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Original Research Article

EVALUATION OF UNION OF INTERTROCHANTERIC FRACTURES OF HIP TREATED WITH PROXIMAL FEMORAL NAIL: AN INSTITUTIONAL BASED STUDY

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ABSTRACT

Background: Intertrochanteric fractures are a common type of hip fracture, particularly in the elderly population. The aim of this study was to evaluate union of intertrochanteric fractures of hip treated with proximal femoral nail.

Materials and Methods: This prospective study included 45 patients with intertrochanteric fractures treated with PFN at Department of Orthopaedics, GMERS Medical College, Gandhinagar, Gujarat, India. The inclusion criteria comprised patients aged 18-90 years who suffered from intertrochanteric fractures and were undergoing primary or index surgery.

Results: The majority of patients were elderly, with 71-80 years being the most common age group. Trivial trauma, often due to domestic accidents, was the leading cause of these fractures. The study demonstrated favorable radiological findings, with 88.88% of patients showing union, and a high success rate of close reduction (88.88%). The procedure was completed within 1 hour in 77.77% of cases.

Conclusion: The results suggest that PFN is an effective treatment option for intertrochanteric fractures, particularly in the elderly population. The advantages of PFN include stable fixation, near-perfect reduction, early weight-bearing, and ambulation, shortened hospital stay, and improved rate of union.

Keywords: Intertrochanteric Fractures, Proximal Femoral Nail (PFN), Treatment Outcomes, Elderly Population, Hip Fractures.

INTRODUCTION

Femoral intertrochanteric fractures are defined as extracapsular fractures that occur between the greater and lesser trochanter. Due to the vascular anatomy, the risk of nonunion and avascular necrosis in trochanteric region fractures is quite low.1 The dramatic increase in average life years, mainly due to medical developments, has led to a rise in the occurrence of intertrochanteric femur fractures, which account for approximately 50% of all hip fractures occurring in the elderly population.[1]

The incidence of intertrochanteric fractures varies widely across countries, and it was predicted that by 2025 there will be 2.6 million hip fractures, and 4.5 million by 2050. It is anticipated that 37% of hip fractures in Asia in 2025 and 45% in 2050 will be intertrochanteric fractures, up from 26% in 1990.[2] High-energy injuries are the usual cause of these fractures in young men, which frequently result in severely displaced and highly comminuted fractures. They usually occur from low-energy falls in elderly osteoporotic women and present as long spiral fractures.[3]

To ensure the patient's comfort and rapid ambulation, operative fixation of the fracture is the preferred treatment approach, despite being a major procedure. The ideal internal fixation device should enable early mobilization of the patient without compromising the stability, reduction, and union of the fracture, thereby facilitating a speedy recovery. hence, the present study was carried to evaluate union of intertrochanteric fractures of hip treated with proximal femoral nail.

MATERIALS AND METHODS

The present prospective study was carried among 45 patients with intertrochanteric fractures over a period of one year at Department of Orthopaedics, GMERS Medical College, Gandhinagar, Gujarat, India. Ethical clearance was obtained from institutional ethical committee and written informed consent was obtained from study participants. The inclusion criteria comprised patients aged 18-90 years who suffered from intertrochanteric fractures and were undergoing primary or index surgery were eligible for the study. The exclusion criteria consisted of patients with pathological fractures, those who had undergone previous surgery on the proximal femur, patients with unstable intertrochanteric femur fractures treated with alternative internal fixation methods, and individuals with old non-unions or mal-unions.

Implantation of the PFN was done with or without a fracture table. The hip was placed in a slight adduction position on the fracture table to facilitate the insertion of the nail. A 5 cm skin incision was made approximately 5 cm cranial to the tip of the greater trochanter. After passing through the fascia and muscles, a 2.8 mm threaded K-wire was inserted at the tip of the greater trochanter under C-arm control. The K-wire was advanced into the femoral shaft so that it was located in the middle of the shaft in both directions. The proximal part of the femoral shaft was reamed manually with a 17 mm reamer. After mounting the nail on the radiolucent insertion device, the nail was introduced manually into the femoral shaft. Via the aiming arm attached to the insertion device, the guide wire for the neck screw was first introduced into the femoral neck so that the screw would be placed into the lower half of the neck on the anteroposterior view and centrally on a lateral view. Thereafter, the guide wire for the anti-rotational hip pin was introduced. The hip pin was introduced first with the tip about 25 mm medial to the fracture line; then, the neck screw was inserted. Afterwards, depending on the type of fracture, distal interlocking was either statically or dynamically achieved via the same aiming arm. In all cases, antithrombotic prophylaxis was given using low molecular weight heparin, and antibiotic prophylaxis was provided (cefuroxime). Anteroposterior and lateral radiographs were obtained 24–72 hours postoperatively and analyzed for reduction and position of the implant. The rehabilitation protocol was demonstrated, and the patients were mobilized on the first postoperative day. Partial weight bearing as tolerated or restricted weight bearing was allowed according to the surgeon's recommendation on the day following surgery.

The assessment protocol consisted of initially, pre-operative x-rays of the pelvis, including both hips and a full-length view of the femur on the fractured side, were taken for comparison with post-operative x-rays. Immediately after surgery, x-ray radiographs of the pelvis, including both hips, and anteroposterior and lateral views of the operated femur were obtained. These radiographs were used to calculate the tip-apex distance and Cleveland index.

At 6 weeks and 3 months post-operatively, follow-up x-rays were taken to assess osteoporosis using Singh's index and were compared to the immediate post-operative findings.

RESULTS

Results shows that commonest age group for intertrochanteric fractures is between 71-80 years in 19 patients (42.22%) followed by 81-90 years in 8 patients (17.77%). Majority 33 patients (73.33%) of the intertrochanteric fractures occurred following trivial trauma usually a domestic accident like fall in bathroom or fall from stairs. Majority 33 patients (73.33%) of the intertrochanteric fractures occurred following trivial trauma usually a domestic accident like fall in bathroom or fall from stairs, The data highlights key findings related to radiological outcomes, types of reduction, and procedure times among patients. Regarding radiological findings, 88.88% of the patients (40 individuals) achieved union, while 4.44% (2 individuals) experienced delayed union, and 2.22% (1 individual) showed non-union. For the type of reduction, the majority of patients (88.88%, or 40 individuals) underwent close reduction, while only 11.11% (5 individuals) required open reduction. In terms of the time taken for procedures, most procedures (77.78%, or 35 cases) were completed in under 1 hour, with 33.33% (15 cases) taking between 1 to 2 hours. No procedures exceeded 2 hours.

Table 1: Age of Incidence

Age(years)	Number of Patients	Percentage (%)
20-30	1	2.22
31-40	2	4.44
41-50	4	8.88
51-60	4	8.88
61-70	7	15.55
71-80	19	42.22
81-90	8	17.77

Table 2: Mode of Injury

Mode of injury	Number of Patients	Percentage (%)
Domestic	33	73.33

Accident	9	20
Assaulted	0	0
Fall from height	3	6.66

Table 3: Radiological Findings

Radiological Finding	Number of Patients	Percentage (%)
United	40	88.88
Delayed Union	2	4.44
Nonunion	1	2.22222222

Table 4: Type of Reduction

Type of Reduction	Number of Patients	Percentage (%)
Close Reduction	40	88.88
Open Reduction	5	11.11

Table 5: Time of Procedure

Time (in hrs)	Number of Patients	Percentage (%)
<1	35	77.777778
1-2	15	33.333333
>2	0	0

DISCUSSION

Present study consists of 45 cases of intertrochanteric fractures treated operatively with proximal femur nail (PFN). Commonest age group for intertrochanteric fractures is between 71-80 years in 19 patients (42.22%) followed by 81-90 years in 8 patients (17.77%). Majority 33 patients (73.33%) of the intertrochanteric fractures occurred following trivial trauma usually a domestic accident like fall in bathroom or fall from stairs. In a comparable study by Bhardwaj S et al,93% of patients were grade ≥3 as per Singh's index for osteoporosis, four patients had severe osteoporosis, i.e., grade <3. Majority 55 patients of the intertrochanteric fractures occurred following trivial fall and among 6 patients it occurred following road Traffic Accident (RTA). The mean duration from admission to surgery was 1.59 days (1-8 days).

Surgical fixation commonly involves the use of implants such as dynamic hip screws or intramedullary devices like the proximal femoral nail (PFN). While dynamic hip screws suffice for stable fractures, they may inadequately stabilize unstable ones. The PFN, although widely used for unstable fractures, is associated with complications such as screw cut out, back out, varus collapse, and rotational instability, particularly in elderly populations, necessitating revision surgery.[4]

All patients received below-knee skin traction and primary supportive care for associated traumatic or medical issues. Most patients underwent surgery within five days of injury, typically as an elective procedure. The operation was completed within one hour for most patients. The stability of the reduction was assessed based on medial cortex continuity. Radiographic analysis revealed that in 95% of anteroposterior (AP) radiographs, the lag screw was positioned in the inferior part of the femoral head, while in 92% of lateral radiographs, the lag screw was placed centrally.

The proximal femur's load-bearing capacity is primarily through the calcar femorale. Intramedullary devices, like proximal femoral nails (PFN), reduce the bending force on the implant by 25-30% compared to dynamic hip screws (DHS). This is particularly beneficial for elderly patients who require early weight-bearing mobilization. Although previous studies favored DHS over intramedullary implants due to complications associated with gamma nails, PFN has shown comparable or better results in treating intertrochanteric fractures,[5] found that patients with a fractured lateral femoral wall had an 8-fold increased risk of re-operation due to technical failure with dynamic hip screws. This is because the fracture line runs parallel to the screw's sliding direction, causing the bone fragments to shift and the fracture to collapse, leading to a high risk of screw cut-out into the hip joint.

The advantages of the dynamic hip screw are that they allow for dynamic interfragmentary compression and are low cost compared to intramedullary devices. The main disadvantages include increased blood loss and open technique. Implant failure can occur due to a lack of integrity of the lateral wall or the placement of the screw, which should be placed at a tip apex distance of less than 25 millimeters.

Intramedullary nailing can be used to treat a broader range of intertrochanteric fractures, including the more unstable patterns such as reverse obliquity pattern. One proposed advantage of the intramedullary hip screw is its minimally invasive approach which minimizes blood loss. Although there are no data suggesting that an intramedullary hip screw is more effective than a sliding hip screw in treating stable fracture patterns, it is becoming more and more commonly used by young surgeons. The choice for short or long intramedullary implants is debatable in these fractures.[6]

Intramedullary nails are associated with less shortening and less sliding of the lag screw. This is

due to the fact that intramedullary nail stops the proximal part of the nail blocks the head-and-neck fragment, preventing its complete impaction. Leading to less limb shortening especially in unstable intertrochanteric fracture. If the hip screw is longer than the lag screw, vertical forces would increase on the hip screw and start to induce cut-out, a knife effect or Z-effect. This might force the hip screw to migrate into the joint and the lag screw to slide laterally. The cut-out rate with a PFN is reportedly 0.6 to 8 %.[7,8] Although complication rates remain low, cut-out of either screw is a serious complication, which can lead to revision surgery and related morbidity. When the hip screw was 10mm shorter than lag screw, the percentage of the total load carried by the hip screw ranged from 8-39% (mean 21%).[9] Unstable type 2 fractures should be initially reduced to a slightly valgus position during PFN/SFN surgery, because the neck-shaft angle would decrease during the first 6 postoperative weeks.

The lag screw should be inserted into the femoral head inferiorly in the AP view, and centrally in the lateral view. The tip of the lag screw should always be inferior to the centre of the femoral head. Anatomic and biomechanical studies have shown that the superomedial quadrant of 'the femoral head is the weakest part for the implant, and therefore, proper positioning of the screw is emphasized. Cut-out usually resulted from poor positioning of the proximal screw in the femoral head, particularly in the osteoporotic bone. In our study, the lag screw is inserted close to the subchondral bone. This resulted in 90% of the lag screws being inserted at the optimal site inferior to the centre of the femoral head and to an optimal depth, thereby achieving rigid fixation. Lateral slide may occur more often in patients with a PFN than a gamma nail, because of impaction of the fracture, rather than migration of the screws, assuming that anchorage of the lag screws in the femoral head for PFN and that of the gamma nail are similar. Restriction of the sliding Mechanism of the gamma nail caused by the more rigid femoral neck screw-nail assembly may initiate cut-out or penetration of the joint.[10]

The results of our study the Intra medullary nail, is an optimum implant for the internal fixation of intertrochanteric fractures with advantages of stable fixation, near-perfect reduction, early weight bearing and ambulation, shortened hospital stay and improved rate of union with early resumption of independent lifestyle.

The duration of hospital stay, operative time is less in Intra medullary nail than DHS. Patients are usually discharged on 5th post operative day if no complication was present.

Our study has several limitations, including the lack of a control group to compare functional outcomes with other implants, a relatively small sample size, and the absence of a subjective method for measuring osteoporosis. Future prospective studies with larger sample sizes are recommended to assess functional outcomes and complications associated with this implant, using more accurate methods to measure osteoporosis severity. Furthermore, it is essential to emphasize to young orthopedic surgeons that achieving optimal reduction is crucial, regardless of the advanced implant design used.

CONCLUSION

In conclusion, this study highlights the demographic and clinical characteristics of intertrochanteric fractures treated with proximal femoral nail (PFN). The majority of patients were elderly, with 71-80 years being the most common age group. Trivial trauma, often due to domestic accidents, was the leading cause of these fractures. The study also demonstrates favorable radiological findings, with 88.88% of patients showing union, and a high success rate of close reduction (88.88%). The procedure was completed within 1 hour in 77.77% of cases. Overall, the results suggest that PFN is a effective treatment option for intertrochanteric fractures, particularly in the elderly population.

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