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Evaluation of functional outcome of distal femur fractures treated by closed reduction and internal fixation with retrograde femoral nail

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Abstract

Introduction: 'Distal femoral fractures' are defined as fractures up to 15 cms from distal femoral articular surface. Their traditional management comprised of skeletal traction, closed manipulation of fracture and external immobilization in the form of casts and cast bracings. These led to various complications. The trend of open reduction and internal fixation has become evident in the recent years, with a variety of implant options. This study aims to evaluate the functional outcome of 35 adult distal femur fractures treated with closed reduction and internal fixation with retrograde femoral nail.

Materials and methods: 35 adults with distal femur fractures without neurovascular injury were considered for this study. After fixation, they were evaluated in regular follow-ups for functional outcome using Neer's score and radiological union.

Results: In our study, the average time for radiological union was 16.89 weeks. There were 3 patients with superficial infection. There were no varus collapse or implant failure. Functionally, 21 (60%) patients had excellent, 12 (34.29%) patients had good and 2 patients (5.71%) had fair results. There were no poor results.

Conclusion: With the present study, we concluded that retrograde intramedullary supracondylar nail is a very good fixation system for distal third femoral fractures, particularly in extra-articular type fractures, due to minimal soft tissue dissection, preservation of fracture hematoma, reduced hospital stays, reduced infection rates and early mobilization.

Keywords: retrograde nail, distal femur fractures

1. Introduction

'Distal femoral fractures' are defined as fractures up to 15 cms from distal femoral articular surface. Distal femoral fractures account for 7% of all femoral fractures and are complex injuries with the potential to cause long term disabilities. If fractures of the hip are excluded, 31% of all femoral fractures involve the distal portion^[1]. Supracondylar and intercondylar femoral fractures are often difficult to treat. The traditional management of displaced supracondylar fracture of femur was along the principle of Watson Jones^[2] and John Charnley^[3]. This comprised of skeletal traction, closed manipulation of fracture and external immobilization in the form of casts and cast bracings^[4-6]. These methods however, led to complications such as angular deformities, limb shortening, prolonged bed rest and complications related to immobilization, knee stiffness, joint incongruity, quadriceps wasting, knee instability and early post-traumatic osteoarthritis.

The trend of open reduction and internal fixation has become evident in the recent years. The various implants used include the AO blade plate, dynamic condylar screw, intramedullary interlocking supracondylar nails and locking compression plates. Supracondylar fractures tend to collapse into varus. During application of AO blade plate or dynamic condylar screw, the shaft of femur is often pulled laterally displacing the line of weight bearing, lateral to the anatomic axis of femoral shaft^[7]. This creates rotational stress at the fracture site leading to lifting off of the blade plate or condylar screws, eventually causing fatigue fractures of the

plates. Also, the presence of osteoporosis leads to fixation failures with screws and plates cutting of the soft bone^[8].

The advantage of an intramedullary device is that it aligns the femoral shaft with condyles reducing the tendency of varus failure at the fracture site. Furthermore, because the bending movement of an intramedullary device is substantially reduced, failure of fixation in osteoporotic bone is also less. In addition, a retrograde intramedullary supracondylar nail has got distinct advantages of preservation of fracture hematoma, decreased blood loss, minimal soft tissue dissection, less operative time, reduced rate of infection and reduced hospital stay. Early weight bearing can be commenced because of the load-sharing property of an intramedullary implant.

Distal femoral locking compression plates (LCPs) are commonly used for distal femoral fractures, more so in ones with intra-articular extension^[9, 10]. Good to excellent results have been noted with LCPs, however there is a risk of extensive soft tissue dissection, loss of osteogenic fracture hematoma, excessive periosteal stripping and wound complications. Weight-bearing is also delayed because the plates are load-bearing, unlike intramedullary devices.

2. Materials and Methods

A prospective study was conducted in Civil Hospital, Ahmedabad, from January 2018 to January 2020. 35 adult patients with closed or Gustillo-Anderson^[11] type 1 and 2 distal femoral fractures, treated by closed reduction and internal fixation with retrograde femoral nailing were selected in this study. Patients with polytrauma, neurovascular injuries and pathological fractures were excluded.

After admission, thorough assessment of patient was done to rule out head/ chest/abdominal/spinal or pelvic injuries. Musculo-skeletal examination of the patients were done to rule out associated fractures. Stabilization of patient with intravenous fluids, oxygen and blood transfusion was done as and when required. Careful assessment of injured limb was carried out to assess the neurovascular status. Primary immobilization of involved limb was done in Thomas splint with a cotton pad below the distal fragment. Antero-posterior and true lateral views of injured limb including complete knee joint and distal femur were taken. CT scans were also done if required. Occasionally oblique views were also taken to view coronal plane fractures. Irrigation, lavage and thorough meticulous debridement of compound wounds was done. Tetanus toxoid and broad spectrum injectable antibiotics and analgesics were administered accordingly. The fractures were classified according to AO/Muller classification^[12] of distal femur fractures.

All patients were posted for surgery after anaesthetic clearance was obtained and only after obtaining an informed written consent from all patients.

All patients were operated with the standard procedure of retrograde femoral nailing. Anaesthesia, a bolster was kept underneath the knee to keep it in 50 to 60 degrees of flexion. Cotton padding was done to prevent neurovascular injury. All aseptic precautions were adhered to. After painting and draping, 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. A straight bone awl was inserted into the joint through the split tendon and positioned against the inter-condylar notch to make entry. The position of bone awl was checked under image intensifier in antero-posterior and lateral position. An entry point was made above the 'blumensaar' line in lateral view and at the

midpoint of intercondylar notch in antero-posterior view under c-arm. The bone awl was then removed and guide wire passed through the entry point. The fracture was reduced with indirect reduction technique under image intensifier control and guide wire passed in proximal fragment. The fragments were then reamed with cannulated reamer. The nail of adequate diameter and length was then loaded over the jig with the help of conical bolt and inserted over the guide through distal and then proximal fragment. Its position was confirmed on image intensifier. Self-tapping interlocking bolts were then inserted from the lateral aspect through stab incisions. Similarly, proximal interlocking bolts were also inserted. After disengaging the jig, thorough wound wash was given, haemostasis achieved and wound closed in layers. Post-operatively, limb elevation, analgesics and antibiotics were given accordingly.

Static quadriceps exercise was commenced on 1st post-operative day. Active bedside knee mobilization was started from 2nd postoperative day. Suture removal was done on 13th-14th postoperative day. Patients were given crutch training and were made ambulatory on bilateral axillary crutches/walking frames without weight bearing. Weight bearing was allowed depending on the clinical and radiological assessments made at 3rd and 6th week post-op and at 3, 6 and 12 months post-operatively. At each follow-up, patient was assessed for radiological union and functional outcome using Neer's rating. The results were classified as Excellent (>85), Good (70-84), Fair (50-69) and Poor (<50).

3. Results

In our study, 35 adult patients with distal femur fractures were considered. Males (24 patients, 68.57%) had a higher incidence as compared to females (11 patients, 31.43%). 34 patients (97.14%) had Type A fractures and 1 patient (2.86%) had type C1 fracture. 21 (60%) patients had fracture on the right side, whereas 14 (40%) had it on the left side. 26 (74.29%) fractures were closed type and 9 (25.71%) were of open type. Successful fracture union was defined as complete bridging callus in 3 cortices together with painless full weight-bearing. The average duration of fracture union was 16.89 weeks. No patient reported non-union.

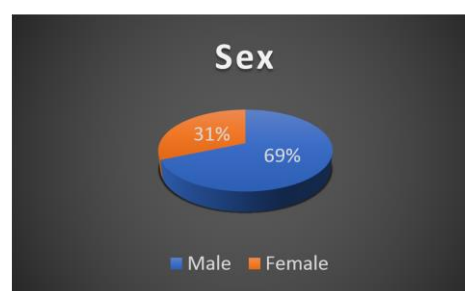


Chart 1: Sex distribution

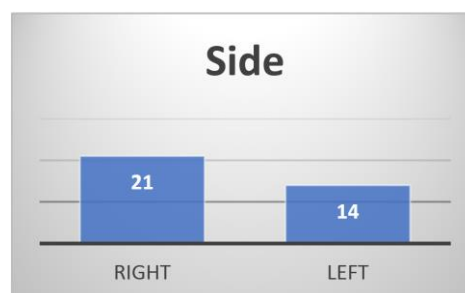


Chart 2: Fracture side

The patients were functionally assessed with Neer’s scoring system. 21 (60%) patients had excellent, 12 (34.29%) patients had good and 2 patients (5.71%) had fair results. There were no poor outcomes. The complications were not severe in nature. There were 3 patients (8.57%) who had superficial wound infections. The infections subsided with daily dressing change and appropriate antibiotics. There was no varus collapse or implant failure. Laubenthal [13] has demonstrated that average motion required for: Normal sitting- 93 degrees, stair climbing- 100 degrees, squatting- 117 degree. Thus, acceptable knee flexion compatible with daily activity would be 110 degree. 33 patients (94.3%) had more than 100 degrees of knee flexion.

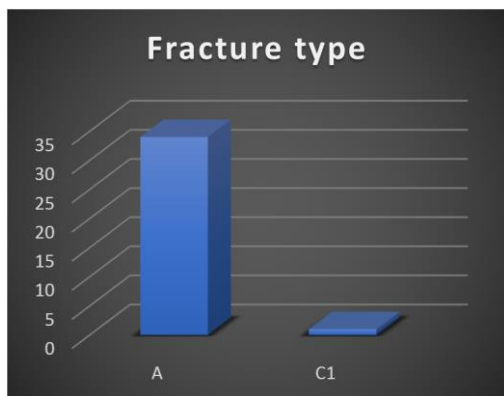


Chart 3: Fracture type (AO/Muller)

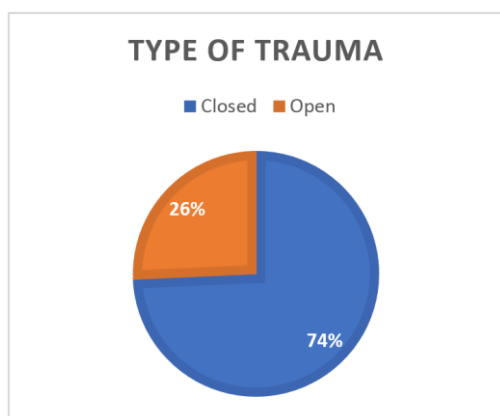


Chart 4: Type of trauma

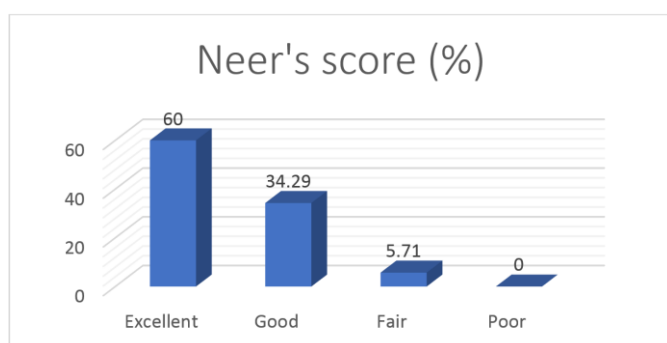


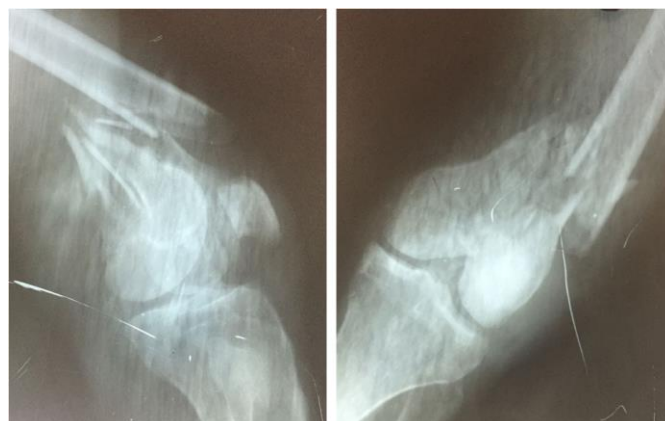
Chart 5: Functional outcome

4. Discussion

Supracondylar fractures of femur are notoriously difficult to treat because they are highly unstable. Because of strong muscular attachments, it is difficult to maintain it in proper alignment without fixation. Also because of their proximity to knee, regaining full knee motion is usually more difficult [5]. JB Giles *et al.* [14] treated 26 cases of supracondylar and

intercondylar fractures with supracondylar plate and lag screw assembly. They reported that this device was very successful in restoring the normal alignment of femur and intra-articular anatomy of the knee joint. In a similar study 1989, JM Siliski [15] reported the use of AO blade plate for the management of 52 supracondylar and intercondylar fractures. They followed the AO classification of fractures and used the Neer rating system for evaluation of results and obtained 92% excellent and good results in C1 type fractures, 72% good/excellent results in C2 type fractures and 85% good excellent results in C3 type fractures. In 1995, in the comparative study conducted by Krickler and Butt MS *et al.* [16], 42 displaced supracondylar and intercondylar fractures of femur in elderly patients were studied. 20 patients received operative treatment with the AO DCS and side plate assembly whereas 22 received skeletal traction followed by cast bracing. Good to excellent results were obtained in 53% of the patients treated surgically while only 31% good results were obtained in conservative group. The author concluded that the use of DCS allowed good alignment, adequate joint congruity and early knee mobilization. In general, there were fewer incidences of complications in the operative group.

Case 1



A: Pre-op X-rays.



B: Immediate post-op X-ray.

and functional outcome.

Case 2



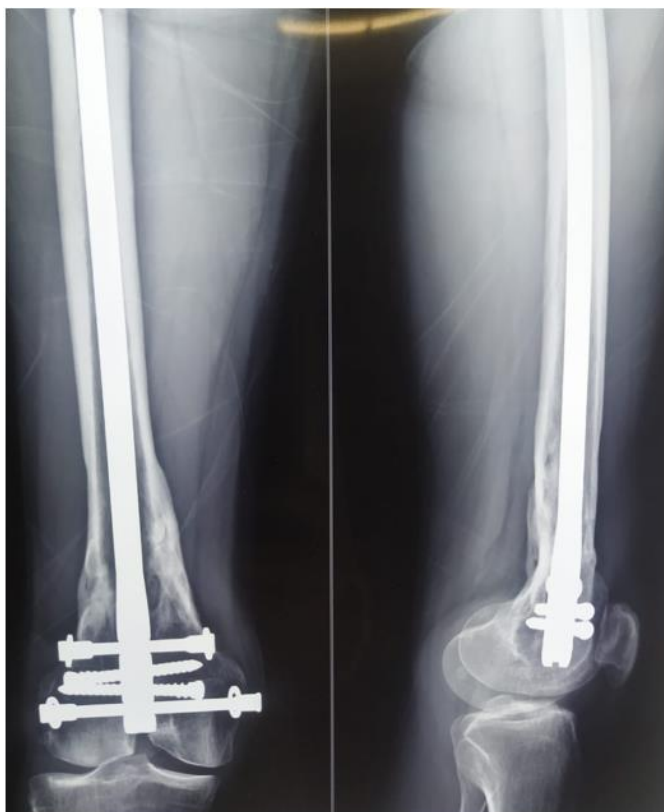
A: Pre-op X-rays.



B: Immediate post-op X-ray.



C: X-ray showing fracture union.



C: Fracture after union.



D: Squatting and cross-legged sitting.

The supracondylar nails were used because they obtain more biological fixation than plates as they are load sharing, rather than load bearing implants. In addition, a retrograde intramedullary supracondylar nail has got distinct advantages of preservation of osteogenic fracture hematoma, decreased blood loss, minimal soft tissue dissection, less operative time and reduced rate of infection.

In 1996, Gellman RE *et al.* [17] reported 26 supracondylar femoral fractures treated with intramedullary supracondylar nail with 77% good to excellent results and average knee range of motion of 104 degrees. In our study, we treated 35 patients with Supracondylar nail. Out of the treated cases, 94.29% had excellent and good results according to Neer's rating scale. In 2000, Kumar A *et al.* [18] reported the results of 18 distal femoral fractures (all Type-A, AO classification) in elderly patients treated with retrograde titanium supracondylar nail. In his study, 15 fractures (93.7%) united in an average duration of 3.6 months. The average range of motion achieved at knee was 100.6 degrees. There were no implant failure.

The results in our study were similar to those in the above mentioned studies with respect to duration of fracture union

5. Conclusion

With the present study, we concluded that retrograde intramedullary supracondylar nail is a very good fixation system for distal third femoral fractures, particularly in extra-articular type fractures. Distal screw related problems are common in nails; however, such problem is faced with plating also. Since there is no requirement of bone graft in nailing due to reaming and preservation of osteogenic hematoma, it decreases the morbidity associated with donor site. With careful selection of cases, retrograde femoral nail can be used successfully in distal femoral fractures with good to excellent outcome.

Case 3



A: Pre-op X-rays.



B: Immediate post-op X-rays.



C: X-ray showing fracture union.

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