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Assesment of tip apex distance in intertrochanteric fractures treated with dynamic hip screw

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Abstract
Fractures of proximal femur account for 30% of all hospitalization for fractures. Most fractures occur in the elderly usually in association with osteoporosis and as a result of only moderate or minimal trauma. Literature suggests, Despite being a great option, the failure chance of DHS fixation is high if negligence made to Tip Apex Distance. This study is to assess the outcome of DHS with regards to Tip Apex distance.

Keywords: DHS, Intertrochanteric fracture, Tip apex distance

Introduction

Fractures of proximal femur account for 30% of all hospitalization for fractures. Most fractures occur in the elderly usually in association with osteoporosis and as a result of only moderate or minimal trauma.

Since the mid 1970's dynamic hip screw has been a favored method for treatment of intertrochanteric fractures, because it allows controlled impaction of the fracture in order to reach a position of stability yet it maintains a constant neck-shaft angle. Nonetheless the mechanical failure of this device has been reported to be as high as 16 to 23 percent.

The mechanism of failure has been the collapse of the neck-shaft angle into varus leading to cut out of the screw from the femoral head. There are various factors which results in the screw cut out, such as age of the patient, quality of the bone, pattern of the fracture, stability of reduction, angle of the implant, position of the lag screw. But there has been no clear consensus to the interrelationships or the relative importance of each factor. Most authors have recognized the importance of accurate placement of screw in the femoral head. There have been various methods to evaluate the position of the screw. We have used the method formulated by Baumgartner *et al*. (JBJS 77A. 1995 JUL) – Tip Apex Distance.

The 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 anterio-posterior radiograph and that distance as measured on a lateral radiograph after correction has been made for magnification.

The apex of the femoral head is defined as the point of intersection between the sub-chondral bone and a line drawn in the centre and parallel to the femoral neck.

Immediate post-operative radiographs are used to measure the tip apex distance. 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 (8mm). Correction was achieved by multiplying the measurement of the distance by this factor.

$$TAD = (X_{ap} \times D_{true} / D_{ap}) + (X_{lat} \times D_{true} / D)$$

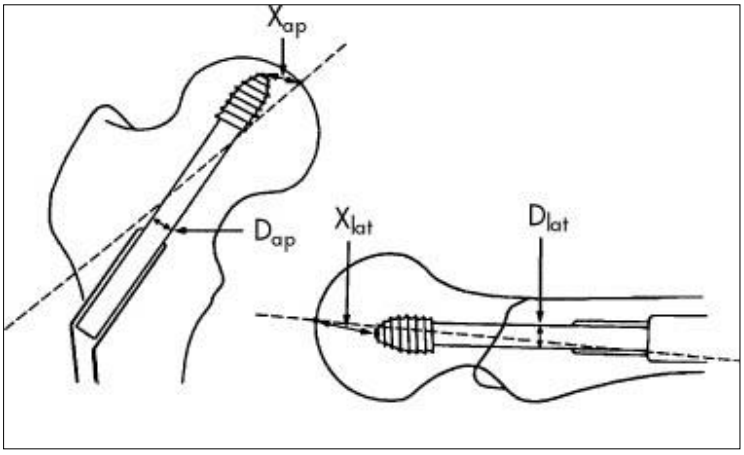
TAD – Tip Apex Distance

X_{ap}, X_{lat} – distance between the tip of the screw to the apex of the femoral head in the anteroposterior lateral radiographs respectively.

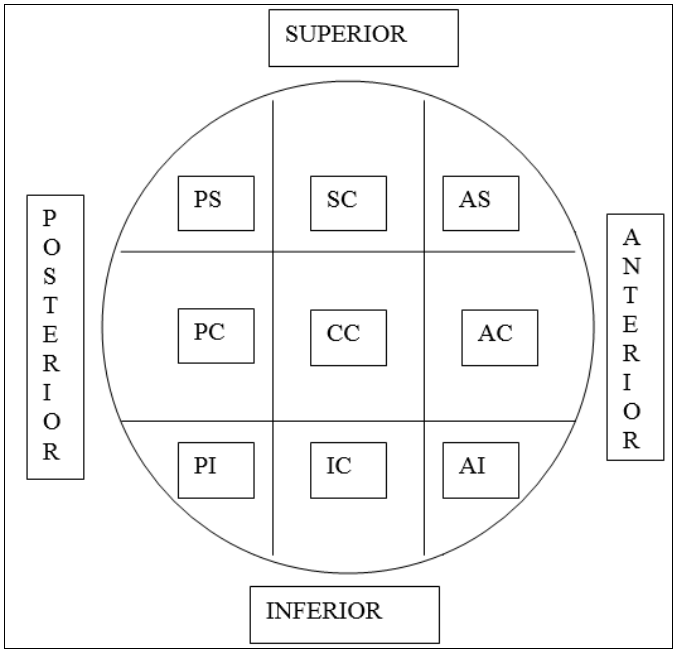
D_{true} – Known diameter of the shaft of the lag screw.

D_{ap} – diameter of the shaft of the screw as measured on the AP radiographs.

D lat - diameter of the shaft of the screw as measured on lateral radiographs.



The femoral head has been divided into a total of nine zones as described by Cleveland *et al*. and subsequently used by Kyle at al. With this method, the femoral head is divided into superior, central, and inferior thirds on the anteroposterior radiograph and into anterior, central, and posterior thirds on the lateral radiograph. In our study we also used these zones to locate the position of the screw.



PS – Posterior Superior
SC – Superior Central
AS – Anterior Superior
PC – Posterior Central
CC – Central Central
AC – Anterior Central
PI – Posterior Inferior
IC – Inferior Central
AI – Anterior Inferior

Materials & Methods

The study was conducted at the Department Of Orthopaedics at Sri Ramachandra Medical College & Research Institute between June 2015 and November 2018.
Total no. of patients – 28
Total no. deaths – 2
Total no. of patients included – 26
The deaths were due to age factor and other co-morbid conditions.
Follow up period ranged between six months to twenty four months.

Inclusion criteria

All intertrochanteric fractures treated with Dynamic Hip Screw. Radiological and clinical follow up had to be available for at least three months or should have documented early failure

Exclusion criteria

Intertrochanteric fractures treated with other modality

Age distribution

Average age 74 yrs.

Sex distribution

- No. of males – 15
- No. of females – 11

Side of injury

- Right side -16
- Left side - 10

Immediate post op anterior-posterior and lateral radiographs were assessed for measuring Tip apex Distance. The placement of the screws were also assessed according to the zones of the femoral head as described by Kyle at al. The fractures were classified according to the system of Boyd & Griffin and Evans.

Fig 1: Shows DHS fixation stable trochanteric fracture in 72years old male with TAD – 22mm.

Fig. 2: Shows DHS fixation in unstable trochanteric fracture in 80years male TAD – 24.2mm

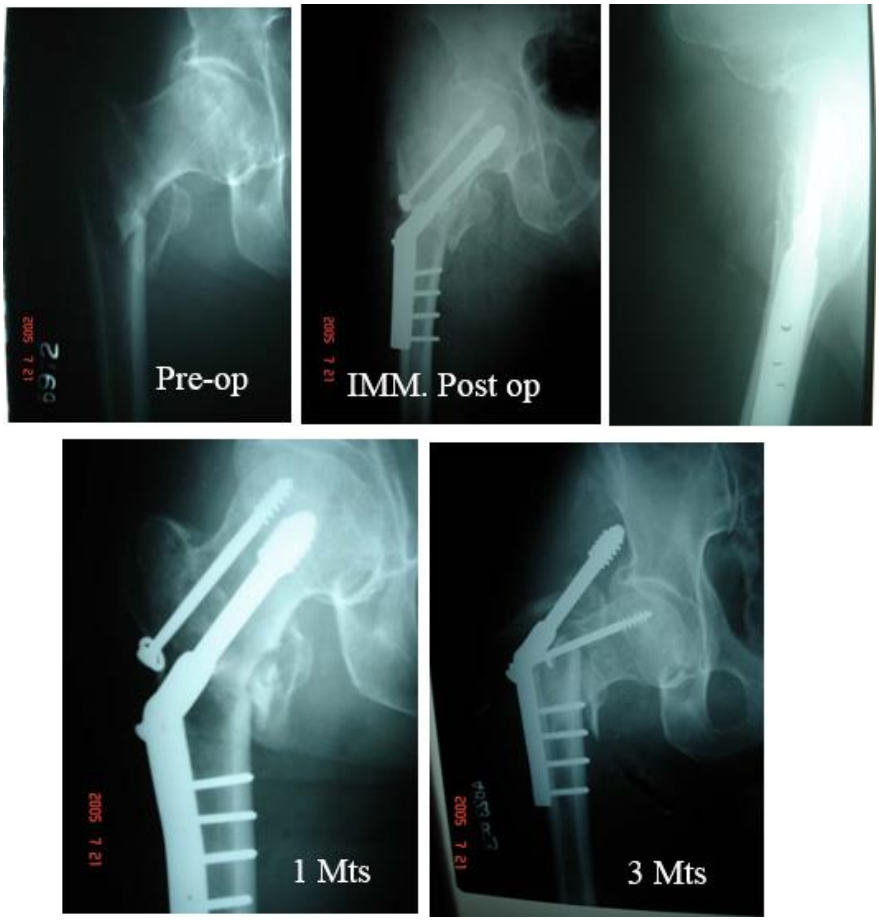


Fig 3: Shows screw cut out in DHS fixation in 75years old TAD – 38mm

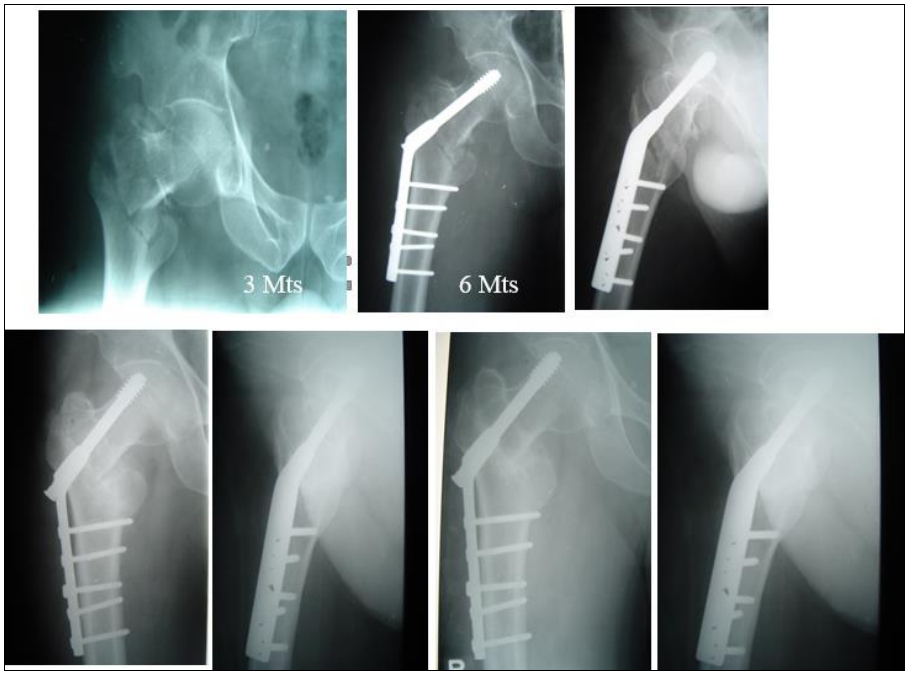


Fig 4: Shows screw migration in DHS fixation in 81years TAD – 35mm.

Results

At the end of the study total 26 fractures were evaluated with average follow up of 12 months. Majority of the patients were in age group between 60 and 70 years (74 yrs avg.), with average stay in hospital of 14 days duration.

The treatment of 2 of the 26 fractures failed. Both of the failures were due to the screw cutting out of the femoral head. The screw cut out occurred within 3 months after the operation.

The Tip Apex Distance averaged 21.8 mm (Range, 14 to 38 mm) for all the 26 fractures. In the two femoral heads where it cut out it averaged 36.5 mm (35 & 38 mm) compared with 20.6 mm (Range 14 to 24.2 mm) where the screw had not cut out.

As evaluated according to the zones described by Cleveland *et al.* and used by Kyle *et al.* lag screws were found to have been placed in 7 out of the 9 zones exception being the superior-posterior & inferior-anterior zones. The 2 cut outs

occurred in the *superior centre* & *inferior-posterior* zone.

The patients in whom the screw cut out had an average age of 78years (75 & 81). Both the patients were males. Of the two screws which cut out, one was used to fix an stable fracture and the other an unstable fracture.

Discussion

In our study of twenty six intertrochanteric fractures treated with dynamic hip screw, there was an average age distribution seventy four years with fifteen males and eleven females. Most common cause was trivial fall. The average tip apex distance for all the twenty six fractures was 21.8mm (Rage 14 – 38mm). Maximum numbers of patients (Fourteen) were in the 15 – 19.9 mm range. There were two screw cut outs whose tip apex distances were 35 and 38 mm. These results were compared with the study done by Baumgartner *et al*. The average tip apex distance in their study was 24mm (Range 9 – 63mm) for the successfully treated fractures, compared with 38mm (Range 28 – 48mm) for whose the screw cut out. None of the 120 screws with tip apex distance less than 25mm cut out. They concluded that regardless of the zone in which the guide pin is placed, if the proposed position results in a tip apex distance of greater than twenty five millimeters, reconsideration of reduction and redirection of the guide pin should be done. Our study also reconfirms their conclusion.

As evaluated according to the zones used by Kyle *et al*. [7] lag screws were found to have been placed in seven out of the nine zones. No screws were placed in the superior – posterior and inferior – anterior zones. Maximum numbers of screws (Eight) were placed in the inferior – central zone, followed by the inferior – posterior zone (Six). One screw out of the total six placed in the inferior – posterior zone cut out, while the only screw placed in the superior – central zone cut out. According to Baumgartner *et al*. [17], highest rate of cut out occurred in the posterior – inferior zone (two of six screws), and in the anterior – superior zone (Two of seven screws).

Regarding the pattern of the fracture (Stable or unstable), we had screw cut out of one stable and one unstable fracture and the age of the patients were 75 years and 81 years respectively. However we had only one patient in the younger age group. According to Baumgartner *et al*. [17] they used logistical regression to test the effects of other variables (Age of the patient, unstable fracture pattern, use of 150 º side plate), but their predictive significance was found to be negligible compared to an increased Tip Apex Distance. In our study we used only 135 º side plates. Logistic regression could not be used in our study as the numbers of patients were not enough for it to be applicable. Osteoporosis was not assessed as the positioning of the patients and quality of the radiographs were too variable to allow uniform assessment.

Conclusion

From our study it can be concluded that Tip Apex Distance is a reliable indicator in predicting screw cut out in intertrochanteric fractures treated with Dynamic Hip Screw.

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