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Outcomes of Open Reduction and Internal Fixatıon of Femur Trochanteric Fractures With Proximal Femur Anatomical Plate

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ABSTRACT

Aim: The aim of this study was to examine the results of the open reduction and proximal femoral anatomical plate (PFAP) fixation procedure, which we use in the surgical treatment of femoral trochanteric fractures, in terms of the risk of post-traumatic osteoarthritis development in the hip joint.

Methods: We retrospectively examined the results of 20 patients with open reduction and PFAP fixation out of 117 patients who underwent surgical treatment in our clinic due to trochanteric femoral fracture. All patients were operated on by the same surgeons using the same surgical method. Bone union was achieved in all of the patient with a mean follow-up of 22 months. The clinical outcomes of these patients were assessed using the Lequesne scoring system.

Results: There were 14 male and 6 female patients in the study (15 left and 5 right femur fractures). The average age was 48.75 years. The average operative time was 3.5 days (range: 1–11 days), the average follow-up time was 22 months (range: 10–48 months), and the average time to union was 4.1 months (range: 2.5–5 months). The Lequesne evaluation test score was an average of 4.53 points. According to the Lequesne scale, 3 of the patients had no risk of osteoarthritis, 8 had mild risk, 6 had moderate risk, 2 had severe risk, and 1 had very serious risk. On average, a mild risk result was found.

Conclusion: In trochanteric fractures, proximal femoral anatomic plate fixation surgery is associated with a low risk for osteoarthritis in the mid-term with a score of 4.53 according to the Lequesne scale.

Keywords: Trochanteric fracture, Proximal Femoral Anatomic Plate, Post Traumatic Osteoarthritis, Lequesne.

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Introduction

Fractures of the trochanteric region of the femur are among the most common large bone fractures (1). These fractures show a bimodal age distribution and high-energy traumas are involved in the etiology, especially in the young patient group (2).

One of the aims of surgical treatment of trochanteric hip fractures is to provide anatomical alignment and to prevent abnormal joint loads and related deformations. Implants with many different properties have been used in surgical treatment to date. Currently, the most preferred implants are Proximal Femoral Nailing (PFN), Dynamic Hip Screw (DHS), and Proximal Femoral Anatomical Plates (PFAP). There are many publications in the literature on the biomechanical properties of these implants. In the publication of Socci et al., while they recommend extramedullary DHS fixation for AO type 31-A1 fractures, it recommends intramedullary PFN fixation for all remaining fractures (3). In their meta-analysis of 1983 patient data, Ma et al. compared these implants in terms of blood loss, hospital stay, fluoroscopy exposure, and implant failure, and stated that PFN should be the first choice. They concluded that DHS is also superior to PFN (4).

Although posteromedial continuity has traditionally been seen as the most important prognostic factor for good outcome, it has been reported that the continuity of the lateral cortical wall plays a key role and rotational stability and varus stability are improved by providing lateral support with these plates (5). Syed İbrahim et al., on the other hand, reported that implant failure and nonunion problems were not seen in any of their patients, and that the mean Harris Hip score was 84.5 in their study involving 21 patients who used PFAP, and that fixation with PFAP is a good and reliable alternative in peritrochanteric fractures (6). In their study in which they compared 3 different implant models, Polat et al. showed that fixation with PFAP gave better biomechanical results than PFN (7).

In the literature, many factors have been identified that can cause hip osteoarthritis. Amin et al. stated that abnormal joint morphology and the changing load type due to fractures can cause osteoarthritis in the hip joint in the long term (8). Brown et al. also reported that 12% of all symptomatic hip, knee, and ankle osteoarthritis cases were post-traumatic (9). In the study published by Khurana et al., they stated that the cause of 62 (5.17%) of 1199 patients who underwent total hip arthroplasty was post-traumatic osteoarthritis (PTOA) (10).

Gallagher et al. (11) reported that the risk of developing hip osteoarthritis is 3 times higher in cases with implant failure after surgical treatment with DHS or PFN for trochanteric fractures. Early implant failures such as cut out or cut through after surgical treatment of trochanteric region fractures can be seen at a rate of 5–7% due to high varus and rotational stress (12). While some studies see extramedullary implants as better (13), some publications suggest that intramedullary implants are superior (14). There are also authors who state that surgical technique and anatomical reduction are more important than implant type in success (15). The aim of our study was to evaluate the risk of developing PTOA in our patients after proximal femoral plate applications.

Methods

In this study, the results of 20 patients who underwent PFAP for trochanteric fractures were evaluated retrospectively. The patients who were operated with other implants such as PFN, DHS, ex-fix and partial hemiarthroplasty were excluded. Clinical approval was obtained for the study (Bursa City Hospital Ethics Committee, No 31-08-2021-001). 14 of our patients were males. The age distribution was

between 24 and 76, and the mean age was 48±7.5. Fractures were in the left femur in 15 patients and in the right femur in 5 patients.

All of the patients were first seen in the emergency department and consulted for head-thorax-abdominal injuries. After the vital signs of patients with additional injuries (5 patients) and patients with concomitant chronic diseases (7 patients) were stabilized, surgical treatment was performed. The duration until the operation was between 1 and 11 days, and they were operated on with an average of 3.5 days. The fractures of the patients were classified according to the Boyd-Griffin and Evans classifications. According to the Boyd-Griffin classification, 8 patients were Type 2, 1 patient was Type 3, and 11 patients were Type 4. Our mean follow-up period was 22.7 months, with the shortest follow-up period of 14 months and the longest, 48 months. In-bed isometric exercises were started on the first post-op day. Patients in good general condition were mobilized on the first day with a walker without any weight bearing. The patients were followed up on a monthly basis. Lequesne score was used to assess hip osteoarthritis (16).

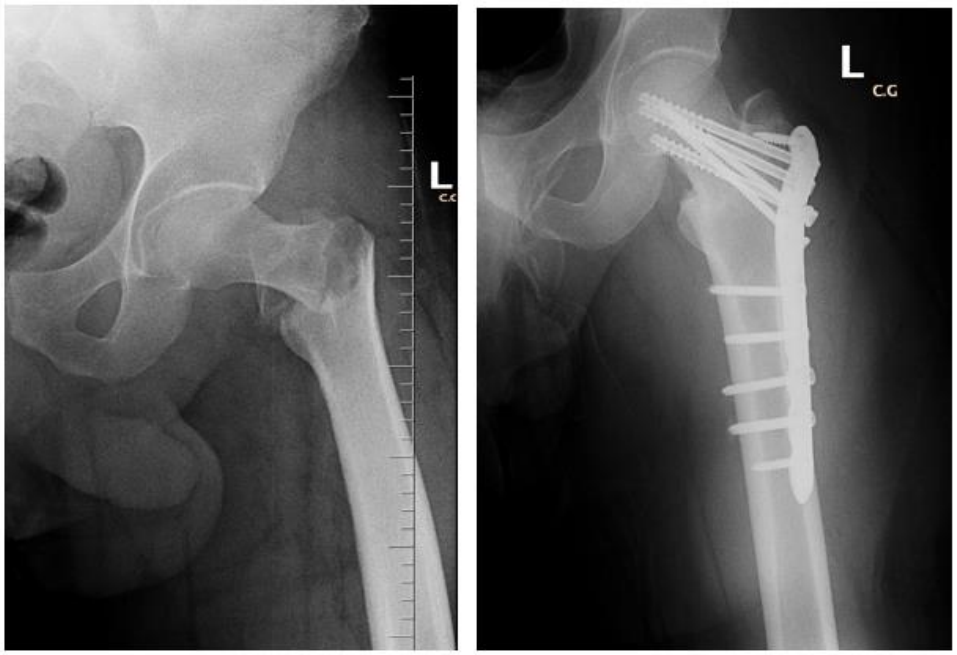
Surgical Technique

All patients were operated on using the same surgical technique and incision as a lateral longitudinal incision (17). The operations were performed under general or regional anesthesia in the supine position. Firstly, interfragmentary fixation was made if needed, followed by traction and reduction, and an anatomical plate was placed. Fixation was achieved with 3 cancellous screws proximally and cortical screws distally. The pre and post operative images of the surgery are given in Figure 1.

Radiologic Evaluation

Postoperative collodiaphyseal angle (CDA), articulotrochanteric distance (ATD), and limb length discrepancy were measured. Lequesne scoring was used for functional evaluation. The change in CDA value was calculated as a proportional (%) change compared to the contralateral healthy hip. ATD measurements were measured as a proportional (%) change relative to the healthy side to ensure standardization between radiographs.

Figure 1. Pre and post op Xr's of fracture treated with proximal femoral anatomical plate (PFAP)



Statistical Analysis

Data analysis was performed with the IBM SPSS Statistics 11.5 (IBM Corporation, Armonk, NY, USA) package program. The Spearman Correlation Test was used to evaluate whether the proportional changes of ATD and CDA were linearly related to fracture classification and Lequesne score. For $p<0.05$, the results were considered statistically significant.

Results

In all patients, union was achieved in an average of 4.1 months, with the earliest being 2.5 months and the latest being 5 months. A mean shortness of 1.15 cm (range 0–4 cm) was detected. The difference in ATD after the union was only 4% when compared to the normal side. The CDA difference was 7%. In other words, we achieved recovery without significant loss or shortening in ATD and CDA values in our patients, most of whom were unstable (75%). The mean Lequesne score was 4.53 ±3.06 points (range 0–11) (Table 1). There was no risk of osteoarthritis in 3 of the patients, mild risk in 8, moderate risk in 6, severe risk in 2 and very serious risk in 1 patient. Considering the mean score, a mild risk result was found.

Table 1. Radiologic results of all patients

	Mean value
Normal Hip CDA	131 ± 5.63
Operated Hip CDA	122 ± 10.08
Operated Hip CDA Difference (%)	7%
Operated Hip ATD Difference (%)	4%
Follow-up time (month)	22.75 ± 9.71
Limb Length Discrepancy (cm)	1.15 ± 1.18
Lequesne Score	4.53 ± 3.06

CDA: Collodiaphyseal angle; ATD: Articulotrochanteric distance.

Discussion

In our study, we found that patients who underwent PFAP due to trochanteric fractures had a slight risk of hip osteoarthritis. As the fracture became unstable, ATD and CDA values varied correlatively. The reduction quality of fixation with the proximal femoral plate was evaluated by ATD and CDA measurements. In this way, a relationship was established between anatomical reduction and OA. Rotem et al. reported that trochanteric extracapsular fractures were associated with high-grade hip osteoarthritis according to Tönnis staging (18). Kumar et al., in their series, showed posttraumatic osteoarthritis as the second most common indication for total hip replacement (19). Moreover, Tetsunaga et al., in their retrospective study of cases of total hip replacement planned as a salvage treatment for osteoarthritis developing after trochanteric region fractures, reported false femoral anteversion and a high risk of surgical complications in these patients (20). Stibolt et al. conducted a meta-analysis study involving 448 patients. They showed that these patients are at higher risk for heterotopic ossification, implant loosening, and infection (21).

Therefore, in the treatment of fractures in this region, it is very important to minimize the risk of post-traumatic osteoarthritis that may develop in the future and the need for secondary surgery. There are many articles in which implants used in the surgical treatment of fractures in this region are compared with each other in terms of surgical time, blood loss, amount of incision, and early mobilization. Oliver et al. stated that intramedullary implants have a higher risk of complications compared to extramedullary implants, but Garg et al. compared the results of 42 patients with trochanteric fractures who had PFN and 39 patients who had DHS, and stated that the intramedullary implant group gave superior results (22,23). Jacob et al. recommend a dynamic hip screw for all extracapsular fractures (24). In their biomechanical study on cadavers, Zderic et al. showed that fractures were reduced anatomically and plates with properly placed proximal screws provided significantly higher stability (25). Contrary to the authors who stated that there was no implant failure after the fixation of trochanteric region fractures with PFAP (9,10), there are also authors who argue that failure is seen at a very high rate (37–41%) (26,27). Implant failure rates related to DHS and PFN have also been reported to be highly variable, ranging from 1.5–56% (28,29).

In their comparative study with finite element analysis and biomechanical tests, Öken et al. showed that proximal femur anatomical plates create optimal loading at the fracture line and the entire proximal femur and give very similar results to PFN in terms of biomechanical properties (30). We could not find a study comparing the risk of PTOA development. We did not encounter implant failure and nonunion in our case series.

This research had several limitations. First, the impact of lifestyle, employment, and intrinsic muscle conditions on hip degeneration coluld not be assessed in this retrospective study. Second, this study's sample size was relatively small. The duration of the study was brief. This was a retrospective cross-sectional study with no longitudinal information. Only prospective longitudinal analyses can truly identify these relations.

Conclusion

Considering that implant failure increases the risk of osteoarthritis threefold (11), we think that the association of PFAP application, which allows open reduction and anatomical fixation, with a low risk of osteoarthritis is compatible with the literature.

Conflict of Interest: The authors declare that there is no conflict of interest.

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References

1. Haidukewych GJ. Intertrochanteric fractures: ten tips to improve results. JBJS. 2009;91(3):712-719.

2. Weiss RJ, Montgomery SM, Al Dabbagh Z, Jansson KA. National data of 6409 Swedish inpatients with femoral shaft fractures: stable incidence between 1998 and 2004. Injury. 2009;40(3):304-308.

3. Socci AR, Casemyr NE, Leslie MP, Baumgaertner MR. Implant options for the treatment of intertrochanteric fractures of the hip: rationale, evidence, and recommendations. The bone & joint journal, 2017;99(1):128-133.

4. Ma KL, Wang X, Luan FJ, Xu HT, Fang Y, Min J, et al. Proximal femoral nails antirotation, Gamma nails, and dynamic hip screws for fixation of intertrochanteric fractures of femur: A meta-analysis. Orthop Traumatol Surg Res. 2014;100(8):859-66.

5. Gotfried Y. The lateral trochanteric wall: a key element in the reconstruction of unstable pertrochanteric hip fractures. Clin Orthop Relat Res. 2004;425:82–86.

6. 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):644-650.

7. Polat G, Akgül T, Ekinci M, Bayram S. A biomechanical comparison of three fixation techniques in osteoporotic reverse oblique intertrochanteric femur fracture with fragmented lateral cortex. Eur J Trauma Emerg Surg. 2019;45(3):499-505

8. Amin RM, Hasenboehler EA, Shafiq B. Post-traumatic Arthritis of the Proximal Femur. In Post-Traumatic Arthritis. 2021;135-151. Springer, Cham.

9. Brown TD, Johnston RC, Saltzman CL, Marsh JL, Buckwalter JA. Posttraumatic osteoarthritis: a first estimate of incidence, prevalence, and burden of disease. Journal of orthopaedic trauma. 2006;20(10):739-744.

10. Khurana S, Nobel TB. Merkow JS, Walsh M, Egol KA. Am J Orthop. 2015;44(7):321-325.

11. Gallagher CA, Jones CW, Kimmel L, Wylde C, Osbrough A, Bulsara M, Hird K, Yates P. Osteoarthritis is associated with increased failure of proximal femoral fracture fixation. Int Orthop. 2019;43(5):1223-1230.

12. Ehlinger M, Favreau H, Eichler D, Adam P, Bonnomet F. Early mechanical complications following fixation of proximal femur fractures: From prevention to treatment. Orthop Traumatol Surg Res. 2020;106(1):79-87.

13. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane database of systematic reviews, 2010;9.

14. Zeng C, Wang YR, Wei J, Gao SG, Zhang FJ, Sun ZQ, et al. Treatment of trochanteric fractures with proximal femoral nail antirotation or dynamic hip screw systems: a meta-analysis. J Int Med Res 2012;40:839–51.

15. Schipper IB, Steyerberg EW, Castelien RM, van des Heijden M, den Hoed PT, Kerver AJH, et al. Treatment of unstable trochanteric fractures. J Bone Joint J Br 2004;86:86–94

16. Lequesne MG, Mery C, Samson M, Gerard P. Indexes of severity for osteoarthritis of the hip and knee. Validation--value in comparison with other assessment tests [published correction appears in Scand J Rheumatol 1988;17(3):following 241] [published correction appears in Scand J Rheumatol Suppl 1988;73:1]. Scand J Rheumatol Suppl. 1987;65:85-89.

17. Lee WT, Murphy D, Kagda FH, Thambiah J. Proximal femoral locking compression plate for proximal femoral fractures. J Orthop Surg (Hong Kong). 2014;22(3):287-293.

18. Rotem G, Sharfman ZT, Rath E, Gold A, Rachevsky G, Steinberg E, Drexler M, Haviv B, Amar E. Does hip morphology correlate with proximal femoral fracture type? Hip Int. 2020;30(5):629-634.

19. Kumar P, Sen RK, Aggarwal S, Jindal K. Common hip conditions requiring primary total hip arthroplasty and comparison of their post-operative functional outcomes. J Clin Orthop Trauma. 2020;11(2):192-195.

20. Tetsunaga T, Fujiwara K, Endo H, Noda T, Tetsunaga T, Sato T, Shiota N, Ozaki T. Total hip arthroplasty after failed treatment of proximal femur fracture. Arch Orthop Trauma Surg. 2017;137(3):417-424.

21. Stibolt RD Jr, Patel HA, Huntley SR, Lehtonen EJ, Shah AB, Naranje SM. Total hip arthroplasty for posttraumatic osteoarthritis following acetabular fracture: A systematic review of characteristics, outcomes, and complications. Chin J Traumatol. 2018;21(3):176-181.

22. Oliver D, Griffiths R, Roche J, Sahota O. Hip fracture. BMJ Clin Evid. 2010.

23. Garg B, Marimuthu K, Kumar V, Malhotra R, Kotwal PP. Outcome of short proximal femoral nail antirotation and dynamic hip screw for fixation of unstable trochanteric fractures. A randomised

prospective comparative trial. Hip Int. 2011;21(5):531-6

24. Jacob J, Desai A, Trompeter A. Decision Making in the Management of Extracapsular Fractures of the Proximal Femur - is the Dynamic Hip Screw the Prevailing Gold Standard? Open Orthop J. 2017;11:1213-1217.

25. Zderic I, Oh JK, Stoffel K, Sommer C, Helfen T, Camino G, Richards G, Nork SE, Gueorguiev B. Biomechanical Analysis of the Proximal Femoral Locking Compression Plate: Do Quality of Reduction and Screw Orientation Influence Construct Stability? J Orthop Trauma. 2018;32(2):67-74.

26. Streubel PN, Moustoukas MJ, Obremskey WT. Mechanical failure after locking plate fixation of unstable intertrochanteric femur fractures. J Orthop Trauma. 2013;27(1):22-8.

27. Johnson B, Stevenson J, Chamma R, Patel A, Rhee SJ, Lever C, Starks I, Roberts PJ. Short-term follow-up of pertrochanteric fractures treated using the proximal femoral locking plate. J Orthop Trauma. 2014;28(5):283-7.

28. Jones HW, Johnston P, Parker M. Are short femoral nails superior to the sliding hip screw? A meta-analysis of 24 studies involving 3,279 fractures. Int Orthop. 2006;30:69–78.

29. Whale C, Hulet D, Beebe M, Rothberg D, Zhang C, Presson A, Stuart A, Kubiak E. Cephalomedullary nail versus sliding hip screw for fixation of AO 31 A1/2 intertrochanteric femoral fracture. Curr Orthop Pract. 2016;27:604–613.

30. Oken OF, Soydan Z, Yildirim AO, Gulcek M, Ozlu K, Ucaner A. Performance of modified anatomic plates is comparable to proximal femoral nail, dynamic hip screw and anatomic plates: finite element and biomechanical testing. Injury. 2011;42(10):1077-83.