Section: Orthopaedics

Case Series

A CASE SERIES ANALYSIS OF THE RESULTS OF IPSILATERAL HIP AND SHAFT FEMUR FRACTURES TREATED WITH RECONSTRUCTION NAIL

S.Lakshminath[1], R.Vijayaragavan[2]

[1]Resident, Department of Orthopaedics, SLIMS, Pondicherry, India
[2]Professor & Head, Department of Orthopaedics, SLIMS, Pondicherry, India

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Corresponding Author:
Dr. R.Vijayaragavan,
Email: drvrpy@gmail.com

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Abstract

Background: Ipsilateral fractures of the hip and shaft of femur are quite a complex problem, and it has the chance of high complications. The difficulty in decision making from the wide range of operative techniques and hardware options makes difficult for an Orthopaedic surgeon. **Materials and Methods:** We present a case series of 30 cases with ipsilateral hip and shaft femur fractures treated by intramedullary reconstruction nail technique. Intraoperative complications and postoperative results were critically analyzed and is being discussed. **Result:** Difficulty in the reduction was observed in fifteen patients, improper placement of cervical screws in thirteen patients and there was postoperative distraction present at fracture site in nine patients. Nine patients had malunion at hip and five at shaft of femur. Nonunion was present in three patients with fracture shaft of femur and one patient with fracture neck of femur requiring secondary surgical procedures. **Conclusion:** While a reconstruction nail is an effective option method for undisplaced or minimally displaced hip fractures, its outcomes in cases with significant displacement and comminution are favorable only when handled by experienced surgeons and it also require further evaluation. The importance of a surgeon's expertise in managing such complex injuries cannot be overstated.

INTRODUCTION

Complex ipsilateral hip and femoral shaft fracture poses significant challenges for orthopaedic surgeons for its high complication rate. These dual fractures are generally seen in young patients, associated with high velocity injury and multisystem involvement trauma. The Ipsilateral femoral neck fractures occurrence is around 2.5% to 5% of patients with femoral shaft fractures.[1] With the literature incidence of missed injuries is as high as around 20-30%. Early detection of these injuries is critical to avoid certain disabling complications such as nonunion or avascular necrosis of the femoral head. The recent advances in the primary resuscitation in multisystem injury have made improvement in the survival rate and definitive care of the bony injuries of the patient.[2,3] A review of literature highlights various operative methods and wide array of hardware available to manage these kinds of complex fractures, yet no consensus has been reached regarding the optimal approach, and controversy persists. The purpose of this study is to share our experience of 30 cases treated with third generation reconstruction nail.[4,5]

MATERIALS AND METHODS

We conducted a study involving 30 patients with ipsilateral femoral neck and shaft fractures treated between 2012 and 2022. All patients were followed for at least one year, with an average follow-up of 2.4 years. The group comprised 25 males and 5 females, with an average age of 40 years (ranging from 25 to 67 years). Twenty-five patients sustained injuries from high-velocity road traffic accidents, including 15 in automobile collisions, 6 in two-wheeler accidents, and 4 from falls from height. Fourteen patients had significant associated injuries, including head injuries in 3, intra-abdominal injuries in 7, and pulmonary contusions in 2. Additionally, 4 patients had fractures of other extremities: one each with a pelvic fracture, contralateral femoral shaft fracture, and tibial fracture.

Femoral neck fractures were classified using Garden's system, with 8 being grade II and 4 grade III. One patient presented with a nonunion of the femoral neck fracture and an in-situ K-nail. Intertrochanteric fractures were categorized by Boyd & Griffin's classification, with 9 type I, 2 type II, 1 type III, and 5 type IV cases. There were three fractures of shaft of femur in proximal third, twenty

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fractures in mid third, and four fractures in mid distal third and three were subtrochanteric. [Table 1].

Table 1

S.no	Type of fractures	No. of patients
A. Shaft of femur	i. Proximal third ii. Mid third iii. Distal third iv. Mid distal third v. Subtrochanteric	4 18 0 5 3
B. Neck of femur	i. Grade 1 ii. Grade 2 iii. Grade 3 iv. Nonunion NOF with K-nail in situ	0 8 4 1
C. Intertrochanteric	i. Type 1 ii. Type 2 iii. Type 3 iv. Type 4	9 2 1 5

Treatment protocol: Following initial resuscitation of the cases, which included emergency managements like managing shock, splintage, and traction, a thorough assessment was conducted to evaluate orthopedic injuries, associated trauma, and any medical comorbidities. Priority was given to the cases which had life-threatening head, chest, and abdominal injuries. Surgery was performed without delay in 21 patients within 24 hours, while 7 underwent surgery within a week. For 2 patients, the procedure was delayed by more than a week due to the severity of associated non-orthopedic injuries. The average hospital stay was 20 days. In femoral neck fractures, the correct entry point is critical, because a lateral entry can result in varus malalignment. The guidewire was introduced at the trochanteric fossa, and an entry portal was created in the midplane of the femur under C-arm guidance. Femoral neck fractures were prioritized for anatomical reduction. A blunt medullary reamer was used as a nail blank in the metaphyseal canal, and K-wires were inserted anteriorly and posteriorly into the femoral head to stabilize the neck fracture during reaming and nail insertion. After inserting a nail of appropriate size, two guidewires were placed in the femoral neck and head, with their positions carefully verified using the C-arm. The reconstruction nails used in this series included a built-in seven degrees of anteversion. For posterior screw placement, the jig was rotated posteriorly in the horizontal plane. The inferior cervical screw was inserted first, positioned just above the calcar, allowing the proximal cervical screw to be placed in the middle or slightly superiorly in the femoral neck. The average C-arm exposure time was 2.63 ± 0.74 minutes, and the mean surgical duration was 3.00 ± 0.67 hours.

RESULTS

Mostly all the Boyd and Griffin type IV intertrochanteric fractures and Garden grade III fractures of neck of femur (9 cases) had difficult reduction [Table 2]. Three of the intertrochanteric fractures opened up when the entry site was made, which resulted in varus reduction. In twelve patients there was difficulty in locating the entry site; out of these ten were comminuted fractures of the upper end femur with intertrochanteric extension. The most common complication which we faced is the improper placing of cervical screws in 12 patients. Most of them either in superior aspect of head or of inadequate length. Distraction of the various degrees was present in 8 patients. The patient who was managed with spiral blade had distraction at the fracture site. 2 patients with comminuted intertrochanteric fractures and 3 patients with fracture shaft of femur had distraction at fracture site. Iatrogenic comminution was seen in 6 patients. Post operatively 2 patients had superficial infection of suture line, which got settled with intravenous antibiotics. One patient had deep vein thrombosis with pulmonary embolism and the patient recovered uneventfully.

Table 2: Distribution according to intra-operative complications.

S.no	Complication	No. of patients
1.	Difficulty in locating entry site	12
2.	Difficulty in passing Guide wire	2
3.	Breaking of reamer	-
4.	Iatrogenic comminution	6
5.	Bending of nail	-
6.	Difficulty in reduction	9
7.	Distraction at site	8
8.	NOF	5
9.	SOF	2
10.	I/T	2
11.	Improper locking screws	12
12.	Breakage of drill bit	-
13.	Neurovascular injury	-

Delayed union [Table 3] was noted in twelve patients with femoral shaft fractures and in three patients with femoral neck fractures. All the 3 femoral neck fractures healed within six months from the date of injury without requiring additional intervention. Nonunion was noted in four cases of femoral shaft fractures and two cases of a femoral neck fracture. Two patients with nonunion had distraction at the fracture site, where bone grafting for healing was done. In another patient, the fracture failed to heal despite of the bone grafting, requiring the reconstruction nail to be replaced with a standard

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interlocking nail along with repeat bone grafting, which eventually led to the healing and was observed during follow-up. The fourth patient with nonunion was recommended for bone grafting but did not comply with the treatment plan and continues to walk with the nail in situ and persistent nonunion. The single case of nonunion in the femoral neck was attributed to inadequate fracture reduction. The patient underwent Meyer's pedicle grafting; however, the fracture remains unhealed still .

Table 3: Distribution according to type of union.

S.no	Type of union	SOF	NOF	I/T
1.	Delayed	12(40%)	3(10%)	-
2.	Non-Union	4(13%)	1(3%)	-
3.	Malunion	3(10%)	5(16%)	3(10%)

In our series, three of our patients experienced malunion of the femoral shaft. One patient had a valgus deformity of 7–9° and posterior angulation of 10° due to anterolateral cortical shattering, while the other two patients had a valgus deformity of 10° resulting from lateral cortex damage and the deformities were clinically insignificant. Five patients had varus malunion of femoral neck fractures. In one case, it was due to cervical screw cut-through, resulting in healing in a varus position. Three patients had varus malunion caused by improper entry points during surgery, and one developed varus angulation and inferolateral neck comminution due to early weight-bearing. And also, three patients with type IV intertrochanteric fractures developed varus malunion. This was due to lateral opening of the fracture line during nail insertion and upward displacement of the proximal fragment by hip abductor forces. Regarding hip joint function, 18 patients achieved a full range of motion, 4 had a range of 0–110°, and 6 had 0–100°. Only two patients had a range of motion less than 100°, and none exhibited fixed flexion deformities. Leg length discrepancy for 19 had no shortening, 5 had 1–2 cm, 4 another had 2–3 cm, and 2 patients experienced shortening of more than 3 cm.

DISCUSSION

Ipsilateral fractures of the hip and femoral shaft represent a complex injury pattern and requires special attention. While there are various techniques have been proposed in the literature, few have been consistently supported by good outcome. Orthopedic surgeons face the following challenges like (i) determining the optimal timing for fracture stabilization, (ii) selecting the appropriate hardware, (iii) deciding whether to address the neck or shaft fracture first, and (iv) achieving anatomical reduction at the hip joint.[6]

This study presents 30 cases of ipsilateral hip and femoral shaft fractures treated by third-generation reconstruction nails with 3 cervical screw options. This design offers several advantages, such as multiple cervical screw options that enhance rotational and vertical stability at the femoral neck, an inbuilt 7° anteversion angle to prevent posterior screw placement, an anterolateral curve that aligns with the femoral shaft's natural curvature, and lateral nail entry through the trochanteric tip, minimizing vascular damage to the femoral head and neck.[7,8]

The literatures report a high incidence (20–30%) of missed femoral neck fractures in cases of femoral shaft fractures. However, in this study, no missed fractures were encountered. As part of our protocol, we routinely performed anteroposterior pelvic X-rays with both hips and an additional hip X-ray in 15° of internal rotation for all trauma patients.[9,10]

The timing of fracture stabilization is one of the least debated aspects of management. Early fixation of the long bone fractures in polytrauma patients is critical as it reduces morbidity, mortality, hospital stay, and costs. Previous studies, such as those by Casey and Chapman, have shown that delayed fixation with traction can lead to life-threatening complications. In our series, all fractures were fixed within 24 hours unless the patients had life-threatening associated injuries. During the delay, traction was applied, and no increase in complications was observed.[11]

Critical surgical steps, including achieving anatomical reduction in femoral neck fractures, selecting precise entry points, and correctly placing cervical screws, were essential for successful outcomes. In 9 cases, achieving reduction was challenging, particularly in patients with Garden Grade III femoral neck fractures and Boyd & Griffin Type IV intertrochanteric fractures. Difficulties in locating entry points were also noted in 12 cases, especially in comminuted fractures involving the proximal femur or intertrochanteric fractures with basal neck involvement. Accurately determining the entry point and inserting the nail to the correct depth can be prevent malunion at the hip, often presenting as varus reduction.

Fixing the neck of femur fractures before addressing the femoral shaft are crucial. Initial stabilization with screws or K-wires helps preserve reduction during reaming and nail insertion. Improper placement of cervical screws was a common issue in 12 cases which was due to inadequate length or positioning. We recommend that inserting the distal cervical screw just above the calcar to allow proper placement of the superior screw and also precise nail depth and jig alignment are essential to prevent posterior screw placement.

Delayed union occurred in 12 cases of femoral shaft fractures and 3 cases of femoral neck fractures, mostly due to severe comminution and soft tissue damage. Nonunion was observed in 4 femoral shaft

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fractures and 1 femoral neck fracture, all associated with high-energy injuries and postoperative distraction. Secondary procedures, including bone grafting and exchange nailing, successfully addressed nonunion in some cases, while one patient declined further treatment. Nonunion of a femoral neck fracture persisted despite intervention with Meyer's pedicle grafting.

Although recent studies report 100% union rates for displaced fractures, our series highlights a high incidence of complications, including malunion and nonunion, likely due to the severity of injuries. Anatomical reduction and stable fixation are key to achieving union, regardless of the timing of intervention. High-energy trauma, comminution, and associated injuries inherently contribute to a higher rate of complications in these cases.

CONCLUSION

While reconstruction nails are effective for undisplaced or minimally displaced fractures, treating fractures with significant displacement and comminution remains challenging and requires considerable surgical expertise. Further evaluation is needed to optimize outcomes in these complex injuries. The importance of the surgeon's expertise in handling such complex injuries cannot be overstated.

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