# **ORIGINAL RESEARCH**

# Analysis of Proximal Femoral Nailing Outcomes in Subtrochanteric Fractures: A Retrospective Study

<sup>1</sup>Dr. Brajesh Kumar, <sup>2</sup>Dr. Vivek Kumar

<sup>1</sup>Associate Professor, <sup>2</sup>Assistant Professor, Department of Orthopaedics, Narayan Medical College, Sasaram, Bihar India

# **Corresponding Author**

Dr. Brajesh Kumar

Associate Professor, Department of Orthopaedics, Narayan Medical College, Sasaram, Bihar India

Received: 07 May, 2022

Acceptance: 11 July, 2022

# ABSTRACT

**Background**: Subtrochanteric fractures pose a challenge for achieving stable fixation in both the young and elderly populations, making it particularly notorious for enabling prompt union and mobility. In this retrospective study, we aimed to analyze the results of proximal femur nailing in the treatment of subtrochanteric fractures. Our focus was on evaluating functional outcomes and radiological union, with a comparative analysis against studies utilizing alternative modalities. **Methods**: An in-depth retrospective analysis was conducted on 80 patients with subtrochanteric fractures, categorized according to the Sienshiemer classification. The patients underwent surgical intervention using the proximal femoral nail implant. Assessment of clinical outcomes was performed utilizing the Harris hip score. **Results**: In our study, the average union time was found to be six months, which was notably shorter than the union rates reported in some series utilizing other implants, such as the AO blade plate with a 7.7% union rate. The proximal femoral nail (PFN) demonstrated a conducive environment, enabling early mobility and independence for patients. This not only reduced complications associated with prolonged bed rest but also facilitated a quicker return to work. **Conclusion**:The findings from our study strongly indicate that the use of the proximal femoral nail (PFN) as an intramedullary implant provides a stable fixation, leading to earlier union when compared to extramedullary implants. Additionally, the PFN approach was associated with lower levels of blood loss and fewer complications, further underscoring its efficacy in the management of subtrochanteric fractures. **Keywords**:Subtrochanteric fracture, Proximal femur nail, Seinsheimer classification

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution -Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

#### **INTRODUCTION**

In the contemporary landscape of orthopedic care, the 21st century has witnessed a notable paradigm shift from a predominant emphasis on anatomical fixation to a more nuanced approach centered around the concept of biological fixation for the management of fractures.<sup>1</sup>Subtrochanteric fractures, a specific subset of fractures occurring in the proximal femur between the inferior aspect of the lesser trochanter and a distance of approximately 5 centimeters distally or at the center of the isthmus of the femoral shaft, present a distinctive and challenging clinical scenario. These fractures, irrespective of the patient's age, stand out as particularly intricate and demanding in terms of achieving both stable fixation and precise anatomical reduction.What distinguishes subtrochanteric fractures is their unique set of characteristics, setting them apart not only from femoral shaft fractures but also from fractures occurring in more proximal regions of the femur. This dissimilarity extends across mechanisms

of injury, treatment modalities, and potential complications.<sup>2</sup> The nuanced nature of these fractures necessitates a tailored and meticulous approach to address the challenges they pose in terms of stabilization and reduction. This evolving perspective underscores the contemporary orthopedic community's commitment to advancing fracture management beyond mere anatomical alignment, recognizing the importance of fostering a biologically conducive environment for optimal healing. As we delve into the intricacies of subtrochanteric fractures, we navigate a landscape where the traditional boundaries of fracture care are continuously redefined to embrace a more holistic and patient-centric approach.Managing subtrochanteric fractures poses a formidable challenge due to the unique biomechanical characteristics of the femur in this region. This particular zone is subjected to maximal mechanical stress, where tensile and compressive forces can surpass several multiples of the body weight.<sup>3</sup> These

extreme stresses not only contribute to the potential failure of implants but also pose challenges related to the slow healing of cortical bone, comminution of the fracture, and the presence of short proximal fragments that are further deformed by the action of hip flexors and abductors. The intricate interplay of these factors significantly complicates the reduction of the fracture.Despite substantial strides in trauma management over the last 50 years, the approach to handling subtrochanteric fractures remains a subject of ongoing debate within the medical community. Various factors contribute to the complexity of management, including the mechanical stresses unique to this femoral region, the challenges posed by specific anatomical features, and the varied nature of fractures encountered.In navigating the therapeutic landscape for subtrochanteric fractures, clinicians are presented with a spectrum of internal fixation options, broadly categorized into two main approaches: intramedullary fixation and plating. Each approach carries its own set of considerations, advantages, and potential drawbacks, adding to the complexity of decision-making in tailoring the most appropriate intervention for each patient.<sup>4,5</sup> The ongoing debate in the field reflects the multifaceted nature of these fractures, highlighting the need for continued research, innovation, and collaboration within the orthopedic community to refine and optimize the management strategies for subtrochanteric fractures. The intramedullary positioning of the implant serves a pivotal role in maintaining alignment between the proximal and distal segments of the fractured bone. This not only aids in the restoration of limb length but also creates a conducive environment for optimal fracture healing. Even in cases of comminuted fractures, the intramedullary implant allows for the transmission of weight from the proximal bony fragment to the distal bony fragment, thereby maintaining alignment and enabling the natural course of weight transmission through the bone. This mechanism not only promotes a more favorable healing environment but also contributes to the longevity of the implant.

The primary objective of our study was to comprehensively evaluate the outcomes associated with the use of proximal femoral nail in the management of subtrochanteric fractures.<sup>6</sup> We aimed to assess functional outcomes and radiological union, seeking to draw meaningful comparisons with studies employing different modalities of treatment for similar fractures. By undertaking this comparative analysis, we sought to contribute valuable insights into the effectiveness of proximal femoral nailing as a treatment modality, considering its impact on both functional recovery and the structural aspects of fracture healing. Through such assessments, we aimed to inform and enhance the decision-making process for clinicians faced with the complex challenge of subtrochanteric fractures.

## MATERIALS AND METHODS

This retrospective study involved the analysis of 80 patients with subtrochanteric fractures of the femur who underwent surgical intervention with proximal femoral nail (PFN) over a period of one year. The follow-up period ranged from 6 to 36 months.

Data collection was meticulously executed through a combination of interviews, scheduled follow-ups at intervals of 1, 2, 4, and 6 months, clinical examinations, and a thorough analysis of case papers. This comprehensive approach ensured a detailed and well-rounded assessment of the patients' progress and outcomes.<sup>7</sup>The inclusion criteria comprised patients aged 18 years and above with closed fractures. On the other hand, exclusion criteria involved patients who were conservatively treated, those with pathological fractures, periprosthetic fractures, and individuals with vascular injuries.Instruments employed during the surgical procedures included reamers, guide pins, the PFN-long, a standard instrument set, and a jig. The Seinsheimer classification system was utilized to categorize the subtrochanteric fractures, providing a standardized framework for assessing and documenting the severity and characteristics of these fractures.

By adhering to stringent inclusion and exclusion criteria and employing a range of instruments, this study aimed to provide a thorough and focused analysis of the outcomes associated with PFN in the context of subtrochanteric femur fractures, contributing valuable insights to the existing body of knowledge in orthopedic research.

The surgical procedure commenced with the administration of spinal or epidural anesthesia, following which patients were carefully positioned on a radiolucent fracture table in a supine orientation, with a perineal post to stabilize the position.<sup>8</sup> The operative leg was slightly adducted and subjected to traction, while the opposite limb was fully abducted to create ample space for the C-arm to be maneuvered between the legs.Reduction of the fracture was primarily achieved through a combination of traction and internal rotation, with additional adjustments in adduction or abduction as deemed necessary. The effectiveness of the reduction was meticulously verified using the C-arm, which provided both anterior-posterior and lateral views for а comprehensive assessment.For surgical access, a 5 cm incision was made above the tip of the greater trochanter and extended deep to expose the gluteus medius muscle. The tip of the greater trochanter was palpated, and minimal muscle attachment was cleared to facilitate further access. The entry point for the procedure was precisely determined on the tip of the greater trochanter in both anterior-posterior and lateral positions. Throughout the surgical intervention, the total time taken for the procedure and the amount of blood loss were diligently recorded, providing crucial intraoperative metrics for evaluating the efficiency and safety of the surgical approach.9 This detailed

account underscores the systematic and meticulous nature of the surgical technique employed in the management of subtrochanteric fractures using the proximal femoral nail.

Postoperative rehabilitation and follow-up care are crucial components of the management protocol for subtrochanteric fractures treated with proximal femoral nail (PFN). The rehabilitation program commenced promptly, with quadriceps physiotherapy, strengthening exercises, sequential compression devices (SQE), and calf pumping initiated as soon as the patient emerged from anesthesia. Knee and ankle mobilization were introduced on the second postoperative day to facilitate joint flexibility and prevent stiffness.Sutures were removed on the 12th postoperative day, marking a critical step in the recovery process. Patients were then advised to engage in non-weight-bearing walking as soon as it was tolerable, typically following suture removal. Subsequent to radiological assessments to ensure stability and the absence of anticipated collapse (around 8 weeks postoperatively), partial weightbearing walking was introduced. The transition to full weight-bearing walking occurred after careful evaluation of both radiological evidence and clinical union. This stepwise progression in weight-bearing activities aimed to optimize patient recovery while minimizing the risk of complications.<sup>10</sup> Patientoriented discharge, emphasizing the individual needs and capabilities of each patient, was implemented. The follow-up schedule involved regular assessments at 1, 2, 3, and 6 months from the date of surgery. During these follow-up appointments, patients underwent a clinical evaluation based on the Harris hip score-a comprehensive tool designed to assess the functional status and outcomes of hip-related conditions, including postoperative recovery from traumatic injuries. This detailed rehabilitation and follow-up plan reflects a holistic approach to patient care, encompassing not only the surgical intervention but

also an integrated rehabilitation strategy and ongoing clinical assessments to monitor progress and address any emerging concerns.

# RESULTS

All cases in this study underwent treatment with intramedullary fixation using the proximal femoral nail (PFN). The study exclusively focused on patients aged 20 years and above, with an age distribution ranging from 20 to 90 years. In the younger and adult age group, fractures were predominantly caused by high-velocity trauma.<sup>11</sup> Notably, among the few cases of low-velocity trauma in this age group, one individual belonged to a very poor socioeconomic stratum, while the other was a chronic alcoholic. In the elderly age group, low-velocity trauma emerged as a more common cause for subtrochanteric fractures. This shift in the mechanism of injury is often attributed to weakened and osteoporotic bone, a prevalent characteristic in the elderly population. Osteoporosis, characterized by decreased bone density and increased bone fragility, contributes to the susceptibility to fractures even with relatively lowimpact incidents.An interesting demographic observation from this study is the predominance of males, constituting approximately 82.5% of the patient population.<sup>12</sup> This gender distribution aligns with the generally higher incidence of traumatic fractures in males, which may be influenced by various factors, including lifestyle, occupational hazards, and differences in bone density.Understanding the demographic profile and specific risk factors for subtrochanteric fractures is crucial for tailoring effective preventive measures and treatment strategies. This study provides valuable insights into the age-related patterns and contributing factors associated with these fractures, laying the foundation for targeted interventions and further research in this area.

Table 1: Age or mode of injury.

Age	No. of patients	Туре	
(in years)	( <sup>•</sup> ⁄%)	High velocity	Low velocity
20-50	50 (62.5)	46	4
>50	30 (37.5)	8	22
Total	80 (100)		



### Figure1: Age and mode of injury





The primary cause of injury in our study was found to be falls, closely followed by road traffic accidents. Falls are often encountered in various settings and can result from a multitude of factors such as environmental hazards, impaired balance, or other predisposing conditions.

In terms of associated injuries, 22.5% of the patients in our study had additional injuries. Among these cases, 17.5% presented with associated injuries in the form of fractures, including those of the shaft of the femur, distal end of the radius, calcaneum, and others.<sup>13</sup> Five percent of the patients had injuries affecting other systems, with both cases involving head injuries. This underscores the importance of comprehensive evaluation and management in cases of subtrochanteric fractures, particularly when associated injuries are present.A notable finding from our study is that the right extremity was more frequently involved. This asymmetry in extremity involvement could be incidental, or it might be influenced by factors such as handedness, side of

falls, other impact during contextual or variables.Understanding the common causes of injury and associated injuries is essential for developing targeted preventive strategies and optimizing treatment plans. The prevalence of falls and road traffic accidents as leading causes reinforces the need for interventions that address environmental safety and road traffic regulations. Additionally, the diverse range of associated injuries emphasizes the importance of a multidisciplinary approach to manage the complexities often seen in cases of subtrochanteric fractures.

# DISCUSSION

In contrast to pertrochanteric fractures, subtrochanteric fractures generally exhibit a slightly higher failure rate. Several factors contribute to this discrepancy, including the inherent instability of subtrochanteric fractures, necessitating more robust stabilization. Additionally, the complexity of fracture reduction is heightened in subtrochanteric fractures

Online ISSN: 2250-3137 Print ISSN: 2977-0122

due to the propensity of the proximal fragment to anteflex relative to the distal fragment-a phenomenon influenced by the activity of the psoas muscle. Another contributing factor is the shorter distance from the locking screw hole to the fracture site.Nonetheless. non-surgical treatment of subtrochanteric fractures is considered impractical or less effective due to the elevated risk of non-unions and malunions. The challenges arise from the inability to control the muscle forces pulling the fracture fragments in different directions, leading to outcomes.14,15 suboptimal healing Prolonged immobilization associated with non-surgical approaches can further contribute to morbidity and, in severe cases, mortality. The nuanced nature of subtrochanteric fractures demands a surgical intervention that not only provides stable fixation but also addresses the specific biomechanical challenges with this fracture type. associated These considerations highlight the importance of tailored approaches in fracture management, acknowledging the distinct characteristics of subtrochanteric fractures compared to pertrochanteric fractures.

The fractures in our study were classified using Seinshemer's classification, which is currently the most commonly used classification system. Type II fractures were the most prevalent, accounting for 35% of cases, followed closely by Type III fractures at 32.5%. Various outcome variables, including the injury-operation interval and operative time, were considered.<sup>16</sup> Although it was initially suggested that fixation with proximal femoral nail (PFN) takes less time compared to other intramedullary and extramedullary devices, our study revealed no significant difference in the mean duration of surgery between the two groups. The literature review highlighted the variability in surgery duration across different series, influenced by factors such as fracture type, patient bone structure, and the skill of the operating surgeon, rather than the implant used. Variables like the injury-operation interval were subject to fluctuation, particularly due to associated injuries from high-velocity trauma. These associated injuries affected postoperative mobilization, weightbearing, and the overall outcome, regardless of the chosen fixation modality. While PFN was initially preferred due to its minimally invasive nature, good results were obtained in cases where a mini-open approach was used, especially in situations requiring encirclage.Intriguingly, the study observed that despite inaccurate anatomical reduction seen on Xrays, excellent functional outcomes were achieved with proximal femoral nails. The impact of associated co-morbid medical conditions, such as hypertension, on patient outcomes was noted. These conditions not only increased the injury-operation time but also extended rehabilitation periods.<sup>17</sup> Two fatalities were reported in the study, one unrelated to surgery (chronic epileptic), and the other involving a patient with multiple medical conditions (diabetes mellitus,

hypertension, and metastatic breast cancer) who underwent PFN followed by hemiarthroplasty due to complications, highlighting the challenges posed by fracture comorbidities in management. In our study, distal locking was consistently performed, and patients were typically allowed bedside hip and knee bending on the 2nd postoperative day, provided it wasn't contraindicated by associated problems. Excellent patient compliance was observed, and most patients were discharged after the 3rd postoperative day.<sup>18</sup> This approach aimed to avoid prolonged immobilization and non-weight bearing, which, in other implants, has been associated with significant joint space narrowing lasting over 9 months.Encouragingly, the study reported only two cases of infection, one of which was deep. In cases with comminution in subtrochanteric fractures, encerclage procedures were employed to enhance contact at the fracture site, increasing the likelihood of union. The amount of blood loss during the operation was minimized in comparison to other intramedullary and extramedullary implants, such as the Gamma nail or dynamic hip screw, due to the femoral head not being reamed and the fracture site not being exposed. The average union time in our study was notably shorter, at 5.12 months, than some union rates reported in series with other implants, such as the AO blade plate with a 7.7% union rate. Two non-unions (5%) were observed in our study, which contrasts with higher non-union rates reported in other studies for angled plates. The fixation of subtrochanteric fractures with intramedullary nails was found to be significantly stronger and more rigid than with other extramedullary screw plate devices, such as dynamic condylar screws and dynamic hip screws. This enhanced fixation is attributed to factors such as the preservation of the fracture hematoma, controlled collapse, and a lower likelihood of postoperative infection, all contributing to the promotion of early fracture union in proximal femoral nails (PFN).

#### CONCLUSION

The study's conclusive findings underscore the significant advantages of utilizing the proximal femoral nail (PFN) as an intramedullary implant for the treatment of subtrochanteric fractures compared to extramedullary implants. PFN's closed method ensures the preservation of the fracture hematoma, promoting early healing and resulting in a shorter mean radiological union time when compared to extramedullary alternatives. The procedure, particularly in the hands of experienced surgeons, proves to be swift and minimally invasive, with small incisions contributing to significantly less blood loss during surgery. Notably, PFN demonstrates a reduction in preoperative complications, emphasizing its efficacy and safety. The study highlights the significantly low infection rates and minimal immediate postoperative complications associated with PFN, attributes attributed to its minimally

invasive nature. Furthermore, the study suggests that PFN's effectiveness extends to elderly patients with multiple pre-existing illnesses, showcasing its versatility and suitability across diverse patient profiles. In summary, the research positions PFN as a superior choice for subtrochanteric fractures, providing a holistic and effective approach to fracture management.

## REFERENCES

- 1. Rüedi TP, Buckley RE, Moran CG. AO Principles of fracture management; Thieme; 2007.
- Seinsheimer F. Subtrochanteric fractures of femur. J Bone Joint Surg Am. 1978;60:300-6.
- George J, Langford J. Subtrochanteric fractures; Rockwood and Green's Fractures in adults. Volume11. 7th International edition. Wolters Kluwer; 2010.
- 4. Fielding JW, Magliato HJ. Subtrochanteric fractures. Surg Gyn Obstet. 1966;122:555-60.
- Morihara T, Arai Y, Tokugawa S, Fujita S, Chatani K, Kubo T. Proximal femoral nail for treatment of trochanteric femoral fractures. J Orthop Surg (Hong Kong). 2007;15(3):273-7.
- 6. Tencer AF. Biomechanics of fixation and fractures; Rockwood And Green's Fractures In Adults. Volume 1. 7th Edition. 2010: 3-42.
- Jones T, Kop A, Swarts E, Day R, Morrison D, Keogh C. Bioengineering Bulletin; Department Of Medical Engineering And Physics; Royal Perth Hospital; 2008.
- Harris WH. Traumatic arthritis of hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end result study using a new method of result evaluation. J Bone Joint Surg Am. 1969:51(4):737-55.
- 9. Sadowski C, Lubbeke A, Saudan M, Riand N, Stern R, Hoffmeyer P. Treatment of reverse oblique and

transverse intertrochanteric fractures with use of an intramedullary nail or a 95 degrees screw-plate: a prospective, randomized study. J Bone Joint Surg Am. 2002;84:372-81.

- Rijal KP, Manandhar RR, Pandey BK. Subtrochanteric fractures of the femur: Results of ORIF at KMCTH. Kathmandu Univ Med J. 2007;5(18):161-5.
- 11. David G, La vele. Fractures of Hip. Campbell's operative orthopaedics. Volume III. 11th International Edition. Elsevier publications; 2008.
- Dorotka R, Schoechtner H. The influence of immediate surgical treatment of proximal femoral fractures on mortality and quality of life. J Bone Joint Surg. 2003;85:1107-13.
- 13. Hung S, Nakamura K. Narrowing of the joint space of the hip after traumatic shortening of femur. J Bone Joint Surg Br. 1996;78(5):718-21.
- 14. Schipper IB, Steyerberg EW, Castelein RM. Treatment of unstable trochanteric fractures: randomized comparison of the gamma nail and the proximal femoral nail. J Rone Joint Surg [Br]. 2004;86:86-94.
- Yolmaz E, Karakurt L, Güzel H, Serin E. Evaluation of treatment results with the 95-degree AO/ASIF angular platein subtrochanteric femur fractures. Joint Dis Rel Surg. 2005;16(1):42-8.
- Rahme DM, Harris IA. Intramedullary nailing versus fixed angle blade plating for subtrochanteric femoral fractures: a prospective randomised controlled trial. J Orthop Surg. 2007;15(3):278-81.
- 17. Curtis MJ, Jinnah RH, Wilson V. Proximal femoral fractures a biomechanical study to compare intramedullary and extramedullary fixation. Injury. 1994;4:99-104.
- Koval KJ, Zuckerman JD. Functional recovery after fracture of the hip. J Bone Joint Surg Am. 1994;76:751-8