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ORIGINAL ARTICLE

Outcomes of proximal femoral nailing in adults treated for subtrochanteric femur fractures.

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ABSTRACT… Objective: To assess the functional & radiological outcomes of proximal femoral nailing (PFN) in treating subtrochanteric femur fractures in adults. **Study Design:** Prospective study. **Setting:** Afridi Medical centre & Teaching Hospital Peshawar Pakistan. **Period:** Jan 2022 to October 2024. **Methods:** Patients of age 20 to 80 years admitted due to acute subtrochanteric (ST) femur fractures were included in the study. Open & pathological ST fractures were excluded. The Harris Hip Score was utilised to assess the postoperative outcomes. In all the cases, patients were put on immobilization preoperatively followed by closed reduction & fixation with PFN under spinal anaesthesia. Both radiological outcome by examining radiological union at fracture site and functional outcome through determining Harris Hip Score were determined at 4 months postoperatively. Microsoft excel was used for data analysis. **Results:** Radiological union was observed in the patients as early as 14 weeks postoperatively followed by radiological union in all the patients at 16th week postoperatively and no non-union case was observed in our study. Out of all 91 cases only 5 cases were having mild surgical site infection which was managed accordingly the sterile dressing and oral antibi.=otics. The overall Harris hip score to be 90.75±6.85 in our study. Among total 91 patients 68 (74.72%) patients fall in excellent, 15 (16.48%) in good, 6 (6.6%) in fair while 2 (2.2%) in poor categories of Harris hip score. **Conclusion:** PFN is an effective implant for treating femoral subtrochanteric fractures. The advantages include reduced surgical exposure, increased stability, and early mobilisation. Because it allows for early and stable mobilization, PFN may be superior for treating subtrochanteric fractures in the elderly as well.

Key words: Femur Fractures, Harris Hip Score, Proximal Femoral Nailing, Subtrochanteric.

INTRODUCTION

Subtrochanteric fractures occur in the proximal part of femur. This region of the femur is situated between the lesser trochanter and reaches about 5 centimetres in a downwardly direction to the narrower section or, more descriptively referred to as the isthmus of the femur. These fractures are very common. These are tough injuries because that area presents a high level of mechanical stress.[1,2]

The subtrochanteric region of the femur is under both tensile and compressive forces, much more than a patient's body weight. The region is subjected to rotational and bending forces that shape the typical fracture patterns seen here. Most of these fractures have small, comminuted proximal fragments that are pulled into a flexed position by the iliopsoas muscle attaching to the lesser trochanter. Another way of forcing the comminution into an abducted and externally rotated position is through abduction muscles pulling on the greater trochanter. In this case, a proximal abduction deformity may be more pronounced as the distal bone fragment gets pulled into adduction by the adductor muscles attached to the femoral shaft.

Muscle-driven deforming forces that make it difficult not to malreduce the fracture are varus, flexion, or external rotation misalignment. The lower trochanter is mainly composed of dense cortical bone, and so fractures rarely occur in the lower trochanter while it endures strong extrinsic forces well, mainly in young people.

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Most fractures are found in younger individuals, and in the concentrated area, the fragments of proximal bones that are subjected to the extrinsic influence of the muscles around it make fracture repair and management very complex.[1,3]

Proximal femur fractures occur around the middle of bones. A total of 230 for every 100,000 patients experience these fracture and, therefore, find it at the forefront of clinical care. About 5 to 10% occur within the subtrochanteric region, a place situated directly distal to the lesser trochanter of the femur.[4,5] Subtrochanteric femur fractures are more frequently observed in females, with studies showing that women experience these fractures 33% more often than men.[5,6] Age and gender are key risk factors, along with low overall bone mineral density, diabetes, and the use of bisphosphonates to treat osteoporosis.[7,8]

Over the past 50 years, the knowledge of the biomechanics of fractures has transformed the management of subtrochanteric (ST) femur fractures. Historically, non-surgical management was associated with major complications, including severe malrotation, limb shortening, and even death from prolonged immobilization. The anatomy of a subtrochanteric fracture is different from any proximal femoral or shaft femoral fractures, and thus, there is a distinct set of challenges in managing these types of fractures. Fractures in these regions require specific implants that can carry the high level of force applied by muscle across an extended healing period. New scientific advances in biological fractures and reduction techniques, along with improved implant biomechanics, have yielded good results. PFN (proximal femoral nail) is the intramedullary device developed in 1996 and specifically recommended for the above fractures, offering an early mobilization of patients, superior rotation stability with a facility to dynamically lock the nail besides having very less soft-tissue interference.[9]

The study evaluated the bone healing of subtrochanteric femur fractures treated with Proximal Femoral Nailing (PFN).

METHODS

This prospective study was conducted in Afridi Medical centre & Teaching Hospital Peshawar Pakistan from Jan 2022 to October 2024 and received approval of the same hospital ethical review board (AMC/014-3/11/2022). Patients of age 20 to 80 years admitted due to acute subtrochanteric (ST) femur fractures were included in the study. Sample size was determined to be 91 patients through WHO sample size calculator 1.1, using 90% confidence interval, and 3% margin of error and 3.1%[10] poor outcome of proximal femoral nail in subtrochanteric femur fractures (anticipated population).

Open and pathological ST fractures were excluded. In all the cases, patients were put on immobilization preoperatively. Spinal or epidural anaesthesia was administered by the anaesthetist while tailoring it according to the specific health status of each patient during every surgical procedure. The surgical method chosen was closed reduction and internal fixation, as to align the fracture without opening the site. In all the procedures, we used Proximal Femoral Nail (PFN) for better Fixation of ST fractures.

All patients underwent surgery with the patient in supine position using specially designed fracture table, which facilitated controlled manipulation of the limb that result alignment & rigid fixation. Anaesthesia was personalized to each patient with modifications as necessary for complex medical issues and safe, practical pain control. Prophylaxis with subcutaneous low-molecular-weight heparin to reduce the risk of developing subsequent venous thromboembolism was employed for such high-risk patients. To reduce the risk of infection, a single dosage of antibiotic was given before surgery followed by oral broad spectrum antibiotics for 7 days. In order to facilitate nail insertion at the greater trochanter, the leg was positioned in neutral or minor adduction while the fracture was oriented using longitudinal traction on a fracture table. To ensure precise alignment, measurements of the opposing leg's length and rotation were made before to preparation and draping. Hospital length of stay, blood transfusion requirements and any complications

were meticulously documented. Both radiological outcome by examining radiological union at fracture site and functional outcome through determining Harris Hip Score were determined at 4 months postoperatively. Total score of Harris hip score were 100 points. Score between 90 and 100 indicated excellent, score between 80 and 89 indicated good, score between 70 and 79 indicated fair and score below 70 indicated poor functional outcomes. Microsoft excel was used for data analysis.

RESULTS

Most of the patients in our study were from male gender. The male were 60 (66%) while female were 31 (34%). Mean age of the participants was 46.2±12 years. 20 (21.98%) patients were in age group 20-40 years, 55 (60.44%) patients were in age group 41-60 years and 16 (17.58%) patients were in age group 60-80 years. All the patients had a trauma history. Majority of the patients i.e. 55 (60.44%) were having history of road traffic accident. Of the remaining participants 20 (21.98%) had a history of fall from height while 16 (17.58%) patients had either history of violence or domestic fall. This means that most patients experienced subtrochanteric fractures due to high-velocity trauma. Most of the participants i.e., 33 (36.26%) were having type IV fractures according to Seinsheimer classification system of subtrochanteric femur fractures. The second most common i.e, 28 (30.77%) was type III subtrochanteric fracture (Table-I).

The operative time was 67.63±13.80 minutes. Partial weight bearing were started using walker frame in most of the participants at 6 to 10 weeks postoperatively after confirming radiological healing of the fracture site while full weight bearing was started from 10 to 14 weeks postoperatively.

Radiological union was observed in the patients as early as 14 weeks postoperatively followed by radiological union in all the patients at 16th week postoperatively and no non-union case was observed in our study. We observed 5 cases having mild surgical site infection which was managed accordingly the sterile dressing and oral antibiotics. We observed the overall Harris hip score to be 90.74±6.85 in our study. Among total 91 patients 68(74.72%) patients fall in excellent, 15(16.48%) in good, 6(6.6%) in fair while 2(2.2%) in poor categories of Harris hip score (Figure-1). 15(16.48%), 0%, 5(5.5%) and 0% patients were having excellent, good, fair and poor outcomes respectively in age group 20 to 40 years. 44(48.35%), 4(4.4%), 6(6.6%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in age group 41 to 60 years. 9(9.9%), 2(2.2%), 4(4.4%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in age group 61 to 80 years. The p value for age groups were 0.460763253 (not significant). 25(27.47%), 1(1.15%), 4(4.4%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in female group. 43(47.25%), 5 (5.50%), 11(12.09%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in male group. The p value for gender group was 0.656053731 (not significant). 5(5.5%), 1(1.15%), 2(2.2%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in type 1 fracture group. 11(12.09%), 3(3.3%), 7(7.7%) and 0% patients were having excellent, good, fair and poor outcomes respectively in type 2 fracture group. 24(26.37%), 2(2.2%), 2(2.25%) and 0% patients were having excellent, good, fair and poor outcomes respectively in type 3 fracture group. 28(30.8%), 0%, 4(4.4%) and 1(1.15%) patients were having excellent, good, fair and poor outcomes respectively in type 4 fracture group. The p value for fracture type group was 0.124226953 (not significant). (Table-II)

Variable	Numbers	%
Gender		
Male	60	66
Female	31	34
Age group		
20-40 years	20	21.98
41-60 years	55	60.44
60-80 years	16	17.58
Fracture Type		
type 1	9	9.89
type 2	22	24.18
type 3	28	30.77
type 4	33	36.26

Table-I. Demographic characteristics of the patients

Variable	Groups	Excellent N (%)	Good N (%)	Fair N (%)	Poor N (%)	P-Value
Age	20-40 yrs	15 (16.48%)	0 (0%)	5 (5.5%)	0 (0%)	0.460763253
	41-60 yrs	44 (48.35%)	4 (4.4%)	6 (6.6%)	1 (1.15%)	
	61-80 yrs	9 (9.9%)	2 (2.2%)	4 (4.4%)	1(1.15%)	
Gender	Female	25 (27.47%)	1 (1.15%)	4 (4.4%)	1 (1.15%)	0.656053731
	Male	43 (47.25%)	5 (5.50%)	11 (12.09%)	1 (1.15%)	
Fracture Type	I	5 (5.5%)	1 (1.15%)	2 (2.2%)	1 (1.15%)	0.124226953
	II	11 (12.09%)	3 (3.3%)	7 (7.7%)	0 (0%)	
	III	24 (26.37%)	2 (2.2%)	2 2.25)	0 (0%)	
	IV	28 (30.8%)	0 (0%)	4 (4.4%)	1 (1.15%)	

Table-II. Functional outcomes of PFN according to different variables

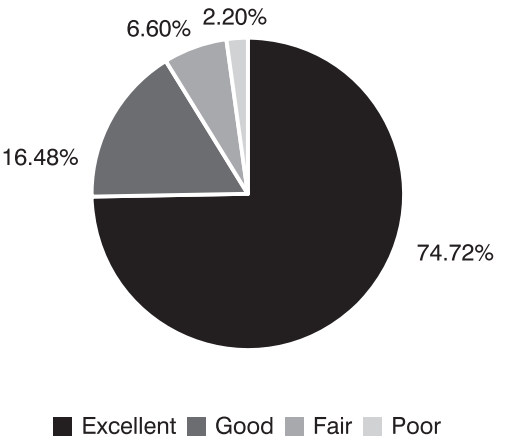

Figure-1. Functional outcome of PFN in subtrochanteric humerous fracture

DISCUSSION

While subtrochanteric (ST) fractures are associated with serious and life-threatening outcomes, ST injuries need to be effectively treated. Prompt management in the right direction is essential because neglect of ST fractures can have deleterious outcome including malunion, non-union and long term functional derangement.[11] Closed reduction with anatomic realignment of fractured bone is very important to get the desired final favourable results because properly aligned fractures support optimal healing and lessen the potential for issues that can affect patient prognosis after an ST fracture.[12,13]

Utilizing the advantages of multiple orthopedic devices, including the Zickel nail, the dynamic hip screw, and the locked intramedullary nail, the Proximal Femoral Nail (PFN) is a load-sharing device intended for intramedullary use. Reduced blood loss, a quicker recovery period, and the potential for early weight-bearing are some of PFN's main benefits. Despite its effectiveness, PFN-treated subtrochanteric fractures often have a little greater failure rate than intertrochanteric fractures.[10]

We investigated 91 patients who had subtrochanteric femur fracture. We treated them by placing a nail into the upper portion of the femur commonly known as proximal femoral nailing. All the patients had a trauma history. Majority of the patients i.e. 55 (60.44%) were having history of road traffic accident. Of the remaining participants 20 (21.98%) had a history of fall from height while 16 (17.58%) patients had either history of violence or domestic fall. This means that most patients experienced subtrochanteric fractures due to high-velocity trauma. This is similar to a research conducted in India by Sangwan et al., who found that 75% of their patients had sustained high-impact injuries in car accidents.[14]

Most of the participants i.e., 33 (36.26%) were having type IV fractures according to Seinsheimer classification system of subtrochanteric femur fractures. The second most common i.e, 28 (30.77%) was type III subtrochanteric fracture. These findings were comparable with the results presented by Patel et al where also the most common fracture was type IV (34.37%) followed by type III fracture (28.12%).[10] Our results in this regard were also comparable to study by Zhou, et al.[15]

Our findings demonstrate that employing PFN for surgery takes less time than other implants such as Dynamic Hip Screw, Dynamic Condylar Screw, and Blade Plates. The operative time of PFN in our study was 67.63±13.8 minutes, which is shorter than the timeframes reported in studies by Sadowski et al.[16] and Rahme et al. for other implants.[17]

The fractures in our study took an average of 16 weeks to heal, which is consistent with the data published by Boldin et al.[18] Percutaneous fixation resulted in less blood loss than extramedullary fixation. This is because PFN is a less invasive surgery that involves less soft tissue dissection, even if open reduction is required.[19] This decreased blood loss lowers morbidity, preserves tissue health, improves healing capacity, and reduces the likelihood of complications.

We experienced 5 cases of mild surgical site infection after surgery. These infections were successfully treated with antibiotics and wound care. The risk of infection after PFN surgery is generally lower because the incisions are smaller and less tissue is disrupted during the procedure. Near similar results were observed by Patel et al.[10]

According to Seinsheimer, the outcome of a femoral fracture is determined by a number of factors, including the amount of bone displacement, the type of fracture, the treatment approach used, and the quality of post-operative care.[20] We observed the overall Harris hip score to be 90.75±6.85 in our study. Among total 91 patients 68 (74.72%) patients fall in excellent, 15 (16.48%) in good, 6 (6.6%) in fair while 2 (2.2%) in poor categories of Harris hip score. Our study yielded very strong results, with 91.2% of patients having excellent or good outcomes and only 8.8% having fair or poor outcomes. Our results are comparable to that of Patel et al who found Harris hip score as following; excellent 75%, good 15.6%, fair 6.25% and poor 3.1%.[10] Our findings are also comparable to those reported by Zhou et al., who found 96.05% excellent or good outcomes and 3.95% fair or poor outcomes.[15]

PFN is a minimally invasive surgical procedure that uses a nail to fix subtrochanteric fracture of proximal femur. This procedure has various advantages over traditional techniques, including smaller incisions, faster healing time, and increased patient compliance. While early mobilization can help reduce stiffness and promote tissue healing, it must be carefully considered in light of the hazards of fracture disruption, implant failure, and ligament damage. Patients who follow a specific rehabilitation plan can optimize the benefits of PFN and early mobilization while reducing potential problems.[21]

CONCLUSION

PFN is an effective implant for treating femoral subtrochanteric fractures. The advantages include reduced surgical exposure, increased stability, and early mobilisation. Because it allows for early and stable mobilization, PFN may be superior for treating subtrochanteric fractures in the elderly as well.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Farmanullah Khan:** Data collection.
2	**Abdus Samad:** Discussion writing.
3	**Afsar Khan:** Review manuscript.
4	**Akhtar Hussain:** Analysis.
5	**Saeed Ahmad:** Data entry.