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COMPARISON OF TIP APEX DISTANCE (TAD) AND CALCAR REFERENCED TIP APEX DISTANCE (CALTAD) AS A PREDICTOR OF LAG SCREW CUTOUT IN PERITROCHANTERIC FRACTURES TREATED BY CEPHALOMEDULLARY NAIL

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KEYWORDS

Peritrochanteric Fractures, Tip Apex Distance, Calcar Referenced Tip Apex Distance

INTRODUCTION

Peritrochanteric fracture are fracture of the proximal femur around intertochanteric line which includes intertochanteric fractures and subtrochanteric fractures. Intertrochanteric fractures were once considered fracture of old age due to trivial domestic falls but now it is seen among the younger population due to high energy trauma and increasing mean age of population

Peritrochanteric fracture is common in elderly patients worldwide, and its incidence is expected to reach by 6.3 million/year by 2050[1]. Most common hip fracture encountered in routine emergency are peritrochanteric fractures. These fractures are more commonly seen in older age group as this age group is more prone to osteoporotic fractures that can occur even with a trivial trauma.

Both extramedullary and intramedullary fixation are viable option for treatment of peritrochanteric fracture, but intramedullary nailing has become most Preferred fixation device due to its biomechanical and biological advantages, especially in unstable fractures[2]. Failure of the initial treatment of peritrochanteric fracture is associated with increase in morbidity mortality and cost to society[3].

Most common cause of mechanical failure of these intramedullary implants(proximal femoral nail) is cutout of lag Screws , the most common cause of mechanical failure of these implants comes out to be cutout of lag Screws. The prevalence of cut-out is estimated between 1.85%–16.5% [4] , and several other factors are thought to be related to this complication, including bone stock quality, cephalic screw positioning and length, tip–apex distance (TAD), calcar tip-apex distance (CalTAD) and fracture reduction.

There are many predictors of screw cutout but most important among them is Tip apex distance (TAD) and it has been said that keeping the TAD < 25mm ,reduce the chances of screw cutout , it also favours Central - Central placement of screw in AP and Lateral views. But it has been observed that keeping the Lag Screw inferior - Central in head in Anteroposterior and Lateral view provide comparablestability as same as Central - Central group even if TAD > 25mm[5].

Inferior placement of Lag screw also favours the placement of second element called anti rotation screw which is placed cephalad to lag screw

The calcar referenced tip-apex distance (CalTAD) is a novel measurement tool that also favours inferior central lag screw placement.[6]

Therefore we did a Prospective randomized study to compare and evaluate the role of Tip Apex distance (TAD) and Calcar referenced Tip Apex distance (CALTAD) as a predictor for screw cutout in osteoporotic Peritrochanteric fractures fixed with cephalomedullary nail.

Methodology

The study was a prospective observational study conducted at M.G.M Medical college & Myh hospital indore between January 2021 - September 2022 on over 100 patients as per the underlying event rate and the duration of the study .All the patients coming to the OPD/Casualty with age more than 60 yrs with peritrochanteric fractures fixed were included in the study. While Patients with pathological fractures , ipsilateral limb injuries and patients with chronic illness were exluded.

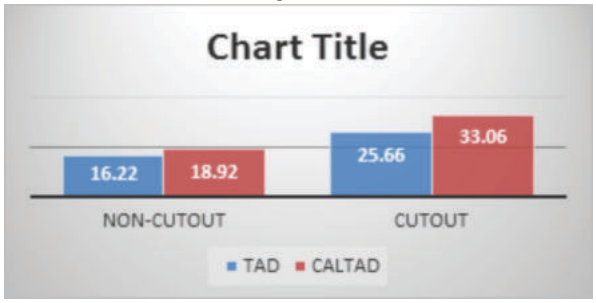
The selected patients were registered for the study and a proper history, clinical examination, plain radiographs (AP & lateral) of hip were done after taking a written informed consent. Immediate post operative xrays were taken along with true hip anteroposterior with limb in 15° internal rotation and true lateral with contralateral limb fixed and abducted. Measurement of TAD and CALTAD done by computer based software & Lag screw position was done by cleveland's classification then regular followup xray was done at 1.5 months, 3 months, 6 months for Identification of cutout and backout of lag screw.

In Our Study, 67 Patients were males while 33 were females. Mean age was 67.21 years, lowest being 60 yrs and oldest being 81 years , 41 were left sided peritrochanteric fractures while 59 were right sided.

Total	Males	Females
100	67	33

Out of 100 cases failure of fixation because of cutout was seen in 3 cases (3%) , for which mean follow up was of 35.03 days. Age , gender *(pvalue-0.31)*, side *(pvalue-0.22)*, fracture type *(pvalue -0.43)*, & lag screw position in AP view *(pvalue-0.42)* in cutout group were not statistically significant as compared to noncutout group. While mean TAD *(pvalue <0.05)*, mean CALTAD *(pvalue <0.05)*, & lag screw position in lateral view in cutout group was statistically significant as compared to non cutout group

In all cases of failure due to cutout, mean TAD value comes out to be 25.66 mm which is close to the mean cutoff value i.e 25mm whereas mean CALTAD value in all cases of cutout is 33.06mm which is 8.06mm more than the cutoff range.

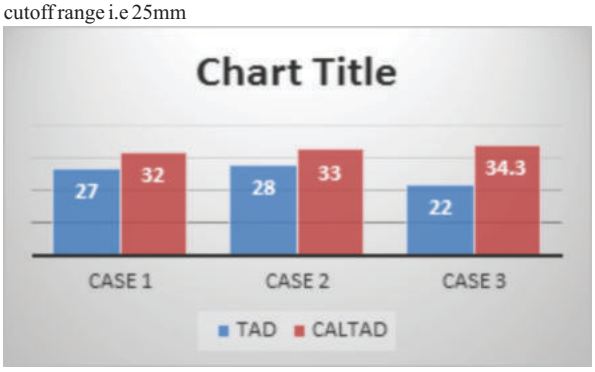


Also in one of the cutout case TAD (22mm) is less than cutoff value(25mm), but CALTAD(34.20mm) was more than the cutoff value i.e 25mm, representing CALTAD to be more reliable predictor of failure than TAD.

RESULTS

In our study, total 100 patients were included, of which 77 were intertrochanteric fractures while 23 were subtrochanteric fractures and out of which complete union was achieved in 97 patients with no lag screw cutout or backout.

In all 3 cases of cutouts mean TAD value was more than 2mm in case 01, more than 3 mm in case 2 and less than 3 mm in case 3 the cutoff range i.e 25mm.While mean CALTAD value was more than 7mm in case 01, more than 8mm in case 02 &more than 9.3 mm in case 03 from cutoff range i.e 25mm



DISCUSSION

Intertrochanteric fractures were considered fracture of old age due to trivial domestic falls but now it is common among the younger population due to high energy trauma due to road traffic accidents.

Fractures associated with high energy trauma tends to be more comminuted and requires better method of fixation. There is change in concept regarding the method of fixation of intertrochanteric fractures in the last two decades. There is increase in tendency towards intramedullary fixation for trochanteric fractures over extramedullary devices attributing to biomechanically stable fixation.

Most common cause of mechanical failure of these intramedullary/ extramedullary implants is cutout of lag Screws with an incidence between 1.4% and 19% depending on fracture type and implants used.

In our study we did a Prospective randomized study to compare and evaluate the role of Tip Apex distance (TAD) and Calcar referenced Tip Apex distance (CALTAD) as a predictor for screw cutout in osteoporotic Peritrochanteric fractures fixed with cephalomedullary nail. Our main goal was to investigate the reliability of the tip apex distance measurement, calcar referenced tip apex distance the Cleveland femoral head dividing system. We also studied the more general variables associated with a patient with an intertrochanteric hip fracture to see whether they were of any interest.

In our study we found clear prevalence of complications in female patients which can be attributed to the higher incidence and severity of osteoporosis in females.

Cephalomedullary nail has has been used as a preferred implant for treatment of unstable intertrochanteric and subtrochanteric hip fractures when compared to SHS.

When compared with SHS, CM nailing is associated with a shorter operating time, reduced intra-operative blood loss, and improved walking ability in unstable hip fractures[7,8]

In cephalomedullary nailing determining the exact position of the screw in the femoral head is of great importance and needs to be precise. The central-central, anterior-inferior, and central-inferior positions contribute significantly to protect the screw from cutting out of the femoral head**.**

In our study in terms of lag screw placement on the AP view, we found no significant association between screw placement and increased rate of cut-out whereas lateral view, we found positioning of screw in posterior quadrant was associated with higher incidence of screw cutout. whereas Baumgaertner et al[9] in their study found highest rates of cut-out in the posteroinferior and antero-superior zones, and consequently recommended a deep central insertion of the lag-screw

Lateron De Bruijn et al also recommended centro-central or low-central lag-screw placement with minimal TAD. These conclusions, however, differ from those of Kaufer, Matthews and Sonstegard who argued in favour of lagscrew placement in the postero-inferior quadrant of the femoral head, as the crossing of tension and compression trabeculae in that area of the femoral head probably provides the best bone for screw placement, thus improving proximal fragment control.

Recently this theory was tested in a biomechanical study by conducted by Kane et al[10]which showed the low central position with a TAD of greater than 25 mm provided comparable stability as comparedto centro-central placement with the then optimal TAD of less than 25 mm.

Recently *Kuzyk et al*[11] in their study found that inferior placement of the lag screw gives the highest axial and torsional stiffness. Similarly *Goffin et al* [12] have also shown that inferior middle and inferior posterior positions are to be preferred, which argues against the accuracy of a TAD > 25 mm cut-off for prediction of cut-out, as TAD measurement suggests a higher rate of cut-out with a more inferior placement of the lag screw and favours a central–central placement.

In the interests of comprehensiveness, we also analysed more general variables of patients with pertrochanteric hip fractures to see whether they would be of any interest , however, we observed no statistically significant differences in the incidence of cut-out related to AO/OTA fracture classification, laterality, type of device, pretrauma anti-resorption medication, .As part of this analysis, however, we did find that there was no statistically significant correlation between the occurrence of cut-out and weight-bearing immediately after surgery. Further studies are required to confirm our results.

CalTAD differs from TAD only in the AP view, with the apex of the femoral head determined using a line parallel to the femoral neck that runs adjacent to the calcar instead of the centre of the femoral neck. It therefore favours inferior–central placement of the lag screw.

Regarding TAD and CalTAD indices, some authors identifiified the prognostic value with a maximum of 25 mm to prevent postoperative complications such as implant cut-out.

In our study, a lower CalTAD resulted in lesser cutout and a statistically significant ($p < 0.001$) association supports its use as a predictor of cutout in biaxial CM nails , similar observation was done by k.puthezath([13].

The significance of CalTAD in both the univariate ($p < 0.01$) and the multivariate ($p < 0.05$) analysis, along with the excellent inter-observer reliability seen in our study which supports its use as a predictor of cut-out for CM nails.

As the mean TAD value in our cutout group (25.66mm) was close to cutoff value (i.e 25mm) but mean CALTAD value(34.56) was significantly higher than cutoff range (25mm) Also in one of the cases of screw cutout it was found that TAD was lower than the cutoff but caltad was significantly higher than cutoff range which signifies caltad to be more better predictor.

The limitations of our study include limited sample size owing to poor patient compliance with follow-up. Although no cut-out was seen with a CalTAD < **29.31mm**, further studies are needed to investigate the impact of using a CalTAD cut-off guideline intra-operatively for the prevention of cut-out, As the size of studied sample increases, the chances of failure case might increase .

CONCLUSION -

Thus in our study we conclude that CalTAD is a better predictor of cutout than TAD in biaxial Cephalomedullary nail with central inferior placement being the best and least commonly associated with complications. However, further more studies with large sample size and long folloup are required to confirm the same.

Declaration

This manuscript is our original work and is not published earlier and we have not submitted this manuscript for publication elsewhere .We have cited the names of the authors whose published materials are used in this manuscripts

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