Original Article

Comparison between Treatment of Unstable Intertrochanteric Fracture of Femur by Dynamic Hip Screws and Proximal Femoral Locked Compression Plate

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Abstract

Background*: Intertrochanteric fractures are among the most frequent types of hip fractures, particularly in elderly individuals with osteoporotic bones. The Dynamic Hip Screw (DHS) remains the gold standard for managing these fractures.*

Objective*: This study aimed to compare the functional and radiological outcomes of unstable intertrochanteric fractures (AO/OTA: 31A2.2, 31A2.3) treated with Proximal Femoral Locked Compression Plate (PFLCP) versus DHS.*

Methods and Materials*: A prospective comparative study was carried out on patients undergoing either PFLCP or DHS treatment between January 2020 and December 2022. Ethical approval was obtained from the Institutional Ethical Review Board (IERB) of President Abdul Hamid Medical College Hospital (PAHMCH) and informed consent was secured from all participants before surgery.*

Results*: Functional outcomes and radiological assessments were evaluated using the Harris Hip Score (HHS) at 3, 6 and 12 months postoperatively. The study found that DHS treatment was associated with higher blood loss (159 ml), longer operative time (105 minutes),and delayed mobilization. In contrast, PFLCP resulted in lower blood loss (73 ml), shorter surgery duration (91 minutes) and earlier mobilization. Limb shortening was greater in the DHS group (9.33 mm) compared to the PFLCP group (4.72 mm).*

Conclusions*:Overall, PFLCP demonstrated advantages over DHS in managing unstable intertrochanteric fractures, including reduced blood loss, shorter operative time, earlier weight bearing and mobilization, shorter hospital stay, lower infection rates and fewer complications*

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Introduction

Intertrochanteric fractures have become increasingly common due to advances in technology, high-velocity transportation, increased life expectancy and a higher prevalence of osteoporosis[1]. Gulberg et al. projected that the total number of hip fractures will reach 2.6 million by 2025 and 4.5 million by 2050[2]. In 1990, intertrochanteric fractures accounted for 26.0% of all hip fractures in Asia, rising to an estimated 37.0% in 2025 and 45.0% by 2050[3]. restore both hip function and stability, particularly in olderpopulations, to optimize outcomes and minimize complications[2]. Among the surgical options, two methods have emerged as the primary approaches for these fractures: the Dynamic Hip Screw (DHS) and the Proximal Femoral Locked Compression Plate (PFLCP). More than 90.0% of hip fractures in the elderly are intertrochanteric, with complication ratesranging from 20.0-30.0% and mortality around 17.0%[4,5,6]. Unstable comminuted intertrochanteric Unstable comminuted intertrochanteric fractures require careful surgical intervention to The DHS has long been a cornerstone in intertrochanteric fracture management. It utilizes a sliding screw mechanism to provide dynamic compression at the fracture site,

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enhancing stability during weight-bearing activities[5]. The lag screw, anchored within the femoral head, is connected to a side plate attached to the lateral femoral shaft, leveraging load-sharing principles to allow the bone to bear part of the physiological load. In contrast, PFLCP emphasizes fixed-angle stability, achieved through locking screws and a plate with predesigned holes. This rigid fixation offers superior stability, particularly against rotational forces, making it a compelling alternative to DHS[7,8]. Although both DHS and PFLCP are preferred techniques for managing unstable intertrochanteric femur fractures, comparative analyses remain limited. Understanding their respective mechanisms, biomechanical properties, advantages and limitations is essential. Therefore, our prospective comparative study was designed to evaluate the treatment of unstable intertrochanteric fractures using both PFLCP and DHS. This investigation aims to elucidate the biomechanical principles, benefits and drawbacks of each technique, while also considering factors such as fracture type, patient characteristics and surgeon experience. By doing so, we seek to provide clinicians with comprehensive insights to guide surgical decision-making and optimize patient outcomes in the management of complex femoral fractures.

Methods

Patients meeting the inclusion and exclusion criteria were treated with either PFLCP or DHS. The study enrolled individuals presenting to the Orthopedics Department of President Abdul Hamid Medical College Hospital, a tertiary care facility, with fresh unstable intertrochanteric fractures.

Inclusion criteria: i) Patients aged over 18 years, ii) Fracture duration less than 2 weeksiii) Pathological or osteoporotic fractures, iv) Both male and female patients and v) Intertrochanteric fractures classified as AO/OTA 31A2 and 31A3

Exclusion criteria: i) Polytrauma, ii) Neglected fractures older than 3 weeks , iii) Diabetes mellitus (DM), iv) Hypertension (HTN) and v) History of stroke

Statistical Analysis

After data collection, all information was organized into a master table and subsequently analyzed using IBM SPSS version 24 for Windows. Categorical qualitative data were presented as frequencies and percentages, while quantitative data were expressed asmean ± standard deviation (SD). Statistical significance was evaluated using a one-tailed paired t-test, with p-values <0.05 considered significant.

Surgical Procedure

All surgeries were performed on a single standard fracture table under spinal anesthesia, following standard operative techniques, with C-arm guidance used in every case. Prophylactic intravenous Cefuroxime Axetil 1.5 g was administered before skin incision and continued for 48 hours postoperatively. Intraoperative parameters- including duration of surgery, radiation exposure, blood loss, incision size and other complications- were recorded. In most cases, closed reduction was achieved and the plate was applied using the minimally invasive percutaneous plate osteosynthesis (MIPPO) technique when applicable. Blood loss was calculated using a method similar to that described by Lee et al.[9].

Postoperative care and Follow-up

All patients followed a standardized rehabilitation protocol, starting mobilization on the second postoperative day, including static quadriceps exercises to enhance knee and ankle movement. Drains were removed within 48 hours, wounds were inspected on thesecond postoperative day and sutures were removed between the 10th and 14th postoperative days. Functional outcomes were assessed using the Harris Hip Score (HHS) and radiological evaluations were performed at 3, 6 and 12 months postoperatively. All patients were followed for a minimum of one year, with no dropouts reported.

Results

A total of 30 patients were included in the study, of whom 16(53.0%) were male and 14(47.0%) were female, with a mean age of 60 years (range: 18-85 years). Trivial trauma was the most common cause of injury (77.0%), followed by road traffic accidents (23.0%). Fractures were evenly distributed between the right and left sides (50.0%

each). The PFLCP procedure required a smaller incision, averaging 5 cm, compared to DHS, which required an average incision length of 17 cm, due to distal locking being performed through a percutaneous stab incision in PFLCP. The mean operative time for PFLCP was 90.6 minutes, which was significantly shorter than DHS at 105.3 minutes (p=0.04). Average intraoperative blood loss for PFLCP was 73 ml, markedly lower than the 159 ml observed in DHS procedures (p=0.001).

Table I: Distribution of study patients by characteristics

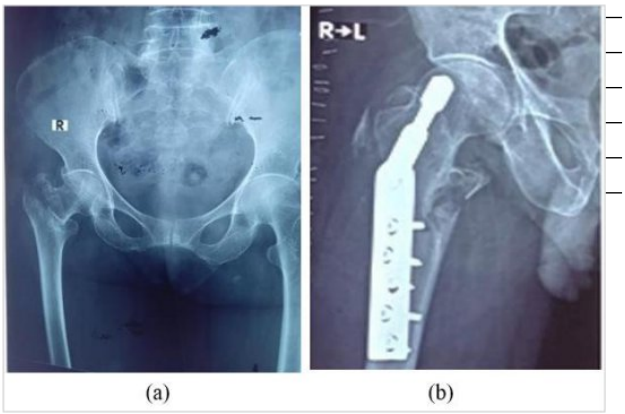

Figure 1: (a) Preoperative anterior-posterior view of an intertrochanteric fracture. (b) Immediate postoperative lateral X-ray showing DHS fixation in the right proximal femur.

Table II: Average number of days/weeks taken for post-operative patient mobilization in each group

Patient mobilization	DHS (n=15)	PFLCP (n=15)
Active hip and knee mobilization	4.27 days	2.33 days
Non-weight-bearing crutch walk	2.93 weeks	1.53 weeks
Partial weight-bearing walking	7.87 weeks	3.73 weeks
Full weight-bearing walking	11.80 weeks	7.93 weeks

Radiological outcomes were evaluated at 3, 6 and 12 months postoperatively. At 3 months, two

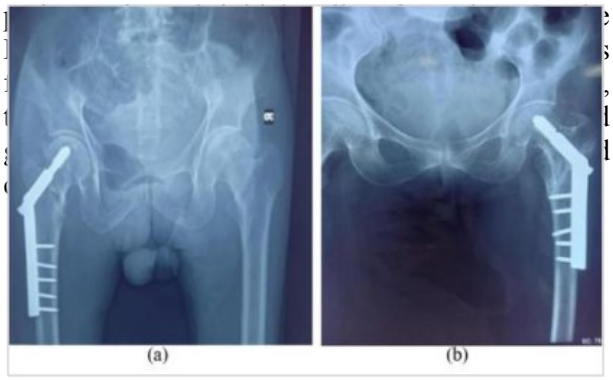

Figure 2: (a) Anteroposterior view at 3 months postoperatively, showing the fracture with maintained neck- shaft angle and stable implant position (b) Anteroposterior view at 6 months postoperatively, demonstrating fracture union of the intertrochanteric region

Table III: Radiological outcome of DHS and PFLCP groups

Follow-up month	DHS (n=15)	PFLCP (n=15)
3rd Month	ACF + Gap-4 (26.7%) ACF-11 (73.3%)	ACF-11 (73.3%) ACF + ^BG Integration–2 (13.3%) ACF With Gap-2(13.3)
6 Month	CAFS-6(40%) CF-8 (53.3%) United In Varus-1 (6.67%)	CF-11(73.3%) CF+ BG Integrated-2 (13.3%)
12th Month	Complete Union-12 (80%) United in Varus-1 (6.67%) Re-fracture-1 (6.67%) Infection-1 (6.67%)	Complete union-13 (86.7%) Screw bend with Union–2 (13.3%)

ACF: Attempted Callous Formation; CAFS: Callous at Facture Site; BG: Bone Grafting; CF: Callous Formation

Table IV: Average functional score (Harris Hip Score; HHP)

Functional score	DHS	PFLCP

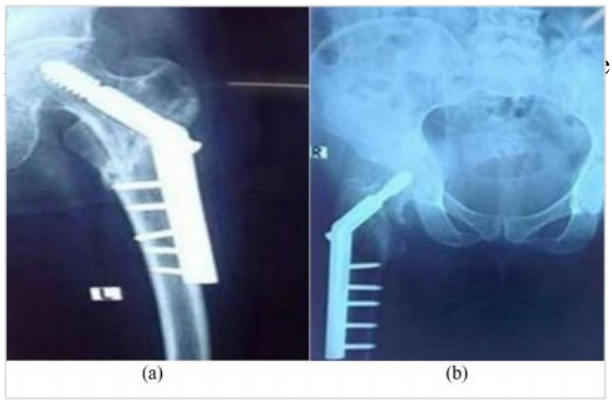

Figure 4: (a) 3 months after operation, X-ray shows uniting intertrochanteric fracture. (b) 6 months after the operation, the X-ray shows callous formation. Postoperative X-ray A/P view shows the position of the implant

At 6 months postoperatively, some variations and complications were observed. In the PFLCP group, all 15 patients achieved good fracture union. In the DHS group, six patients experienced collapse at the fracture site, eight patients demonstrated solid union and one patient developed a varus malunion of 120° due to excessive collapse. By 12 months postoperatively, 13 patients in the DHS group had complete fracture union, while all 15 patients in the PFLCP group showed good union. Functional outcomes, assessed using the Harris Hip Score (HHS) at 6 and 12 months, showed notable differences. At baseline, the average HHS was 32.67 for the DHS group and 52.87 for the PFLCP group (p=0.001). By 6 months, scores improved to 67.6 in the DHS group and 85.4 in the PFLCP group (p=0.001). At 12 months, the mean

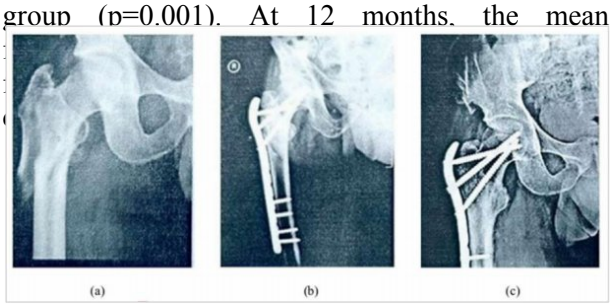

Figure 5: (a) Preoperative X-ray of the hip A/P view showing unstable intertrochanteric fracture. (b) postoperative X-ray of the hip A/P view showing ORIF with PFLCP. (c) After 6 months of operation, the X-ray showed good union

Discussion

Treatment of intertrochanteric fractures remains a significant challenge, with the primary goal being anatomic reduction and stable fixation to allow early functional rehabilitation. Historically, these fractures have predominantly been managed with the Dynamic Hip Screw (DHS)[9]. Over the decades, various fixation devices have been introduced, with treatment choice still depending on fracture type and bone quality. DHS has long been regarded as the gold standard for intertrochanteric fracture fixation. Earlydevices, such as the Smith-Peterson and Jewett nails, emerged in the 1930s, while modifications to sliding devices by Pugh and Massie in the 1950s and 1960s led to the development of the DHS. Kuntscher et al. later introduced an intramedullary nail (IMN)combined with a Sliding Hip Screw (SHS)[10,11,12]. The advantages and disadvantages of the original Gamma nail design have been well documented in studies comparing it with DHS[13,14,15]. Recent evidence suggests

intramedullary devices achieve union rates up to 100.0%, compared to approximately 80% with extramedullary devices[14,15]. However, Kyle et al. noted that initiating sliding in intramedullary devices requires greater force than in DHS constructs[16]. The complication rate for unstable fractures treated with a DHS plate ranges from 3.0% to 26.0%[17]. with primary or secondary varus collapse and hardware failure ("cut-out" of the femoral head screw) being the most common complications[18]. The role of intramedullary devices such as proximal femoral nail (PFN), Gamma nail (GN) and proximal femoral nail anti-rotation (PFNA) in managing unstable intertrochanteric fractures remains controversial, with variable outcomes. Certain fracture patterns-including comminuted intertrochanteric fractures extending into the lateral femoral cortex, long subtrochanteric extensions, reverse oblique fractures and fractures associated with severe osteoporosis- are not reliably managed with DHS. The Proximal Femoral Locked Compression Plate (PFLCP) has emerged as a superior alternative in these cases. Unlike DHS, the lag screw in PFLCP securely stabilizes lateral cortex fragments, reducing the risk of varus collapse and limb shortening[20]. PFLCP provides anatomic reduction, stable fixation and preservation of blood supply. Biomechanically, it is stronger or equivalent to other fixation methods for trochanteric and subtrochanteric fractures[19,20]. DHS is associated with larger incisions, longer operating times, increased fluoroscopy exposure and greater blood loss compared to PFLCP. In previous studies, Glassner et al. reported a 70.0% failure rate with PFLCP (including 30.0% varus collapse and 20.0% each for screw and plate breakage) compared to 12.0% in this study[20]. Karl Wieser et al., in a study of 14 patients, reported four failures using PFLCP and emphasized the importance of proper reduction and restricted weight bearing in unstable fracture patterns[19]. In this study at President Abdul Hamid Medical College Hospital (300 beds, planned expansion to 500 beds), the limited patient population was a constraint, making the sample size a primary limitation. Despite this, PFLCP proved to be a feasible and effective alternative for treating unstable intertrochanteric fractures. Complications, such as proximal locking screw breakage due to increased bending stress at the plate-femur junction, were observed in one case. Proper fracture reduction and restriction of early postoperative weight bearing are essential to prevent such complications. Further biomechanical studies are warranted to more comprehensively assess the effectiveness and safety of PFLCP in managing unstable intertrochanteric fractures.

Conclusion

The primary aim of surgical management for unstable intertrochanteric fractures is to stabilize the fracture, enable early mobilization, restore limb length and achieve pain-free function. These goals were more effectively met using PFLCP compared to DHS.PFLCP shows considerable potential in treating unstable intertrochanteric fractures; however, further randomized controlled trials with larger sample sizes are required to validate these findings.

Conflict of interest

The authors declare that there is no conflict of interest.

Data availability

Data sets analyzed during the current study are available from the corresponding author on reasonable request. No financial or conflicting interests are present.

Authors' contribution

The principal authors contributed to the study's conception and design. Dr. Sabbir drafted the manuscript, while Dr. Sushmoy assisted with data.

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All authors declare that they have no financial or personal relationships with individuals or organizations that could inappropriately influence this work.

References

1. John C Weinlein, Fracture and Dislocation of hip, In: KAY Daugherty and Linda Jones, editors; Campbell Operative Orthopaedies. 12th edition. Volume 3, Elsevier Mosey. 2013. p. 2737.
2. Gulberg B, Johnell O, Kanis JA. World-wide projection for hip fractures. Osteoporos Int. 1997;7(5):407-13.
3. Melton LJ 3rd, Kearns AE, Atkinson EJ, Bolander ME, Achenbach SJ, Huddleston JM et al. Secular trends in hip fracture incidence

and recurrence. Osteoporos Int. 2009;20(5):687-94.
4. Campbell WC, Canale ST, Beaty JH. Campbell's operative orthopaedics. 11th ed. Philadelphia, PA: Mosby/Elsevier; 2008.
5. Paganini-Hill A, Chao A, Ross RK, Henderson BE. Exercise and other factors in the prevention of hip fracture: the Leisure World study.Epidemiology. 1991;2(1):16-25.
6. Rockwood CA, Green DP, Bucholz RW. Rockwood and Green's fractures in adults. 7th ed. Philadelphia, PA:
7. Lee MH, Ingwersen BT, Kirpensteijn J, Jensen AL, Kristensen AT. Quantification of surgical blood loss.Vet Surg. 2006; 35(4):388-93.
8. Ozkan K, Eceviz E, Unay K, Tasyikan L, Akman B, Eren A. Treatment of reverse oblique trochanteric femoral fractures with proximal femoral nail. International Orthopaedics. 2011;35(4):595-98.
9. Babhulkar SS. Management of trochanteric fractures. Indian J Orthop. 2006;40(4)210-18.
10. Kuntscher G. A new method of treatment of pertrochanteric fractures.Proc R Soc Med. 1970;63(11 Part 1):1120-1.
11. Russell TA. Fractures of hip and pelvis. In: Crenshaw AH, Wenger Dr, editors. Campbell's Operative Orthopaedics. 8th ed.St Louis: CV Mosby; 1992. p.895-7.
12. Hardy DC, Descamps PY, Krallis P, Fabeck L, Smets P, Bertens CL et al. Use of an intramedullary hip-screw compared with a compression hip-screw with a plate for intertrochanteric femoral fractures. A prospective, randomized study of one hundred patients.J Bone Joint Surg Am. 1998;80(5):618-30.
13. Spivak JM, Zuckerman JD, Kumme FJ. Fatigue failure of sliding hip screw in hip fracture fixation: a report of three cases. J Orthop Trauma. 1991;5(3):325-31.
14. Leung KS, So WS, Shen WY, Hui PW. Gamma nails and dynamic hip screws for peritrochanteric fractures. A randomized prospective study in elderly patients.J Bone Joint Surg Br. 1992;74(3):345-51.
15. Kyle RF, Wright TM, Burstein AH. Biomechanical analysis of the sliding characteristics of compression hip screws.J Bone Joint Surg Am. 1980;62(8):1308-14.
16. Yong CK, Tan CN, Penafort R, Singh DA, Varaprasad MV. Dynamic Hip Screw Compared to Condylar Blade Plate in the Treatment of Unstable Fragility Intertrochanteric Fractures. Malaysian Orthopaedic Journal. 2009;3(1):13-8.
17. Kim WY, Han CH, Park JI, Kim JY. Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to pre-operative fracture stability and osteoporosis. International Orthopedics. 2001;25:360-62.
18. Nurguks KS, Olerud C, Rehnberg L. Treatment of subtrochanteric fractures with the AO dynamic condylar Screw. Injury. 1993:24;90-2.
19. Wieser K, Babst R. Fixation failure of the LCP proximal femoral plate 4.5/5.0 in patients with missing posteromedial support in unstable per-, inter- and subtrochanteric fractures of the proximal femur: Arch Orthop Trauma Surg. 2010; 130:1281-7.
20. Glassner PJ, Tejwani NC. Failure of Proximal femoral Locking Compression Plate: A Case Series. J Orthop Trauma/ 2011;25(2):76-8.