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Comparative Bony Union Time Analysis of Dynamic Hip Screw and Proximal Femoral Plate Implants

Nauman Manzoor[1], Ali Shami[2], Muhammad Hanif[3], Badar Munir[4], Muhammad Zeeshan Aslam[5], Waqas Ahmad Rao[6], Ali Akhtar[7]

[1]Registrar Trauma and Orthopaedics, Worthing Hospital, West Sussex, UK
[2]Assistant Professor, Dept. of Orthopaedics, Pakistan Institute of Medical Sciences, Islamabad
[3]Assistant Professor, Dept. of Orthopaedics, Islamabad Medical & Dental College, Islamabad
[4]Surgical Specialist, Tehsil Headquarter Hospital, Fatehpur, Kotli, AJK, [5]Consultant Orthopaedic Surgeon, Tehsil Headquarter Hospital, Gujar khan, [6]Casualty Medical Officer, Tehsil Headquarter Hospital, Murree, [7]Professor, HBS Medical and Dental College, Islamabad

Author`s Contribution

[1]Conception, synthesis, planning of research and writing of manuscript [2]Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work, [3,4,5]Active participation in methodology, interpretation and discussion, review of manuscript and data analysis,[7]Final approval of the version to be published,

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Address of Correspondent
Dr. Ali Shami
Assistant Professor
Pakistan Institute of Medical Sciences, Islamabad
drshami@hotmail.com

ABSTRACT

Objective: To determine the comparative and effective applicability of the Dynamic Hip Screw (DHS), and proximal femoral plate (PFP) in terms of the rapid bony union and complications for treating unstable pertrochanteric fractures.

Methodology: This comparative study was conducted at the Department of Orthopedic surgery, Pakistan Institute of Medical Sciences, Islamabad during a period of 8 months from August 2017 to May 2018. Patient's ages of 45 to 90 years, with close fresh unstable pertrochanteric fractures (one week) and of either gender were included. All the patients were divided into two groups. Patients in group A underwent PFP treatment and patients of group B underwent DHS treatment. Patients were followed up after 6 weeks and then every 2 weekly afterwards for a total period of 3 months for assessment of bony union both clinically and radiologically.

Results: A total of 84 patients were analysed, and average age of the patients in the PFP group was 66.57 ± 11.71 years and in the DHS group was 70.14 ± 9.03 years. Females were found in majority in both groups. No union was found till six weeks in both groups, while on 2nd month followup, union was found significantly high 19.0% in cases of the PFP group, compared to the 2.4% in the DHS group (p-0.014). On 2.5th months the union rate was significantly higher 59.5% in the PFP group, compared to the 7.1% DHS group (p-0.014), while on the 3rd month followup the union was almost in all cases in both groups (p-0.557) and the overall average union duration was significantly lower in PFP group compared to the DHS (p-0.001).

Conclusion: The proximal femoral plate technique for treating unstable pertrochanteric fractures was observed to be more effective in terms of significant rapid bony union with minimum complications compared to the Dynamic Hip Screw (DHS).

Keywords: Bone plates, Femoral fractures, Femoral surgeries, Fracture fixation, Union duration.

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Introduction

The development of trochanteric breaks involving the femur alludes to per trochanteric femoral fractures. According to an estimate, every 3rd woman and 12th man will endure hip fractures, where 86% of these fractures appear in older adults (≥65 years).[1] Pelvis fractures have increased by 23.5% from 2002 to 2017. Per trochanteric fractures of the femur transpire between the greater trochanter (connecting site at the muscular region of

abductors and extensors), and the smaller trochanter (the connecting site of the pelvis flexor muscle). Elderly patients are principally affected by these fractures.[2]

These fractures can primarily be cured by implementing surgical procedures. The Dynamic Hip Screw (DHS) is a treatment devised for fracture fixation. DHS is a screw that facilitates controlled dynamic sliding of the lag screw over the barrel of the side plate and permits dynamic compression while experiencing weight and stabilizes the femur to endure remodelling and fracture remedial. DHS is proposed as the gold standard treatment to cure proximal femur fractures,[3] as it extensively rectifies the bone fractures and is not associated with any major complications.[4] However, several pitfalls of this device include plate lift-off, break down of the lag screw and sagging, toggling, and cracking of screws essentially in unstable fractures of osteoporotic bone are the chief causes of implant failures. Accordingly, the application of DHS in unstable pertrochanteric fractures consequences in the retraction of screws that perhaps pinch the soft tissues accompanying pain and discomfort to the patient.[5] A proximal femoral plate (PFP) is a substitutive device that is anatomically contoured to precisely estimate the lateral facet of the proximal femur (left and right). Additionally, it stabilizes the femur by facilitating neck anteversion of the femur. The length of the plate can effectively minimize the duration of bony union (PFP; 14.6± 3.1< DHS; 16.5 ± 3.1 weeks) and spans the entire diaphysis in segmental fracture patterns. Additionally, the deployment of locking screws offers an angularly stable construct (independent of bone facet), owing to which, it is considered befitting for unstable and osteoporotic pertrochanteric fractures.[6,7] DHS and PFP are the typical implants rendering fixation of femoral fractures accompanying distinctive outcomes. Although several studies found different findings as recently it has been reported that the combination of a wire approach with a DHS appears to be effective for obtaining improved stability in unstable fractures.[8] On the other hand it has been reported that compression plate was introduced as a new implant that allows angular stability for the treatment of complex comminuted, osteoporotic, and unstable fractures of the proximal femur to overcome the complications associated with dynamic hip screw.[9] After taking above controversial staments this study has been done to evelaute the comparative and effective applicability of Dynamic Hip Screw (DHS), and Proximal femoral plate (PFP) in terms of the rapid bony union and complications in the treatment of unstable pertrochanteric fractures.

Methodology

This comparative study was conducted at the department of orthopaedic surgery, Pakistan Institute of Medical Sciences, Islamabad during a period of 8 months from August 2017 to May 2018. All the patients aged between 45 to 90 years, both males and females, with close fresh unstable pertrochanteric fractures (one week) were included. All the patients with polytrauma and associated injuries, pregnant females, infected cases, and cases having pathological fractures were excluded. Ethical clearance was obtained from the hospital ethical committee before the initiation of the study. A comprehensive history and thorough were examined for all patients. Written informed consent was obtained from each patient planned for inclusion into the study and for surgical intervention. All patients planned for surgery were properly accessed preoperatively for anesthesia fitness. All the baseline investigations were done including, ECG and Chest X-rays were performed for the patients above 50 years of age or with a history of hypertension/Ischemic heart disease. All the patients were evaluated by randomization depending upon the inclusion criteria of the study, and fracture fixation was conducted by PFP and DHS devices comparatively by dividing all the cases into two groups as per treatment. A total of 84 patients were selected, particularly 42 cases in each group after the sample size calculation by using the WHO sample calculator. Patients of group A underwent PFP surgeries which were performed on a traction table with the patient in supine position, after use of proper aseptic technique, a direct lateral incision on the thigh was given centred over the greater trochanter and the lateral aspect of the femur shaft. Following reduction conformation, the appropriate length of the plate was selected, and the plate was temporarily held with bone with k wires. Sleeves were applied to proximal holes and guide wires passed. The position of the guide wires conformed with fluoroscope. Reaming was done over the guide wire and a 7.3 mm partially threaded cannulated screw was used to fix the fracture. Preferably, 3 screws were applied through the proximal holes of the plate into the neck of the femur up to the sub chondral bone. The distal end of the plate was fixed with locking and cortical screws as required according to the situation. The patients in group B underwent DHS group by placed on a fracture table with a perineal post. The foot of the

contralateral/normal lower extremity was placed in a boot and scissoring of the legs was performed (unaffected hip extended relative to the injured side).The affected extremity was also placed into a boot after the reduction maneuver was carried out. All the patients were followed up after 6 weeks and then every 2 weeks afterwards, for a total period of 3 months, for assessment of bony union both clinically and radiologically. To limit the selection bias, all the study procedures and data collection were performed by the researcher himself. The data was collected on a pre-structured Performa and the analysis was done by using SPSS version 26.

Results

A total of 84 patients were studied, and the average age of the patients in the PFP group was 66.57 ± 11.71 years, and in the DHS group was 70.14 ± 9.03 years. The PFP group comprised 16 males and 26 females, while the DHS group encompassed 3 males and 29 females, and effected site in shown in the table I.

At six weeks in both groups, there was no union found, while on 2nd month follow up, the union was found to be significantly higher at 19.0% in cases of the PFP group, compared to 2.4% in the DHS group (p-0.014). On the 2.5th month of follow up, the union was significantly higher at 59.5% in the PFP group, compared with the 7.1% DHS group (p-0.014). Although, by the third month, the union was almost intact in all cases in both groups, except a few cases in both groups due to comorbidities and failure to follow management instructions (p-0.557), and the overall average of union duration was significantly lower in the PFP group compared to the DHS group, as shown in table II.

The post-operative infection rate was very low and statistically insignificant compared to both groups. The overall average of the union duration was statistically insignificant according to gender (p->0.05) as shown in the table. III

Table I: Demographic variable statistics of the study participants (n=84)

Variable		PFP Group	DHS Group
Age	Mean±SD	66.57 ±11.71	70.14 ±9.03
Sex	Males (n)	16	03
	Females (n)	26	29
Affected side	Right (n)	21	25
	Left (n)	21	17

Table III: Overall average duration of union during three months follow-up according to gender (n=84)

Study groups	Gender	Average Union Time MEAN ± SD	p-value
PFP	Male	2.71± 0.25 months	0.745
	Female	2.69 ± 0.24 months	
DHS	Male	3.00 ± 0.00 months	0.236
	Female	2.9 ± 0.75 months	

Table II: Comparison of the union during three months follow-up in both groups (n=84)

Variables			Study groups		p-value
			PFP group	DHS group	
Union on 6th week	**Yes**	Count	--	--	1.000
		% within groups	--	--	
	No	Count	42	42	
		% within groups	100.0%	100.0%	
Union on 2nd month	**Yes**	Count	8	1	0.014
		% within groups	19.0%	2.4%	
	No	Count	34	41	
		% within groups	81.0%	97.6%	
Union on 2.5th month	**Yes**	Count	25	3	0.0001
		% within groups	59.5%	7.1%	
	No	Count	17	39	
		% within groups	40.5%	92.9%	
Union on 3rd month	**Yes**	Count	41	40	0.557
		% within groups	97.6%	95.2%	
	No	Count	1	2	
		% within groups	2.4%	4.8%	
Overall average union time (months)			2.7 ± 0.24	2.9 ± 0.13	0.001

Discussion

This study to analyze the efficacy of DHS and PFP devices for treating unstable per trochanteric fractures. Observations revealed potentially influential outcomes from PFP implants for the surgical fixation of unstable per trochanteric fractures. About 59.5% of PFP implants healed at 2.5 months (≈10 weeks) while the other 40.5% of the patients displayed bony union at 3 months (≈12 weeks). Closed and hybrid compression plates have also been implicated recently for unsteady fractures, with preliminary results as yet.[10] In this study, on 2nd month follow up, union was found significantly high at 19.0% in cases of the PFP group, compared to the 2.4% in the DHS group (p-0.014). At 2.5th month of followup, the union was significantly higher at 59.5% in the PFP group, compared with the 7.1% DHS group (p-0.014). Although on the 3rd month folllwup the union was almost in all cases in both groups except a few cases in both groups due to some comorbidities and not following the management instruction (p-0.557) and the overall average union duration was significantly lower in PFP group compared to the DHS group. Consistently, Asif N et al9 observed that the use of a proximal femoral locked plate (PFLCP) to treat unstable intertrochanteric fractures can result in excellent healing and a low risk of complications. Dhamangaonkar AC et al., on the other hand, concluded that in unstable intertrochanteric fractures, a non-collapsing locking device enabled bone union with a lower risk of limb shortening and shaft medialisation. A one-year follow-up study implanted with PFLP revealed 88% bony union at 3 months, 93% at 6 months, and 100% bone unification was achieved at the end of the year. Post-operative complications were exclusively detected in 10.5% of the cases, latter cured by bone grafting.[11] Accordingly, for the reconciliation of unstable, inter, and sub-trochanteric fractures, PFLP (proximal femoral locking plate) (facilitates bony union in the meantime of 13.5 ± 3 weeks with 31.3% of patients experienced the consequences of implant failure, malrotation, distal screw fractures, implant-associated infections, and post-traumatic pelvis impingement.[12]

Conversely, PFLP treatment for unstable per trochanteric fractures has displayed a delayed mean union time of 21.53 ± 4.18 weeks accompanied by the vulnerabilities of infections (2 cases) and backing of screws (2 cases).[13] Biomechanical studies on sub trochanteric fractures evidenced the lesser failure incidences of proximal femoral locking plate than a proximal femoral nail, yet higher frequencies compared to angled blade plate.[14] A lateral plate can be employed with fixed angle screws followed by intraoperative fracture compressions, uphold the remedial potential and avoid additional shortening. Zhong B. et al. compared the efficacy of PFLCP (Proximal Femoral Locking Compression Plates) and DHS for treating sub trochanteric fractures. Outcomes revealed shorter bony union (5.2 ± 0.4 versus 8.8 ± 1.0 month), reduced blood loss, outstanding scores at Sanders' traumatic hip rating scale (92.9% versus 55.5%), and lower complications in PFLCP implants than DHS intervention group.[15] Another benefit of using PFP in revision surgeries (when there is extensive loss of lateral bone stock or weak bone), is the locking mechanism, which provides excellent support in osteoporotic bones, making it a perfect choice in the elderly population and patients with decreased bone density.[16]

The Dynamic Hip Screw (DHS) is one of the standard treatments being provided to femoral fractures; even so, a high failure rate is reported in unstable fractures.[17] The present study revealed the recovery of 7.1% of patients at 2.5 months, while the remaining 92.9% were restored to health at 3 months. Moreover, the DHS treatment group suffered inimical outcomes, including varus collapse and delayed union of the bones. The unstable intertrochanteric fractures having reverse obliquity, medial displacement of the shaft inclines secondary to an adductor muscle pull. Fixation employing a DHS may lead to implant failure due to the unconstrained co-axial collapse of the proximal fragment with medialisation of the shaft. The screw may abandon the DHS side plate, leading to increased stress at the screw plate junction. This problem can be managed by deploying a non-collapsing implant with a locking neck and shaft screws.[15] The comparative interventional analysis of DHS (group A) and proximal femoral nail (group B) outlined equivalent affectivity with harris hip scores of 81.83±23.01 and 87.62±17.28, respectively. Post-operative infections were identified in 2 patients of group A and 1 of group B.[18] Contrarily, a recent evaluation of DHS in combination with trochanteric stabilizing plate (TSP) has brought up faster bony union when compared to PFLP (proximal femoral locking plate). The DHS-TSP group averagely healed at 14.47 ± 5.37 weeks; however, the PFLP group recovered at 17.67 ± 3.37 weeks.[19] For the recovery of A2 and A3 fractures, the DHS-TSP devices exploited lessening of post-operative reduction of haemoglobin for unstable intertrochanteric fractures, however, accompanied by an increase of residual pain

and implant irritation.[20] This perhaps is linked to the additional treatment of trochanteric stabilizing plate that may offer steadier healing in elderly unstable per trochanteric fractures. Hence, the solitary use of sliding hip screws is presumably discouraging due to several reported postoperative complications, including femoral head screw cut out,[21] avascular necrosis of the femoral head, cracking of screws, femoral fracture below the plate, and the development of coxarthrosis and pseudoarthrosis.[22] Convincingly, for treating stable fractures, in which there is enough lateral support and the trochanter is undamaged, the DHS is an ideal choice of implant. However, in cases where there is a loss of the lateral strength of natural bone stock or in reverse oblique fractures, the PFP has proven more effective in contrast to DHS. Accordingly, stable fractures of the proximal femur can be effortlessly cured by implying osteosynthesis alongside conventional implants to produce predictable results. However, anatomical reduction poses a great challenge to the surgeons in managing unstable fractures.

Conclusion

According to the clinical and radiographical conclusions, the proximal femoral plate technique for treating unstable per trochanteric fractures was observed to be the most effective in terms of significant rapid bony union with minimum complications compared to the Dynamic Hip Screw (DHS). However, more studies with large sample sizes will be required to establish consolidated outcomes.

References

1. Hoyem K, Oron A, Rozinsky P, Kosashvili Y. Pertrochanteric Fractures in the Elderly: Is the Severity of Fracture Pattern associated with age and an increased rate of mortality? J. Orthop. Surg. 2020;3(1):21-26 https://doi.org/10.37515/ortho.8231.3106
2. Hemmann P, Friederich M, Körner D, Klopfer T, Bahrs C. Changing epidemiology of lower extremity fractures in adults over a 15-year period - a National Hospital Discharge Registry study. BMC Musculoskelet. Disord. 2021;22(1): 1-24 https://doi.org/10.1186/s12891-021-04291-9
3. Jonnes C, SM S, Najimudeen S. Type II Intertrochanteric Fractures: Proximal Femoral Nailing (PFN) Versus Dynamic Hip Screw (DHS). Arch. Bone Jt. Surg. 2016;4(1):23-28
4. Dhanwal D, Cooper C, Dennison E. Geographic Variation in Osteoporotic Hip Fracture Incidence: The Growing Importance of Asian Influences in Coming Decades. Journal of Osteoporosis. 2010;2010(757102):1-5 https://doi.org/10.4061/2010/757102
5. Gaba S, Agrawal P, Das S, Singh R, Kumar A, Yadav G. Dynamic hip screw versus proximal femur locking compression plate in intertrochanteric femur fractures (AO 31A1 and 31A2): A prospective randomized study. J Nat Sci Biol Med. 2017;8(1):87. https://doi.org/10.4103/0976-9668.198352
6. Kumar N, Kataria H, Yadav C, Gadagoli B, Raj R. Evaluation of proximal femoral locking plate in unstable extracapsular proximal femoral fractures: Surgical technique & mid term follow up results. J Clin Orthop Trauma. 2014;5(3):137-145. https://doi.org/10.1016/j.jcot.2014.07.009
7. Dhamangaonkar AC, Joshi D, Goregaonkar AB, Tawari AA. Proximal femoral locking plate versus dynamic hip screw for unstable intertrochanteric femoral fractures. J Orthop Surg.2013; 21:317-22. https://doi.org/10.1177/230949901302100311
8. Wu HF, Chang CH, Wang GJ, Lai KA, Chen CH. Biomechanical investigation of dynamic hip screw and wire fixation on an unstable intertrochanteric fracture. Biomedical engineering online. 2019 ;18(1):1-2. https://doi.org/10.1186/s12938-019-0663-0
9. Asif N, Ahmad S, Qureshi OA, Jilani LZ, Hamesh T, Jameel T. Unstable intertrochanteric fracture fixation-Is proximal femoral locked compression plate better than dynamic hip screw. Journal of clinical and diagnostic research: JCDR. 2016 Jan;10(1):RC09. https://doi.org/10.7860/JCDR/2016/11179.7084
10. Rowe-Guthrie K, Markel M, Bleedorn J. Mechanical Evaluation of Locking, Nonlocking, and Hybrid Plating Constructs Using a Locking Compression Plate in a Canine Synthetic Bone Model. Veterinary Surgery. 2015;44(7):838-842 https://doi.org/10.1111/vsu.12368
11. Ibrahim S, Meleppuram J. A retrospective analysis of surgically-treated complex proximal femur fractures with proximal femoral locking compression plate. Revista Brasileira de Ortopedia (English Edition). 2017;52(6):644-650. https://doi.org/10.1016/j.rboe.2016.12.012
12. Hodel S, Beeres F, Babst R, Link B. Complications following proximal femoral locking compression plating in unstable proximal femur fractures: medium-term follow-up. Eur. J. Orthop. Surg. Traumatol 2017;27(8):1117-1124. https://doi.org/10.1007/s00590-017-1981-1
13. Kovalak E, Ermutlu C, Atay T, Başal Ö. Management of unstable pertrochanteric fractures with proximal femoral locking compression plates and affect of neck-shaft angle on functional outcomes. J Clin Orthop Trauma. 2017;8(3):209-214. https://doi.org/10.1016/j.jcot.2017.07.006
14. Viberg B, Rasmussen K, Overgaard S, Rogmark C. Poor relation between biomechanical and clinical studies for the proximal femoral locking compression plate. Acta

Orthopaedica.2017;88(4):427-433. https://doi.org/10.1080/17453674.2017.1304207
15. Zhong B, Zhang Y, Zhang C, Luo C. A comparison of proximal femoral locking compression plates with dynamic hip screws in extracapsular femoral fractures. Orthop Traumatol Surg Res . 2014;100(6):663-668. https://doi.org/10.1016/j.otsr.2014.06.012
16. Lee W, Murphy D, Kagda F, Thambiah J. Proximal Femoral Locking Compression Plate for Proximal Femoral Fractures. J Orthop Surg. 2014;22(3):287-293. https://doi.org/10.1177/230949901402200304
17. Taheriazam A, Saeidinia A. Salvage of failed dynamic hip screw fixation of intertrochanteric fractures. Orthopedic Research and Reviews. 2019;11:93-98 https://doi.org/10.2147/ORR.S215240
18. Adeel K, Nadeem R, Akhtar M, Sah R, Din I. Comparision Of Proximal Femoral Nail (Pfn) And Dynamic Hip Screw (Dhs) For The Treatment Of Ao Type A2 And A3 Pertrochanteric Fractures Of Femur. J Pak Med Assoc. 2020;(0):1. https://doi.org/10.5455/JPMA.295426
19. Selim A, Beder F, Algeaidy I, Farhat A, Diab N, Barakat A. Management of unstable pertrochanteric fractures, evaluation of forgotten treatment options. SICOT-J. 2020;6:21. https://doi.org/10.1051/sicotj/2020020
20. Fu C, Chen J, Liu Y, Liao K, Lu Y. Dynamic Hip Screw with Trochanter-Stabilizing Plate Compared with Proximal Femoral Nail Antirotation as a Treatment for Unstable AO/OTA 31-A2 and 31-A3 Intertrochanteric Fractures. BioMed Research International. 2020;2020:1-7. https://doi.org/10.1155/2020/1896935
21. Arastu M, Phillips L, Duffy P. An unusual failure of a sliding hip screw in the immediate post-operative period. Injury Extra. 2013;44(2):23-27. https://doi.org/10.1016/j.injury.2012.10.011
22. Hrubina M, Skoták M, Běhounek J. Complications of dynamic hip screw treatment for proximal femoral fractures. Acta Chir. Orthop. Traumatol. Cechoslov.. 2010;77(5):395-401.