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ORIGINAL ARTICLE

Is Proximal Femoral Locking Plate a Reliable Alternative to Sliding Hip Screw for Fixation of Femoral Neck Fractures in the Young?

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Background Intracapsular femoral neck fracture constitute a major entity of orthopedic trauma and of geriatric fractures, yet there is no clear consensus on the favored fixation modality regarding achievement of sound union with the least complication rate.

Patients and Methods We conducted a retrospective observational study of 6o patients with intracapsular femoral neck fracture, 30 of them (Group A) had undergone DHS fixation while the other 30 (Group B) were fixed with proximal femoral locking plates.

Results Both groups had no significant difference regarding age, gender, fracture type and preoperative medical comorbidities. Also, they showed no remarkable difference regarding operative time, blood loss and length of hospital stay. Concerning the postoperative period follow up that reached 12 months with a mean of 6 months, they showed similar union rates, functional scores, AVN and reoperation rates, with the preoperative displacement being the only statistically significant index that is predictive of functional outcome.

Conclusions We believe that PFLP provide comparable results to those of sliding hip screw in management of intracapsular femoral neck fractures with the advantage of feasibility of post-fixation MRI studies.

Keywords Avascular necrosis, Dynamic hip screw, Locking plates, Neck of femur fractures, Ununited femoral neck fracture.
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INTRODUCTION

Fractures of the hip joint are common, approximately 20% of the cases of the orthopedic trauma unit, and proximal femoral fractures account for 60-65% of all geriatric fractures. Also, fractures of the femoral neck account for about 50% of all hip fracture cases [1].

Fractures of the neck femur in young patients typically result from high-energy trauma to the hip. Urgent anatomical reduction and internal fixation in the young (aiming at preservation of the blood supply to the femoral head) is the treatment of choice [2,3] With critical blood supply of the femoral head, these fractures carry high risks of avascular necrosis and fracture non-union, comprising 16% and 33% of complications respectively [4]. Femoral neck fractures have a 20 to 36% reoperation rate within two years of the 1st internal fixation of the fracture [5].

Dynamic hip screws, three cannulated screws and proximal femoral locking plates are widely used internal fixation devices for neck of femur fractures in young adults [6]. Cannulated screws and dynamic hip screw allow compression of the femoral neck fracture site during weight bearing, but it cannot prevent 2^{ry} limb shortening due to the head or neck fragment lateralization from gliding along the screws [7]. Anatomic locking plates allow angular-stable plating for the treatment of complex comminuted & porotic fractures [8]. Deneka *et al*., published a biomechanical comparison of internal fixation devices for the treatment

of neck femur fractures, the results supported the use of dynamic hip screws [9].

Considering the growing belief in fixed-angle constructs for better stability & less loss of reduction for such injuries, we conducted this retrospective cohort study to assess the reliability of anatomical proximal femoral locking plates in achieving comparable results to those of dynamic hip screw in fixing neck of femur fractures in the young.

PATIENTS AND METHODS

Study design & data collection

This retrospective cohort study of prospectively collected data was undertaken to compare the functional & radiologic outcomes of dynamic/sliding hip screw and proximal femoral locking plate for the fixation of femoral neck fractures. It reviewed the medical records of 60 young adult patients (both males & females) with displaced femoral neck fracture (who met the inclusion criteria) who were operated upon from January 2018 till january 2023 at our level 1 trauma center. Those who fulfilled a minimum of 6 months follow up were enrolled in the study.

Dynamic/sliding hip screw fixation was the procedure done for 30 patients (Group A), while the other 30 patients had undergone proximal femoral locking plate fixation (Group B), with the choice of implant being the senior surgeons own preference. Based on the work of others and difference in proportions and means between groups, and after calculating the sample size needed for detecting a range of outcomes desired in this study using a power of 80% and a 95% CI using epi info version 7 (CDC) a sample of 30 per group was deemed as adequate.

Clinically we collected patient's sociodemographic data (age & gender), BMI, smoky habits & comorbidities, and the two groups were matched accordingly. Patients were originally interviewed by trained authors, and radiographic assessment was routinely done by two orthopedic surgeons. Radiologically, the time to union, loss of reduction & any complication (occurrence of AVN, nonunion & arthritis) were reviewed. Ethical approval for this study was obtained from the ethical committee review board.

Eligibility

Inclusion criteria: displaced femoral neck fractures (including intracapsular & extracapsular fractures) in skeletally mature adults (between 20-55 years of age) with an intact cognitive state to achieve informed consent.

Exclusion criteria: associated fracture (pelvis, acetabulum, or femur), hip dislocation, the fracture is pathologic, active infection, age (below 20 years or above 55 years), and pre-fracture inability to walk freely.

Surgical procedures & postoperative rehabilitation

All patients were originally assessed both clinically and radiologically by the same physician, consented, and prepared for the operative intervention. Preoperative data including age, gender, medical comorbidities, and fracture pattern classification (Pawel & Garden) were collected & documented. All surgeries were performed by one of the two authors who are senior pelvis and arthroplasty surgeons. All patients in both groups underwent regional spinal anesthesia and operated upon in the supine position on a radiolucent traction table. Image intensifier was used for intraoperative assessment of reduction and for placement of the implant.

All patients of both groups achieved accepted closed reduction under the image intensifier (restored anteromedial cortex, neck-shaft angle and anteversion) with no need for open reduction of the neck fracture and capsulotomy. Group A underwent sliding/dynamic hip screw fixation (Figure 1) with a 4-hole locking plate and a relevant length lag screw, while Group B underwent fixation via a locking plate (Figure 2) that includes three 7.3mm cannulated screws for the neck (in an inverted triangle orientation) and a single cortical screw for the femoral shaft fixation. Regarding Group A, an additional superior de-rotational guide wire was used during the step of drilling for the lag screw using the triple reamer, to ensure maintenance of reduction.

Postoperative *X*-Rays were done, and analgesia and anticoagulation were given for all patients of both groups, while the duration of anticoagulation differed among patients according to personal ability for early ambulation using a walker or crutches. Weight bearing was not allowed for the first 4 weeks while immediate functional rehabilitation and full passive range of motion for both hips and knees were encouraged.

Outcomes

Intraoperative bleeding, operative time and length of hospital stay were retrieved from operative reports. After discharge, the outpatient clinic data registry was used for reporting outcomes at the regular follow up visits at 6, 12 and 24 weeks postoperatively. Patients' follow up period reached 12 months postoperative, with a minimum of 6 months.

Modified Harris hip score (with its 100 points covering pain, limping, use of support and different daily activities) was used for clinical and functional assessment for all patients of both groups, while loss of reduction, union and AVN rates were the radiologic outcomes observed at the follow up visits. Also, reoperation rates were observed and compared.

RESULTS

Regarding both groups, A (DHS) and B (locking plate), there was no statistically significant difference regarding the mean age, gender distribution, side of injury or cause of trauma of both groups' subjects. Also, the preoperative status and relevant comorbidities; namely DM and smoking distribution, were within the same range concerning both groups, with no statistical difference. Our follow up period reached 12 months postoperative, with a minimum of 6 months (Table 1).

For the intraoperative variables, the mean operative time, bleeding, and length of stay for Group A was 26.75min (80-120), 450cc (90-750) and 60 hours (48-72) respectively, while for Group B it was 24.04min (70-120), 470cc (80-800) and 60 hours (48-72) respectively, with no statistically significant difference regarding any of these 3 variables.

Twenty-eight cases achieved full radiologic & clinical union before the 6th month for each of the 2 groups (93.33%). Also, by the 6th month, Group A had a mean HHS of 90% while that for Group B was 92%, with no statistically significant difference between both groups. The preoperative displacement showed a statistically significant correlation with functional outcome irrespective of the used fixation device, in which all cases with non-displaced fractures showed satisfactory outcome (Table 2).

Table 1: Age & Gender distribution:

	Group A DHS (*n*=30)		**Group B PFLP (*n*=30)**		**test** ***P* value**
Age					
Range	20-49		21-47		T=1.14
Mean	35.93		32.83		0.105 N.S.
SD	10.24		8.67		
Gender	No	%	No	%	
Male	25	83.33	20	66.67	X^2=1.25
Female	5	16.67	10	33.33	0.070 N.S.

Table 2: Postoperative outcomes:

	Group A DHS (*n*=30)		**Group B PFLP (*n*=30)**		X^2 ***P* value**
	No	%	No	%	
Union					
Non-union	2	6.67	2	6.67	0.500
Present	28	93.33	28	93.33	1.00 N.S.
Timing of union					
<6 months	26	86.66	27	90.00	
6> month	2	6.67	1	3.33	1.08
Nonunion	2	6.67	2	2.67	0.290 N.S.
Returned to full activity	25	83.3%	26	86.67%	0.569 NS
No limp	16	33%	19	63.33%	0.98 NS
Loss of reduction	2	6.67%	3	10%	0.685 NS
AVN	3	10%	2	6.67%	0.62 NS
Reoperation rate	3	10%	4	13.3%	0.347 NS

Loss of reduction occurred for 2 cases before the 2nd month in Group A, while 3 cases suffered the same problem in Group B, with no statistically significant difference. Also, there was no statistically significant difference between the failure of reduction and the grade of neck fracture. AVN was observed in 3 cases in Group A, while it occurred in 2 cases in Group B, with no statistically significant difference, despite of the use of the triple reamer for application of the lag screw in Group A. Reoperation rate for Group A was 3 cases (10%), while for Group B was 4 cases (13.3%), with no statistically significant difference. The overall complication rate was 10% (3 cases) for Group A and 13.3% (4 cases) for Group B, with no statistically significant difference between both groups. (Figures 3,4).

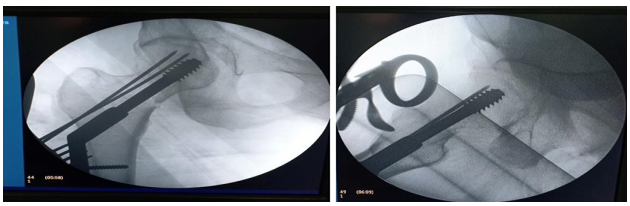

Figure 1: Intraoperative Image intensifier AP (A) and lateral (B) views during the final stage of implantation of a sliding hip screw for a femoral neck fracture of Group A.

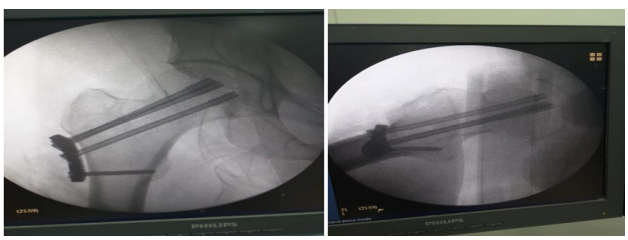

Figure 2: Intraoperative Image Intensifier AP (A) and lateral (B) views after fracture reduction and fixation with PFLP of Group B.

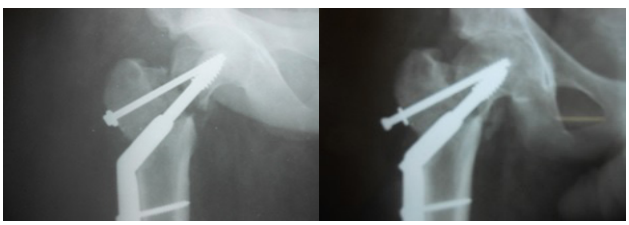

Figure 3: Immediate and 6 months postoperative *X*-Ray of a case with transcervical fracture in Group A that suffered loss of reduction and AVN.

Figure 4: A case of high transcervical fracture in Group A who suffered after 6 months (picture to the far right) loss of reduction and screw penetration.

DISCUSSION

Femoral neck fractures in young adults have been regarded as a challenge in orthopaedic Surgery [10-19]. Fractures of the neck femur in young patients typically result from high-energy trauma. Anatomic reduction and stable internal fixation are essentials for achieving the goals of treatment in this young population allowing preservation of the femoral head while minimizing rates of femoral head avascular necrosis and non-union [11].

In the present study, we retrogradely assessed and compared the results of short proximal femoral locked plate and DHS for the fixation of fracture neck of femur. This study included 30 patients with fracture neck femur (66.67% males & 33.33% females) aged from 21–47 years (mean 32.83) treated with dynamic hip screw (Group A), and 30 patients (83.33% males and 16.67% females) aged from 20-49 years (mean 35.93) treated with proximal femoral locked plate with cannulated screws (Group B). There are few published reports focusing on proximal femoral locked plate with cannulated screws in the treatment of femoral intracapsular displaced neck fractures.

Lin *et al.,* (2012) [10] studied the results of the proximal femoral locked plate with cannulated screws over 41 patients. Twenty-six (63%) patients had excellent results. He concluded that proximal femoral locking plate is effective and had fewer complications for management of femoral neck fractures. In the present study the results obtained from the group treated with the proximal femoral locked plate was 84% satisfactory &16% unsatisfactory were equal to the results of Lin *et al.,* [10] who used the same implant and their study found 83% ofthe patients had satisfactory results and 17% of the patients had unsatisfactory results.

Xiang Hu *et al.*, [18] carried out a study over 54 patients with femoral neck fracture who were treated with proximal locking plate fixation, satisfactory results were found in 40 cases (74.5%). Also, Parker *et al.,* [14], Biber *et al.*, [15], Korver *et al.*, [16] and Osarumwense *et al.,* [17] used a similar device with telescoping screws to allow compression (dynamic proximal femoral locking plate) and concluded good results; were 66.5%, 83%, 87% and 90%, respectively.

On the other hand, Majernicek *et al.*, [12] carried out a prospective study of 64 patients treated with dynamic hip screw for femoral neck fractures, satisfactory results were achieved in 73.4% of the cases. Also, Schwartsmann *et al.,* [13] documented satisfactory union in 80 out of 96 patients with sub-capital neck fractures managed by DHS in his prospective study.

Time lapse between injury and the surgery was 7 to 76 hours in our present study Lin and Biber [10,15]. in their studies included patients with time lapse before surgery up to 168 hours (7 days) and 504 hours (21 days).

In the present study, the mean time to union for the both groups was 3.4 months (3-7 months). Lin (2012) [10] reported a similar range for PFLP with mean of 3.8 months.

In the current study, rate of union was 93.3% for both groups, while AVN was observed at a rate of 10% in Group A and 13.3% in Group B. Lin *et al.*, (2012) [10] had two patients (4.88%) who did not achieve union, and 4 patients (9.75%) who had AVN. Also, Schwartsmann *et al.*, [13] had a nonunion rate of 3% and AVN in 16% of cases, respectively.

In the study by Osarumwense *et al.*, [17], one case (2%) treated with the TFN plate had nonunion and three cases (7%) suffered AVN. Also, Parker *et al.,* [14] who used the same implant reported 10% (35 out of 320 cases) rate of nonunion after TFN plating and observed AVN in 28 cases (8.7%).

Korver (2013) [16] reported 12.5% overall rate of complications with TFN plates, however, complication rates in some studies who used DHS were higher. Schwartsmann *et al.*, (2014) [13] in their study over 96 patients, nonunion was observed in three cases (19%) and AVN was observed in 17% of the cases. Majericek *et al.,* [12] reported an overall complication rate of 26.6% with sliding hip screw.

Although several studies have compared the use of different plates & screws for the fixation of femoral neck fractures, only few studies focused on the comparison between locked plates and DHS in the fixation of femoral neck fractures, among which is our study. Eschler *et al.*, (2014) [19] compared the outcome of fracture neck femur fixation by DHS and TFN plate, they found a later conversion to total hip rate (due to implant failure) of 32% and 15% among patients fixed by DHS & TFN plate respectively. Also, the use of MRI for the diagnosis of AVN in PFLP group highlights a significant advantage in favor of the use of this titanium-made implant, hence eliminating the compatibility problems experienced with stainless steel composition of the DHS.

Despite the small sample size and the relatively short follow-up period of the cases of this study, it stands among the few literature reviews focusing on the comparison between DHS and locking plates for management of the fractured femoral neck in adults, in absence of a clear consensus on which is the more favorable implant. Also, including several predictive variables (namely: comorbidities, patient's age and gender, time-lapse to surgery, preoperative displacement degree, operative time and blood loss, and length of stay) were of the strength points of this study.

CONCLUSION

This retrospective cohort study of 60 young adults with neck of femur fracture compares the use of DHS (Group A) versus PFLP (Group B) as a fixation modality. We relatively advise for the use of PFLP for the believed less risk of loss of reduction, while still having the same reliability of DHS in achieving satisfactory good to excellent results. Larger prospective controlled studies comparing fixed-angle devices regarding AVN, nonunion and implant failure rates are still recommended.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCE

1. Leighton, R.K. (2006) Fractures of the Neck of the Femur. In: Bucholz, R.W., Heckman, J.D. and Court-Brown, C.M., Eds., Fractures in Adults, 6th Edition, Lippincott, Philadelphia, 1753-1788.
2. Swiontkowski MF. (1994). Intracapsular fractures of the hip. J Bone Joint Surg Am. 1994 Jan;76(1):129-38. doi: 10.2106/00004623-199401000-00019. PMID: 8288657.
3. Tooke SM., Favero KJ. (1985). Femoral neck fractures in skeletally mature patients, fifty years old or less. J Bone Joint Surg Am. 1985 Oct;67(8):1255-60. PMID: 4055851.
4. Lu-Yao GL., Keller RB., Littenberg B., Wennberg JE. (1994). Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. J Bone Joint Surg Am. 1994 Jan;76(1):15-25. doi: 10.2106/00004623-199401000-00003. PMID: 8288658.
5. Davidovitch RI., Jordan CJ., Egol KA., Vrahas MS. (2010). Challenges in the treatment of femoral neck fractures in the nonelderly adult. J Trauma. 2010 Jan;68(1):236-42. doi: 10.1097/TA.0b013e3181c428ce. PMID: 20065780.
6. Miyamoto RG., Kaplan KM., Levine BR., Egol KA., Zuckerman JD. (2008). Surgical management of hip fractures: an evidence-based review of the literature. I: femoral neck fractures. J Am Acad Orthop Surg. 2008 Oct;16(10):596-607. doi: 10.5435/00124635-200810000-00005. PMID: 18832603.
7. Hasenboehler EA., Agudelo JF., Morgan SJ., Smith WR., Hak DJ., Stahel PF. (2007). Treatment of complex proximal femoral fractures with the proximal femur locking compression plate. Orthopedics. 2007 Aug;30(8):618-23. doi: 10.3928/01477447-20070801-18. PMID: 17727017.
8. Strauss EJ., Schwarzkopf R., Kummer F., Egol KA. (2008). The current status of locked plating: the good, the bad, and the ugly. J Orthop Trauma. 2008 Aug;22(7):479-86. doi: 10.1097/BOT.0b013e31817996d6. PMID: 18670289.
9. Deneka DA., Simonian PT., Stankewich CJ., Eckert D., Chapman JR., Tencer AF. (1997). Biomechanical comparison

of internal fixation techniques for the treatment of unstable basicervical femoral neck fractures. J Orthop Trauma. 1997 Jul;11(5):337-43. doi: 10.1097/00005131-199707000-00007. PMID: 9294797.

10. Lin D., Lian K., Ding Z., Zhai W., Hong J. (2012). Proximal femoral locking plate with cannulated screws for the treatment of femoral neck fractures. Orthopedics. 2012 Jan 16;35(1):e1-5. doi: 10.3928/01477447-20111122-08. PMID: 22229598.
11. Egol, K. A., Koval, K. J., Zuckerman, J. D. (2015). Femoral neck fractures: Handbook of fractures (Fifth edition). Wolters Kluwer Health. 371-380.
12. Majernícek M., Dungl P., Kolman J., Malkus T., Vaculík J. (2009). Osteosyntéza intrakapsulárních zlomenin krcku stehenní kosti metodou DHS [Osteosynthesis of intracapsular femoral neck fractures by dynamic hip screw (DHS) fixation]. Acta Chir Orthop Traumatol Cech. 2009 Aug;76(4):319-25. Czech. PMID: 19755057.
13. Schwartsmann CR., Jacobus LS., Spinelli Lde F., Boschin LC., Gonçalves RZ., Yépez AK., Barreto RP., Silva MF. (2014). Dynamic hip screw for the treatment of femoral neck fractures: a prospective study with 96 patients. ISRN Orthop. 2014 Apr 24;2014:257871. doi: 10.1155/2014/257871. PMID: 24967124; PMCID: PMC4045372.
14. Parker M., Cawley S., Palial V. (2013). Internal fixation of intracapsular fractures of the hip using a dynamic locking plate: Two-year follow-up of 320 patients. Bone Joint J. 2013 Oct;95-B(10):1402-5. doi: 10.1302/0301-620X.95B10.31511. PMID: 24078540.
15. Biber R., Brem M., Bail HJ. (2013). Targon Femoral Neck for femoral-neck fracture fixation: lessons learnt from a series of one hundred and thirty five consecutive cases. Int Orthop. 2014 Mar;38(3):595-9. doi: 10.1007/s00264-013-2176-y. Epub 2013 Nov 23. PMID: 24271332; PMCID: PMC3936070.
16. Körver RJ., Wieland AW., Kaarsemaker S., Nieuwenhuis JJ., Janzing HM. (2013). Clinical experience, primary results and pitfalls in the treatment of intracapsular hip fractures with the Targon® FN locking plate. Injury. 2013 Dec;44(12):1926-9. doi: 10.1016/j.injury.2013.05.002. Epub 2013 Jun 13. PMID: 23769658.
17. Osarumwense D., Tissingh E., Wartenberg K., Aggarwal S., Ismail F., Orakwe S., Khan F. (2015). The Targon FN system for the management of intracapsular neck of femur fractures: minimum 2-year experience and outcome in an independent hospital. Clin Orthop Surg. 2015 Mar;7(1):22-8. doi: 10.4055/cios.2015.7.1.22. Epub 2015 Feb 10. PMID: 25729515; PMCID: PMC4329529.
18. Hu X., Liu BJ., Wen XM., Zheng YH., Jia K. (2018). [Clinical observation of closed reduction and compression cannulated screw fixation for the treatment of femoral neck fracture in young and middle-aged patients]. Zhongguo Gu Shang. 2018 Feb 25;31(2):111-114. Chinese. doi: 10.3969/j.issn.1003-0034.2018.02.003. PMID: 29536678.
19. Eschler A., Brandt S., Gierer P., Mittlmeier T., Gradl G. (2013). Angular stable multiple screw fixation (Targon FN) versus standard SHS for the fixation of femoral neck fractures. Injury. 2014 Jan;45 Suppl 1:S76-80. doi: 10.1016/j.injury.2013.10.026. Epub 2013 Oct 28. PMID: 24268670.