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Clinical Femoral Length Measurement as a Reliable Guide for Cephalic Lag (Calcar) Screw Sizing in Proximal Femoral Nailing Procedures

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ABSTRACT
Proximal femur fractures, including intertrochanteric and subtrochanteric fractures, predominantly affect the elderly population and commonly result from low-energy mechanisms such as falls from standing height, direct impact over the greater trochanter, or underlying osteoporosis. These fractures are associated with substantial morbidity and mortality in geriatric patients and therefore demand timely and effective management.
The majority of intertrochanteric and subtrochanteric fractures are treated surgically, with internal fixation using intramedullary devices being one of the most widely accepted treatment modalities. Proximal femoral nailing has gained popularity due to its biomechanical advantages, minimally invasive nature, and favorable clinical outcomes.
However, most commercially available implants are manufactured in standardized sizes, which may not always correspond optimally to patient-specific femoral anatomy. In this context, accurate selection of the cephalic lag (calcar) screw length is crucial to achieve stable fixation and reduce implant-related complications.
Therefore, the present study aims to clinically measure femoral length in patients with extracapsular proximal femur fractures and to evaluate its correlation with the cephalic lag (calcar) screw size used during proximal femoral nailing, with the objective of improving implant selection and surgical planning..

I. MATERIALS AND METHODS:

This study included a total of 100 patients who underwent surgical fixation with a proximal femoral nail for extracapsular proximal femur fractures. The fracture patterns comprised intertrochanteric fractures classified as Boyd and Griffin type I and II, and subtrochanteric fractures classified as Seinsheimer type I and II.
Clinical measurement of femoral length was performed on the uninjured limb with the patient positioned supine. Femoral length was measured from the tip of the greater trochanter to the lateral joint line of the knee using a measuring tape, and the values were recorded in centimeters.
Radiographic evaluation of the proximal femur was carried out using standard anteroposterior and lateral radiographic views. Postoperative radiographic measurements, including the tip–apex distance, were obtained using Digital Imaging and Communications in Medicine (DICOM) software.

II. RESULTS:

The study population comprised 74 male and 26 female patients. The mean age was 75.97 ± 10.94 years in males and 63.42 ± 15.10 years in females. The predominant mechanism of injury was a fall from standing height, accounting for 83% of cases, while road traffic accidents constituted 7% of injuries.

With respect to fracture distribution, 85% of patients sustained intertrochanteric fractures, whereas 15% presented with subtrochanteric fractures. Statistical analysis demonstrated a strong and statistically significant correlation between clinically measured femoral length and the cephalic lag (calcar) screw size used during proximal femoral nailing, with a correlation coefficient (r) of 0.9128 ($p < 0.001$).

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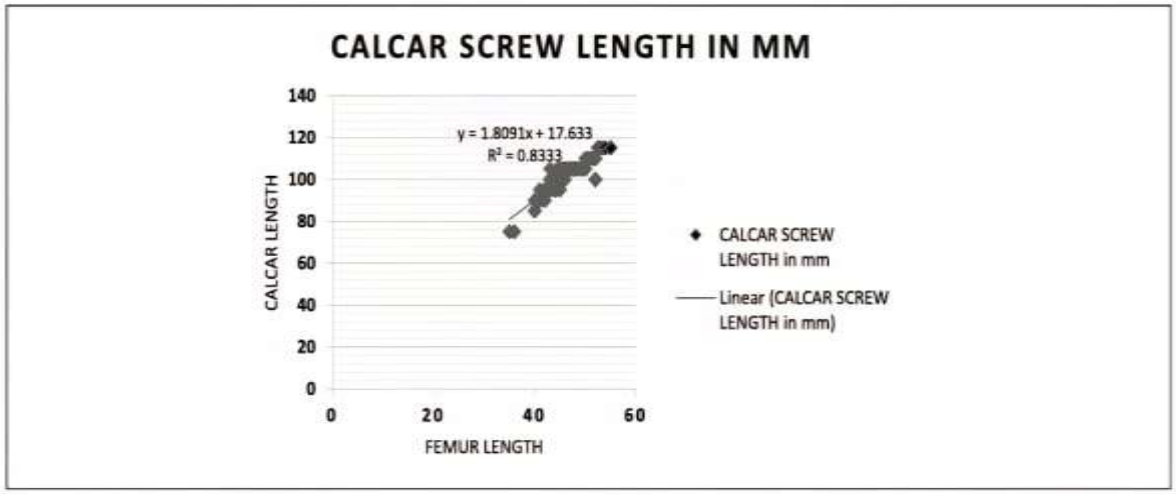

Figure 1: Scatter graph showing strong linear correlation between the femur length and calcar screw size.

Table 1: Regression equation formulae for calcar screw size in mm and femur length in cm

Group	Regression equation	R2
Study population	Calcar screw size = 1.8091 × femur length + 17.633	0.8333

Table 2: Comparing the count of estimated screw to actual screw used in fracture fixation.

Estimated calcar screw size (mm)	Actual calcar screw Size (mm) used in fracture fixation									
	75	80	85	90	95	100	105	110	115	Grand total
80	1									1
85	1									1
90			3	5	1					9
95				2	16	6	1			25
100					2	9	9			20
105							21			21
110						2	4	9		15
115									8	8
Grand total	2	0	3	7	19	17	35	9	8	100

III. DISCUSSION

Proximal femoral fractures, including intertrochanteric and subtrochanteric fractures, predominantly occur in the elderly population and are frequently associated with osteoporosis and low-energy trauma. In this age group, operative management is generally preferred, as prolonged immobilisation with traction is associated with a high incidence of complications such as deep venous thrombosis, pressure ulcers, and pneumonia. Consequently, the majority of intertrochanteric and subtrochanteric fractures are managed surgically using internal fixation, most commonly with intramedullary devices incorporating calcar (lag) screws.

Meticulous preoperative planning is essential to achieve optimal surgical outcomes. Appropriate selection of calcar screw length is particularly important to maintain a tip–apex distance (TAD) of less than 25 mm, thereby reducing the risk of mechanical failure. Accurate preoperative estimation of screw length can minimise repeated intraoperative adjustments, thereby decreasing fluoroscopic exposure, operative time, soft-tissue trauma, and blood loss. These factors collectively contribute to improved implant stability, reduced postoperative discomfort, and a lower incidence of implant-related complications.

The findings of the present study suggest that intraoperative depth-gauge measurements and repeated trial-and-error changes of calcar screws may be avoided by utilising preoperatively estimated screw lengths derived from clinical measurement of femoral length on the contralateral, unaffected limb. This approach simplifies the operative workflow while maintaining accuracy in screw selection.

In the current series, an estimated screw length of 90 mm corresponded with the actual screw used in 71% of cases, while 95 mm matched in 84% of cases. Similarly, estimated screw lengths of 100 mm, 105 mm, 110 mm, and 115 mm matched the actual screw lengths in 52%, 60%, 100%, and 100% of cases, respectively. These findings demonstrate a high degree of concordance between preoperatively estimated and intraoperatively utilised calcar screw sizes, particularly at higher screw lengths.

The clinical importance of accurate calcar screw placement is well documented. Undersized screws may result in inadequate subchondral purchase within the femoral head, predisposing to screw back-out and cut-out. Conversely, excessively long screws may penetrate the hip joint, leading to articular cartilage damage, restricted range of motion, and the development of secondary osteoarthritis. In addition, inaccuracies in screw length may cause soft-tissue irritation involving the iliotibial band and vastus musculature.

By employing preoperatively estimated calcar screw lengths, the present study demonstrates a potential reduction in operative time, intraoperative blood loss, and surgical trauma, while facilitating optimal screw impaction and fixation. Statistical analysis revealed a strong and statistically significant linear correlation between femoral length and calcar screw length ($r = 0.9128$, $p < 0.001$), supporting the reliability of this method in predicting appropriate screw size and minimising clinically significant mismatch during fracture fixation.

IV. CONCLUSION

This study was not intended to establish sex-specific calcar screw dimensions but rather to provide a practical preoperative reference to assist surgeons in selecting an appropriate initial screw length. Preoperative estimation of calcar screw size has the potential to improve operative efficiency by shortening surgical duration, reducing anesthesia exposure, and minimizing operative trauma to the proximal thigh, thereby potentially decreasing the risk of surgical site infection.

Accurate calcar screw selection is essential for achieving stable fracture fixation and minimizing postoperative implant-related complications. The findings of this study support the usefulness of preoperative calcar screw estimation as a reliable guide, contributing to reduced intraoperative blood loss, decreased postoperative morbidity, and facilitating earlier functional recovery in patients with proximal femoral fractures.

V. LIMITATIONS

This study has several limitations that merit consideration. Variations in femoral anatomy, including femoral bowing and increased soft-tissue bulk in patients with obese or fatty thighs, may influence the accuracy of clinical femoral length measurements. In addition, factors such as implant positioning, the entry point of the intramedullary nail, and intraoperative fracture reduction may affect the final calcar screw length selected. The neck–shaft angle also plays a significant role in determining optimal screw length and may contribute to variability in screw size.

Furthermore, this was a single-center study conducted at a tertiary care institution. Although the study included a relatively large sample size, the findings may not fully represent the anatomical and demographic diversity observed across different regions and populations, thereby limiting the generalizability of the results

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