DOI: https://doi.org/10.53350/pjmhs20221612304

ORIGINAL ARTICLE

Functional Outcome of Tip Apex Distance in Predicting Implant Failure in Intertrochanteric Fracture Femur Treated with Dynamic Hip Screw

HAFIZ UMAIR HUSSAIN[1], AHMAD JAMAL[2], MANZOOR HUSSAIN[3], MUHAMMAD ISHFAQ[4], MUHAMMAD MAHMOOD AHMAD[5], MUHAMMAD KAMRAN SIDDIQUI[6]

[1]MBBS, FCPS, Medical Officer of Orthopaedic Dept. Nishtar Hospital University, Multan
[2]MBBS, FCPS, Senior Registrar of Orthopaedic Dept. Nishtar Hospital University, Multan
[3]MBBS, FCPS Medical Officer of Orthopaedic Dept. Nishtar Hospital University, Multan
[4]MBBS, FCPS, Senior Registrar of Orthopaedic Dept. Nishtar Hospital University, Multan
[5]MBBS, FCPS, Medical Officer of Orthopaedic Dept. Nishtar Hospital University, Multan
[6]MBBS, FCPS, FRCS, Professor of Orthopaedic Dept. Nishtar Hospital University, Multan
Corresponding to: Dr. Hafiz Umair Hussain, Email: umairortho2012@gmail.com, Cell: 0336 1118787

ABSTRACT

Objective: To evaluate the importance of tip apex distance in implant failure in intertrochanteric fracture femur treated with Dynamic hip screw, so that optimum tip apex distance should maintain to decrease the implant failure in intertrochanteric fracture femur treated with DHS.

Study Design: It was a descriptive cross sectional study.

Study Setting and Duration: Patients were selected from orthopedic unit of Nishtar Hospital, Multan, from July 2020 to June 2021.

Methodology: All patients meeting the inclusion criteria who presented with a femur fracture were included in the analysis. SPSS version 24.0 was used to analyse the data. Quantitative data analysis was done using means and standard deviations like age and tip apex distance. Categorical variables like gender, functional outcome and implant failure was calculated and presented as frequency and percentage.

Results: A total of 81 patients with mean age of male patients were 38.51 and SD was 11.79, similarly in female patients mean age was 41.87 and SD 11.60. Mean tip apex distance in male was 16.08 and SD 8.49, in female mean tip apex distance was 15.40 and SD 9.368. Tip Apex distance was ≤ 25 cm in 61 (75.3%) patients and >25 cm in 12 (24.7%) patients. As concern to the outcome variable (implant failure) 12 (14.8%) patients were having implant failure and 69 (85.2%) patients were having successful outcomes.

Practical implication: The use of Dynamic Hip Screw in Intertrochanteric Fracture Femur treated would show improved clinical results and fewer hardware failures

Conclusion: Tip Apex distance is a valuable measurement in dynamic hip screw fixation of Intertrochanteric fracture femur.

Keywords: Fracture, Femur, Tip Apex Distance, Dynamic Hip Screw, Implant Failure, Orthopedic

INTRODUCTION

Elderly adults, particularly those living in Europe, are prone to low-energy intertrochanteric femur fractures.[1] Due to rising life expectancy, international travel, and the development of diagnostic modalities including digital radiography, computed tomography, magnetic resonance imaging, and radionuclide (DEXA) scanning, the disease's prevalence is also rising in Asia and other emerging countries.[2] When the medial wall of the lesser trochanter is still intact following an intertrochanteric fracture, the dynamic hip screw (DHS) is the most common and effective method of treatment.[3,4]

Since the 1960s, dynamic hip screw management has been considered the gold standard for treating femoral intertrochanteric fractures. Some alternative surgical techniques and latest devices are available but DHS is still most successful and frequent technique.[5] Deep insertion of implant, impaction and compression are main advantages of DHS, but in cases of unstable fracture it is still a challenge for surgeons. TAD can be measured on AP and lateral views by screw length (from its tip to the top of the femoral head) plus screw diameter (in millimetres).[6,7]

This procedure allows the slide of screw within barrel that leads to the compression at fracture site during weight bearing.[8,9] In previous published literature DHS failure was reported up to 13%, but in recent studies this ratio decreased to 6.8% gradually. In 1995 1st time describe the concept of Tip Apex Distance in management of intertrochanteric fracture management which was accepted as good marker for procedure in 1997.[10] It was recommended that TAD should be < 25 mm to prevent the implant failure or DHS cut out which is common if screw position is away from tip of head of femur.[9,10]

To the best of our knowledge there is dearth of local published literature on this topic. The objective of this study is to highlight the therapeutic efficacy of the tip apex distance as an important predictors of cut-out of the lag screw that was used for the purpose of stabilizing an unstable fracture of the intertrochanteric region of the hip. Consequently, this research might be useful in establishing prevention and treatment measures.

METHODOLOGY

Study Design: Descriptive case Series study.

Study Setting: Orthopedic unit of Nishtar Hospital, Multan

Duration: 1 Year from July 2020 to June 2021

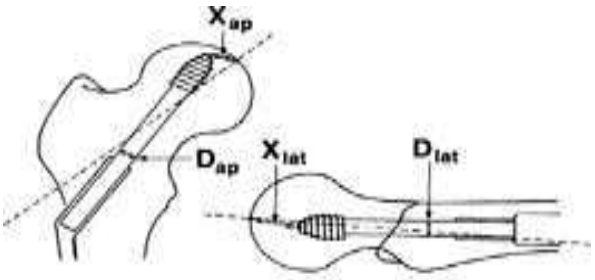
Sample Size: By using WHO sample size calculator, sample of 81 is calculated at confidence level 95%, power of the study 80% margin of error 5%.

Inclusion Criteria: Patients of age 20 – 60 years, both genders, intertrochanteric fracture and treated with DHS were enrolled

Exclusion Criteria: Patients having fractures treated conservatively (without surgery), basic cervical or sub trochanteric fractures (detected on X-Ray) and transverse fractures at the level of the lesser trochanter were excluded from the study.

Methodology: This descriptive case series study was conducted at department of Orthopaedic Nishtar Hospital, Multan in one year duration from July 2020 to June 2021. The study's conduct was sanctioned by the hospital's ethics committee. Patients gave their written consent after being fully informed of the risks and benefits of the study. Data was coded with study ID numbers to remove bias. Same surgeon performed all surgeries.

Antibiotic and deep vein thrombosis prophylaxis was given pre-operatively. Patients were shifted to Operation Theater with two large bore intravenous lines on dorsal sides of hands. Whole surgical procedure in all patients was performed by the same team of surgeons under spinal anesthesia. Researcher was the part of surgical team in all cases. After completion surgery patients were shifted to recovery room. Patients were discharged at 2nd post operative day and advised for follow up to three months. On every follow up visit mobility level of patients was assessed and recorded. Radiographic outcomes diameter, correction angle and TAD was measured. As end points, the radiographs were evaluated for union, nonunion, and screw cutout.



$$TAD = \left(X_{ap} \times \frac{D_{true}}{D_{ap}}\right) + \left(X_{lat} \times \frac{D_{true}}{D_{lat}}\right)$$

All patients meeting the inclusion criteria who presented with a femur fracture were included in the analysis. SPSS version 24.0 was used to analyse the data. Quantitative data analysis using means and standard deviations like age and tip apex distance. Effect modifiers such as gender and age were controlled by stratification taking P value <0.05 as significant.

RESULTS

A total of 81 patients included in the study, in this study mean age of male patients were 38.51 and SD was 11.79, similarly in female patients mean age was 41.87 and SD 11.60. As concern to the gender 51 (63%) were male and 30 (37%) were female. Mean duration of fracture in male patients was 3.22 and SD 1.94, in female mean duration was 3.73 and SD 2.363. Mean tip apex distance in male was 16.08 and SD 8.49, in female mean tip apex distance was 15.40 and SD 9.368 (Table-1).

Tip Apex distance was ≤ 25 cm in 61 (75.3%) patients and >25 cm in 12 (24.7%) patients. As concern to the outcome variable (implant failure) 12 (14.8%) patients were having implant failure and 69 (85.2%) patients were having successful outcomes (Table-2). When compared to fractures with poor reduction and a cutoff percentage of 55.56 percent, all fractures with good reduction had a superior prognosis.

Table-1: Demographics

Characteristics	Mean ±SD
Age of patients	39.75 ± 11.766
Male	51 (63.0%)
Female	30 (37%)
Duration of fracture	3.41 ± 2.108
Tip Apex Distance	15.83 ± 8.773
Implant Failure	12 (14.8%)

Table-2: Association of Implant failure with Tip Apex Distance

Implant Failure	Tip Apex Distance		P Value
	≤ 25 cm	≥25 cm	0.000
Yes	3	9	
No	58	11	

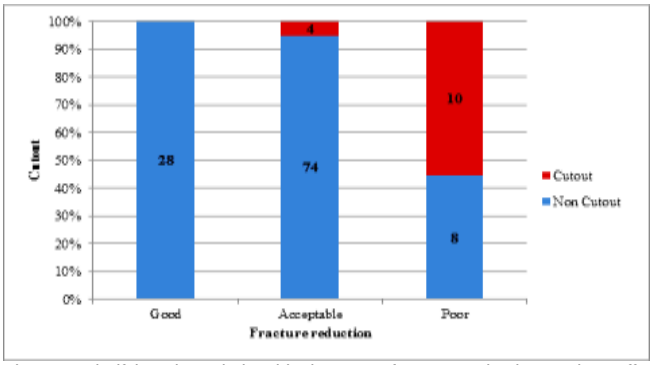


Figure I: clarifying the relationship between fracture reduction and cutoff frequency.

Figure II: In a case of TAD > 25mm, a radiograph depicts a screw cutout

DISCUSSION

In these days, there is no clear suggestion regarding tip apex distance measurements and implant failure of DHS. In a study Firas et al[11] reported that TAD is a predictor of good and bad outcomes and implant failure of femoral intertrochanteric fracture managed with dynamic hip screw technique. In his study 71.4% of patients were having TAD <25 mm but implant failure was observed in only 1 patient.

Baumgaertneret al[12] concluded that increase in TAD is associated with increase rate of cut out. Similarly, Parker et al concluded that cut out is more frequent in in cases with >25 mm TAD either seen on superior, posterior, anteroposterior or lateral radiographs. Cut out incidence is decreased from 13% to 6.8% in recent years.

Hsueh et al[14] conducted a study on 937 patients and concluded that tip apex distance is a strong predictor of implant cut out, 6.8% of patients of his study found with cut out. He also suggested that fracture pattern is also contributing factor. In another study Guvenet al[15] reported that TAD is an important factor that can predict implant failure in DHS procedure especially intertrochanteric fracture.

Another study conducted by Walton et al[16] reported contrast finding that there was no association between TAD and implant failure of DHS, using DHS there was no effect of TAD. Another similar study was carried out by Geller et al[17] on tip apex distance as predictor of implant failure and concluded that TAD above 25mm is a strong predictor of screw cut out. Out of 46 Intertrochanteric fracture 8.5% patients were having implant failure.

Umair et al[18] conducted a similar study on tip apex distance and concluded that DHS is highly acceptable procedure for this fracture and TAD above 25mm is associated with high implant failure ratio. Sidhu et al[19]conducted a study on this TAD measurement as predictor of implant failure and concluded that TAD above 30mm associated with 36% cut out and TAD above 35mm is associated with 60% cut out. Recent literature on this topic concluded similar finding about TAD and DHS fixation, 25mm or above TAD predict cut through lag screw[20].Many cases of revision surgeries are performed due to increased TAD than 25mm[21].

CONCLUSION

Tip Apex distance is a valuable measurement in dynamic hip screw fixation of Intertrochanteric fracture femur. Tip apex distance >25mm is a strong predictor of implant failure in after dynamic hip screw fixation.

Limitations: Most of patients in our study belongs to remote areas of Punjab Pakistan they didn't allow pictures of procedure and outcomes, they lost their follow up or delay in follow ups are main limitations of our study.

Recommendations: Further studies on large sample size and multicenter analysis required along with awareness programming of early diagnosis and treatment of colorectal carcinoma are recommended.

REFERENCES

1. Mohan G, Anantharaman C, Kathir Azhagan S. Assesment of tip apex distance in intertrochanteric fractures treated with dynamic hip screw. International Journal of Orthopaedics. 2019;5(2):1005-9.
2. Khairy HM, El-Alfy AT, El-Malt AE, Samy RN. Value of Tip-Apex Distance (TAD) in the Fixation of Intertrochanteric Fractures by Dynamic Hip Screw (DHS). Archives of Pharmacy Practice. 2019 Jul 1;1(3):81-6.
3. Aicale R, Maffulli N. Greater rate of cephalic screw mobilisation following proximal femoral nailing in hip fractures with a tip–apex distance (TAD) and a calcar referenced TAD greater than 25 mm. Journal of Orthopaedic Surgery and Research. 2018 Dec;13(1):1-9.
4. Akhtar S, Din SU, Shah FA. Frequency of lag screw cutout after dynamic hip screw fixation of stable intertrochanteric femur fracture by keeping tip apex distance less than 25 milli meter. Pakistan Journal of Medical and Health Sciences. 2018 Apr 1;12(2):844.
5. John B, Sharma A, Mahajan A, Pandey R. Tip-apex distance and other predictors of outcome in cephalomedullary nailing of unstable trochanteric fractures. Journal of clinical orthopaedics and trauma. 2019 Oct 1;10:S88-94.
6. Memon K, Siddiqui AM, Khan ZA, Zahoor A. Dynamic Hip Screw Fixation Vs. Proximal Femur Nail For Unstable Per-Trochanteric Fractures: A Comparative Analysis Of Outcomes And Complications. Journal of Ayub Medical College, Abbottabad: JAMC. 2021 Jan 1;33(1):34-8.
7. Khanna V, Tiwari M. Significance of Tip Apex Distance in Intertrochanteric Fracture femur managed with Proximal femoral nailing. Orthopaedics& Traumatology: Surgery & Research. 2021 Oct 1;107(6):103009.
8. Ebrahimpour A, Karimi A, Sadighi M, Sajjadi M, Okhovatpour MA, Irani A, Zandi R. Correlation between Post-Operation Center-Trochanteric Distance (CTD) and Tip Apex Distance (TAD) changes in Intertrochanteric Fractures Treated by Dynamic Hip Screw. Trauma Monthly. 2019 Nov 1;24(6):32-7.
9. Lee CH, Su KC, Chen KH, Pan CC, Wu YC. Impact of tip–apex distance and femoral head lag screw position on treatment outcomes of unstable intertrochanteric fractures using cephalomedullary nails. Journal of International Medical Research. 2018 Jun;46(6):2128-40.
10. Chen SY, Tuladhar R, Chang SM. Fracture reduction quality is more important than implant choice for stability reconstruction in two-part intertrochanteric femur fractures. Journal of Orthopaedic Trauma. 2020 Jun 1;34(6):e227.
11. Firas A. Tip Apex Distance as a Predicting Factor for the Outcome of Femoral Intertrochanteric Fracture Fixed by Dynamic Hip Screw. IASJ. 2013;12(4):1-5.
12. Baumgaertner MR, Curtin SL, Lindskog DM, Keggi JM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. J Bone Joint Surg. 1995;77:1058-64.
13. Parker MJ. Cutting-out of the dynamic hip screw related to its position. J Bone Joint Surg Br. 1992;74:625.
14. Hsueh KK, Fang CK, Chen CM, Su YP, Wu HF, Chiu FY et al. Risk factors in cutout of sliding hip screw in intertrochanteric fractures: An evaluation of 937 patients. Int Orthop. 2010;34:1273–6.
15. Guven M, Yavuz U, Kadiloglu B, Akman B, Kilincoglu V, Unay K, et al. Importance of screw position in intertrochanteric femoral fractures treated by dynamic hip screw. OrthopTraumatol Surg Res. 2010;96:21–7.
16. Walton NP, Wynn-Jones H, Ward MS, Wimhurst JA. Femoral neck-shaft angle in extra-capsular proximal femoral fracture fixation; does it make a TAD difference? Injury. 2005;36:1361–4.
17. Geller JA, Saifi C, Morrison TA, Macaulay W. Tip-apex distance of intramedullary devices as a predictor of cut-out failure in the treatment of peritrochanteric elderly hip fractures. International orthopaedics. 2010 Jun;34(5):719-22.
18. Umair M. Umair M, Akram R, Ahmed A, Ahmed I, Zaman AU, Ahmed N, Aziz A. Evaluation of tip apex distance in predicting implant failure in stable intertrochanteric fractures of femur managed by dynamic hip screw. Pak J Surg. 2017;33(4):296-300.
19. Sidhu AS, Singh AP, Singh AP, Singh S. Total hip replacement as primary treatment of unstable intertrochanteric fractures in elderly patients. International orthopaedics. 2010 Aug;34(6):789-92.
20. Rubio-Avila J, Madden K, Simunovic N, Bhandari M. Tip to apex distance in femoral intertrochanteric fractures: a systematic review. J OrthopSci 2013;18:592-8.
21. Shah AA, Kumar S,RashidRH,Noordin S, Rehman A. Dynamic hip screw fi xation for inter-trochanteric fractures: determinants of outcomes. JPMA. 2014;64:S-95.