Section: Orthopedics

Original Research Article

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE INTERTROCHANTERIC FEMUR FRACTURES IN ELDERLY PATIENTS TREATED WITH PROXIMAL FEMORAL NAIL - A RETROSPECTIVE STUDY

G Nagaraju[1], S Gopi[2], M Guru Teja[3], Lins Mathew[4], Amal PS[5], Ebel Raj N[5]

[1]Associate Professor, Department of Orthopedics, Yella Pragada subbarao government medical college and general hospital, Eluru, Andhra Pradesh, India
[2]Assistant Professor, Department of Orthopedics, Siddartha Medical College, Vijayawada, Andhra Pradesh, India
[3]Assistant Professor, Department of Orthopedics, Alluri Sitarama Raju Academy of Medical Sciences, Eluru, Andhra Pradesh, India
[4]Department of Orthopedics, Govt. Taluk Hospital, Pudukkad, Thrissur, Kerala, India
[5]Assistant Professor, Department of Orthopedics, Alluri Sitarama Raju Academy of Medical Sciences, Eluru, Andhra Pradesh, India

Received *: 15/042026*
Received in revised form *: 10/06/2026*
Accepted *: 26/06/2026*

Corresponding Author:
Dr. Amal PS,
Assistant Professor, Department of Orthopedics, Alluri Sitarama Raju Academy of Medical Sciences, Eluru, Andhra Pradesh, India.
Email: amalps1@gmail.com

DOI: 10.70034/ijmedph.2026.3.42

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 253-257

ABSTRACT

Background: Intertrochanteric fractures are among the most common injuries encountered in the elderly population and are predominantly managed surgically. Treating unstable intertrochanteric fractures remains challenging, particularly in older patients. The optimal choice of implant for fixation continues to be debated. Implants are broadly classified into extra-medullary and intra-medullary types. The Dynamic Hip Screw (DHS), an extra-medullary device, has long been considered the gold standard; however, it is associated with higher complication rates in unstable fracture patterns. The Proximal Femoral Nail (PFN), a newer intra-medullary implant, has gained popularity in recent years. This study aims to evaluate the functional and radiological outcomes of unstable intertrochanteric femur fractures in patients aged over 50 years treated with PFN.

Materials and Methods: This study was conducted in the Department of Orthopedics at Government Medical College/Government Teaching General Hospital, Eluru, Andhra Pradesh, India, from June 2023 to January 2025. A total of 33 patients aged above 50 years with unstable intertrochanteric fractures treated using Proximal Femoral Nail were included. Patients were followed up at regular intervals to assess fracture healing, functional outcomes, and any associated complications. Functional assessment was performed using the Harris Hip Score.

Results: All patients achieved fracture union with a mean duration of 20 weeks. No complications were observed in 23 patients. Among the remaining cases, 3 patients experienced screw back-out, 3 developed varus malunion, and 4 reported anterior thigh pain. No cases of infection were noted. The mean Harris Hip Score at one year postoperatively was 83, indicating a good functional outcome.

Conclusion: Management of unstable intertrochanteric fractures in elderly patients using Proximal Femoral Nail yields favorable functional and radiological outcomes, with a high rate of fracture union and an acceptable complication profile. These complications can be further minimized with proper surgical technique.

Keywords: Unstable Intertrochanteric fracture, Proximal Femoral Nail, Harris hip score, Singh's index, AO, elderly

INTRODUCTION

Intertrochanteric fractures occur in the proximal femur between the greater and lesser trochanters and are commonly seen in the elderly following low-energy trauma such as falls. In younger individuals, they are usually the result of high-energy injuries like road traffic accidents. With the rising elderly population, the incidence of hip fractures is increasing, with nearly half being intertrochanteric fractures.[1] These injuries are three to four times more common in females, largely due to postmenopausal osteoporosis, and approximately 35–40% are unstable. The management of these fractures has evolved with a focus on prevention of fragility fractures, standardization of early care protocols, and improvement in fixation techniques for osteoporotic bone. Although surgical treatment is now the standard of care, the choice of procedure remains debated. Options include internal fixation and arthroplasty (bipolar hemiarthroplasty or total hip arthroplasty), though factors such as lower acetabular retroversion and cost considerations limit the use of total hip arthroplasty in the Indian population.[2,3]

Internal fixation aims to achieve anatomical reduction, stable union, and early mobilization. Fixation methods are broadly classified into extra-medullary and intra-medullary techniques. The Dynamic Hip Screw (DHS) has long been considered the gold standard; however, it is associated with higher failure rates in unstable fractures, including screw cut-out, varus collapse, and implant failure. Intramedullary devices, such as Proximal Femoral Nail (PFN), PFN-A2, and Gamma nail, offer biomechanical advantages as they are load-bearing, positioned closer to the mechanical axis, and associated with reduced operative time and blood loss. Introduced by the AO group in 1997, PFN has become widely used for unstable intertrochanteric fractures.[4,5] However, it is technically demanding and may be associated with complications such as Z-effect, reverse Z-effect, varus collapse, and peri-implant fractures.[6]

Aims and Objectives: The present study is aimed to evaluate functional and clinical outcomes of the proximal femoral nail (PFN) in the treatment of unstable inter-trochanteric femur fractures in elderly patients.

MATERIALS AND METHODS

Study Design and Period: This retrospective analytical study was carried out in the Department of Orthopaedics at Government Medical College/Government Teaching General Hospital, Eluru, from June 2023 to January 2025, after obtaining approval from the Institutional Ethics Committee (IEC). The sample size was calculated considering an 80% confidence level and 80% power. Based on reference data, the mean pre-treatment Harris Hip Score (HHS) was 67.77 with a standard deviation of 33.18, while the mean post-treatment HHS was 80.35. The sample size was determined using the formula:

$N = 2(t\alpha + t\beta)^2 / (\mu_0 - \mu_a)^2$, where t represents the T-distribution value at α and β.

Using this calculation and considering a minimum HHS difference of 33, the final sample size was estimated to be 33 patients, who were included in the study.

IEC NUMBER: IEC-GMC-ELR/011-2025

IEC REGISTRATION NUMER: IEC/NEW/INST/2025/5028

Date of Issue : 29/09/2025

Inclusion criteria

Patients enrolled in the study were those who were medically and anesthetically fit for surgery and provided informed written consent. The inclusion criteria were as follows:

1. Unstable intertrochanteric femur fractures classified as AO type 3A and above, including cases with medial wall comminution, reverse oblique patterns, intertrochanteric fractures with subtrochanteric extension, and fractures involving the greater trochanter.
2. Patients aged more than 50 years.

Exclusion Criteria

1. Pathological fractures
2. Compound fractures
3. Previously operated fracture or old hip fracture
4. Bilateral hip fractures.

Fractures were classified preoperatively using the AO/OTA classification system based on X-ray findings. On admission, detailed patient information was recorded, including age, sex, mechanism of injury, time interval between injury and surgery, and associated comorbidities such as hypertension, diabetes, and ischemic heart disease. All patients underwent pre-anesthetic evaluation to assess surgical fitness. Based on this assessment, patients were categorized according to the American Society of Anesthesiologists (ASA) grading system, ranging from Grade I to IV, where Grades I and II indicated good general health and Grades III and IV reflected poorer systemic status.[7,8]

Surgical Technique: All patients received a single preoperative dose of intravenous fourth-generation cephalosporin. Surgery was performed under combined spinal–epidural anesthesia (CSEA) with the patient positioned supine on a fracture table. Closed reduction was initially attempted using traction and internal rotation under fluoroscopic guidance. If reduction was inadequate, percutaneous assistance using a Steinmann pin was employed to achieve alignment. In cases with subtrochanteric extension, provisional stabilization was obtained using minimally invasive cerclage wiring. Fixation with Proximal Femoral Nail (PFN) was carried out following standard technique under fluoroscopy. The lag screw was positioned inferocentrically within the femoral head, and the anti-rotation screw was placed parallel to it. After fixation, the wound was irrigated

with hydrogen peroxide, povidone-iodine, and normal saline. The incision was closed in layers, followed by application of sterile dressing and a compression bandage.

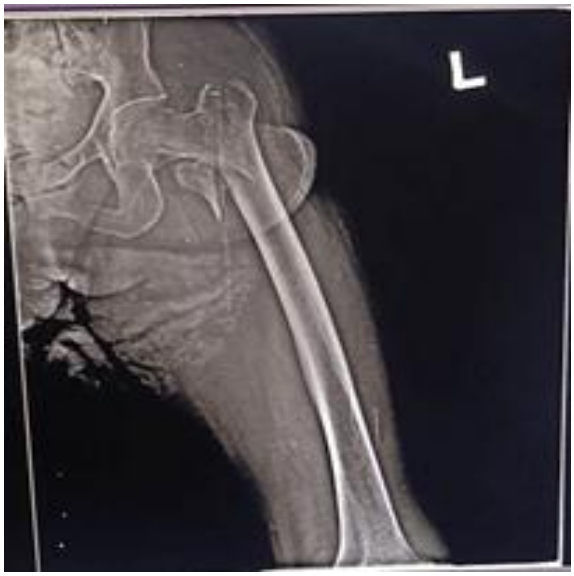
Post-operative Management: Postoperatively, patients were kept on bed rest with elevation of the operated limb for 24 hours. Intravenous antibiotics were administered for the first 2 days, followed by oral antibiotics for 5 days. Anteroposterior and lateral radiographs were obtained on the second postoperative day to evaluate fracture reduction, screw position, and tip–apex distance (TAD) as per Baumgärtner's criteria[9]. Static quadriceps exercises were initiated on postoperative day 2, followed by active quadriceps exercises from day 4.

Follow up: Patients were mobilized early using a walker with non–weight-bearing ambulation. Progression to full weight bearing was allowed at around three months postoperatively, depending on radiological signs of fracture union on follow-up X-rays. Follow-up evaluations were conducted at 2 weeks, 1 month, 3 months, 6 months, and 1 year postoperatively, with anteroposterior and lateral radiographs taken at each visit. Fracture union was defined by the presence of callus formation in at least three cortices. Functional outcomes were assessed using the Harris Hip Score (HHS), which evaluates pain, function, deformity, and range of motion. The total score is 100, with pain (0–44), function (0–47), deformity (0–4), and range of motion (0–5). Scores were graded as poor (<70), fair (70–80), good (80–90), and excellent (90–100).

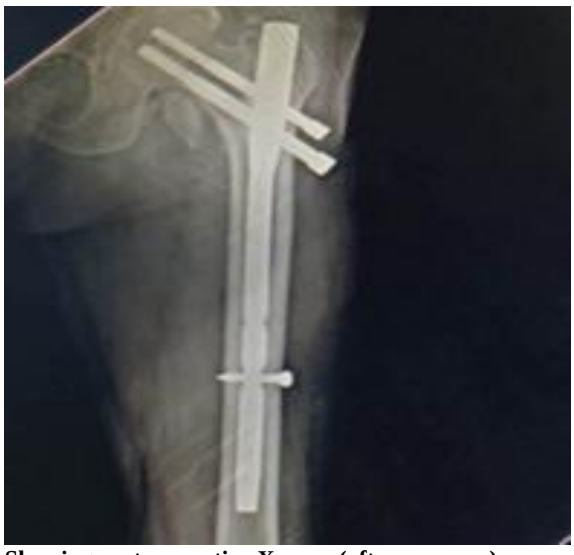
Statistical Analysis: The collected data were organized and analyzed according to the study objectives. Statistical analysis was performed using Microsoft Excel 2010, with calculation of means and percentages, and comparisons made with relevant external data where required.

RESULTS

A total of 33 patients aged above 50 years were included in this study. The mean age was 64.2±8.29 years (range 51–80 years). Among them, 18 (54.5%) were males and 15 (45.5%) were females. The mean duration of surgery was 67.58±18.38 minutes, with an average incision length of 8.58±1.15 cm. Intraoperative blood loss, calculated using Gross's formula, had a mean value of 68.18±30.15 ml. The average hospital stay was 4.09±1.26 days. Based on Singh's index, osteoporosis grading showed 1 (3.0%) patient with grade 1, 3 (9.1%) with grade 2, 12 (36.4%) with grade 3, 11 (33.3%) with grade 4, and 6 (18.2%) with grade 5 osteoporosis. The tip–apex distance (TAD), measured on standard anteroposterior and lateral radiographs as per Baumgartener's criteria, was 16.55±4.56 at 15 days, 16.97±4.47 at 3 months, 17.30±4.73 at 6 months, and 17.70±5.28 at 1-year follow-up. The mean cervico-diaphyseal angle was 129.45˚±3.88˚ at 15 days, 12.64˚±4.74˚ at 3 months, 128.48˚±4.77˚ at 6 months, and 128.48˚±4.77˚ at 1-year follow-up. Lag screw positioning was assessed using the Cleveland index and is presented in [Table 1].



Showing pre-operative X- rays

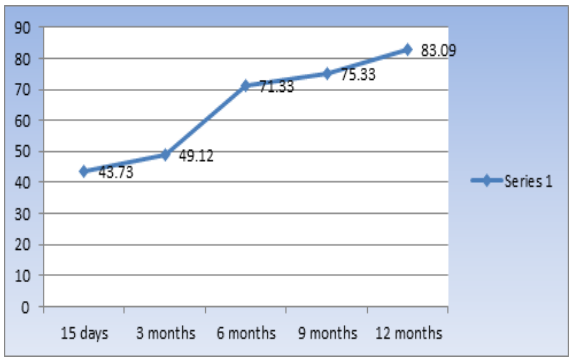


Showing post -operative X- rays (after one year)

Table 1

15days			3 Months		6 Months		12 Months	
Score	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
4	1	3.0	1	3.0	1	3.0	1(3.0)	3.0
5	3	9.1	3	9.1	3	3	3(9.1)	9.1
7	4	12.1	4	12.1	12.1	12.1	4(12.1)	12.1
8	22	66.7	22	66.7	66.7	66.7	22(66.7)	66.7
9	3	9.1	3	9.1	9.1	9.1	3 (9.1)	9.1
Total	33	100.0	33	100.0	33	100.0	33	100.0

The mean Harris Hip Score (HHS) progressively improved over time, measuring 43.73±6.463 at 1 month, 49.12±5.936 at 3 months, 71.33±8.940 at 6 months, 75.33±9.636 at 9 months, and 83.09±6.658 at 1-year follow-up.



Partial weight-bearing was initiated based on fracture stability and patient compliance. Of the 33 patients, 30 (90.9%) began partial weight-bearing at 1 month postoperatively, while the remaining 3 (9.1%) started at 3 months. Progression to full weight-bearing was guided by radiological evidence of union, defined by callus formation in at least three cortices, along with stable fixation and absence of implant failure. Full weight-bearing was commenced in 12 (36.4%) patients at 4 months, 5 (15.2%) at 5 months, 7 (21.2%) at 6 months, 6 (18.2%) at 8 months, and 3 (9.1%) at 12 months postoperatively. In this study, 26 (72%) patients had no complications. Screw back-out was observed in 3 (9.09%) patients, varus malunion in 3 (9.09%), and anterior thigh pain in 4 (11%) patients. No cases of infection were reported.

DISCUSSION

Intertrochanteric fractures are common in the elderly and their incidence is rising with increasing life expectancy. The primary goals of management are early mobilization and functional rehabilitation to reduce complications related to prolonged immobilization. Surgical treatment remains the preferred approach, with options including internal fixation and arthroplasty (bipolar hemiarthroplasty or total hip arthroplasty). Among these, internal fixation is the standard modality. Fixation methods are broadly categorized into extra-medullary and intramedullary techniques. The Dynamic Hip Screw (DHS) is the most commonly used extra-medullary device, while intramedullary options include Proximal Femoral Nail (PFN), PFN-A2, and Gamma nail.

PFN provides controlled compression at the fracture site and ensures both axial and rotational stability, which is particularly important in unstable fractures. Being minimally invasive, intramedullary implants are better tolerated in elderly patients. Compared to the Gamma nail, PFN uses two smaller proximal screws that offer improved rotational control. However, complications such as Z-effect, reverse Z-effect, lateral screw protrusion, lateral wall fracture, intraoperative shaft fractures, and anterior thigh pain have been reported.

In the present study, 33 patients aged above 50 years were included, with 12 in the 51–60 years group, 14 in 61–70 years, and 7 in 71–80 years, with a mean age of 64.2±8.29 years. This is comparable to the study by Dr. Ravishankar et al,[10] where the mean age was 64 years. Of the 33 patients, 18 (54.5%) were male and 15 (45.5%) were female, indicating male predominance, similar to the findings of Dr. Ravishankar et al,[10] (62.2%). The mean duration of surgery was 67.58±18.38 minutes, comparable to Bartonicek J,[11] (70 minutes) and other studies by Pan et al,[12] (59.16 min), Saudan et al,[13] (64 min), and Shen et al,[14] (62.06 min). The mean incision length in this study was 8.58±1.15 cm, which is shorter compared to Pan et al,[12] (14.20 cm) and Zhao et al,[15] (9.60 cm).The mean intraoperative blood loss was 68.18±30.15 ml, which is significantly lower compared to Pajarinen et al,[16] (320 ml), Pan et al,[12] (273.33 ml), Shen et al,[14] (123.73 ml), and Zhao et al,[15] (179 ml). The mean hospital stay was 4.09±1.26 days, which is shorter than that reported by Anmol Sharma et al,[17] (9.29 days).

The mean tip–apex distance (TAD), calculated using Baumgartner's criteria,[9] was 17.70±5.28 at 1 year. In comparison, Jeffrey A. et al,[18] reported a mean TAD of 20 mm ± 9 mm with an 8.5% cut-out rate (n = 7). A TAD greater than 25 mm, varus reduction, and poor reduction are associated with fixation failure; however, no screw cut-out was observed in this study. The mean cervico-diaphyseal angle was 129.45±3.88 at 15 days, indicating satisfactory alignment. Functional outcomes assessed using Harris Hip Score (HHS) showed progressive improvement: 43.73 (SD 6.463) at 1 month, 49.12 (SD 5.936) at 3 months, 71.33 (SD 8.940) at 6 months, and 83.09 (SD 6.658) at 12 months, indicating good recovery. Similar trends were observed in the study by R.N. Singh et al,[19] although their scores were comparatively higher (33 (SD 0.4), 58 (SD 5.6), 88 (SD 2.5), and 93 (SD 2.7)), but the difference was not statistically significant.

Osteoporosis was assessed using Singh's index from radiographs of the contralateral hip, with 48.48% of patients having a score ≤3 compared to 38% in the study by Sharma A et al.[20] No significant correlation was found between osteoporosis and functional outcome, suggesting that PFN fixation with proper technique yields good results even in osteoporotic bone. The average time to union was 20 weeks (range 16–24 weeks). However, increasing age and Singh's index ≤3 were associated with higher complication rates such as implant failure, delayed union, and varus collapse. Lag screw positioning was evaluated using the Cleveland index on AP and lateral radiographs, which remained stable over 1 year. Patients with a Cleveland index >4 had fewer complications such as screw backout and Z-effect due to better screw purchase in the inferomedial calcar region.

Postoperative complications included screw backout in 3 (9.09%) patients, varus malunion in 3 (9.09%), and anterior thigh pain in 4 (12.12%), with some patients having multiple complications. Overall, 26 (72%) patients had no complications. Compared to other studies, Sharma A et al,[20] reported screw backout in 28.4% (115) cases, while Gadegone et al,[21] reported complications such as 4 (4%) superficial infections, 1 (1%) AVN, 1 (1%) non-union, 5 (5%) mechanical failure, 6 (6%) varus malunion, 7 (7%) thigh pain, and 10 (10%) limb shortening. Their study was limited to short PFN, whereas the present study included both short and standard PFN. Overall, the complication rates in this study are comparable or lower than those reported in similar literature.

Limitations

Limitations of the study include small sample size and relatively short follow up limited to one and half year only. Further research with large sample size and longer follow up is needed to know long term outcomes.

CONCLUSION

Unstable intertrochanteric fractures in elderly patients managed with Proximal Femoral Nail (PFN) demonstrate favorable functional and radiological outcomes, with a high rate of fracture union and an acceptable complication profile. Complications can be reduced by ensuring proper intraoperative fracture reduction, accurate implant placement, and meticulous surgical technique with minimal soft tissue injury.

REFERENCES

1. Mallya S, Kamath SU, Madegowda A, Krishnamurthy SL, Jain MK, Holla R. Comparison of radiological and functional outcome of unstable intertrochanteric femur fractures treated using PFN and PFNA-2 in patients with osteoporosis. Eur JOrthopSurgTraumatol. 2019;29(5):1035-1042.
2. Mulay Sanjay, Kumar Pushpak& Singh Abhishek. Functional outcome of treatment of fractures of distal radius with volar locking plate & crossed k wires. International Journal of Orthopaedics Sciences. 2017; 3:778-782.
3. Evans EM. The treatment of trochanteric fractures of the femur. J Bone Joint SurgBr. 1949;31B(2):190–203.
4. Mulay, Sanjay&Singh, Abhishek&Saji, Mahammadakram. Study of treatment of fracture neck of femur with Bipolar / Austine Moore's Prosthesis. International Journal of Orthopaedics Sciences. 2017; 3:377-382.
5. Deepak Tambe,Arvind Goregaonkar,BinotiSheth, Rahul Supe. Radiographic signs of retroversion of acetabulum in adult Indian population, retrospective observational study. Int J OrthopSci. 2018; 4(1):80-83.
6. Mulay, Sanjay &Thadeshwar, Dr Rabari, Yash&Dhaytadak Dinesh & Kumar, Pushpak. Comparitive study of fixation done in intertrochanteric fractures by PFN &DHS.International Journal of Orthopaedics Sciences. 2017; 3:146-152.
7. Schipper IB, Steyerberg EW, Castelein RM et al. Reliability of the AO/ASIF classification for pertrochanteric femoral fractures.ActaOrthop Scand. 2001; 72(1):36–41
8. Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. J Bone Joint Surg (Am). 1970;52A:457–467.
9. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. The Journal of bone and joint surgery American. 1995; 77(7):1058-64
10. Ravishankar J, Dr.Puneeth, Dr.Jaipalsinh R Mahida. A prospective study to evaluate the radiological and functional outcome of unstable intertrochanteric fractures treated with proximal femoral nail. Int J Orthop Sci. 2016;2(4):302-306.
11. Bartonícek J, Dousa P, Kostál R, Svatos F, Skála J. Duration of surgery in osteosynthesis of fractures of the trochanter. Acta Chir OrthopTraumatol Cech. 2001;68(5):294-9.
12. Pan S, Liu X-H, Feng T, Hui-Jun K, Zhi-Guang T,Chun-Guang L. Influence of different great trochanteric entry points on the outcome of intertrochanteric fractures: a retrospective cohort study. BMC Musculoskelet Disord 2017;18(1):107
13. Saudan M, Lübbeke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: is there an advantage to an intramedullary nail?: a randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. J Orthop Trauma. 2002 Jul;16(6):386-93. doi: 10.1097/00005131-200207000-00004. PMID: 12142826.
14. Shen J, Hu C, Yu S, Huang K, Xie Z. A meta-analysis of percutenous compression plate versus intramedullary nail for treatment of intertrochanteric HIP fractures. Int J Surg. 2016 May;29:151-8. doi: 10.1016/j.ijsu.2016.03.065. Epub 2016 Apr 5. PMID: 27063859.
15. Zhao C, Liu DY, Guo JJ, Li LP, Zheng YF, Yang HB, Sun JH. [Comparison of proximal femoral nail and dynamic hip screw for treating intertrochanteric fractures]. Zhongguo Gu Shang. 2009 Jul;22(7):535-7. Chinese. PMID: 19705724.
16. Pajarinen J, Lindahl J, Savolainen V, Michelsson O, Hirvensalo E. Femoral shaft medialisation and neck-shaft angle in unstable pertrochanteric femoral fractures. Int Orthop. 2004;28(6):347-353. doi:10.1007/s00264-004-0590-x.
17. Sharma A, Sethi A, Sharma S. Treatment of stable intertrochanteric fractures of the femur with proximal femoral nail versus dynamic hip screw: a comparative study. Rev Bras Ortop. 2017 Nov 8;53(4):477-481. doi: 10.1016/j.rboe.2017.07.008. PMID: 30027082; PMCID: PMC6052185.
18. Geller JA, Saifi C, Morrison TA, Macaulay W. Tip-apex distance of intramedullary devices as a predictor of cut-out failure in the treatment of peritrochanteric elderly hip fractures. IntOrthop. 2010;34(5):719-22.
19. Kumar R, Singh RN, Singh BN. Comparative prospective study of proximal femoral nail and dynamic hip screw in treatment of intertrochanteric fracture femur. J Clin Orthop Trauma. 2012; 3(1):28-36.
20. Sharma A, Mahajan A, John B. A Comparison of the Clinico-Radiological Outcomes with Proximal Femoral Nail (PFN) and Proximal Femoral Nail Antirotation (PFNA) in Fixation of Unstable Intertrochanteric Fractures. J Clin Diagn Res. 2017 Jul;11(7):RC05-RC09. doi: 10.7860/JCDR/2017/28492.10181. Epub 2017 Jul 1. PMID: 28892987; PMCID: PMC5583812.
21. Gadegone WM, Salphale YS. Short proximal femoral nail fixation for trochanteric fractures.Journal of orthopaedic surgery. 2010; 18(1):39-44.