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Original Article

A Comparative Study between Dynamic Hip Screw and Proximal Femoral Nail in Fixing Intertrochanteric Fractures

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ABSTRACT

Background: Among the elderly, intertrochanteric fractures are among the most commonly encountered fractures.

Aim of the work: The goal was to assess the dynamic hip screw [DHS] versus interlocking nail in the treatment of intertrochanteric fractures, focusing on fracture union, complications, and functional outcomes.

Patients and Methods: In this prospective randomized control trial, 40 patients with intertrochanteric fractures were treated using either a DHS or an interlocking nail at the duration from September 2022 to March 2024. which 20 cases were managed by DHS [group I] and also, 20 cases were managed by GAMMA Nail [group II]

Results: Key differences between the two groups were found. Group I had a significantly higher rate of blood transfusions compared to Group II [$p < 0.001$], but there were no significant differences in surgery duration or timing between the groups. In terms of outcomes, Group I showed a higher proportion of unsatisfactory functional results despite having satisfactory anatomical outcomes, whereas Group II demonstrated better alignment between anatomical and functional results. Additionally, for patients under 65, Group I had more satisfactory functional outcomes. Smoking was found to be associated with poorer functional results and longer time to union in Group I, but this effect was not observed in Group II.

Conclusion: The Gamma Nail [Group II] showed better anatomical-functional alignment, while Group I had more unsatisfactory functional results and required more blood transfusions. However, Group I performed better in younger patients under 65, suggesting it may be more effective for them.

Keywords: Dynamic Hip Screw; Fracture Union; Intertrochanteric Fractures; Proximal Femoral Nail [Gamma Nail]

INTRODUCTION

The prevalence of intertrochanteric fractures in the elderly is rising, in part because of increased life expectancy, population expansion, industrialization, and traffic accidents [1]. Roughly 10% of these fractures in younger patients are brought on by high-energy trauma, such as falls from a height or accidents. In contrast, about 90% of these fractures occur in older people as a result of minor falls brought on by weakening bones from osteoporosis or other pathological conditions [2].

Comorbidities such as diabetes mellitus, hypertension, coronary artery disease, chronic renal failure, and thyroid disorders are frequently linked to fractures in older adults and raise the risk of complications during anesthesia [3]. In order to lower morbidity and mortality in elderly patients and restore pain-free, active lives for younger patients, early mobilization is essential, as these factors collectively present orthopedic surgeons with considerable challenges in managing fractures [4]. Therefore, in order to support early mobilization and rehabilitation, timely surgical intervention is required [5]. As surgical methods have evolved, the development of new implants has led to the categorization of implants as extramedullary or intramedullary. The Dynamic Hip Screw [DHS], a commonly used extramedullary implant, continues to be regarded as the gold standard for the treatment of intertrochanteric fractures by numerous clinicians [6]. Despite this, several studies have examined the advantages and drawbacks of the DHS, particularly after the introduction of intramedullary devices like the intramedullary nail in 1988 [7].

Although intramedullary devices have been used extensively over the last 20 years, systematic reviews and meta-analyses evaluating their efficacy in comparison to conventional DHS implants have failed to identify a definitive implant for the treatment of trochanteric fractures [8].

The goal of this study was to compare the performance of the DHS and interlocking nail in treating intertrochanteric fractures, concentrating on union rates, complications, and functional outcomes.

PATIENTS AND METHODS

A dynamic hip screw [DHS] and an intramedullary nail [GAMMA Nail] were used to treat 40 patients with intertrochanteric fractures respectively in this randomized controlled trial. From September 2022 to March 2024, the study was conducted, and each patient was monitored for six months. All patients received the standard pre-anesthetic evaluations, and informed consent was acquired after the study's full details were presented. Clinical and radiological follow-up evaluations were performed at 6, 12, 18, and 24 weeks to gauge recovery and results. In accordance with the Declaration of Helsinki and other pertinent guidelines, the study was examined and approved by the ethical committee. Every participant provided their informed consent prior to enrollment, and their information was kept private. Withdrawing from the study at any time did not impact the participants' course of treatment.

In order to exclude patients with other significant fractures that might affect the outcome or rehabilitation, the study only included patients who were over 18 and had a trochanteric femur fracture. Patients who could have surgery within two weeks of the trauma and who were ambulatory prior to the injury were eligible. Participants who had open fractures, pathological fractures from tumors or metastases, were medically unfit for anesthesia, had psychiatric or chronic neuromuscular disorders, had trauma that lasted longer than two weeks, or declined to participate in the study were excluded.

Initial assessments were conducted at Shebin El Kom Teaching Hospital, Al-Zahraa University Hospital and Minia University Hospital, including physical examination and radiographs. Surgeries were performed under spinal anesthesia using standard approaches for DHS and interlocking nails. Post-operative care included antibiotics, analgesics, physiotherapy, and gradual weight-bearing, with follow-up focusing on clinical recovery, radiographic union, and complications such as angulation or limb length discrepancies.

Data collection involved a detailed history, including personal details, injury mechanism, time since fracture, pre-injury ambulation, and medical history such as comorbidities and medications. A general examination assessed vital signs, associated injuries, and skin condition, while the local exam focused on the injury site. Radiological assessments included preoperative X-rays to evaluate fracture characteristics and follow-up X-rays at 2, 6, and 12 weeks. Laboratory tests included complete blood count, blood glucose, liver and renal function, bleeding profile, and viral markers for HBV, HCV, and HIV.

Preoperative management included stabilizing the patient, classifying the fracture with X-rays, applying skin traction, correcting dehydration and anemia, and administering prophylactic antibiotics. Spinal anesthesia was given, and the patient was positioned on the fracture table with proper supports and padding.

In Group I [DHS], the patient was positioned supine on the traction table, and traction was applied prior to internal rotation and abduction in order to reduce the fracture. An open reduction was carried out using a lateral approach in situations where closed reduction was unsuccessful. The femoral shaft was made visible by splitting the iliotibial tract and making a straight incision beneath the greater trochanter. This raised the vastus lateralis muscle. The placement of a guide wire into the femoral head was verified by fluoroscopy. A lag screw was put in, the femoral head was reamed, and the DHS plate was put on and secured. The wound was layered closed after the fracture was compressed using the DHS compression screw.

Similar to Group I, the patient in **Group II [Gamma Nail]** had their fracture lessened by traction and adduction. To access the femoral medullary canal, a cannulated awl was used to make a tiny incision 2–5 cm above the greater trochanter. The right size Gamma nail was inserted after the canal was reamed. The nail's proximal and distal ends were secured with locking screws, and screw rotation was avoided by using a set screw. Layers were finally applied to close the wound.

Postoperative care: Patients were advised to follow a partial weight-bearing regimen, depending on the stability of the fracture, with full weight-bearing allowed once healing was adequate. Follow-up visits were planned at 2 weeks for suture removal, and then at 6 weeks, 12 weeks, and 6 months for ongoing clinical and radiological assessments, including evaluation of fracture healing, screw positioning, and monitoring for complications.

The results were evaluated using Foster's grading system, which assessed both functional and anatomical outcomes.

For functional grading, the categories were as follows: ***Excellent*** was defined as walking without limping or pain; ***Good*** indicated walking with crutches; ***Fair*** involved using crutches with considerable limping or pain; and ***Poor*** described being bedridden or chair-bound.

In terms of anatomical grading, ***Excellent*** signified union in an anatomical position; ***Good*** represented union with minimal deformity; ***Fair*** reflected union with moderate deformity; and ***Poor*** indicated significant deformity or shortening. This comprehensive grading system

enabled a thorough evaluation of both the functional recovery and the healing of the fracture.

Table [1]: Foster's grading system [9].

	Functional grading	Anatomical grading
Excellent	Walks well as before operation, no limping, no pain	Union in anatomical position
Good	Walks well, uses crutches to go out	Union with less than 10º varus, minimal shortening
Fair	Requires crutches, considerable limping or pain	Union with 20-25º varus, half to one inch shortening
Poor	Bed-ridden or confined to chair	Varus deformity of 25º or more or over an inch of shortening

Sample Size: To calculate the sample size for a study comparing DHS and GAMMA Nail outcomes, several factors needed to be considered, such as significance level [alpha = 0.05], statistical power [80%], and expected proportions of satisfactory outcomes [15% for DHS and 90% for GAMMA Nail]. Using a standard formula for comparing two independent proportions, the required sample size per group is calculated to be approximately 15 participants. This ensures 80% power to detect a significant difference between the groups, assuming a 95% confidence level and the specified proportions of satisfactory outcomes.

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \cdot (p_1(1-p_1) + p_2(1-p_2))}{(p_1 - p_2)^2}$$

Statistical analysis: The study utilized IBM SPSS version 28.0 for statistical analysis, applying descriptive statistics to the demographic and clinical data. Chi-square and t-tests were used to compare baseline variables between the GAMMA Nail and DHS groups. Outcome measures were analyzed using appropriate tests, and subgroup analyses were conducted, considering a significance level of $p < 0.05$.

RESULTS

Table [2] showed that Group-I had a significantly higher rate of blood transfusions [70%] compared to Group II [30%] with a p-value of <0.001. No significant differences were found between the groups in terms of duration before surgery, time to surgery, or surgery duration, with comparable results in these categories.

Table [3] showed a significant difference in the alignment between anatomical and functional outcomes between the two groups. Group I [DHS] had a higher rate [70%] of unsatisfactory functional results despite satisfactory anatomical outcomes, while Group II [Gamma Nail] had 90% satisfactory outcomes in both categories [p < 0.001].

Table [4] highlighted the relationship between functional outcomes and age in both groups. In patients under 65, a significant difference was found, with Group I [DHS] showing a higher proportion of satisfactory functional outcomes [60%] compared to Group II [50%] [p = 0.032]. However, no significant differences were observed in patients aged 65 and above, as both groups showed similar functional results [p = 0.465].

Table [5] showed that smoking negatively impacted functional outcomes in both groups. In Group I [DHS], smokers had a significantly higher rate of unsatisfactory functional results [20%] compared to non-smokers [0%] [p = 0.045]. While smokers in Group II [Gamma Nail] also showed poorer outcomes, the effect was less pronounced than in Group I.

Table [6] showed that in Group I [DHS], smokers had a significantly longer time to union [mean = 2.35 ± 0.63] compared to non-smokers [mean = 1.95 ± 0.44], with a p-value of 0.014, indicating a negative impact of smoking on healing. However, in Group II [Gamma Nail], no significant difference was observed in the time to union between smokers and non-smokers [p = 0.648], suggesting that smoking may not affect healing in this group.

Table [2]: Comparison between the two studied groups according to operation data.

Operation Data	Group I [n=20]	Group II [n=20]	Test of Sig.	p
Blood Transfusion				
No	6 [30.0%]	14 [70.0%]	χ^2=5.333	<0.001*
Yes [one packed RBCs]	14 [70.0%]	6 [30.0%]		
Duration before surgery [days]				
<4	14 [70.0%]	15 [75.0%]	χ^2=0.067	0.796
>4	6 [30.0%]	5 [25.0%]		
Min. – Max.	2.0 - 7.0	2.0 - 7.0		
Mean ± SD.	3.75 ± 2.45	3.75 ± 2.45	U=200.0	1.000
Time of surgery [min]				
≤ 50	3 [15.0%]	7 [35.0%]	χ^2=2.057	0.151
> 50	17 [85.0%]	13 [65.0%]		
Min. – Max.	50.0 - 80.0	50.0 - 80.0		
Mean ± SD.	64.75 ± 7.86	63.50 ± 8.13	U=182.50	0.612

Table [3]: Relation between functional results and anatomical results in each group.

Anatomical Grading \ Functional Grading	Group I [n=20]	Group II [n=20]	χ^2	p
Unsatisfactory \ Unsatisfactory	2 [10.0%]	1 [5.0%]	4.211	0.200
Unsatisfactory \ Satisfactory	1 [5.0%]	1 [5.0%]		
Satisfactory \ Unsatisfactory	14 [70.0%]	0 [0.0%]	20.000	<0.001*
Satisfactory \ Satisfactory	3 [15.0%]	18 [90.0%]		

Table [4]: Relation between functional results and age in each group.

Age [years] \ Functional Grading	Group I [n=20]	Group II [n=20]	χ^2	p
<65				
Unsatisfactory	0 [0.0%]	2[10.0%]	4.6	0.032*
Satisfactory	12 [60.0%]	10[50 .0%]		
≥65				
Unsatisfactory	1[5.0%]	0[0.0%]	0.533	0.465
Satisfactory	7 [35.0%]	8[40.0%]		

Table [5]: Relation between functional results and smoking in each group.

Smoking \ Functional Grading	Group I [n=20]	Group II [n=20]	χ^2	p
Smoking				
Unsatisfactory	4 [20.0%]	1 [5.0%]	2.003	0.045*
Satisfactory	7[35.0%]	9[45.0%]		
Not Smoking				
Unsatisfactory	0 [0.0%]	2[10.0%]	2.022	0.045*
Satisfactory	9 [45.0%]	8 [40.0%]		

Table [6]: Relation between smoking and time of union in each group.

Time of Union \ Smoking	Group I [n=20]	Group II [n=20]	t	p
Smoking				
Min. – Max.	1.50 – 3.0	1.50 – 3.0	7.500	0.014*
Mean ± SD.	2.35 ± 0.63	2.27 ± 0.61		
Not Smoking				
Min. – Max.	1.50 – 3.0	2.0 – 3.0	0.465	0.648
Mean ± SD.	1.95 ± 0.44	2.39 ± 0.49		

Cases:

Case 1: In a traffic accident, a 36-year-old man from Shebin Elkom, Menoufia Governorate, suffered an intertrochanteric fracture of his left femur. He had no pre-existing conditions or other injuries. Surgery was done on the second day after the trauma, and open reduction internal fixation [ORIF] using DHS was used to treat the fracture, which was graded as A/O 31-A13. The sixth week was chosen as the new date for partial weight-bearing. The patient had a full range of motion, little pain, and an exceptional ability to walk after the procedure, and the fracture healed successfully and without infection over the course of a 3-month follow-up [Figure 1].

Case 2: A fall caused an intertrochanteric fracture of the right femur in a 63-year-old man from the Menoufia Governorate. He has hypertension and diabetes, but no prior surgical history. On the third day after the injury, a Gamma III nail was used for closed reduction internal fixation of the fracture, which was identified as A/O 31-A13. Weight-bearing was postponed for six weeks. Full joint motion, little pain, and good walking ability were among the excellent postoperative outcomes at the 3-month follow-up, when the fracture had healed without any indications of infection. Excellent was the rating given to the postoperative score **[Figure 2].**

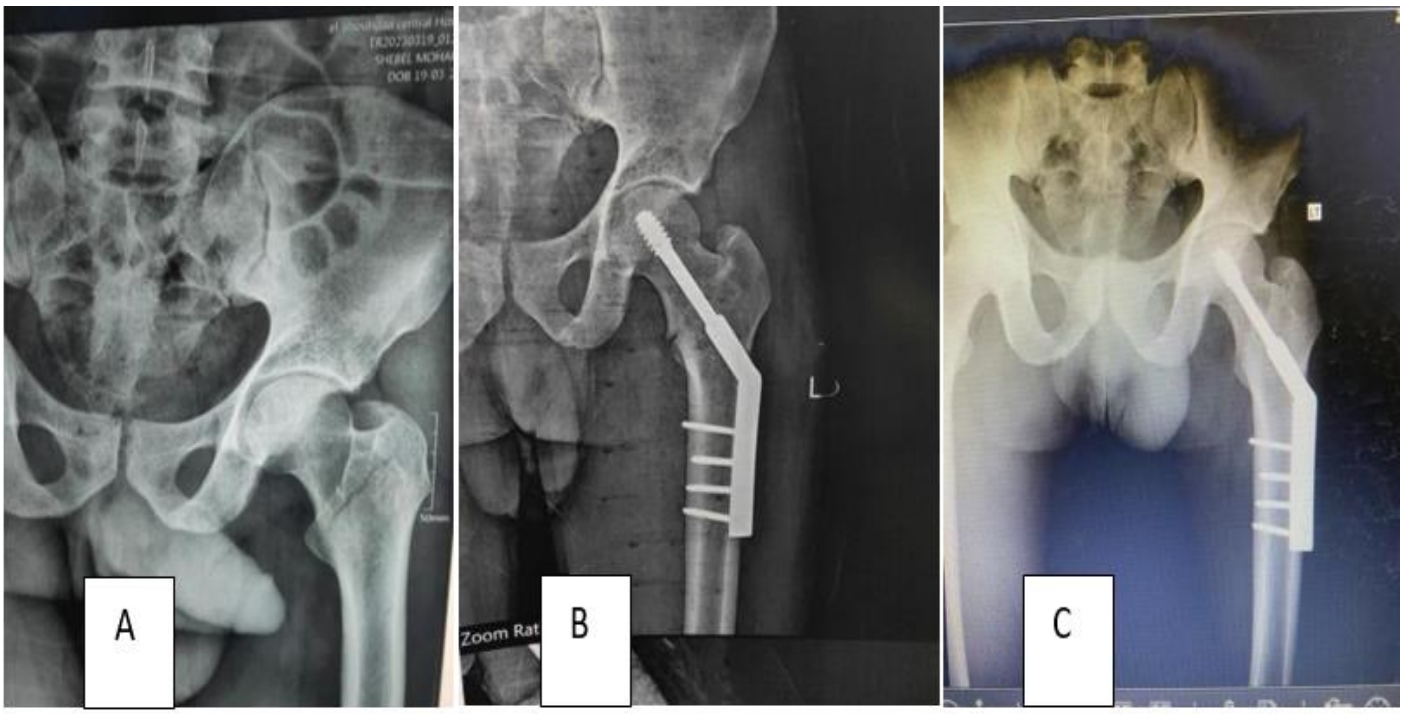

Figure [1]: [A] Preoperative radiographs. [B] Postoperative radiographs. [C] Radiograph taken 6 months after surgery.

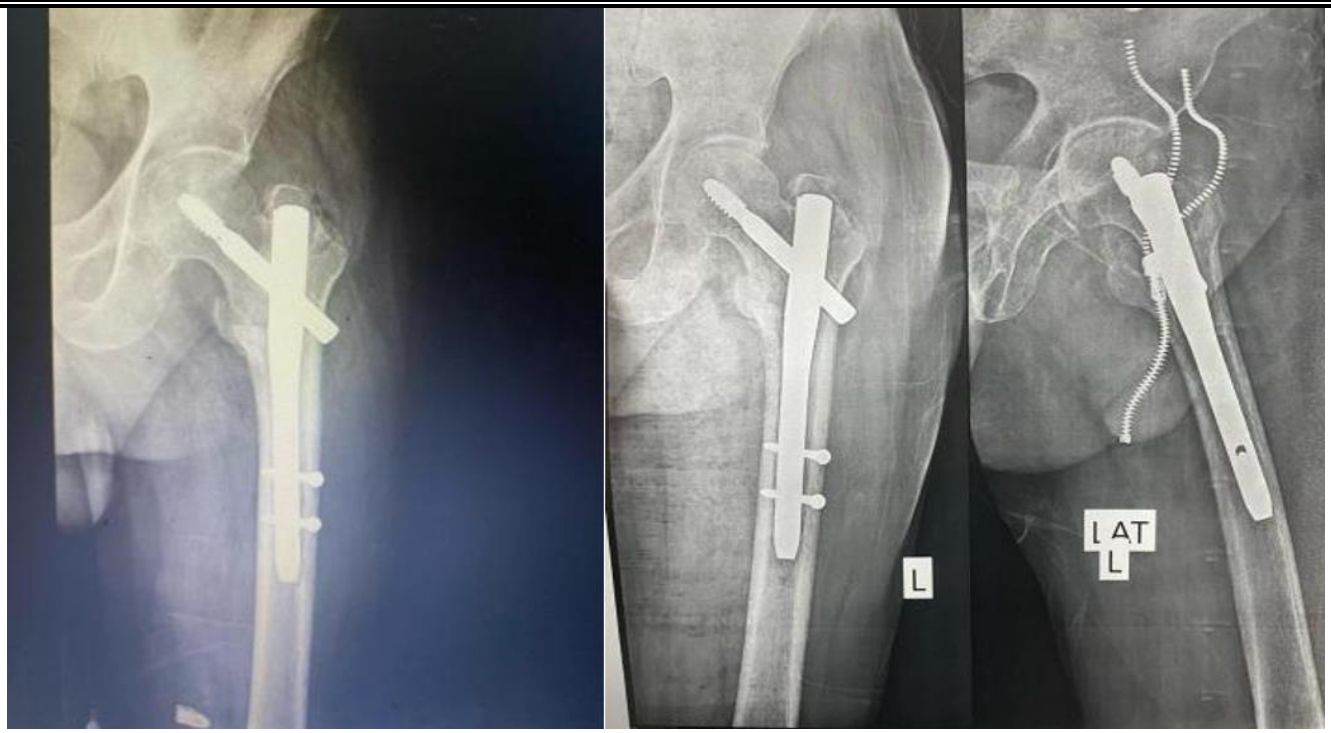

Figure [2]: [A] X-rays taken before the operation. [B] X-rays taken after the surgery. [C] X-ray taken 6 months after the surgery.

DISCUSSION

Orthopedic clinicians face a great deal of difficulty in fixing intertrochanteric femur fractures, especially when it comes to maximizing functionality, minimizing complications, and achieving proper alignment. The advantages of surgical intervention over conservative approaches in fostering early rehabilitation and functional recovery have made it the preferred course of treatment. The two main methods for fixing fractures are intramedullary and extramedullary fixation [10]. In order to treat intertrochanteric fractures, this study compared the dynamic hip screw [DHS] and interlocking nail in terms of union, associated complications, and functional outcome. There was a notable disparity in the two groups' blood transfusion rates, with Group I needing more transfusions than Group II. However, variables like the time and length of the surgery were the same for both groups, indicating that the higher transfusion rates in Group I have nothing to do with surgical complexity or delays. According to **Khan *et al.*** [1], the DHS group required more transfusions than the other group because they had a longer surgical time [125.17 minutes] and suffered more blood loss [89.93 minutes].

Our study revealed a significant difference in the alignment between anatomical and functional outcomes between the two groups. Group I, which received the Dynamic Hip Screw [DHS], had a higher rate [70%] of unsatisfactory functional results, despite achieving satisfactory anatomical outcomes. Conversely, Group II, treated with the Gamma Nail, achieved 90% satisfactory outcomes in both anatomical and functional categories [$p < 0.001$]. These findings suggest that the Gamma Nail may offer a more balanced and effective approach, leading to superior overall outcomes in both anatomical healing and functional recovery compared to DHS. **Jewell *et al.*** [11] supported the hypothesis that the Gamma III nail offers a stronger build than the DHS plate. They suggested the Gamma III nail may be particularly beneficial for patients with poor-quality osteoporotic bone or unstable fracture topologies. This agree with our study, where we observed better functional outcomes with the Gamma Nail overall.

In contrast to our findings, **Badawy *et al.*** [12] reported no significant difference in functional and anatomical outcomes between the two groups, both of which achieved satisfactory results in over 80% of cases. Specifically, Group I [DHS] showed a distribution of functional outcomes with five patients achieving excellent, nine good, two fair, and one poor results. Group II [Gamma Nail] had five excellent, ten good, one fair, and one poor functional outcome. Anatomically, Group I had five excellent, ten good, and two fair outcomes, while Group II had four excellent, twelve good, and one fair outcome, with no poor cases in either group. Consequently, their study found functional and anatomical outcomes to be similar between the two groups. **Sharma *et al.*** [13] also compared the clinical and radiological outcomes of stable intertrochanteric fractures treated with the proximal femoral nail or DHS. While the DHS group had marginally lower 1-month Harris Hip Scores than the proximal femoral nail group, by 3 and 6 months, the DHS group had higher mean scores. At 1 year, both groups showed similar scores. Their study concluded that the proximal femoral nail provides a significantly shorter surgery with fewer wound-related complications. However, they noted that the proximal femoral nail was more technically challenging, leading to a higher rate of technical errors, implant failures, and reoperations.

while our study supports the superiority of the Gamma Nail over DHS in terms of both anatomical and functional outcomes, other studies have reported mixed results. Variations in findings may be attributed to differences in patient characteristics, study designs, and assessment methods. The findings of this study provide valuable insights into the relationship between age and functional outcomes across both treatment groups. In patients under 65, a notable difference in functional outcomes was observed, with Group I [DHS] demonstrating a higher proportion of satisfactory results [60%] compared to Group II [50%]. This suggests that in younger patients, the DHS may offer better functional outcomes. However, in patients aged 65 and above, no significant differences were found between the two groups, with both Group I and Group II showing similar functional results. These findings imply that age may play a crucial role in the effectiveness of treatment, with younger patients potentially benefiting more from the DHS, while the functional outcomes in older patients appear to be less influenced by the choice of treatment method.

Supporting this, **Giessauf *et al.*** [14] reported that in their cohort of 62 patients with intertrochanteric fractures treated with the Gamma III nail,

fair and poor functional outcomes were concentrated in older patients, further highlighting the impact of age on functional recovery. Additionally, **Badawy *et al.*** [12] similarly found that age significantly influenced functional results, with older patients [over 65 years] experiencing poorer functional outcomes, consistent with the notion that younger patients tend to achieve better functional results overall.

The results from our study suggest that smoking has a negative effect on both functional outcomes and healing times, with these effects being more pronounced in Group I [DHS]. Smokers in this group exhibited a notably higher rate of unsatisfactory functional results [20%] compared to non-smokers [0%], and they also experienced longer healing times. However, in Group II [Gamma Nail], although smokers showed poorer functional outcomes, the difference was less significant, and no meaningful difference in healing times was found between smokers and non-smokers. This finding implies that the detrimental effects of smoking on healing may be less severe when using the Gamma Nail treatment.

These results align with previous studies. **Smolle *et al.*** [15] found that smoking significantly impacts the development of nonunions and postoperative infections, supporting the idea that smoking hinders recovery. Similarly, **Messner *et al.*** [16] concluded that active smokers face a higher risk of non-union compared to non-smokers or former smokers, further emphasizing the negative impact of smoking on healing and bone union. This consistency with earlier research strengthens the argument that smoking should be considered a modifiable risk factor in fracture healing and post-surgical recovery.

The study's findings are limited by several factors, including a small sample size, which may affect the generalizability of the results, and a focus on short-term outcomes, highlighting the need for longer follow-up to assess the long-term durability and complications of both the Gamma Nail and Dynamic Hip Screw. Additionally, while smoking was considered, other factors like diet, physical activity, and pre-existing conditions were not fully controlled, which could also influence healing. The study also suggests that the Dynamic Hip Screw may be more effective for patients under 65 but does not account for age-related factors like bone density or comorbidities. Future research should involve a larger, more diverse sample, include longer follow-up to assess long-term outcomes, control for a broader range of influencing factors, and explore the impact of age-related variables to refine treatment recommendations.

Conclusion: Based on this study, the Gamma Nail [Group II] appears to be the better option overall, as it demonstrated better alignment between anatomical and functional outcomes compared to the Dynamic Hip Screw [Group I]. While Group I showed satisfactory anatomical results, it had a higher rate of unsatisfactory functional outcomes, and required more blood transfusions, which may indicate a higher degree of surgical complexity or complications. Furthermore, the Gamma Nail did not show the same negative impact of smoking on functional recovery, as observed in Group I. However, for patients under 65, Group I had more satisfactory functional outcomes, suggesting that the Dynamic Hip Screw may be more effective for younger, healthier patients.

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