

EFFECT OF TIP APEX DISTANCE IN DYNAMIC HIP SCREW FIXATION OF INTERTROCHANTERIC FRACTURE OF FEMUR

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ABSTRACT

Background: Intertrochanteric fractures are the most common type of fractures requiring surgical interventions. They also have high value of surgical mortality and morbidity among surgical procedure. Among the many different techniques used for fixation of this type of fracture, use of the Dynamic Hip Screw (DHS) has gained wide acceptance. Tip Apex Distance (TAD) concept has a great impact on the result of fixation and can exactly predict the survival or failure of the screw. TAD is the distance from the screw tip to the apex of the femoral head on AP and lateral views. TAD should be below 25mm in order to prevent DHS cut-out or failure, which most often happens if the screw is placed too superior or too anterior. **Materials and Methods:** This is a retrospective cohort study including 30 cases who were skeletally mature patients with post-traumatic intertrochanteric fractures treated with DHS in the period from February 2024 to January 2025 with a follow up of at least 6 months in the Department of orthopedics, Darbhanga medical college Laheriasarai, Darbhanga, Bihar. The ITFs were internally fixated with DHS and postoperative follow-up. We measured the TAD postoperatively and after 6 months to detect the importance of TAD in the stability of lag screw in the head and neck of femur and reported cases that developed cut-through the lag screw. **Result:** TAD is a crucial parameter in the placement of DHS implants, reflecting the positioning of the lag screw within the femoral head and neck. The incidence of screw cut-off in the present study was 21%. In our study majority of patients with intertrochanteric fractures were above 50 years of age with mean age of 60.6 ± 7.3 years. The quality of reduction observed in intertrochanteric fractures categorized by the presence of cut-through phenomenon during dynamic hip screw (DHS) fixation. The study classified reductions into three categories: Good, Acceptable, and Poor. Among cases where cut-through occurred (Yes, $n=10$), only 25% achieved a Good reduction, while 75% resulted in a Poor reduction. **Conclusion:** TAD of less 25mm is safe and more than 25mm may result in the penetration of implant, non-union, cut-through, and other complications. Therefore, TAD is a reliable factor and has great value in DHS operations.

INTRODUCTION

Intertrochanteric fractures are the most common type of fractures requiring surgical interventions. They also have high value of surgical mortality and morbidity among surgical procedure. Among the many different techniques used for fixation of this type of fracture, use of the Dynamic Hip Screw (DHS) has gained wide acceptance.^[1]

The DHS is on the basis of the tension band principle and allows the screw to slide in the barrel in order to

enable the fracture compression when the patient starts to bear weight. This principle works only in the presence of the intact medial wall and therefore cannot be successful in a reverse oblique fracture of the proximal femur.^[2]

Nevertheless, it is crucial that the screw placement technique is accurate and should be central in the femoral neck, on both lateral and AP radiographs. That is why the Tip Apex Distance (TAD) concept has a great impact on the result of fixation and can exactly predict the survival or failure of the screw.^[3]

The concept of TAD came up in 1995, and then in 1997 by Baumgaertner et al., as they acknowledged the importance of an appropriate surgical technique in the treatment of trochanteric fractures using TAD as a useful clinical method to describe the screw position.^[4]

TAD is the distance from the screw tip to the apex of the femoral head on AP and lateral views. TAD should be below 25mm in order to prevent DHS cut-out or failure, which most often happens if the screw is placed too superior or too anterior.^[5]

MATERIALS AND METHODS

This is a retrospective cohort study including 30 cases who were skeletally mature patients with post-traumatic intertrochanteric fractures treated with DHS in the period from February 2024 to January 2025 with a follow up of at least 6 months in the Department of orthopedics, Darbhanga medical college Laheriasarai, Darbhanga, Bihar. The ITFs were internally fixated with DHS and postoperative follow-up. We measured the TAD postoperatively and after 6 months to detect the importance of TAD in the stability of lag screw in the head and neck of femur and reported cases that developed cut-through the lag screw.

Inclusion criteria

Patients with an isolated intertrochanteric femur fracture. Fracture fixation was done by DHS. Follow up for at least 6 months.

Exclusion criteria

Pathological fracture. Pre-existing femoral acetabular deformities such as coxa vara, acetabulum dysplasia or previous malunion. Intertrochanteric Femoral fracture with associated posteromedial comminution and reverse obliquity.

All patients were subjected to complete radiological and clinical evaluations: X-ray was done in anteroposterior, lateral views, and anteroposterior pelvis with traction and internal rotation of the lower limb. Besides the routine preoperative investigations that were carried out for all patients, further special investigations were requested by the anesthesiologist to complete anesthetic judgment. Two units of blood were prepared for each patient, but their use was according to the individual situation.

Surgical Technique: Patients were placed in the supine position and the traction table was used in all patients. Under image intensification guidance, closed reduction was done using traction and slight abduction and internal rotation. The reduction quality was evaluated as explained by Baumgaertner et al. The reduction was satisfactory when there was smooth anterior and medial cortical bony buttressing. The lateral approach of the proximal femur was used in all patients. Fixation was done by DHS and the plate. Lag screws lengths, in the study, were from 80 mm to 105 mm. 4 – 6 whole plates were used. Anti-medialisation plate and Anti-rotational screws were

not used. Bone graft and cement were not used in this study.

Closure of the wound (muscle layer vastus lateralis and an iliotibial tract by continuously locked sutures and subcutaneous layer then skin by mattress sutures and simple sutures).

Technique for calculating the Tip Apex Distance. TAD is the sum of the distance in mm from the apex of the femoral head to the tip of the lag screw with correction for magnification in AP and lateral views. Derived from Baumgaertner.

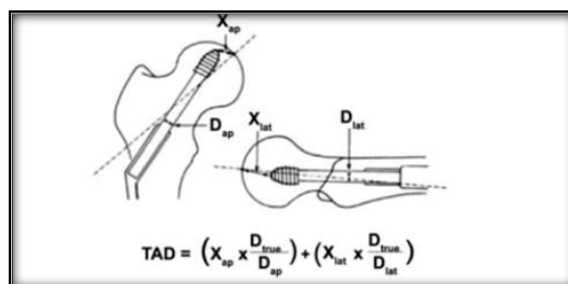


Figure 1: Technique for calculating the tip apex distance

RESULTS



Figure 2: Pre-op X-ray



Figure 3: Post-op X-ray

The present study presents the measurements of Tip-Apex Distance (TAD) in patients undergoing fixation of intertrochanteric fractures with Dynamic Hip Screw (DHS).

In our study, Nine cases had a TAD (Tip-Apex Distance) exceeding 25 mm postoperatively. After 6 months of radiological follow-up, 3 cases reported the lag screw cut through the femoral head. The mean time to screw cut-out was 4.7month. TAD is a crucial parameter in the placement of DHS implants, reflecting the positioning of the lag screw within the femoral head and neck. The incidence of screw cut-off in the present study was 21%.



Figure 4: Post-op X-ray at 6th Month follow-up

In our study majority of patients with intertrochanteric fractures were above 50 years of age with mean age of 60.6 ± 7.3 years. The quality of reduction observed in intertrochanteric fractures categorized by the presence of cut-through phenomenon during dynamic hip screw (DHS) fixation. The study classified reductions into three categories: Good, Acceptable, and Poor. Among cases where cut-through occurred (Yes, $n=10$), only 25% achieved a Good reduction, while 75% resulted

in a Poor reduction. In contrast, cases without cut-through (No, $n=20$) showed significantly better outcomes with 76.4% achieving a Good reduction and only 10% resulting in a Poor reduction ($p=0.028^*$). Acceptable reductions were similar between both groups, with 25% in the cut-through group and 25% in the non-cut-through group. These findings underscore the impact of cut-through phenomenon on the quality of reduction in intertrochanteric fractures treated with DHS fixation, emphasizing the importance of meticulous surgical technique.

DISCUSSION

Proximal femoral fractures are common in the elderly age and result in a heavy burden to the affected individuals and society. Its frequency is increasing with the more aging population. Early operative treatment decreases morbidity and mortality, reducing the risk of prolonged bed rest and giving the best chance of early independence.^[6]

Internal fixation enables early mobilization. Sliding hip screws are widely used but are associated with problems. The ideal implant should enable full weight-bearing immediately after surgery, be easy to handle, and provide enough purchase in the femoral head/neck fragment to limit cut-outs secondary to varus rotation and deviation.^[7]

For unstable trochanteric fractures treated with extramedullary devices such as the DHS, there were high varus-displacement and cut-out rates, wound problems, and infections. The extramedullary devices seem to be better than intramedullary ones when the fractures are stable.^[8]

The importance of the screw position in the femoral head has been recognized in the antero-posterior and lateral radiograph aiming for better bone stock in the femoral head; however, by superiorly and anteriorly positioning of the screw, the screw tip ended in more cancellous bone and not in the preferred subchondral bone, which leads to the failure of the implant.^[9]

Quality of reduction was classified into 3 groups as Baumgaertner, et al. noted that reduction was assessed on the amount of displacement and neck-shaft alignment on immediate postoperative AP and lateral radiographs, being categorized as poor, acceptable, or good.^[10]

Agni et al. showed that there are predictive factors for lag screw cut-out, the most important determining factor is the TAD, in addition to other factors including the degree of comminution of the fracture site and quality of reduction. That was demonstrated by our study.^[11]

Baumgaertner et al. demonstrated the TAD as a reproducible useful tool to evaluate the adequacy of sliding hip screw fixation. Describing the TAD calculation to evaluate the adequacy of the placement of lag screw in the femoral head, and regression defined the TAD $>25\text{mm}$ as unsafe due to the increased risk of associated lag screw cut-out.^[10]

Therefore, Davies, et al. noticed that there are other factors that judge the presence of cut-through including infection, posteromedial comminution, osteolysis, quality of reduction severe osteoporosis, and the quality of bone for purchase within the head and neck varies from one quadrant to another. The optimal position of a compression screw should be central or slightly central inferior. The bone of the lowest quality is in the anterosuperior aspect of the head and neck.^[5]

The incidence of screw cut-out ranges from 2.0% as reported by Chua et al,^[12] to as high as 12.6%.

CONCLUSION

TAD of less 25mm is safe, and more than 25mm and may result in the penetration of implant, non-union, cut-through, and other complications. Therefore, TAD is a reliable factor and has great value in DHS operations.

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