

A Hand-Palm Technique for Localization of the Greater Trochanter Tip During Proximal Femoral Nailing: A Prospective Pilot Validation Study

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Learning Point of the Article:

The “hand-palm technique” is a practical surface landmarking aid for localization of the greater trochanter tip and demonstrates satisfactory localization accuracy in a pilot validation study.

Abstract

Introduction: An accurate localization of the tip of the greater trochanter (GT) is required for proper skin incision placement and correct entry point creation during proximal femoral nailing (PFN) for intertrochanteric femur fractures. Direct palpation of the GT tip may be unreliable in obese or edematous patients, potentially resulting in extended incisions and improper entry points. This study describes the “hand-palm technique,” a surface landmarking method for localization of the GT tip.

Materials and Methods: The technique was applied in two variations based on the surgeon's glove size. For surgeons with glove size ≥ 7 , the width of four medial fingers placed along the iliac crest from the anterior superior iliac spine was used to identify the GT tip. For surgeons with glove size ≤ 6.5 , the entire palm, including the thumb, was used similarly. Fluoroscopic confirmation was performed in all cases. In addition, an observational pilot study involving 41 patients undergoing PFN was conducted to assess localization accuracy, fluoroscopy usage, operative parameters, and reproducibility of the technique. Descriptive statistical analysis and subgroup comparison between obese and non-obese patients were performed. A body mass index-based subgroup analysis was additionally performed to assess localization accuracy, fluoroscopy usage, reproducibility, and operative parameters across different body habitus categories.

Results: A total of 41 patients were included in the pilot study. The mean localization error from the fluoroscopically confirmed GT tip was 2.19 ± 1.74 mm, and the mean number of fluoroscopic images required was 1.66 ± 0.62 . The mean operative time was 39.90 ± 7.01 min, the mean blood loss was 119.51 ± 49.85 mL, and the mean incision length was 5.61 ± 0.40 cm. Obese patients demonstrated a trend toward higher localization error and fluoroscopy requirement compared with non-obese patients.

Conclusion: The hand-palm technique is a simple and practical surface landmarking method with satisfactory localization accuracy in this pilot study. It may reduce repeated fluoroscopic localization attempts and unnecessary incision extension, particularly in obese or edematous patients. However, fluoroscopic confirmation remains essential, and further prospective studies are needed to validate it.

Keywords: Greater trochanter tip, incision, entry point, proximal femoral nailing, intertrochanteric femur fracture, hip arthroplasty.

Introduction

Proximal femoral nailing (PFN) is widely used for the surgical management of intertrochanteric femur fractures. Nowadays, the commonly used implants in various hospital setups are PFN

(conventional PFN), PFN antirotation, and InterTan, which are minimally invasive [1]. These nails have a greater trochanteric tip entry point because of their lateral bend in the coronal plane [2]. Thus, the surface landmark location of the greater trochanter

Author's Photo Gallery



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Figure 1: For surgeons with hand glove size >7, the anterior superior iliac spine is indicated with a skin marker. Consequently, using the width of the surgeon's four medial fingers (from the index to the little finger), a point is marked on the iliac crest.

(GT) tip is the most vital step at the beginning of the surgery using these implants, which helps in applying the appropriate skin incision and entry points. The localisation of the GT tip becomes difficult in edematous and obese patients, potentially resulting in a malpositioned entry point or an unnecessarily extended skin incision, which should ideally be placed 3–5 cm from the GT tip [3] and may be associated with other complications [2]. In this report, we describe a simple, reliable, reproducible surface marking, the “hand-palm technique,” to locate the tip of the GT, which is confirmed by C-arm images. A



Figure 2: From the marked point (as in Figure 1), the four fingers are aligned parallel to the iliac crest. A point is then marked that indicates the precise location of the tip of the greater trochanter.

pilot observational study was additionally conducted to evaluate the clinical applicability, localization accuracy, reproducibility, and operative parameters associated with the technique.

Materials and Methods

Written informed consent (consent to participate and consent to publish) was obtained from all participants, and IEC approval was sought (AIIMS/IEC/M12/F379/2026). A prospective pilot observational study was performed in 41 patients undergoing PFN for intertrochanteric femur fractures between February and May 2026. Patient demographics, body mass index (BMI) distribution, localization accuracy, fluoroscopy usage, operative parameters, and reproducibility of the technique were evaluated. The marked point identified using the hand-palm technique was correlated with fluoroscopic confirmation of the GT tip in all patients.

Table 1: Demographic and baseline characteristics of patients

Total (<i>n</i>)	Mean age (years)/range	Mean BMI (kg/m ²)/Median/ range	Male patients, <i>n</i> (%)	Female patients, <i>n</i> (%)	Obese patients (BMI ≥30), <i>n</i> (%)	Overweight (25–29.9), <i>n</i> (%)	Normal BMI (18.5–24.9), <i>n</i> (%)	Underweight (BMI <18.5), <i>n</i> (%)
41	61.85±9.70 (42–80)	22.79±3.01/22.3 5/(18.2–31.8)	20 (48.8)	21 (51.2)	2 (4.9)	6 (14.6)	32 (78.0)	1 (2.4)
Fracture type (AO type 31A)			Number of patients (<i>n</i>)			Percentage		
Type A1			25			60.9		
Type A2			12			29.3		
Type A3			4			9.8		
Total			41			100		
Values are expressed as frequency and percentage of the total study population. Values are expressed as mean±standard deviation unless otherwise specified. BMI: Body Mass Index.								



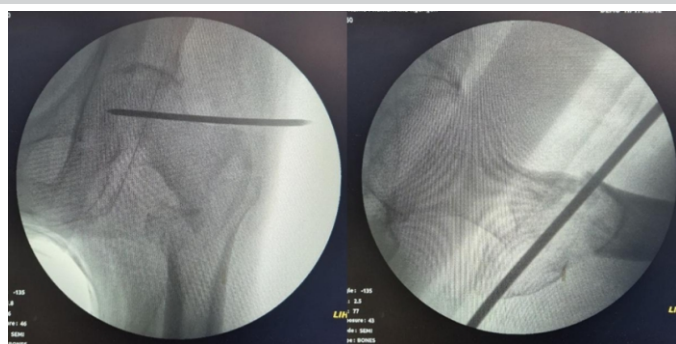


Figure 3: The marked location (as in Figure 2) was verified through fluoroscopic imaging (both anteroposterior and lateral views) using a metal marker to confirm the location of the greater trochanter tip.

Statistical analysis

Descriptive statistical analysis was performed using mean $\pm$ standard deviation, median, range, and frequency distribution. Subgroup analysis between obese and non-obese patients was performed using the Mann-Whitney U test. Additional BMI subgroup analysis was performed among underweight, normal BMI, overweight, and obese patients to evaluate validation parameters, reproducibility, and operative outcomes. $AP < 0.05$ was considered statistically significant.

Hand palm technique

The technique is outlined in two scenarios to ensure reproducible outcomes:

- For surgeons using hand gloves size 7 or larger
- For surgeons using gloves size 6.5 or smaller.

Table 2: Technique validation parameters

Parameter	Value
Mean localization error from fluoroscopic GT tip (mm)/range	2.19 $\pm$ 1.74 (0–5.4)
Median localization error (mm)	2.1
Mean fluoroscopic images required/range	1.66 $\pm$ 0.62 (1–3)
Median fluoroscopic images required	2
Cases requiring incision extension, <i>n</i> (%)	3 (7.3)
Cases without incision extension, <i>n</i> (%)	38 (92.7)

Values are expressed as mean $\pm$ standard deviation unless otherwise specified. GT: Greater trochanter



Figure 4: For surgeons with hand glove size <6.5 , the anterior superior iliac spine (ASIS) is marked. The surgeon uses the width of the entire palm. From the ASIS, a point is marked on the iliac crest.

For a surgeon wearing gloves sized 7 and above

In this case, the patient was laid supine on the fracture table with traction applied. Following the closed reduction of the fracture, painting and draping procedures were performed. The anterior superior iliac spine (ASIS) was indicated with a skin marker. Subsequently, using the width of the surgeon's four medial fingers (from index to little), a point was marked on the iliac crest (Fig. 1). From this marked point, the four fingers were aligned parallel to the iliac crest (Fig. 2). A point was then marked that indicates the precise location of the tip of the GT. This location was verified through direct palpation of the GT tip in the designated area and through fluoroscopic imaging (both anteroposterior and lateral views) utilizing a metal marker to confirm the technique (Fig. 3).

For a surgeon with glove size 6.5 and below

In a similar manner to the previous description, after the closed reduction of the fracture, painting and draping were conducted.



Figure 5: The palm is positioned parallel to the marked point over the iliac crest (as in Figure 4), which gives the location of the tip of the greater trochanter.

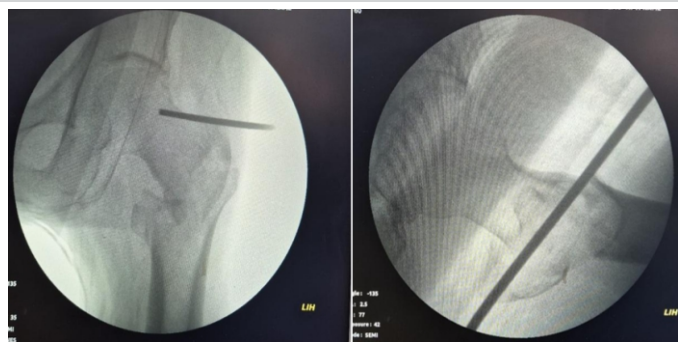


Figure 6: The marked point (as in Figure 5) is confirmed with a metallic marker using C-arm images (anteroposterior and lateral views).

The ASIS was marked. In this instance, the surgeon used the width of all fingers, including the thumb, thereby employing the entire palm. From the ASIS, a point was marked on the iliac crest, and then the palm was positioned parallel to the iliac crest. The marked point indicated the location of the GT tip, which was confirmed using a metal marker and C-arm imaging (Figs. 4, 5, 6).

Results

A total of 41 patients were included in the pilot study. The mean age was 61.85 ± 9.70 years, and the mean BMI was 22.79 ± 3.01 kg/m². Patient demographic characteristics and baseline parameters are summarized in Table 1. Fracture type distribution among the study population is shown in Table 1. Type A1 fractures were the most common pattern (60.9%), followed by type A2 (29.3%) and type A3 fractures (9.8%).

The hand-palm technique demonstrated satisfactory localization accuracy with a mean localization error of 2.19 ± 1.74 mm from the fluoroscopically confirmed GT tip. The mean number of fluoroscopic images required was 1.66 ± 0.62 . Technique validation parameters are summarized in Table 2.

Operative parameters including operative time, blood loss, fluoroscopy time, and incision length were also analyzed and

Table 3: Operative parameters

Parameter	Value
Mean operative time (minutes)/range	39.90 ± 7.01 (25–54)
Median operative time (minutes)	40
Mean blood loss (mL)/range	119.51 ± 49.85 (50–200)
Median blood loss (mL)	100
Mean fluoroscopy time/range	3.98 ± 0.65 (3–5)
Median fluoroscopy time	4
Mean incision length (cm)/range	5.61 ± 0.40 (5–6.4)
Median incision length (cm)	5.6
Values are expressed as mean±standard deviation unless otherwise specified	

are summarized in Table 3.

Subgroup analysis demonstrated a trend toward greater localization error and increased fluoroscopic image requirement in obese patients compared with non-obese patients, although the difference was not statistically significant (Table 4).

BMI subgroup analysis demonstrated variations in localization accuracy, fluoroscopy requirement, reproducibility, and operative parameters among underweight, normal BMI, overweight, and obese patients. Obese patients demonstrated comparatively higher localization error and fluoroscopic image requirement, whereas overweight patients showed relatively higher operative time and blood loss. BMI-wise validation and operative parameters are summarized in Table 5. Incision extension was required in 3 patients (7.3%), including one patient each from the normal BMI, overweight, and obese categories.

Table 4: Subgroup analysis between obese and non-obese patients

Variable	Obese patients (n=2)	Non-obese patients (n=39)	P-value*
Localization error (mm)	3.75 ± 2.33	2.11 ± 1.71	0.258
Fluoroscopic images required	2.00 ± 0.00	1.64 ± 0.63	0.359
Values are expressed as mean±standard deviation. *Subgroup comparison performed using Mann-Whitney U test. $P < 0.05$ was considered statistically significant			

Discussion

Intertrochanteric femur fractures are widely treated with PFNs with newer designs nowadays. The studies related to the surgical outcomes of these implants have documented less blood loss during surgery because of smaller surgical incisions and less operating time [1,4,5,6]. In a scenario of obese patients, an extended incision because of improper localization of the GT tip may lead to excessive blood loss; hence, proper identification of the tip of the GT is necessary. Furthermore, studies in the literature [4,5,7] have reported less use of fluoroscopy images while using newer designs of PFN. In the

Table 5: BMI-wise validation, reproducibility, operative parameters

BMI category	n	Localization error (mm) mean±SD	Fluoroscopic images mean±SD	Reproducibility Mean±SD	Operative time (min) mean±SD	Blood loss (mL) mean±SD	Fluoroscopy time Mean±SD	Incision length (cm) mean±SD
Underweight (<18.5)	2	1.20±1.70	1.00±0.00	0.50±0.71	44.50±0.71	75.00±35.36	4.00±0.00	5.65±0.21
Normal BMI (18.5–24.9)	32	2.35±1.68	1.72±0.63	0.53±1.11	39.50±6.90	120.31±50.58	3.97±0.69	5.67±0.41
Overweight (25–29.9)	5	0.96±1.60	1.40±0.55	1.60±1.14	44.60±5.77	130.00±57.01	4.00±0.71	5.28±0.22
Obese (≥30)	2	3.75±2.33	2.00±0.00	0.00±0.00	30.00±0.00	125.00±35.36	4.00±0.00	5.50±0.28

Values are expressed as mean±standard deviation. Localization error was calculated as the distance between the marked point and the fluoroscopically confirmed greater trochanter tip. Reproducibility was assessed using interobserver variation. Operative parameters were analyzed according to BMI subgroup distribution. BMI: Body mass index, SD: Standard deviation

present pilot study, the mean number of fluoroscopic images required was low (1.66 ± 0.62), suggesting that the technique may help reduce repeated C-arm localization attempts and associated radiation exposure. Although direct palpation techniques for identifying the GT tip have been described [3,7], palpation may be difficult in patients with increased soft-tissue thickness or obesity. Anatomical variability among patients, including differences in pelvic width, body habitus, obesity, soft tissue thickness, and skeletal proportions, may influence the exact surface relationship between the ASIS and the GT tip [2]. Potential inaccuracies may therefore occur in markedly short, tall, obese, or anatomically variant individuals, as obesity and altered body habitus may increase the difficulty of surface landmark identification and fluoroscopic localization during femoral nailing procedures [8]. BMI-wise subgroup analysis in the present pilot study demonstrated comparatively higher localization error and fluoroscopic image requirement among obese patients. However, operative parameters remained within acceptable limits across all BMI categories, suggesting that the technique may still be clinically applicable in patients with varying body habitus. Hence, the hand-palm technique may be considered an adjunctive surface localization aid, and fluoroscopic confirmation remains essential before definitive entry point creation. The technique may also help in positioning the correct entry point without damaging nearby structures such as abductors and tendons, the capsule of the hip joint, and the division of the medial circumflex femoral artery [2,9]. Hence, the hand-palm technique appears to be a practical and reproducible surface landmarking aid for localization of the GT tip. The technique may also have potential utility in hip arthroplasty performed through a posterolateral approach, where the GT tip is used as a surface landmark for skin-incision placement [3], unless there is no proximal migration of the GT.

Furthermore, the technique is useful for intra-articular hip injections in the outpatient clinic, where palpating the GT tip is a vital step for locating the landmark of the injection site [10,11,12]. It is easy to learn and apply, making it beneficial for trainees and in less-resourced settings.

Limitations

The present study has certain limitations. This was a pilot observational study with a relatively small sample size and without a comparative control group. Although operative parameters and localization accuracy were assessed, direct comparison with conventional palpation techniques was not performed. Larger prospective comparative studies are required to further validate reproducibility and clinical utility.

Conclusion

The hand-palm technique is a simple and practical surface landmarking method for approximate localization of the GT tip during PFN. The technique demonstrated satisfactory localization accuracy in this pilot study and may be particularly useful in obese or edematous patients, in whom direct palpation is difficult. However, fluoroscopic confirmation remains essential before definitive skin incision and entry point creation. Further prospective comparative studies are required for validation.

Clinical Message

The “hand-palm technique” is a practical surface landmarking aid for localization of the greater trochanter tip and demonstrates satisfactory localization accuracy in a pilot validation study.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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