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Functional and radiological outcome of subtrochanteric fracture treated with proximal femoral nail

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Abstract

Subtrochanteric fractures are one of the common fractures encountered in general population following a fall due to high velocity injury warranting immediate and active intervention. The main benefit of Proximal Femoral Nailing is being a closed technique offering an excellent reduction at the fracture site and adequate strength for weight bearing even in unstable hip fractures. This intramedullary device is proven to be biomechanically superior to DHS which is an extramedullary device in the treatment of subtrochanteric fractures. The objective of this study is to analyse and evaluate the functional and radiological outcome of subtrochanteric fracture treated with proximal femoral nail. A study population was selected and was carried out with a total of 25 patients (male: 20, female: 5) treated with proximal femoral nail from the year 2015-2016. All the patients were selected based on inclusion criteria such as closed fractures of less than 3 weeks and age above 25. The appropriate selected patients were assessed both clinically and radiologically at regular intervals of 4wks, 8wks, 12wks, 16wks and 20wks. The functional outcome was assessed using Harris Hip score. From our selected study sample we found majority of the patients were unstable fractures (70%) and others were stable fractures (30%). Based on the union, 50% of patients showed full union by 10 to 15 weeks and 35% showed full union by 16 to 20 weeks. We had 95% of the patients with good anatomical results and 50% of the patients with excellent functional results. PFN is a quite safe, well tolerated and effective instrumentation useful in the treatment of all subtrochanteric fractures. Being a closed intramedullary procedure early mobilization and rehabilitation is possible with early restoration of premorbid functions.

Keywords: Subtrochanteric, proximal femoral nailing, femur

Introduction

Subtrochanteric fractures are one of the common fractures encountered in general population as a result of simple fall and after high velocity injury involving both direct and indirect forces. Direct forces travels along the axis of the femur or the greater trochanter leading to subtrochanteric fracture. PFN is the latest intramedullary device designed by AO / ASIF in 1996 consisting two proximal screws for the neck and head and two distal locking screws. The key feature is being a closed technique having good reduction at the fracture site and provides sufficient strength to allow weight bearing even in unstable hip fractures. This intramedullary device is proven to be biomechanically superior to DHS which is an extra medullary device in the treatment of subtrochanteric fractures.

Materials and Methods

The study was conducted with a sample size of 25 patients with subtrochanteric fractures admitted in the Department of Orthopaedics at Indira Gandhi Medical College & Research Institute, Puducherry from 2015-2016. The inclusion criteria such as patients with subtrochanteric fractures of less than 3 weeks, closed fractures and age above 25 including both sex groups and the exclusion criteria such as Fractures of more than 3 weeks, Open fractures, Age below 25 years were involved. After clinical assessment, blood investigation and radiological work up was done and pre Anaesthetic checkup obtained. All the patients. Underwent Proximal Femoral Nailing as proposed. Type of surgery and the application of technique used for fixation of the implant was documented. Post-operative care such as use of

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medications, regular wound inspection, suture removal and mobilization from day 1 with gait training was initiated using a walker or crutches were also documented. Patients were advised for regular follow ups on OPD basis at 4, 8, 12, 16, 20 weeks post operatively. During each visit, patients were assessed both clinically and radiologically based on severity of, hip range of movements, fracture union and complications using Harris Hip score.

Operative Technique

Under spinal or general anaesthesia patient on supine was then placed on the fracture table with his contralateral leg placed on a leg support. 2 to 3 cm incision was made 2cm above proximal end of the greater trochanter on the extension line of the femoral axis. Soft tissues were separated and the trochanter tip was reached, the entry point was felt which is located at the junction of anterior two third and posterior two thirds of greater trochanter. The entry was made with the awl and the guide wire was passed along the femoral axis and the reduction was checked with C arm in two planes. The proximal and distal two fragments were reamed using 10, 11, 12, 13, 14 reamers. Nail of at least 2mm less than that of the last reamer used was selected. After fixing into the jig using the AP view, the PFN was inserted by hand until the lag screw holes are lined up within the centre of femoral neck. Later the guide sleeve was introduced through the jig and a 2cm incision was made on the lateral aspect of the thigh. A 2.8mm guide wire was inserted through the drill sleeve and position were checked under image intensifier in AP and lateral view. A position in the caudal area of the femoral head was selected so that both proximal screws can be inserted. In

lateral view, the wire should be in the centre the femoral neck. The guide wire was inserted subchondrally or 5mm away into the femoral head. After reaming over the guide wire, the appropriate caudal hip screw was introduced. Then the cranial hip screw was introduced just above the caudal hip screw using the jig. Both the distal locking screws were inserted to improve the stability and the wound is closed with 1-3 sutures.

Results and Discussion

Results

A Prospective study was conducted on 25 patients who underwent closed reduction internal fixation with proximal femoral nail to study the functional outcome based on the type of surgery. Age of involvement ranging from 25 to 75 years with male accounting 80% and female accounting 20% were noticed and most of the patients had a slip and fall (70%) and the rest were road traffic accidents (30%). Majority were unstable fractures according to Boyd and Griffin (70%) and the rest were stable fractures (30%). Post operatively patients were mobilized on the second day with non-weight bearing crutch walking (60%) and partial weight bearing (45%) in the first five weeks later with full weight bearing in the first 10 to 14 weeks (55%). 50% of the patients showed full union by 10 to 15 weeks and 35% showed full union by 16 to 20 weeks, the mean time taken for full union was 16 weeks. The mean range of motion for hip was 101 degrees and the knee was 134 degrees, we had 95% of the patients with good anatomical results and 50% of the patients with excellent functional results.



Discussion

The femur is the longest and strongest bone of the body and like all long bones consists of a shaft and two ends. It articulates at its upper end with the hipbone and at its lower end with both the patella and the tibia. The upper end of the femur comprises a head, a neck, a greater and a lesser trochanter. The neck of the femur is rather more than half a Sphere & is directed upwards, medially and slightly anteriorly. The neck is about 5cm long, connects the head to the shaft. Anteriorly at the junction of the shaft and the neck is a rough bony ridge, the intertrochanteric line and the region just below that is the subtrochanteric area. Posteriorly a prominent ridge of bone, the intertrochanteric crest is a round protuberance called the quadrate tubercle. The greater trochanter is large and quadrangular laterally positioned and irregular. The upper posterior margin overhangs the trochanteric fossa. The greater trochanter provides insertion for most of the muscles of the gluteal region. The lesser

trochanter is a conical eminence, which projects medially and backwards from the shaft at its junction with the lower and posterior part of the neck. It gives attachment to the psoas major on its summit and the iliac us at its base.

The description of adult vessels is based on the work of Since the vascular pattern established during the phase of growth is not replaced at maturity, but persists throughout in life, the basic arrangement is one of an epiphyseal and metaphyseal circulation, even when the growth plate has disappeared outline the anastomotic arrangement around the upper femur. Corck described the blood supply to the proximal end of the femur, which he divided into three major groups.1) an extracapsular arterial ring located at the base of the femoral neck. 2) Ascending cervical branch of the arterial ring on the surface of the femoral neck. 3) Arteries of the ligamentum teres. The extracapsular arterial ring is formed posteriorly by a large branch of medial femoral circumflex artery and anteriorly by branch from lateral femoral circumflex artery.

The ascending cervical branches of retinacular vessels ascend on the surface of the femoral neck in anterior, posterior, medial and lateral groups. The lateral vessels are most important. Their proximity to the surface of the femoral neck makes them vulnerable to injury in femoral neck fractures.

Blood supply to the femur, like that of all tubular bones, is by the way of metaphyseal, periosteal and endosteal supply. The periosteal supply is related to the multiple muscle origins from the shaft to the femur. The nutrient arteries perforate the femoral shaft along the linea aspera. The arteries are derived from perforating branches of profunda femoris artery. The peritrochanteric and subtrochanteric area can be a site of stress concentration owing to the short radius of curvature at this site. When bone has insufficient opportunity to turnover and remodeling as in metabolic bone disease this may be a site of pathologic fracture.

Muscular Forces: The upper end of the femur is surrounded by a mass of powerful muscles. Inclusion of muscles forces necessary during single leg support adds to the complexity of the problem and can increase the stress to much higher values. On the other hand, some muscles such as the tensor fascia lata, may act to partially neutralize bending forces under certain conditions. In a normal hip, the strong gluteal muscles abduct, and the powerful psoas flexes and rotates. These forces are balanced by the abductors and hamstrings. The same muscle forces act upon the fixation device after operation. These force have been shown to generate high forces on the femoral head even when the patient is in bed, which in turn cause stresses in the subtrochanteric area as shown by Koch. Rydell has demonstrated that muscular pull for merely flexing of extending the hip in bed caused as much pressure on the femoral head as did slow walking with or without crutches.

Subtrochanteric features of the femur are defined as the fracture located in the proximal third of femur from the level of lesser trochanter to a point 5cms distally. It may occur as an extension from a trochanteric fracture or as an isolated fracture (Boyd and Griffin 1949). Fielding defined subtrochanteric area as three inches below the lesser trochanter and fractures occurring in this area are called subtrochanteric fractures.

Mechanism: Fractures of the proximal femur occur by one of the three mechanisms, in the elderly, these fractures are usually due to low energy trauma, typically a minor fall. Spiral fractures generally result perhaps with butterfly comminution. The second mechanism is that of the trivial trauma, with fracture through a defect in the proximal femur due to neoplasia, most commonly metastatic carcinoma. Such pathological subtrochanteric fractures require assessment and management of the neoplastic process as well as of the fracture. The third mechanism is high-energy trauma, motor vehicle accident or fall from significant height. Communication, soft tissue damage including possible open wound and presence of associated injuries are typical concerns.

Traumatic Anatomy

Fromson described the pathologic anatomy and physiology in fractures in the subtrochanteric region in which strong opposing muscles immediately distort relationships of the fragments. The proximal fragment is flexed and externally rotated by the iliopsoas muscles, abducted and further rotated externally by the gluteal and the abductor and hamstring

groups, shortened by the pull of these muscles and usually posteriorly displaced by the weight of the limb when the patient is in the recumbent position. Biomechanical Studies: During the past century a better understanding of the biomechanics of subtrochanteric fractures has led to the development of better implants and radical changes in treatment modalities. Koch analysed mechanical stress on the femur during weight bearing and found that compression stress exceeds 1200lb per square inch in the medial subtrochanteric area 1 to 3cms distal to the lesser trochanter and lateral tensile stress measured about 20% less. Frankel and Burstein demonstrated significant stress force on the hip and proximal femur with activities such as flexing and extending the hip while supine, indicating continuous stress on the implant system even with bed rest. Rybickie, Simonen, and Weis found that higher forces are generated with eccentrically placed devices, such as plate and devices, compared with Centro medullary devices.

PFN for proximal femur is available to fit specific anatomic requirement and fracture type of proximal femur. Proximal locking is achieved through two 8 mm femoral neck screws. Proximal fixation delivers rotational stability. 6 medio-lateral implant angle for easy insertion. The anatomic nail design prevents intramedullary stresses and thus secondary fractures at the end of the nail.

PFN nail sizes are 9, 10, 11, & 12 mm lengths of 20 cm, 22 cm, & 24 cm. Cervical screws are of 8 mm cannulated with lengths varying from 70 to 110 mm, Distal locking with two 5 mm screws. PFN for peritrochanteric fractures is a versatile implant system which is used in both simple and complex fractures in the peritrochanteric region. PFN consists of 3 components. 1. The intramedullary nail. 2. The cervical screws. 3. The distal locking screws.

The cervical screws transmit the forces acting on the proximal femur to the intramedullary nail. Early load bearing of the fracture is possible. Two proximal screws ensure rotational stability of the PFN during the operation and subsequent healing process. The PFN is tapered at the distal end. This reduces stiffness and stress peaks, which can cause pain. Holes in the distal part allow a choice of either static or dynamic locking.

Conclusion

PFN is safe, effective and patient friendly device useful for the treatment of all Subtrochanteric fractures irrespective of their comminution. Early mobilization and rehabilitation is possible since it is closed intramedullary procedure. Weight bearing should be delayed in severely comminuted fractures. It is mandatory to place both proximal screws in the neck, along with distal locking screws for better implant stability in osteoporotic as well as severely comminuted fractures.

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