Journal of Orthopaedic Science and Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Research Article

Comparative Outcome of Short Proximal Femoral Nail Versus Proximal Femoral Locking Compression Plate in the Management of Unstable Trochanteric Fractures

Abhijit Das[1*], Harikrishnan NG[2], Devan P Nambiar[3], Indrajit Chakraborty[4], Sourabh Kumar Jha[5], Tirupati Shivanand Shirdinayak[5], Subhrajyoti Biswas[6]

[1]Senior Resident, RG Kar Medical College and Hospital, Kolkata, India

[2]FNB- Fellowship in Arthroplasty, Ganga Hospital, Coimbatore, India

[3]Senior Resident in Gauhati Medical College and Hospital, Guwahati, India

[4]Postgraduate Trainee, Gauhati Medical College and Hospital, Guwahati, India

[5]Senior Resident, Assam Medical College and Hospital, Dibrugarh, India

[6]Postgraduate Trainee, Assam Medical College and Hospital, Dibrugarh, India

***Correspondence author:** Abhijit Das, Senior Resident, RG Kar Medical College and Hospital, Kolkata, India; Email: abhijit2993@gmail.com

Citation: Das A, et al. Comparative Outcome of Short Proximal Femoral Nail Versus Proximal Femoral Locking Compression Plate in the Management of Unstable Trochanteric Fractures. J Ortho Sci Res. 2023;4(2):1-8.

https://doi.org/10.46889/JOSR.2023.4209

Received Date: 05-08-2023

Accepted Date: 22-08-2023

Published Date: 30-08-2023

Abstract

Introduction: Trochanteric fractures are mostly due to RTA and falls. Unstable trochanteric fractures include those with a reverse oblique fracture line, intertrochanteric comminution, big posteromedial fragment, subtrochanteric extension, a broken greater trochanter and lateral cortex breach. As per the AO Classification of intertrochanteric fractures, AO31-2.2, AO31-2.3, AO31-3.1, AO31-3.2 and AO31-3.3 fall under the category of unstable trochanteric fractures. Internal fixation is mandatory to provide early mobilization of patients with partial weight-bearing and prevent further compli&cations.

Materials and Methods: 43 patients more than 18 years old with unstable trochanteric fractures, less than 3 weeks old trauma were included in the prospective study for 1 year period (1st June 2020 to 31st May 2021). 22 cases were treated with short Proximal Femoral Nail (PFN) and 21 cases were treated with Proximal Femoral Locking Compression Plate (PFLCP).

Results: ($P<0.05$), mean duration of surgery, blood loss was less in the PFN group (67minutes; 80mL) than PFLCP group (99 minutes; 152 ml). Union and partial weight-bearing was seen earlier in PFN group (14.1weeks; 10.6weeks) than in PFLCP group (18.7 weeks; 15.8weeks) ($P<0.05$). Good-excellent outcome was seen in 100% cases in PFN group and 85.71% cases in PFLCP group. There were 3 cases of delayed union in PFLCP group and 1 in PFN group. 1 PFLCP case had malunion in varus deformity.

Conclusion: Short PFN is the optimum implant in treatment of unstable trochanteric fractures as it is an intramedullary, load sharing device with short lever arm and hastens biological healing with early ambulation and minimal complications.

Keywords: Short Proximal Femoral Nail; Proximal Femoral Locking Compression Plate; Harris Hip Score; Kyle's Criteria

Introduction

Extracapsular fractures of the proximal femur that occur between the greater and lesser trochanters are known as intertrochanteric fractures [1,2]. Trochanteric fractures are either due to high energy trauma (like road traffic accidents, fall from height), or low energy trauma (like simple domestic fall) [3,4]. Unstable trochanteric fractures include those with a reverse oblique fracture line, intertrochanteric comminution, big posteromedial fragment, subtrochanteric extension, a broken greater trochanter and lateral cortex breach [5]. As per the AO Classification of Intertrochanteric Fractures, AO31-2.2, AO31-2.3, AO31-3.1, AO31-3.2 and AO31-3.3 fall under the category of unstable trochanteric fractures [6,7].

The ideal choice of treatment of the trochanteric fracture is surgery by internal fixation to provide early mobilization of patients with partial weight-bearing and prevent further complications (decubitus ulcers, urinary tract infection, respiratory tract infection, joint contractures and thromboembolism) [8]. Complications encountered in the treatment of unstable trochanteric fracture are non-union, migration of screw, implant breakage, erosion of femoral head, avascular necrosis of femoral head, cut out of a screw, shattering in the lateral cortex, aseptic loosening, etc. [9,10].

Proximal Femoral Nail (PFN) is the biomechanically stable intramedullary device for fixation of unstable trochanteric fracture. It has the advantage of a short lever arm (as it is located close to the axis of weight-bearing); provides bending and torsional stability and minimizes the tensile strain on the implant [11,12]. Proximal Femoral Locking Compression Plate (PFLCP) is also another device for the fixation of unstable trochanteric fracture. It is anatomically pre-contoured to fit the proximal femur and provides angular stability with the placement of multiple locking screws and stress shielding for the lateral trochanteric wall [13,14]. The purpose of this study is to compare the outcome of short PFN versus PFLCP in the management of unstable trochanteric fracture.

Materials and Methods

In this study, we treated 22 cases of unstable trochanteric fractures with short PFN and 21 cases with PFLCP between 1st June 2020 and 31st May 2021. Patients over the age of 18 years who granted informed agreement were included in the study with unstable trochanteric fractures. Institutional Ethics Committee clearance was obtained for the study. Patients having open fractures, old fractures (more than 3 weeks old), pathological fractures and cases contraindicated for surgery were excluded from the study.

Surgical Technique

For Short PFN15

Following anesthesia and draping, the patient was placed supine on a fracture table with the operated limb in traction and adduction to allow for easy reduction, nail entry and locking. The uninjured limb was placed in abduction on the fracture table. An attempt was made for closed reduction using any of the following maneuvers- reduction with direct traction, abduction and external rotation; joystick with the help of a 3.0 mm Kirschner wire (K-wire) inserted perpendicularly into the front part of the femoral neck and cerclage wiring technique [15-17]. An open reduction was performed, if the closed method failed to reduce the fracture. A 3-5 cm skin incision was made 10 cm proximal to the tip of the greater trochanter. With a bone awl, entry point was made on the tip of the greater trochanter in the anteroposterior view and between the anterior one-third and posterior two-thirds in lateral view. A guidewire was inserted and adequate reaming was performed to allow for smooth nail insertion. Using a jig, the nail was manually inserted as far as possible into the femoral opening. 2 guide wires were passed from the lateral surface of the femur through the neck of the femur to the subchondral position of the head followed by the placement of screws. The hip pin was inserted first. Because only the femoral neck screw was load-bearing, the hip pin used was always 15-20 mm shorter than the femoral neck screw. The device was not locked proximally to preserve the implant's dynamic nature and to allow compression across the fracture site. An image intensifier was used to confirm the final position. Rotation of the distal fragment was confirmed, followed by distal locking with a jig and layer closure of the wound with an antiseptic dressing.

For PFLCP

After anesthesia was administered, the patient's positioning, draping and reduction method (except for the operated limb being in abduction) were the same as described in the short PFN. A straight incision from the greater trochanter was used to perform a lateral approach to the proximal femur without jeopardizing the vascularity. After ensuring perfect anatomic placement of the plate to the proximal fragment, a 2.5 mm guidewire was inserted at a predetermined 95° angle into the most proximal hole (7.3 mm). Another two guidewires were inserted into the second (7.3 mm) and third (5.0 mm) holes at 120° and 135° angles, respectively. The tips of the guide wires were kept 1 cm below the articular surface of the femoral head and fluoroscopy confirmed their correct placement. For holding the plate's alignment to the shaft, a conventional 4.5 mm screw was used in the plate's most distal combihole. 2 screws (7.3 mm) were inserted into the femoral neck. Distally, the plate was secured with bicortical 5.0 mm locking head screws. The 5.0 mm locking head screw was then inserted in the third proximal hole at a 135° angle to converge with the 95°, 7.3 mm screw to form a buttress that increases fracture fixation stability. To allow a larger area of stress distribution on the plate and reduce strain at the fracture, at least 3 to 4 holes of the plate were left empty at the level of the fracture in metaphyseal comminution. The drain was given and the wound was closed in layers and an antiseptic dressing was applied.

Blood Loss

Intra-operative blood loss was measured by the mopping method [18]. Only a dry mop was used. Blood loss was calculated based on weight gained in the mop. Any intra-operative complication was noted. A post-operative X-ray was done. Wound inspection was done on the 3rd postoperative day or earlier if soakage occurred. Sutures were removed on 12 to 14th post-operative day. Non-weight bearing crutch aided ambulation was done as per the patient's pain tolerance. Full non-assisted weight-bearing was allowed once clinico-radiological fracture union was achieved. Patients were followed up in Orthopaedics OPD at 4, 6, 8, 12, 16 weeks and 6 months. At every follow-up visit, patients were assessed clinically and with an X-ray of the involved hip with the femur to assess union, functional outcome and complication. Union of fracture was defined clinico-radiologically as the presence of bridging callus (callus appearance on three or four cortices on anteroposterior and lateral radiograph views), the number of bridged cortices and the disappearance of fracture lines; absence of pain or tenderness at the fracture site during weight-bearing [19-21]. Delayed union occurred when there had been an adequate interval of time for healing of the fracture (average time to union for that particular bone) but healing was incomplete [20,21]. Malunion was defined as the healing of bones in an abnormal position. Varus malunion is more common than valgus malunion in intertrochanteric femur fractures. Clinical findings include supratrochanteric shortening with broadening of trochanteric prominence and external rotation attitude of limb and ipsilateral abductor insufficiency. Deformity (Varus angle) was calculated by the intersection of two central lines, one through the head and neck of the femur and the other through the shaft of the femur [22,23]. Nonunion is the cessation of both the periosteal and endosteal healing responses without bridging; persistent fracture lines, absence of bony bridging, lack of progressive healing on serial radiographs, progressive deformity and the presence of loose or broken implants. Functional outcome at each follow-up visit was accessed by using Harris Hip score and Kyle's criteria [24-26].

Statistical Analysis

The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. Results on continuous measurements are presented as mean ± standard deviations are compared using a student t-test. Discrete data are expressed as numbers (%) and are analyzed using the Chi-square test and Fischer's exact test (where the cell counts were <5 or 0). The statistical significance was fixed at a 5% level (p-value<0.05) for all analyses.

Results

Pre and Intra-Operative Variables (Table 1)

Variables	Short PFN (n=22)	PFLCP (n=21)
Mean age (years)	55.09 ± 6.82	52.86 ± 9.55
Sex	Male:15 (68.18%); Female:7 (31.82%)	Male:11 (66.67%); Female:6 (33.33%)
Mode of injury	RTA:9 (40.91%); self-fall:13 (59.09%)	RTA:10 (47.62%); self-fall:11 (52.38%)
Side of involvement	Right:10 (58.8%); Left:7 (41.2%)	Right:10 (58.8%); Left:7 (41.2%)
AO fracture classification type AO31-	AO31-2.2: 3; AO31-2.3: 7; AO31-3.1: 3; AO31-3.2: 3; AO31-3.3: 6	AO31-2.2: 0; AO31-2.3: 5; AO31-3.1: 4; AO31-3.2: 2; AO31-3.3: 10
Time interval between trauma and surgery	7.95 ± 2.70 days	7.14 ± 1.82 days
Duration of surgery	66.82 ± 10.37 minutes	99.29 ± 10.87 minutes
Length of incision	6.05 ± 0.94 cm	11.87 ± 0.93 cm
Blood loss	80.36 ± 12.89 mL	152.14 ± 24.73 mL
Duration of hospital stay	15.32 ± 3.55 days	15.67 ± 2.75 days

Table 1: Pre and Intra-Operative Variables.

Union and Functional Outcome (Table 2)

Variables	Short PFN (n=22)	PFLCP (n=21)
Mean time to union	14.09 ± 2.31 weeks	18.71 ± 3.45 weeks
Period of early ambulation	Axillary crutch assisted ambulation with tip toe touch down on operated limb: 9.14 ± 3.68 days Axillary crutch assistance on both sides: 4.91 ± 1.02 weeks A singles axillary crutch on non-operated limb: 10.55 ± 1.82 weeks Full weight bearing without crutch: 14.09 ± 2.31 weeks	Axillary crutch assisted ambulation with tip toe touch down on operated limb: 42.24 ± 10.06 days Axillary crutch assistance on both sides: 10.81 ± 1.12 weeks A singles axillary crutch on non-operated limb: 15.76 ± 2.32 weeks Full weight bearing without crutch: 18.76 ± 3.52 weeks
Functional outcome in terms of Harris Hip Score (HHS) and Kyle's criteria	At 1 month: 66.77 ± 3.24 At 2 months: 6.05 ± 4.74 At 3 months: 86.68 ± 5.35 At 6 months: 90.64 ± 3.23	At 1 month: 65.52 ± 3.53 At 2 months: 72.00 ± 4.57 At 3 months: 81.10 ± 6.20 At 6 months: 87.05 ± 6.18

Table 2: Union and functional outcome.

Complications (Table 3, Fig. 1-3)

Variables	Short PFN (n=22)	PFLCP (n=21)
Delayed Union	1 (4.55%)	3 (14.29%)
Malunion	0	1 (4.76%)
Non-union	0	0
Superficial infection	1 (4.55%)	4 (19.05%)
Deep infection	2 (9.09%)	2 (9.52%)
Periprosthetic Fracture	0	0
Screw Loosening	1 (4.55%)	0

Table 3: Complications.

Figure 1: Cases treated with short PFN.

Figure 2: Cases treated with PFLCP.

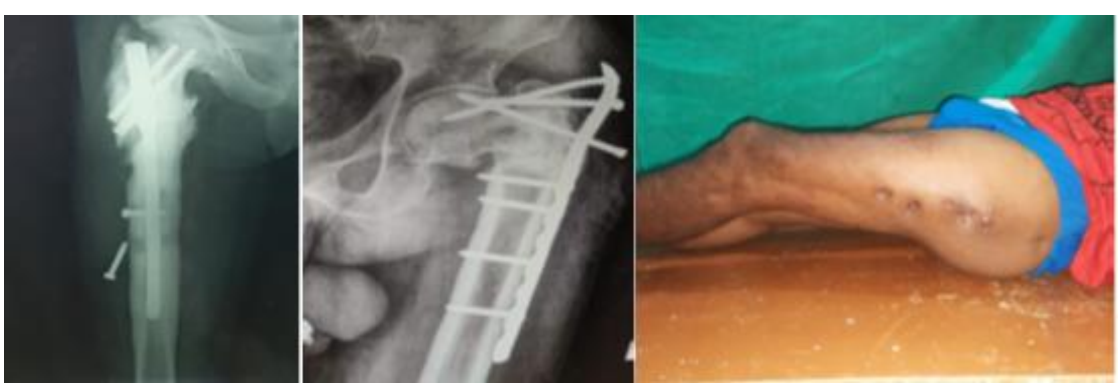

Figure 3: Complications.

Discussion

The best way to treat an unstable trochanteric fracture is still up for debate. Surgical treatment is essential to provide early mobilization with partial weight-bearing and also prevent complications (pneumonia, deep vein thrombosis, joint contractures, urinary tract infection and decubitus ulcers) [8,9]. Different surgical methods such as intramedullary nailing, sliding hip screw, Medoff sliding plate and proximal locking plate fixation have been described.

We conducted a study on 43 patients (22 patients treated by short PFN and 21 patients treated by PFLCP) with unstable trochanteric fractures in the Department of Orthopaedics, Assam Medical College and Hospital, Dibrugarh from June 2020 to May 2021; and attempted to survey, evaluate, document and quantify the results in terms of perioperative measures, early ambulation, union, functional outcome and complications. There were 29 males and 14 females in our study. Altogether, 19 patients (44.2%) sustained these fractures due to an RTA and 24 patients (55.8%) sustained them due to a fall. A total of 19 patients (44.19%) had right-sided fractures and 24 patients (55.81%) had left-sided fractures.

The mean duration of surgery of PFN (66.73 ± 10.51 minutes) was less than PFLCP (99.29 ± 10.87 minutes). The mean length of incision of PFN (6.05 ± 0.94 cm) was less than PFLCP (11.87 ± 0.93 cm). The mean blood loss was also less with PFN (80.36 ± 12.89 ml) in comparison with PFLCP (152.14 ± 24.73 ml). Short PFN results in fracture union earlier (14.09 ± 2.31 weeks) than PFLCP (18.71 ± 3.45 weeks) in the management of unstable trochanteric fractures (18.71 ± 3.45 weeks). These differences in results between PFN and PFLCP were found to be statistically significant in our study. Period of early ambulation was accessed in terms of partial weight-bearing (by use of axillary crutch assisted ambulation with tip toe-touch weight-bearing, crutch assisted on both sides and crutch assisted on the non-operated side) and full weight-bearing. It was found that patients managed with short PFN had partial weight-bearing and full weight-bearing earlier than patients managed with PFLCP significantly. All fractures got united in both groups (100% union rate). Only 1 patient treated with PFN and 3 patients treated with PFLCP had delayed union. One of the three delayed union cases treated with PFLCP had malunion in the varus position. Short PFN was found to be significantly better than PFLCP in terms of functional outcome at 2, 3 and 6 months of follow-up. The PFN group had fewer post-operatively superficial surgical site infections (n=1, 4.55%) than the PFLCP group (n=4, 19.05%). All these patients responded to conservative treatment with sensitive antibiotics. Persistent deep infection was comparable in both the PFN (n=2, 9.09%) and PFLCP (n=2, 9.52%) groups. Thorough wound debridement and empirical intravenous antibiotic therapy were used to treat these patients. 1 episode of screw loosening complication occurred in 1 patient in each group. In our study, the differences in the rates of complications between PFN and PFLCP were not found to be statistically significant (p>0.05). Other complications, such as periprosthetic fractures and non-union, revision surgery and so on, were not observed in either group of patients.

Studies	Sample Size	Results
Ranjan, et al.,[19] (2017)	30	Mean time to union at 16.2 weeks 86.67% Good-excellent outcome Deep infection-1; Nonunion-1
Fezollari, et al.,[27] (2020)	10	Mean time to union at 16 weeks 90% Good-excellent outcome Screw breakage-1; Varus deformity-1
Shashank, G et al.,[28] (2021)	28	Mean time to union at 14.97 ± 1.9 weeks 85.71% Good-excellent outcome Full weight bearing at 14.97 ± 1.9 weeks
Our study (2020-2021)	22	Mean time to union at 14.09 ± 2.31 weeks 100% Good-excellent outcome Full weight bearing at 14.09 ± 2.31 weeks Superficial infection-1; Deep infections-2; Screw loosening-1, Delayed union-1

Table 4: Comparison of PFN with various studies.

Studies	Sample Size	Results
Nath, et al.,[29] (2017)	23	91.3% Good-excellent outcome Superficial infection-1; Nonunion-1
Ibrahim, et al.,[14] (2018)	21	76.19% Good-excellent outcome Superficial infection-1; Delayed union-2
Our study (2020-2021)	21	Mean time to union at 18.71 ± 3.45 weeks 85.71% Good-excellent outcome Full weight bearing at 18.76 ± 3.52 weeks Superficial infections-4; Deep infections-2; Delayed union-3; Varus malunion-1

Table 5: Comparison of PFLCP with various studies.

Conclusion

This study concludes that most of the unstable trochanteric fractures occur in the sixth decade predominantly in males mainly due to road traffic accidents or falls with AO31- type A3 fractures being more common. Short PFN has significant intraoperative advantages such as a shorter length of incision, a shorter duration of surgery and less intra-operative blood loss when compared to PFLCP. Short PFN is better than PFLCP in the treatment of unstable trochanteric fractures significantly in terms of fracture healing, early ambulation, full weight-bearing and better functional outcome. Complications were less common in short PFN patients, but there was no statistically significant difference between the two groups. We conclude that the short PFN is an intramedullary and load-sharing device with a short lever arm. It is also the optimum implant in the treatment of unstable trochanteric fractures as it hastens the fracture union, allows early ambulation and has minimal complications.

Conflict of Interest

The authors have no conflict of interest to declare.

References

1. Karakus O, Ozdemir G, Karaca S, Cetin M, Saygi B. The relationship between the type of unstable intertrochanteric femur fracture and mobility in the elderly. J Orthop Surg Res. 2018;13(1):1-5.
2. 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. 2018;53(4):477-81.
3. Hwang LC, Lo WH, Chen WM, Lin CF, Huang CK, Chen CM. Intertrochanteric fractures in adults younger than 40 years of age. Arch Orthop Trauma Surg. 2001;121(3):123-6.
4. Hopkinson-Woolley JA, Parker MJ. Fractures of the hip: Does the type of fall really affect the site of fracture? Injury. 1998;29(8):585-7.
5. Babhulkar S. Unstable trochanteric fractures: Issues and avoiding pitfalls. Injury. 2017;48:803-18.
6. Sonawane DV. Classifications of intertrochanteric fractures and their clinical importance. Trauma Int. 2015;1(1):7-11.
7. Klaber I, Besa P, Sandoval F, Lobos D, Zamora T, Schweitzer D, et al. The new AO classification system for intertrochanteric fractures allows better agreement than the original AO classification. An inter- and intra-observer agreement evaluation. Injury. 2021;52(1):102-5.
8. Browner B, Levine A, Jupiter J, Trafton P. Skeletal trauma, Basic science, management and reconstruction. 3rd Ed. philadelphia: saunders; 2003. in: skeletal trauma, basic science, management and reconstruction. 3rd Editi. Philadelphia, PA: Elsevier/Saunders. 2003.
9. Cheng CL, Chow SP, Pun WK, Leong JCY. Long-term results and complications of cement augmentation in the treatment of unstable trochanteric fractures. Injury. 1989;20(3):134-8.
10. Audigé L, Hanson B, Swiontkowski MF. Implant-related complications in the treatment of unstable intertrochanteric fractures: Meta-analysis of dynamic screw-plate versus dynamic screw-intramedullary nail devices. Int Orthop. 2003;27(4):197-203.
11. Fogagnolo F, Kfuri M, Paccola CAJ. Intramedullary fixation of pertrochanteric hip fractures with the short AO-ASIF proximal

femoral nail. Arch Orthop Trauma Surg. 2003;124(1):31-7.
12. Curtis MJ, Jinnah RH, Wilson V, Cunningham BW. Proximal femoral fractures: a biomechanical study to compare intramedullary and extramedullary fixation. Injury. 1994;25(2):99-104.
13. Govindasamy R, Gnanasundaram R, Kasirajan S, Meleppuram JJ, Archit K. Proximal femur locking compression plate in complex proximal femoral fractures: a retrospective analysis. Int J Res Orthop. 2016;2(3):104.
14. Ibrahim S, Meleppuram JJ. A retrospective analysis of surgically-treated complex proximal femur fractures with proximal femoral locking compression plate. Rev Bras Ortop. 2017;52(6):644-50.
15. Kammar SF, Bhasme VK, Hosthota A. Functional outcome of proximal femur fracture managed surgically using Proximal Femoral Nail (PFN). J Karnatka Orthop Assoc. 2017;5(1):40-4.
16. Okazaki A, Murase T, Sakano H, Saito T. A New joystick technique for the reduction of unstable trochanteric Hip Fractures: Especially with Rotational Deformity. Tech Orthop. 2020;35(4):281-5.
17. Gao YS, Guo YJ, Yu XG, Chen Y, Chen C, Lu NJ. A novel cerclage wiring technique in intertrochanteric femoral fractures treated by intramedullary nails in young adults 11 medical and health sciences 1103 clinical sciences. BMC Musculoskelet Disord. 2018;19(1):1-6.
18. Algadiem EA, Aleisa AA, Alsubaie HI, Buhlaiqah NR, Algadeeb JB, Alsneini HA. Blood loss estimation using gauze visual analogue. Trauma Mon. 2016;21(2):e34131.
19. Ranjan R, Kumar R, Singh A. Functional outcome of patients treated with proximal femoral nail for unstable trochanteric fractures. Int J Orthop Sci. 2017;3(4e):349-51.
20. Hak DJ, Fitzpatrick D, Bishop JA, Marsh JL, Tilp S, Schnettler R, et al. Delayed union and nonunion: epidemiology, clinical issues and financial aspects. Injury. 2014;45(SUPPL.2):S3-7.
21. Ducharme NG, Nixon AJ. Delayed union, nonunion and malunion. Equine Fracture Repair. 2019:835-50.
22. Spivak JM, Zuckerman JD, Kummer FJ, Frankel VH. Fatigue failure of the sliding screw in hip fracture fixation: A report of three cases. J Orthop Trauma. 1991;5(3):325-31.
23. Mushtaq F, Rashid M, Ghani I, Yawar B. Functional results of valgus intertrochanteric osteotomy in malunitedintertrochantertic fractures. J Fatima Jinnah Med Univ. 2016;10(2).
24. Mahomed NN, Arndt DC, McGrory BJ, Harris WH. The Harris hip score: comparison of patient self-report with surgeon assessment. J Arthroplasty. 2001;16(5):575-80.
25. Banaszkiewicz PA, Kader DF. Classic papers in orthopaedics. Classic Papers in Orthopaedics. 2014;1-624.
26. Kyle R, Gustilo R, Premer R. Analysis of six hundred and twenty-two intertrochanteric hip fractures. Orthop Trauma Dir. 1979;8(06):25-9.
27. Fezollari L, Caushi G, Ruci V, Duni A, Dogjani A, Selmani E, et al. Treatment of unstable trochanteric / subtrocanteric fractures with pfn, first cases in university hospital of trauma and American hospital. results and complications. Albanian J Trauma Emerg Surg. 2020;4(1).
28. Shashank G, Rajendra J, Muralidhar N, Sathish BD. Evaluation of functional outcome in Extracapsular proximal femur fractures treated with proximal femoral nail in a tertiary care centre, South India. Int J Orthop Sci. 2021;7(1):518-22.
29. Nath RG, Ansari S. Role of proximal femoral locking plate in treatment of subtrochanteric fractures: case series. MedPulse Int J Orthop. 2017;3(7):1-7.