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Comparative Analysis of Functional Outcome in the Management of Unstable Intertrochanteric Fractures by Proximal Femoral Nailing versus Dynamic Hip Screw

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HIGHLIGHTS

- PFN reduced operative duration.
- PFN lowered intraoperative blood loss.
- PFN improved functional recovery.
- HHS improved in both groups.
- Complications were similar between groups.

Key Words:

Intertrochanteric fracture
Proximal femoral nailing
Dynamic hip screw
Harris Hip Score
Functional outcome

ABSTRACT

Introduction: Unstable intertrochanteric fractures require fixation that provides mechanical stability, facilitates early mobilization, and restores functional independence. Proximal femoral nailing (PFN) offers an intramedullary load-sharing construct, whereas dynamic hip screw (DHS) remains a widely used extramedullary device. **Aim & Objective:** To compare functional outcomes of unstable intertrochanteric fractures treated with PFN and DHS using Harris Hip Score (HHS) at one, three, and six months, and to evaluate perioperative and postoperative outcomes between both groups. **Materials & Methods:** This prospective comparative interventional study was conducted over two years in the Department of Orthopaedics, Mysore Medical College and Research Institute, Mysuru. Thirty-two patients aged 40–80 years with unstable closed intertrochanteric fractures were divided equally into PFN and DHS groups (16 each). Functional outcome was assessed using HHS at 1, 3, and 6 months. Operative duration, blood loss, tip-apex distance, and complications were also evaluated. Statistical significance was set at $p < 0.05$. **Results:** Mean operative duration was significantly shorter with PFN than DHS (85.50 ± 10.99 vs 103.00 ± 14.99 minutes; $p = 0.001$), while mean blood loss was lower with PFN (136.88 vs 253.13 mL). The groups were comparable for age, fracture laterality, and Boyd-Griffin fracture type, with Type 2 fractures predominating overall and no significant difference in fracture classification. HHS improved in both groups, but remained higher with PFN at 1 month (66.94 vs 60.13), 3 months (82.69 vs 73.69), and 6 months (86.88 vs 79.56). Tip-apex distance was comparable, and complication rates were similar in both groups. **Conclusion:** Both techniques were effective, but PFN provided superior perioperative efficiency and consistently better functional recovery, supporting its preferential surgical use in unstable intertrochanteric fractures.



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INTRODUCTION

Intertrochanteric fractures are extracapsular fractures of the proximal femur occurring between the greater and lesser trochanters and represent an important component of the global hip-fracture burden [1]. They are encountered predominantly in older adults after low-energy falls, especially in the presence of osteoporosis, although high-energy trauma can produce similar injuries in younger patients. With population ageing, hip fractures continue to impose a major clinical burden because they are associated with pain, loss of mobility, dependence in daily activities, prolonged rehabilitation, and excess mortality [2]. Global data across 204 countries confirm that hip fractures remain an important cause of disability among adults aged 55 years and older, emphasizing the need for fixation strategies that permit early mobilization and durable restoration of function [3].

The treatment challenge becomes greater when the intertrochanteric fracture is unstable. Instability is commonly related to posteromedial comminution, loss of the calcar, disruption of the lateral femoral wall, reverse-obliquity configuration, or subtrochanteric extension. Such patterns have reduced intrinsic bony support and are more susceptible to varus collapse, excessive impaction, shortening, rotational displacement, and fixation failure under physiological loading [4]. Many unstable fractures within the AO/OTA 31-A2 and 31-A3 spectrum therefore require an implant capable of maintaining reduction while resisting axial, bending, and rotational forces until union occurs. Reduction quality, restoration of medial and lateral support, implant position, and bone quality are critical determinants of stability and functional recovery [5].

The principal goals of operative management are acceptable reduction, stable fixation, preservation of limb length and alignment, fracture union, and early mobilization. These objectives are particularly important in elderly patients, in whom prolonged immobility can contribute to medical complications,

s.muscle wasting, and loss of independence. Modern management therefore focuses not only on radiological union but also on pain relief, walking ability, range of motion, return to daily activities, and overall functional recovery. Current guidelines also support early weight bearing to tolerance after surgical treatment when clinically appropriate [5].

The Dynamic Hip Screw (DHS) has long been an established extramedullary fixation method for intertrochanteric fractures. Its sliding lag-screw mechanism permits controlled fracture impaction and can provide reliable fixation when adequate lateral-wall and posteromedial support are present. The implant is familiar to orthopaedic surgeons, comparatively straightforward, and relatively economical [6]. In unstable configurations, however, its longer lever arm and dependence on bony buttresses may permit excessive collapse, varus deformity, limb shortening, screw cut-out, or plate-related mechanical failure. These limitations become particularly important when the lateral wall is compromised or the fracture has a reverse-oblique orientation [4]. Proximal Femoral Nailing (PFN) is an intramedullary, load-sharing method that places the implant closer to the mechanical axis of the femur. Its shorter lever arm reduces the bending moment acting on the fixation construct and provides a biomechanical advantage in unstable fracture patterns [7]. PFN also provides proximal fixation within the femoral head and neck, while distal locking assists in controlling rotational and axial instability. Compared with extramedullary plating, intramedullary fixation generally requires less extensive exposure, and systematic reviews have demonstrated advantages such as shorter operative time and reduced intraoperative blood loss, although functional and complication outcomes have varied among different studies and fracture patterns [8]. Current evidence increasingly supports cephalomedullary fixation for unstable intertrochanteric fractures. The American Academy of Orthopaedic Surgeons gives a strong recommendation based on high-

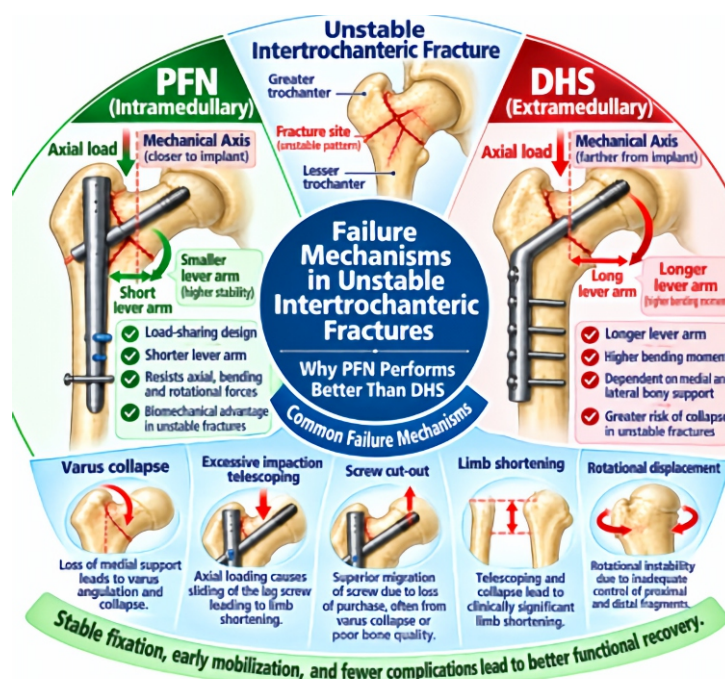


Figure 1: Biomechanical Failure Mechanisms of PFN and DHS in Unstable Intertrochanteric Fractures.

quality evidence that unstable intertrochanteric fractures should be treated with a cephalomedullary device; cephalomedullary fixation is similarly recommended for reverse-obliquity and subtrochanteric fracture configurations. Meta-analyses comparing PFN or proximal femoral nail antirotation with DHS have generally demonstrated shorter operative time and reduced blood loss with intramedullary fixation, while some analyses have shown advantages in functional or mechanical outcomes in unstable fracture [9]. However, randomized-trial syntheses have not demonstrated consistent superiority across every postoperative complication, indicating that implant selection alone does not determine the final clinical result [8].

Functional recovery is central to comparing PFN and DHS because successful fracture fixation should restore mobility and independence rather than merely achieve radiographic union [10]. The Harris Hip Score, incorporating components of pain, function, deformity, and range of motion, has frequently been used for assessment after intertrochanteric fracture fixation. Comparative studies have reported favorable early functional recovery with PFN in unstable fracture patterns, whereas differences between fixation methods may become less pronounced during later follow-up [6]. More recent evidence also suggests some functional advantages of intramedullary nails over DHS, although differences in quality of life and mortality have not consistently been demonstrated [11].

Mechanical complications such as screw cut-out, varus collapse, telescoping, limb shortening, nonunion, implant failure, and reoperation can impair rehabilitation and functional recovery [12]. Although intramedullary nails offer biomechanical advantages, technical errors may cause failure, while DHS may be disadvantaged with deficient lateral or posteromedial support. Therefore, functional, radiological, operative, and complication outcomes require comparison. Comparative evaluation of PFN and DHS in unstable intertrochanteric fractures can guide implant selection, improve fixation stability, support earlier rehabilitation, reduce complications, and enhance functional recovery and quality of life [9].

Figure 1. Biomechanical Failure Mechanisms of Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) in Unstable Intertrochanteric Fractures. The figure illustrates the biomechanical advantages of intramedullary PFN fixation over extramedullary DHS fixation, highlighting differences in mechanical axis, lever arm, load distribution, and resistance to bending and rotational forces. It also depicts common failure mechanisms, including varus collapse, excessive impaction and telescoping, screw cut-out, limb shortening, and rotational displacement, emphasizing the importance of stable fixation for early mobilization and improved functional recovery.

The aim of this study was to compare the functional outcomes of unstable intertrochanteric fractures managed with Proximal Femoral Nailing and Dynamic Hip Screw. The objectives were to evaluate functional recovery following each fixation method using the Harris Hip Score and to compare postoperative functional outcomes between the two groups during follow-up at one, three, and six months after surgery.

MATERIALS & METHODS

This prospective comparative interventional study was conducted over two years at the Department of Orthopaedics, Mysore Medical College and Research Institute, Mysuru. Thirty-two patients aged 40–80 years with unstable closed intertrochanteric fractures fulfilling the eligibility criteria were included and allocated into two equal groups: PFN (n=16) and DHS (n=16). All patients underwent the respective fixation procedure followed by standard postoperative antibiotics, early mobilization, and physiotherapy. Functional outcome was assessed using the Harris Hip Score at 1, 3, and 6 months. Data were analyzed using descriptive statistics, Chi-square test, unpaired t-test/Mann–Whitney U-test, and Cramer's V, with $p < 0.05$ considered statistically significant overall.

RESULTS

Females predominated in both groups, comprising 75.0% of the PFN group and 62.5% of the DHS group, with an overall female proportion of 68.8%. Males accounted for 25.0% and 37.5% in the PFN and DHS groups, respectively. The mean age was 56.06 ± 9.10 years in the PFN group and 58.81 ± 13.50 years in the DHS group. The age difference was statistically non-significant ($p = 0.504$), indicating comparable age distribution between the two treatment groups.

Right-sided fractures were slightly more common overall, occurring in 53.1% of patients, while left-sided fractures accounted for 46.9%. In the PFN group, 56.2% had right-sided and 43.8% had left-sided fractures. In the DHS group, right- and left-sided fractures were equally distributed at 50.0% each. Overall, fracture laterality was nearly balanced between the two treatment groups, suggesting comparable baseline side distribution (**Table 1**). Self-fall was the predominant mode of injury in both treatment groups. In the PFN group, 14 patients sustained fractures following self-fall, while 2 patients had road traffic accident-related injuries. In the DHS group, all 16 patients sustained fractures following self-fall, with no cases due to road traffic accidents. These findings indicate that low-energy self-fall was the principal mechanism responsible for unstable intertrochanteric fractures in this study population (**Figure 2**). Boyd-Griffin Type 2 fractures predominated overall, accounting for 81.2% of cases, with a higher proportion in the PFN group (93.8%) than in the DHS group (68.8%). Type 4 fractures were less frequent overall (18.8%) but were more common in the DHS group (31.2%) compared with the PFN group (6.2%). The difference in fracture-type distribution between the two groups was statistically non-significant ($\chi^2 = 3.282$, $p = 0.172$). Thus, the two treatment groups were broadly comparable with respect to Boyd-Griffin fracture classification (**Table 2**).

Bone quality differed descriptively between the two treatment groups, with good bone quality observed in 9 patients in the PFN group compared with 6 patients in the DHS group. Osteoporotic bone was present in 7 PFN patients and 10 DHS patients. Thus, good bone quality was more frequent in the PFN group, whereas osteoporosis predominated in the DHS group. This distribution indicates a greater burden of poor bone quality among patients

managed with DHS (**Figure 3**). The mean duration of surgery was significantly shorter in the PFN group (85.50 ± 10.99 minutes) compared with the DHS group (103.00 ± 14.99 minutes). The mean difference of approximately 17.5 minutes favored PFN. This difference was statistically significant ($t = -3.767$, $p = 0.001$). Thus, PFN was associated with a substantially shorter operative time than DHS in patients with unstable intertrochanteric fractures (**Table 3**).

Mean blood loss was lower in the PFN group (136.88 mL) compared with the DHS group (253.13 mL). Patients treated with DHS therefore experienced substantially greater intraoperative blood loss than those treated with PFN. This finding suggests that PFN was associated with less surgical blood loss, likely reflecting a less extensive operative approach. Overall, PFN demonstrated an advantage over DHS in terms of intraoperative blood conservation (**Figure 4**).

The mean TAD was 22.69 ± 5.96 mm in the PFN group and 21.12 ± 3.13 mm in the DHS group. Although the DHS group showed a slightly lower mean TAD, the difference between groups was small. This difference was statistically non-significant ($t = 0.927$, $p = 0.361$). Thus, both groups demonstrated comparable TAD values, indicating similar adequacy of implant positioning with respect to this parameter (**Table 4**).

Harris Hip Score improved progressively over 1, 3, and 6 months in both treatment groups, indicating continued functional recovery after surgery. The PFN group consistently demonstrated higher mean HHS values, increasing from approximately 67 at 1 month to 83 at 3 months and 87 at 6 months. In comparison, the DHS group improved from about 60 to 74 and 80 over the same follow-up periods. Overall, PFN showed consistently better functional recovery than DHS throughout the 6-month follow-up period (**Figure 5**).

Table 1: The sample distribution by side and groups

Sample		PFN	DHS	Total
Right	F	9	8	17
	%	56.2%	50.0%	53.1%
Left	F	7	8	15
	%	43.8%	50.0%	46.9%
Total	F	16	16	32
	%	100.0%	100.0%	100.0%

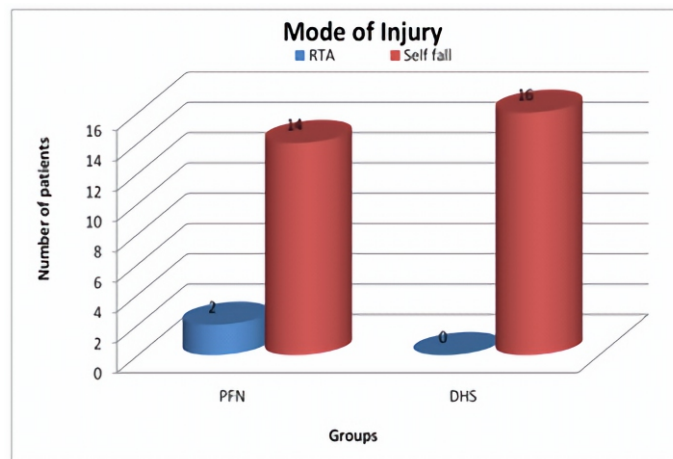


Figure 2: The sample distribution by Mode of Injury (MOI) and groups

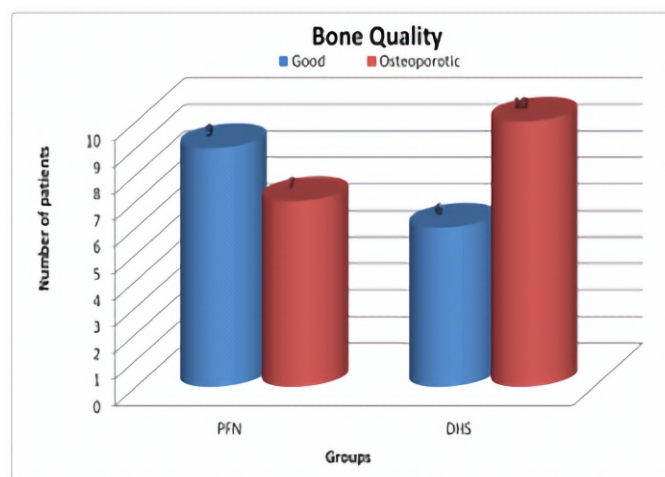


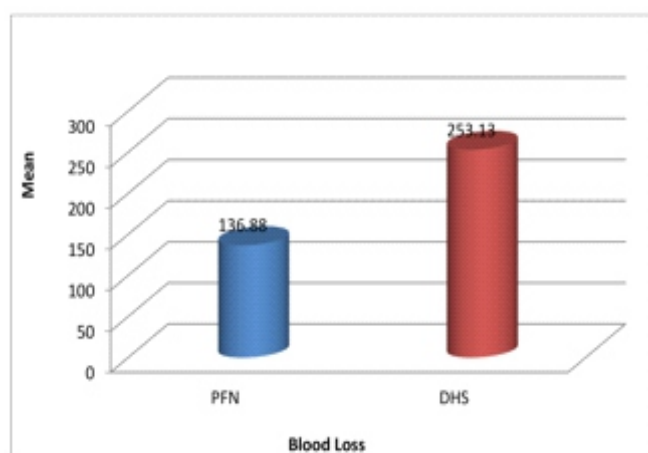
Figure 3: The sample distribution by Bone Quality and groups

Table 2: The sample distribution by Boyd Griffin Fracture Type and groups with results of chi-square test

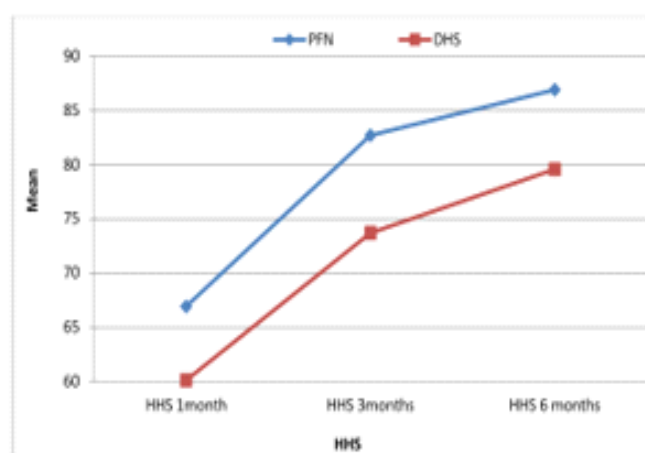
Fracture Type	Groups		Total	Test statistics
	PFN	DHS		
Type 2	F 15	11	26	$\chi^2 = 3.282$; p = .172
	% 93.8%	68.8%	81.2%	
Type 4	F 1	5	6	
	% 6.2%	31.2%	18.8%	
Total	F 16	16	32	
	% 100.0%	100.0%	100.0%	

Table 3: Mean Duration of Surgery in both groups with results of independent sample t test

	Groups	N	Mean	Std. Deviation	Test statistics
Duration of Surgery	PFN	16	85.50	10.99	t = -3.767; p = .001
	DHS	16	103.00	14.99	

**Figure 4: Mean Blood Loss in both groups****Table 4: Mean TAD in both groups with results of independent sample t test**

	Groups	N	Mean	Std. Deviation	Test statistics
TAD	PFN	16	22.69	5.96	t = .927; p = .361
	DHS	16	21.12	3.13	

**Figure 5: Functional Outcomes: Harris Hip Score (HHS)**

DISCUSSION

The present comparative analysis demonstrated that Proximal Femoral Nailing (PFN) provided perioperative advantages over Dynamic Hip Screw (DHS) in the management of unstable intertrochanteric fractures, while both methods produced satisfactory functional recovery. The study included 32 patients equally distributed between PFN and DHS groups. Baseline characteristics were comparable, with no significant association between treatment groups and fracture type or bone quality,

supporting comparison of postoperative outcomes. Saudan et al. [13], in a randomized prospective study comparing PFN with DHS, similarly emphasized that both implants are effective options for pertrochanteric fractures, although their perioperative and functional profiles may differ. A major finding was the significantly shorter mean operative duration with PFN, 85.50 ± 10.99 minutes compared with 103.00 ± 14.99 minutes for DHS ($p=0.001$). Intraoperative blood loss was also markedly lower with PFN, 136.88 ± 17.02 mL versus 253.13 ± 63.22 mL with DHS ($p=0.001$).

These findings are consistent with Huang et al. [14], whose meta-analysis comparing PFN and DHS supported advantages of intramedullary fixation in operative parameters. This is clinically relevant because Foss and Kehlet [15] demonstrated substantial blood loss associated with hip-fracture surgery, highlighting the importance of limiting perioperative blood loss. The less extensive exposure and intramedullary position of PFN may contribute to lower surgical trauma.

Functional recovery assessed by Harris Hip Score improved in both groups, but PFN consistently showed higher mean scores. At 1 month, mean HHS was 66.94 in the PFN group and 60.13 in the DHS group; at 3 months, scores were 82.69 and 73.69; and at 6 months, 86.88 and 79.56, respectively. However, the group-by-time difference was not statistically significant ($p=0.490$). Reindl et al. [16], in a prospective randomized controlled trial of unstable intertrochanteric fractures, also compared intramedullary with extramedullary fixation and supported favorable functional recovery with intramedullary fixation. Similarly, Shen et al. [17] and Zeng et al. [18], through meta-analyses, compared proximal femoral intramedullary devices with DHS and provided broader evidence supporting intramedullary fixation in appropriately selected unstable fractures. Pain outcome was favorable in the PFN group, with a significant difference in the pain component ($p=0.018$). Matre et al. [19] evaluated pain and function following intramedullary nailing versus sliding hip screw fixation, reinforcing the clinical importance of functional recovery domains.

Tip-apex distance was comparable between groups, but its weak negative correlation with 6-month HHS ($r=-0.285$, $p=0.045$) reinforces the importance of optimal implant positioning. Baumgaertner et al. [20] established tip-apex distance as an important predictor of fixation failure. Blood loss correlated negatively with HHS at 1, 3, and 6 months, while longer operative duration correlated negatively with 6-month HHS, suggesting that greater surgical burden may adversely influence recovery. Complication rates were identical at approximately 6.3% in both groups, with one Z-effect following PFN and one infection following DHS. Uzun et al. [21] described complications following PFN, while Aros et al. [22] compared sliding hip screws with intramedullary nails. Overall, PFN showed clear advantages in operative efficiency and consistently better functional scores, although both techniques achieved acceptable outcomes.

CONCLUSION

The present study concluded that Proximal Femoral Nailing provides favorable functional and perioperative outcomes compared with Dynamic Hip Screw in unstable intertrochanteric fractures. PFN was associated with shorter operative duration and lower intraoperative blood loss, while Harris Hip Scores remained consistently higher at one, three, and six months. Both fixation methods showed comparable complication rates and safety. Reduced blood loss and shorter surgery were associated with better functional recovery. Although both implants were effective, PFN appears to be a preferable option for unstable

fracture patterns were minimizing surgical trauma, promoting early mobilization, and improving postoperative function are important treatment goals.

LIMITATIONS & FUTURE PERSPECTIVES

The study's limitations include a single-centre setting, a relatively small sample size, and a short study duration, which may limit the broader applicability of the results. Future studies should incorporate multi-centre designs with larger populations to enhance validity, assess long-term outcomes, and investigate advanced diagnostic & management approaches. Such efforts will improve overall patient care & help minimize complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical health-care, diagnosis, and treatment outcomes. By highlighting real-care applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

PFN: Proximal Femoral Nail

DHS: Dynamic Hip Screw

HHS: Harris Hip Score

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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None

ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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