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Study of tip-apex distance vs calcar referenced tip-apex distance in predicting the cut-out risk after osteosynthesis of proximal femoral fracture

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Abstract

This study evaluates postoperative outcomes related to cut-out complications in patients undergoing closed reduction and internal fixation with dynamic hip screw (CRIF+DHS) for intertrochanteric femur fractures. We measured the tip-apex distance (TAD) and calcar-referenced tip-apex distance (CAL-TAD) using anteroposterior (AP) and lateral views of the pelvis in 45 patients, analyzing the cut-out risk using Parker's index. Radiographic measurements were compared to determine their correlation with clinical outcomes. Among the patients, two cases of screw cut-out were documented, highlighting an average TAD of 26.76 mm and an average CAL-TAD of 29.03 mm. Our findings suggest that maintaining a TAD under 26.76 mm and a CAL-TAD under 29.03 mm, along with optimal screw positioning, may reduce the risk of cut-out complications.

Keywords: Tip-apex distance, calcar-referenced tip-apex distance, Parker's index, cut-out complications, dynamic hip screw

Introduction

- Proximal femoral fractures are subset of fractures that consists the break of the upper segment of femur bone in proximity of the pelvic socket, the acetabulum.
- Proximal femoral fractures are divided into intracapsular or extracapsular.
- For extracapsular fractures, extramedullary and intramedullary fixations are viable options [Dynamic hip screw (DHS), Dynamic condylar screw (DCS), Proximal femoral nail (PFN)], intramedullary nailing has become the most used fixation device in per trochanteric fractures worldwide, especially in unstable fractures. However, the use of intramedullary nailing, with its unique set of clinical implications, has introduced a new set of complications.
- The most common cause of failure for this type of fixation is nail cut-out: which is defined as extrusion of the cephalic screw as a consequence of a varus collapse of the neck-shaft angle.
- The tip-apex distance (TAD), and the calcar-referenced tip apex distance (Cal TAD) are the radiographic parameters that most predict the risk of cut-out.
- Tip-apex distance is defined as the distance between the tip of the screw and the apex of the femoral head. In this new calcar referenced Tip-apex distance the femoral head apex is referenced to the femoral calcar and not the center of the neck.
- Osteosynthesis is the process of mechanically bringing the ends of a fractured bone close together as by wiring together or attaching to a metal plate.
- The Cut-out is one of the most common mechanical failures in the internal fixation of trochanteric fracture, optimal Cal TAD value has not yet been defined, but the optimal TAD value is reported as 25 mm or less

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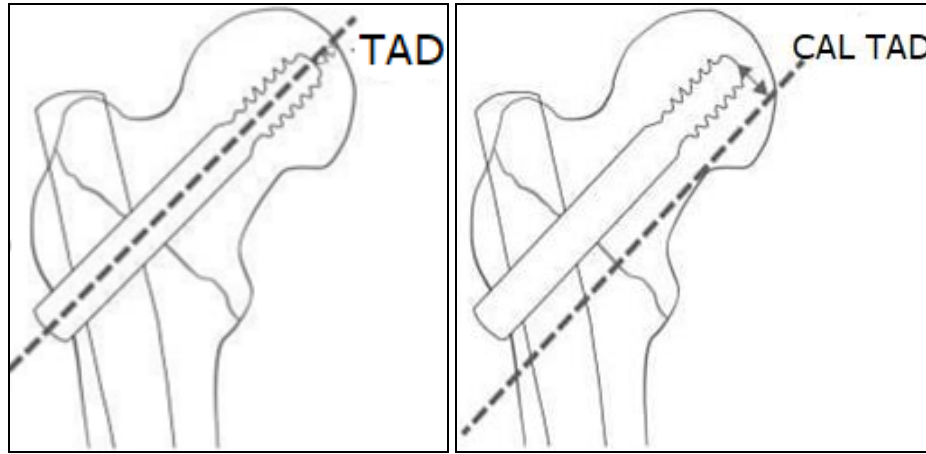


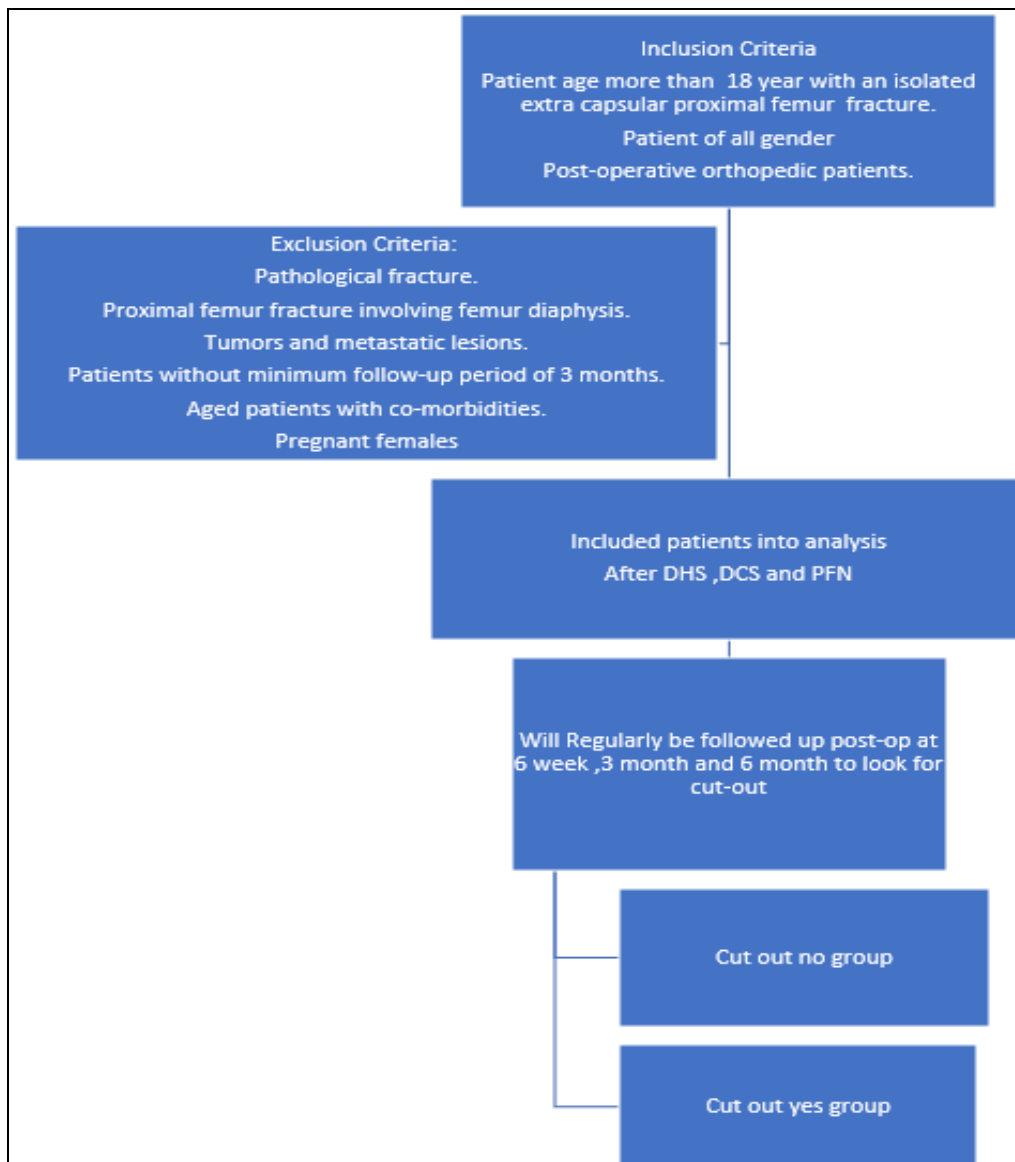
Fig 1: Dynamic condylar screw (DCS)

Methodology

- We took the 45 patients of extra-articular proximal femur fracture undergoing surgery either Pfn, Dhs Or Dcs.
- Measurement of the tad and cal tad were very simply performed using a matrix table constructed in a mathematical spreadsheet programme (excel 2003,

Microsoft corporation pty ltd.), both in ap and lateral view of plain radiograph.

- Parker index also used as a factor for predicting the cut-out, NCCT based Cleveland category system used to assign the position of head screw.
- Followed up for 6 months and looked for cut out.



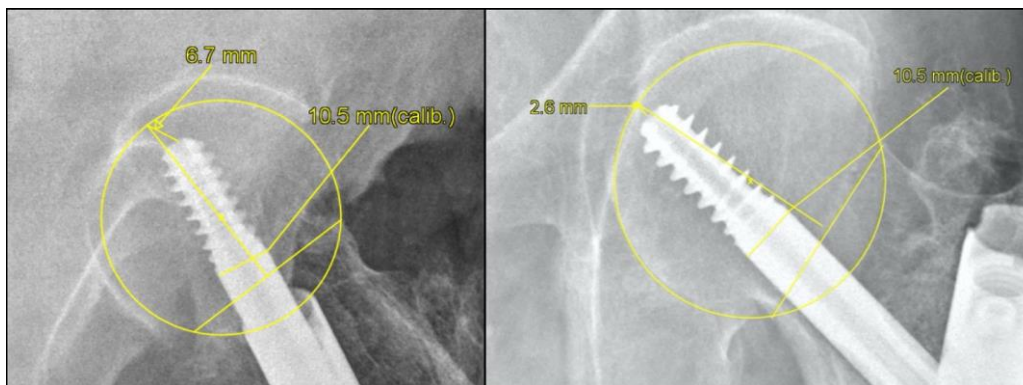
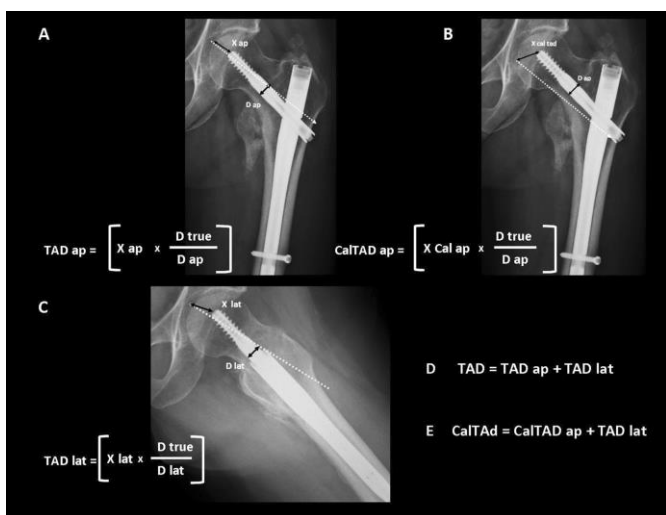


Fig 2: Measurement of TAD at 6 weeks on digital X-rays using the reference method described by Johnson *et al.*



Case 1 of cut out

- Patient Name-Baugan Devi
- Age/ sex-68/F
- Diagnosis-Fracture I/T Rt femur
- Procedure –CRIF+DHS
- Tad-5.33
- Cal-tad-17.31
- parker index- 33.33

Cleveland system classified as: for the Cleveland index. The femoral head (axial view) was divided into nine zone to document the position of the tip of the blade.

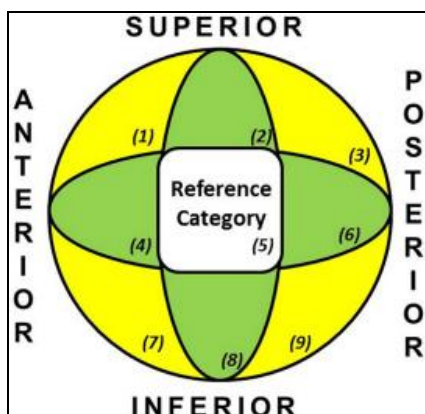


Fig 3: Pre-op x-ray

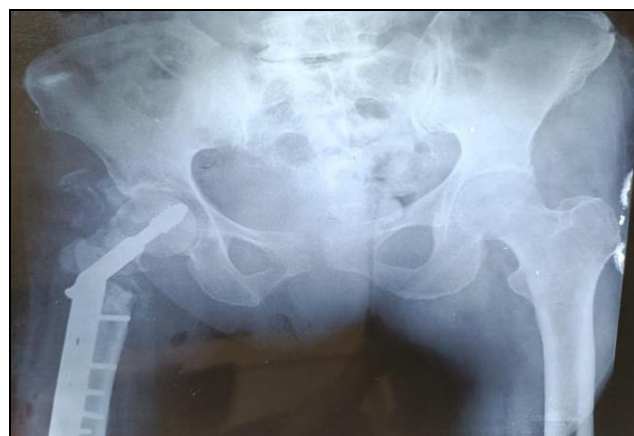


Fig 4: Immediate Post-op x-ray

Post –op evaluation

- We will measure the tip-apex distance and calcar referenced tip apex distance on AP and lateral view of pelvis with bilateral hip and to calculate the cut out risk by using Parker’s index. A post op NCCT of the pelvis with bilateral hip of the patient also will be done for assigning the Cleveland category.
- Parker’s index calculated by position of the screw was determined on anteroposterior (AP) and lateral radiographs by the method shown in Figures 1 and 2, then recording the ratio of AB to AC, multiplied by 100, to give a range from 0 to 100 for each view.



Fig 5: After 3 months

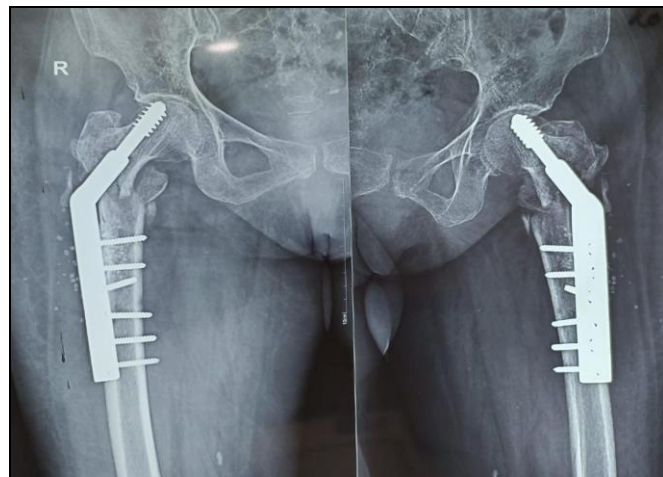


Fig 8: AP and Lateral view after 3 months

Case 2 of cut out

- Patient Name-Sarla
- Age/ sex-67/F
- Diagnosis-Fracture I/T Rt femur
- Procedure –CRIF+DHS
- TAD- 18.62
- Cal-TAD- 27.98
- Parker index-66.66



Fig 6: Pre –op x-ray



Fig 7: Immediate Post-op x-ray

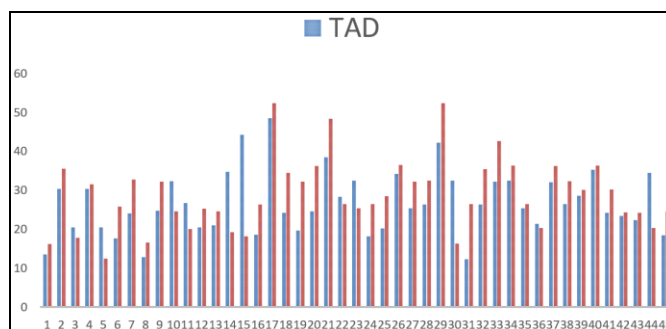


Fig 9: TAD

Result

- A total of 45 patients taken which comes under inclusion criteria and prospective study was done of which two patients had cut-out.
- The average TAD was 26.76 mm.
- Average CAL-TAD was 29.03 mm.

Discussion

- Cut-out is one of the complications of cephalomedullary nailing of the proximal femur fracture. our study is limited by the systemic bias associated with multiple factors as bone quality, quality of reduction and weight bearing.
- Baumgaertner *et al.* introduce the definition of TAD ad define optimal cut out of screw at 25 mm, while the concept of CAL TAD was given by Kuzyk *et al.* However no definitive CAL-TAD cut-off has yet been established.
- Some studies also shows relation of distal locking and choice of nail for the cutout.
- Also positioning of lag screw in upper quadrant according to the Cleveland system increases the risk of cut-out. However it is still under discussion whether the best screw position is the centre-centre or the inferior-centre quadrant as also tried to explained with the Parker index.
- We presume TAD and CAL-TAD would seem to be more selective and safer method for establishment of weight bearing

Conclusion

- Limited to our study in order to reduce the incidence of cut-out, it is advisable to perform careful minimal reduction, and achieve stable synthesis avoiding

TAD>26.76 and CAL-TAD >29.03 and to position of screw in CLEVELAND zone 5, PARKER index of around 50.

- TAD and CAL-TAD are the predictor factors for cut out of screw in osteosynthesis of proximal femur fracture but are not only the factors, because cut out also depends upon the bone quality, stability of fracture, type of reduction, post-operative weight bearing etc.

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