) with a mean age of 42.7 years (minimum: 24/maximum: 70). Left side 15/20 (75%) was affected more as compared to 5/20 (25%).

Most injuries were caused by high energy trauma (n = 16/20, 80%) resulting from MVA (n = 12) and falls from a height (n = 6), while less energy trauma was less observed (n = 4/20, 20%). Isolated and associated injuries were balanced representing 10/20 (50%) each.

According to the AO/ASIF, fracture classification 8/12 (40%) belonged to type 33 (distal femur) and 12/20 (60%) to type 32 (femoral shaft). Most frequently, 33 A-1 (n = 4) and 33 A-2 (n = 7) fractures types were encountered in the distal femur, no 33 B and 33 C were included while type 32 A-1 was predominantly seen (n = 5) in shaft fracture, followed by 32 A3 and B3 (n = 3) (Figure 1). In one patient, retrograde nailing was used for repair of a non-union of the femoral shaft after unreamed antegrade nailing. In distal femoral fractures (AO/ASIF type 33), the use of retrograde IMN was free to the estimation of the treating 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 or where distal nail insertion seemed favorable due to the injury pattern (e.g., floating knee injury) or a problematic proximal approach (e.g., inlying implant) (Table 1). Distal femoral nail (DFN) of stainless steel 316L and for left and right use consists of 160-460 mm (20 mm increments) long nail with 1.5 m radius of curvature for anatomic fit, of which is available in 9, 10, 11, 12, and 13 mm diameter. Distally, the nail can be locked statically through mediolateral hole. Proximally, the nail can be locked statically or dynamically using the round locking mediolateral hole. Intraoperatively, patients were positioned supine on an radiolucent 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 parapatellar approach (18/20, 90%) or percutaneous (2/20, 10%) technique was used. The distal fragment was opened under direct vision and fluoroscopic control at the entry point by the use of a guide wire and a cannulated reamer. The femoral shaft was only reamed in very narrow medullary space. Post-operative mobilization/physiotherapy started immediately, and weight bearing was adapted to the fracture type, comorbidities, the estimated quality of osteosynthesis, and bone stock. Patients were assessed at regular intervals of time both clinically and radiologically for 6 months, and function outcome was assessed using the modified knee-rating system based on knee-rating scale of "The Hospital for Special Surgery."

Table 1: Data (mean values) of 20 fractures treated with retrograde IMN in 20 patients

Particulars	Femoral shaft fx (n=10)	Distal femoral fx (n=10)
Age	46.6	38.8
Operative duration (min)	101	88
Full weight bearing (weeks)	12.3	13.9
Osseous healing (weeks)	13.3	11.4

RESULTS

All other fractures were stabilized with the retrograde DFN. All the isolated fractures were operated within 1st week (10/20, 50%), and fractures with associated injuries were operated within 2nd and 3rd weeks (10/20, 50%). Reduction of the fracture was in all cases indirectly accomplished either manually by traction or external fixation. Mean operation time lasted 96.25 min (minimum: 60 minimum/maximum: 125 min). Post-operative full weight bearing was adapted to individual fracture anatomy, estimated quality of stablization, and concomitant injuries. It was started in femoral shaft fractures after 12.3 weeks on an average (minimum: 10 - maximum: 14) compared to distal fractures after 13.9 weeks (minimum: 10 - maximum: 16). Osseous healing in acute fractures took slightly longer in shaft fractures with 13.3 weeks (minimum: 12 - maximum: 24) than in distal fractures with 11.4 weeks (minimum: 11 - maximum: 15) (Table 1). Adequate fracture healing was observed in 19/21 fractures (95%), while delayed union developed in one case only.

Complications were seen in 5/20 fractures (25%) but required reintervention in only 2/20 (10%) (Table 2). Varus Malalignment was seen in two patients, but both were not corrected as deviation was mild. Distal screw pain was complained by 6 cases. No case of implant failure and refracture was observed. Examination included X-rays of the affected limb and clinical evaluation of the patients according to the criteria of knee-rating scale of "The Hospital for Special Surgery," there were 7 (35%) excellent, 11 (55%) good, 1 (5%) fair, and 1 (5%) poor results (Table 3).

The mean arc of motion in shaft fractures consisted of 119.3° on an average (minimum: 85°/maximum: 135°) Average range of motion in isolated fractures was 123.5° and fractures associated with injuries had 115.5° (Table 4). Two cases had extension lag of 10° which improve by physiotherapy. Rest, all the cases achieved full extension.

Table 2: Complications in 20 patients/20 fractures with retrograde IMN of the femur. Overall rate:/20 fractures (%) re-intervention rate: 2/20 (10%)

Complication	Number of cases
Neurovascular injury	None
Infection	
Superficial	One
Deep	None
Malunion	
Varus > 5	2
Valgus	None
Recurvatum > 5	One
Procurvatum	None
Shortening >2 cm	(1S)
Delayed union	(1)
Non-union	None
Patellar impingement	None
Distal screw pain	6
Breakage of distal screw	0
Refracture	None
Screw missing the locking hole proximal to fracture	2
Extensor lag	2

Table 3: Functional outcome after retrograde IMN in 20 patients

Results	Number of cases (%)
Excellent	7 (35)
Good	11 (55)
Fair	1 (5)
Poor	1 (5)

Table 4: Range of motion

Range of motion	Number of cases (%)
>120	7 (35)
110-120	8 (40)
100-110	4 (20)
<100	1 (5)

DISCUSSION

Operative treatment of distal femoral fractures is frequently problematic, as in young patients and high energy trauma, many comminuted areas are found, while in elderly patients, a poor bone stock and/or inlying implants are present. Plate osteosynthesis of these injuries by conventional technique (ORIF) adds considerable surgical trauma and impairment of the local vascularity, which is mirrored in high rates of septic complications and primary non-unions.[1,2,14] The introduction of indirect fracture reduction techniques and soft tissue preserving approaches significantly reduced these complications regardless the use of extra- or intra-medullary implants.[4,5,15] Specially designed implants for the anatomy of the distal femur and minimal invasive

Figure 1: (a and b) Pre-operative radiographs, (c and d) post-operative radiographs

techniques are the LISS internal fixator[9] and retrograde femoral nails.[7,10] Both philosophies cover most indications of distal femoral fractures[15-17] and provide specific biomechanical advantages.[18] However, in an individual fracture, the selection of implant is influenced by the grade of articular comminution as well as the design of eventually inlying implants and the personal preference of the surgeon. However, patients with a poor bone stock due to severe osteoporosis or pathologic fracture benefit from minimal blood loss and early weight bearing in retrograde IMN.[16] Schmeiser[19] found in 14 patients with tetra-/paraplegia after spinal cord trauma an average ROM of the operated knees of 108° at dismission and 100% fractures healing at follow-up examination 11 months on an average after the trauma. Especially, the vulnerable and atrophic soft-tissue envelope of the knee area is very well preserved in these patients as the implant is completely submerged beneath the bone surface, while painful soft tissue irridiation caused by the prominent implant edges represents a common problem in LISS osteosynthesis with reported hardware removal rates between 3% and 14%.[20] Except the distal femur, retrograde IMN offers a reliable alternative in the treatment of femoral shaft fractures, especially when they extend into the distal metaphysis or when problems of the piriform fossa approach exist. The latter problem is frequently encountered in the elderly population, where obstruction of the femoral canal by inlying implants/prostheses is reported up to 50%.[21,22] Furthermore, high rates of ipsilateral femoral pathologies are seen in patients over 55 years,[23] pre-existing impairment of the locomotor system, or associated ipsilateral local problems. These cases as well as deformities of the proximal femur (severe hip dysplasia and girdlestone hip) represent an ideal indication for retrograde nailing, which offers sometimes the only

treatment option. Due to a quicker approach and lesser X-ray exposure, retrograde nails may also be preferable in femoral shaft fractures with extreme adipositas, pregnancy, or polytrauma. In associated patellar or tibial fractures (floating-knee injury) (Figure 2), the retrograde nailing of femoral shaft fractures offers an elegant way to stabilize all fractures from one small incision.[24-26]

Comparing the results of antegrade and retrograde femoral, IMN reveals no significant differences in respect to operation time, radiation exposure, technical complications, and bone union rates.[27,3,13] Thigh pains are dominant in antegrade nailing[3,12,13] while minor knee pains seem to be slightly dominant and quite common in retrograde nailing[27,3] with rates between 13% and 60%.[28-30] However, development of knee pains[29] seems not to be influenced by trans- or para-patellar approach. Concern has been issued in the literature about possible intra-articular lesions due to insertion of the nail into the femoral groove, namely, the posterior cruciate ligament, and some authors advocate arthroscopic control of the nails entry point.[31] On the other hand, Carmack[32] found that identification of an optimal entry point (in line with the long femoral axis a.p. and lateral) by fluoroscopic control alone resulted in 100% of portals located within a safe area in relation to the patellofemoral joint and without harm to the PCL. Thus, we consider in daily routine fluoroscopic control of the entry point sufficient as we saw no ligamentous instability related to nail insertion and rarely saw axial malalignment ($n = 2/20$; 410%) indicating an incorrect starting point. The overall complication rates of LISS and retrograde nailing are comparable,[7,15,17] and the risk of intra-articular infection after retrograde IMN is low within18%.[33]

Figure 2: (a and b) Pre-operative radiographs, (c and d) post-operative radiographs

Retrograde IMN provides reliable fracture healing[9,33] and good functional results, even in the elderly age group[34,23,28,21,35] or in extreme osteoporosis.[19] Thus, excellent and satisfactory results, according to Neers classification, are found in 72-85%[23,35] of geriatric collectives. El Kawy[28] emphasized the benefit of early mobilization provided by IMN without decrease of mobility, though he observed in his collective a high rate (35%) of post-operative malalignment. A survey of the literature found an average mobility of the knee joints operated with retrograde IMN for distal femoral fractures of 104° and femoral shaft fractures of 127°. The authors Wagner and Weckbach.[35] attributed the better results in femoral shaft fractures to the fracture location, the younger age of the patients group, and the absence of any pre-existent lower extremity pathology. Although we cannot draw clear conclusions from our small collective, our data support that an increased age in our distal femoral fracture group influenced the functional outcome as well as the motion of the knee joint. Most functional deficits were based on a decreased knee joint motion, which mainly resulted from concomitant and pre-existing disabilities. On the other hand, the retrograde IMN proofed to be a reliable treatment option in both distal and femoral shaft fractures due to minimal rates of persisting pains and instabilities, thus providing a pre-requisite for early mobilization.

CONCLUSION

To us, retrograde nailing represents an established stabilization method in extra-articular distal femoral fractures (AO/ASIF classification 33-A1-3). In femoral shaft fractures (AO/ASIF classification 32), the retrograde technique offers a reliable alternative to antegrade nailing and may be in some situations even advantageous, especially in the presence of hip pathologies/implants which are increasingly common in elderly patients. Especially, this age group benefits from retrograde IMN by early post-operative mobilization of the patients combined with a minimal compromise of local vascularity and an almost complete submerging of the implant, which reduces soft tissue irritation and makes the implant feasible even in persons of poor general status.

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