

Tip Apex Distance as a Predicting Factor for the Outcome of Femoral Intertrochanteric Fracture Fixed by Dynamic Hip Screw

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ABSTRACT:

BACKGROUND:

Dynamic hip screw is still one of the most widely used devices for the fixation of femoral intertrochanteric fractures. A recognized complication with this device is the screw cut-out from the femoral head.

OBJECTIVE:

Of this study is to assess if the tip apex distance is a reliable predicting factor for the subsequent lag screw position and so the outcome of femoral intertrochanteric fractures fixed by dynamic hip screws.

Design of the study: Prospective Cohort Study.

PATIENTS AND METHODS:

42 patients (27 female, 15 male), with an average age of 63 years, (ranging from 55 to 72 years), with stable intertrochanteric fractures of the femur treated by dynamic hip screws. All patients were investigated and optimized for surgery. Good and accepted closed reduction was done under fluoroscopic control with the use of orthopedic table. Dynamic hip screws were inserted by a standard technique. Tip apex distance for every case was measured by immediate postoperative plain x-ray. Patients were reviewed clinically and radiologically on 2nd, 6th, 12th, and 24th weeks.

Setting: department of orthopedic-medical city complex and private job.

RESULTS:

There were 30 cases (71.4 %) with tip apex distance below 25 millimeters. Only 1 case of them ended with mechanical failure. And there were 12 cases (28.6 %) with tip apex distance more than 25 millimeters. 5 cases out of these 12 cases ended with mechanical failure. So the mechanical failure represented 41.7 % when the tip apex distance was more than 25 millimeters while it was 3.3 % when the tip apex distance was below 25 millimeters. The two-tailed P value equals 0.0047

CONCLUSION:

It is concluded that the tip apex distance is a strong predicting factor for the mechanical failure of stable intertrochanteric fracture of the femur fixed by dynamic hip screw.

KEY WORDS: dynamic hip screw, tip apex distance, femoral intertrochanteric fracture.

INTRODUCTION:

Hip fracture is the second most common cause of hospitalization for elderly patients⁽¹⁾. Intertrochanteric fracture is common in elderly population, 90 % of intertrochanteric fractures in the elderly patients result from a simple fall⁽²⁾ and is a considerable burden to the health care system through their association with increased mortality and morbidity⁽³⁾.

The goal of treating hip fracture is to return patients to their pre fracture level of function

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without long-term disability and avoiding medical complications⁽⁴⁾.

Although many devices can achieve rigid fixation, the dynamic hip screw is most commonly used device for intertrochanteric fractures^(5, 6,7).

Dynamic hip screw utilizes controlled impaction during weight bearing to stabilize the fracture, thus facilitating healing⁽⁸⁾.

Despite been a highly successful device, it has a rate of mechanical failure which has been reported between 16 and 23 %^(9,10,11).

The usual mechanism of failure has been the

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collapse of the neck-shaft angle into varus leading to extrusion or so called cut-out of the screw from the femoral head. Many factors have been identified as causes for its mechanical failure including quality of bone, patient age, fracture pattern, adequate fracture reduction and lag screw position⁽⁹⁾.

The ideal position for a lag screw in both planes is deep and central in the femoral head within 10 mm of the subchondral bone⁽¹²⁾.

Tip apex distance measurement is a simple technique which describes the placement of the lag screw within the femoral head. With this measurement a single number is generated to summarize the position and depth of the lag screw on both the anteroposterior and lateral radiographs⁽⁹⁾.

The purpose of this study is to emphasize the clinical usefulness of the tip apex distance as a reliable predictor of cut-out of the lag screw used for fixation of stable intertrochanteric fracture of the hip.

PATIENTS AND METHODS:

This study was carried out on 42 patients (27 female and 15 male) with an average age of 63.9 years (ranging from 55 to 72 years) who have attended the surgical emergency department or out-patient clinic in Medical City- orthopedic and trauma consultation unit and private job, during the period from Feb.2010 till Feb. 2012 and they had stable intertrochanteric fractures of the hip.

Mechanism of injuries were fall on the ground (mainly) and road traffic accidents.

Fracture patterns were classified according to the systems of Muller et al and of Evans as modified by Kyle, Gustilo and Premer,⁽¹³⁾ and considered as stable (type 1 and 2) or unstable (type 3 and 4).

Only stable fractures were included in this study. After investigating and optimizing the patients for surgery, they were admitted to the operating theatre and good and acceptable reduction of the

The radiographs were assessed for union, nonunion and screw cutout as end points.

displaced fractures were done by orthopedic table under fluoroscopic control(under General or spinal anesthesia).

Reduction was assessed on the amount of displacement and neck shaft alignment on immediate postoperative anteroposterior and lateral radiographs being categorized as =

A good reduction had normal or slightly valgus neck shaft alignment on anteroposterior radiograph, less than 20 degrees of angulations on lateral radiograph and displacement of less than 4 millimeters on either view.

Acceptable reductions met the requirements as regards alignment or displacement but not both.

Poor reductions met neither criteria.

Only good and acceptable reductions were included in this study. A 135 angled dynamic hip screws were inserted to fix the fractures.

Then immediate postoperative plain x-ray both anteroposterior and lateral views were taken, and Tip Apex Distance were measured.

Tip Apex Distance is defined as (the sum of the distance in millimeters from the tip of the lag screw to the apex of the femoral head as measured on an anteroposterior radiograph and that distance as measured on a lateral radiograph after correction has been made for magnification)⁽⁹⁾.

The Apex of the femoral head is defined as the point of intersection between the subchondral bone and a line in the centre of and parallel to the femoral neck.

The amount of radiographic magnification was determined precisely by dividing the diameter of the projected shaft of the screw as seen on the radiograph by its known diameter and correction was achieved by multiplying the measurement of the distance by this factor (figure 1)⁽¹⁴⁾.

The patients were followed clinically and radiologically at 2nd, 6th, 12th and 24th weeks postoperatively.

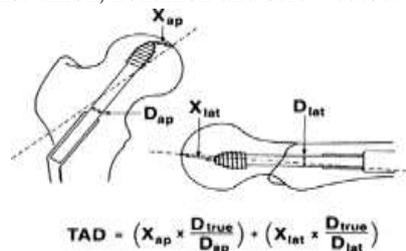


Figure 1:⁽¹⁴⁾ The real diameter of the shaft of our lag screw is = 8 millimeters.

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RESULTS :

After exclusion of 9 cases (6 due to poor reduction , 1 was ended with infected nonunion and 2 were lost during follow up) 42 patients were included in this study, 27 (64.28%) female

and 15 (35.71%) male patients with an average age of 63.9 years , ranging from 55 to 72 years.

Table 1:

Tip Apex Distance in millimeters		Number of cases	Total	Cut-out	Total
≤ 15	≤ 25	9	30	0	1
16–25		21		1	
26 – 35	> 25	9	12	3	5
>35		3		2	

* < means less than, > means more than, ≤ means less than or equals to, ≥ means more than or equals to.

There were 30 cases with Tip Apex Distance ≤ 25 millimeters representing 71.4% of the total number of cases (9 cases were with Tip Apex Distance ≤ 15 millimeters and 21 cases were with Tip Apex Distance between 16 – 25 millimeters).

Only 1 case out of these 30 cases (3.3 %) ended with cut out of the lag screw (mechanical failure).

There were 12 cases with TAD > 25 mm representing 28.6 % of the total number of cases

(9 cases were with TAD between 26 and 35 mm and 3 cases were with TAD > 35 mm).

There were 5 cases out of these 12 cases (41.7 %) ended with cut-out of the lag screw (mechanical failure), 3 cases were with TAD between 26 and 35 mm and 2 cases were with TAD > 35 mm.

A total of 6 cases out of 42 cases (14.3 %) ended with mechanical failure, 5 cases out of these 6 cases were with TAD > 25 mm and they required revision surgery.(table 1).

Table 2:Tip Apex Distance(TAD).

Mechanical failure	≤ 25	>25	Total
No	29	7	36
Yes	1	5	6

Fisher's exact test was performed because 2 cells (50.0%) have expected count less than 5. The two-tailed P value equals 0.0047. (Table 2).

The association between tip apex distance and mechanical failure is considered to be very statistically significant.

DISCUSSION:

Proximal femoral fractures are common in the elderly and frequency is increasing with more ageing population^(15,16).

Early operative treatment reduces both mortality and morbidity, giving the best chances of early independence and reducing the risk of prolonged bed rest⁽¹⁷⁾.

Meta-analysis has suggested that the dynamic hip screw should be favored for the treatment of pertrochanteric fractures^(18,19).

The importance of the position of the screw within the femoral head has been recognized

since the earliest reports of clinical results associated with the use of the dynamic hip screw. Shumpelick and Jantzen concluded from their review of the results for the first 28 fractures that they had treated with this device, that the screw should run along the inferior portion of the femoral head, remain low in the head and appear well centered on the lateral radiograph and that the tip of the screw should be 3 to 5 millimeters from the articular surface. Clawson recommended deep placement to within 6 millimeters of the subchondral bone. Neither of these reports included data on variance of the position of the implant to support the author's recommendations⁽⁹⁾.

Trigkilidas, Murphy and Wallace study⁽¹⁴⁾, showed that a large proportion of the trainees were not familiar with the TAD principle, many thought that the screw position should be inferior

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in the anteroposterior radiograph and posterior in the lateral radiograph aiming for better bone stock in the femoral head, however by positioning the screw inferiorly and posteriorly, the tip of the screw ended in more cancellous bone and not in the preferred subchondral bone which is shown to lead to failure of the implant. Others preferred to accept a suboptimal screw position, in order to save operative time, claiming that dynamic hip screw is a forgiving device and not significantly affected by screw position⁽¹⁴⁾.

The results of this study raised awareness, emphasized and reproduced the importance of the TAD being ≤ 25 mm during fixation of these fractures by DHS.

Interestingly there was 1 dynamic hip screw which cut-out, although its TAD was < 25 mm. this can be explained as there are other factors that can affect the failure of this device such as quality of bone and patient's age, this patient was 71 years old, with osteoporosis.

The mechanical failure rate in this study was 14.3 % which is below the reported mechanical failure rate for this device (16 – 23%)⁽⁹⁾, this was happened may be due to inclusion of only stable fractures in this study, as well as exclusion of cases with poor reduction from this study.

CONCLUSION AND RECOMMENDATIONS:

It was concluded that TAD is a strong reliable predicting factor for the outcome and mechanical successfulness of the DHS.

We recommend that this TAD principle is emphasized and regularly reinforced to all orthopedic trainees in order to improve the outcome of intertrochanteric fractures of the hip that are fixed by DHS, and so the safety and quality of life for those patients.

REFERENCES:

1. Beaupre LA, Jones CA, Saunders LD, Johnson DWC, Buckingham J, Majumdar SR. Best practices for elderly hip fractures patients: a systemic overview of the evidence. *J Gen Intern Med* 2005;20:1019-25.
2. Koval JK, Cantu RV, Intertrochanteric fractures in :Bucholz RW, Heckman JD, Court-Brown CM, editor. Rockwood and Green fracture in adults 6th ed. Philadelphia Lippincott Williams and Wilkins 2006:1793-825.
3. Kanis J, Borgstrom F, Delaet C, Johnsson H, Johnell O, Jonsson B, et al. Assessment of fracture risk. *Osteoporos Int* 2005;16:581-89.
4. Iavelle DG. Fractures and dislocations of the hip. In: Canale ST, Beaty JH, editor. *Campbell's operative orthopaedics*. 11th ed. Philadelphia: Mosby 2008:3237-8.
5. Alobaid A, Harry EJ, Elder GM. prospective randomized trial of two techniques of insertion of a standard dynamic fixation device. *J orthop Trauma* 2004;18:207-12.
6. Bolhofner B, Russo P, Carmen B. Results of intertrochanteric femur fractures treated with a 135-degree sliding screw with a two-hole side plate. *J ortho Trauma* 1999;13:5-8.
7. Mcloughlin S, Wheeler D, Rider J. Biomechanical evaluation of the dynamic hip screw with two-and four- hole side plates. *J orthop Trauma* 2000;14:318-23.
8. Moroni A, Faldini C, Pegreff F, Kim AH, Vannini S. Dynamic hip screw compared with external fixation for treatment of osteoporotic peritrochanteric fractures: A prospective randomized study. *J Bone Joint Surg Am* 2005;87:753-59.
9. 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 Am*; 1995; 77-A :1058-64.
10. Simpson, A.H; Varty, K.; and Dodd, C.A.: Sliding hip screws: modes of failure: *Injury*. 20: 227-231. 1989.
11. Wolfgang, G.L; Bryant, M.H.; and O'Neill, J.P: Treatment of Intertrochanteric fracture of the femur using sliding screw plate fixation. *Clin. orthop*, 1982;163:148-58..
12. Haidukewych GJ: intertrochanteric fractures: Ten Tips to improve results. *J Bone Joint Surg Am*; 2009; 91:712-19.
13. Kyle RF, Gustilo RB, Premer RF. Analysis of six hundred and twenty-two intertrochanteric hip fractures: a retrospective and prospective study. *J Bone Joint Surg Am*; 1979;61-A: 216-21.
14. D. Trigkilidas, G. Murphy, D. Wallace: Tip to apex distance in DHS fixation. An audit of practice at a district general hospital. *The internet Journal of orthopedic surgery*. 2010;16.
15. Wallace WA. The increasing incidence of fractures of proximal femur: an orthopedic epidemic. *Lancet* 1983;I 1413-14.

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16. Rockwood PR, Home JG, Cryer C. Hip fracture: a future epidemic?. *Orthop Trauma* 1990;4:388-93.
17. Leung KS, SO WS, Shen WY, Hui PW. Gamma nail and dynamic hip screw for peritrochanteric fractures. A randomized prospective study in elderly patients. *J Bone Joint Surg* 1992;73-B :345-51.
18. Parker MJ, Handoll HHG, Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures. *Cochrane Musculoskeletal injuries Group Cochrane Database of Systemic Reviews*. 2003;3.
19. Parker MJ, Pryor GA. Gamma nailing versus dynamic hip screw for extracapsular femoral fracture: a meta-analysis of 10 randomized trials. *Int Orthop* 1996;20:163-68.