TIP APEX DISTANCE OF INTRAMEDULLARY DEVICES AS A PREDICTOR OF CUT-OUT FAILURE IN TREATMENT OF PERITROCHANTERIC ELDERLY HIP FRACTURES

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ABSTRACT

BACKGROUND
A Tip-Apex Distance (TAD) of greater than 25 mm has been shown to be an accurate predictor of lag screw cut-out when Sliding Hip Screws (SHS) are used to treat Peritrochanteric (PT) fractures. The purpose of this study was to determine, which factors, including TAD correlated with successful clinical outcomes of PT hip fractures surgically treated with intramedullary devices.

MATERIALS AND METHODS
A total of 72 patients were included in this retrospective study. TAD values were radiographically analysed at a mean follow up of 13 months. This was correlated with limited functional status and rate of revision for implant failure or inability to achieve fracture union. Only 62 patients had adequate follow up to fracture union or definitive failure.

RESULTS
There were 36 intertrochanteric fractures and 26 subtrochanteric fractures. Overall, 5 patients (9.8%) went on to experience lag screw cut out. The average TAD of patients who did not cut-out was 18 mm compared to 38 mm for those who did (p=0.012). All patients who cut-out had IT fractures.

CONCLUSION
The percentage of cut outs correlated clinically to both the severity of IT fractures and the TAD. Using a cut-off of 25 mm, there was a statistically significant difference in the incidence of lag screw cut-out (p<0.001). As in sliding hip screw, surgeons should strive for a TAD less than 25 mm when using IM devices in the treatment of PT hip fractures to help avoid lag screw cut-out.

KEYWORDS
Tip-Apex Distance, Proximal Femur Fractures, Lag Screw, Screw Cut-Out, Subtrochanteric Fractures.

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AIMS AND OBJECTIVES
- The aim of this study is to determine, which factors, including TAD correlated with successful clinical outcomes of IT and ST hip fractures surgically treated with IM devices.
- Our hypothesis was that as with the use of SHS, a TAD of 25 mm would show improved clinical results and fewer hardware failures by lag screw cut-out.

MATERIALS AND METHODS
Inclusion Criteria
- A retrospective review of all the hip fracture patients treated with IM devices between 2012 and 2016 at the author’s institution, a tertiary referral teaching facility was performed.
- There were no patients excluded based on age or other medical comorbidity.

Exclusion Criteria
- Patients with less than 3 months follow up and those with pathological fractures were excluded.

Data Collection
- Data collected included patient’s age at surgery, gender, fracture type, operative side, surgeon, type of implant, quality of reduction, TAD, three-month postoperative ambulatory status.
- Fracture type, quality of reduction and TAD were determined using preoperative and postoperative Anterior-Posterior (AP) and lateral hip digital radiographs.
- The IT fracture patterns were classified according to the system of Muller and Evans modified by Kyle et al 6 with types III and IV considered unstable. ST fracture patterns were classified according to the system of Seinsheimer, 5 which is based on the number of fragments with type V being the most severe with 5 or more fragments.

METHODS
- The quality of reduction was modified from the system of Baumgartner et al based on immediate postoperative AP and lateral radiographs. 2,3 For both fracture types, reductions were evaluated on the basis of displacement and angulation and categorised as good, acceptable or poor.
- Reduction met the displacement criteria if there was less than 4 mm of displacement on either the AP or lateral x-ray.
- The angulation criteria was met if the neck shaft angulation was normal or slightly valgus (130-150 degrees) and there was less than 20 degrees of angulation on the lateral x-ray.
- Reduction should be categorised as good if it met both criteria, acceptable if it met one criteria and poor if it did not meet either criteria. All radiographs were analysed as previously described in the literature regarding IM nails in the treatment of PT hip fractures. 6

- Radiographs were adjusted for magnification by multiplying the measured distances on both AP and lateral radiographs by the ratio of the true to measured lag screw diameter.
- TAD was determined by measuring the distance from the tip of the lag screw to the apex of the femoral head on both AP and lateral radiographs.
- The final endpoint of the study was lag screw cut-out or fracture union, respectively. Interval and dichotomous data were analysed using Student’s test and Fisher’s test, respectively.

![Figure 1. Tip Apex Distance](image)

OBSERVATION AND RESULTS
There was a total of 72 patients treated with IM devices during the study period. Of these, 62 patients met the inclusion criteria. There were a total of 22 males and 40 females with an average age of 78 ± 12 years included in this study. There were 36 IT fractures and 26 ST fractures of which 41% (n=15) were considered unstable. Good (32%) or acceptable (55%) reduction criteria were met for 54 out of 62 patients (87%). The total number of cut-outs was 5 (0.08%).

The IM device used was trochanteric fixation nail. All versions had an angle of 125 degrees. The lag screw diameter was 12.5 mm. The choice of implant was based on entirely on the surgeon’s preference.

All patients who had cut-out had non-union, intertrochanteric fractures (n=6) while there were no cut-outs in the subtrochanteric group. The non-union rates at a mean of 13 months follow up was 10% (n=1), 21.4% (n=3), 33.3% (n=2) for IT fractures type II, III and IV, respectively. All ST and type I IT fractures healed fully. Unlike IT fractures, severity of subtrochanteric fractures was not associated with cut-out.

Overall, there was an average TAD of 20 mm ± 9 mm with an 8.5% cut-out rate for (n=7) patients. The mean TAD of the patients who did cut-out compared to those who did not was 38 mm and 18 mm, respectively. Since, no patient with a TAD below 25 mm had a cut-out and 44% of patients with TAD above 25 mm had a cut-out, there was a strong statistical difference in the incidence of lag screw cut-out between patients above and below 25 mm.

Percentage of cut-outs and non-cut-outs for all Subtrochanteric (ST) and Intertrochanteric (IT) fracture pattern subtypes. IT fracture patterns were classified based on Muller and Evans classification with types III and IV considered unstable.

DISCUSSION
With the rise in an aging population and a limited amount of healthcare resources in the foreseeable future, it will be increasingly important to find ways to avoid complications when treating hip fractures. This cohort of patients is exceedingly fragile as evidenced by the occurrence of the fracture itself. Most of these patients will be unable to endure a second operation, let alone tolerate prolonged physical therapy. They will probably be placed into another institution for an extended period of time. Even after one operation, the one year mortality rate after a hip fracture is alarmingly high at 25%.

Baumgartner et al in his initial landmark report documenting the ideal position of the lag screw in the centre-centre position showed a small cohort of patients who were treated using a cephalomedullary implant. Other studies have compared the IM devices versus traditional SHSs. However, our literature review found no studies that specifically evaluated the lag screw cut-out rate using cephalomedullary implants. The advantages of our study include a satisfactory number of patients with adequate follow up in this cohort of patients with typically poor follow up. It seems commonplace that a large majority of these patients fail to return for follow up due to a multitude of factors when they are transferred to a skilled nursing facility after discharge from hospital.

The major disadvantages of this study are the retrospective nature and the difficulty we experienced trying to increase the follow up data pool of patients. The investigation does, however, provide valuable analysis of this extremely common and likely increasingly needed surgical procedure.

CONCLUSION
- In conclusion, the high incidence (44%) of cut-outs in IT fractures surgically fixed with TAD >25 mm in this study is a dramatic statistic.
- It stresses the importance of accurate surgical technique in the prevention of extremely unfortunate situations where revision fixation maybe needed.
- It may be due to poor bone quality in the region surrounding the lag screw postoperatively and patients who have significantly comminuted IT fractures maybe more prone to IM device cut-out.
- If revision surgery becomes necessary, it may lead to possibility of mortality or at least a high rate of morbidity and cost.
- As shown in other studies focusing on sliding hip screws, IM devices are susceptible to cut-out at TAD values greater than 25 mm. Hence, surgeons should strive for a TAD <25 mm when using IM devices, especially in treatment of comminuted IT hip fractures to help avoid lag screw cut-out.
- This study hence reconfirms that cephalomedullary devices are appropriate for ST fractures and that unstable IT fractures can be more troublesome than was classically considered.

REFERENCES


