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RESEARCH

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Comparative efficacy of different anti-shortening screws in preventing postoperative shortening in displaced femoral neck fractures: a retrospective cohort study

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Abstract

Background Femoral neck fractures are common with high complication rates. Postoperative shortening is a significant issue, causing functional decline and increased avascular necrosis risk. The Femoral Neck System (FNS) is widely used but has a high shortening risk. Anti-Shortening Screws (ASS) have been introduced to address this, with varying efficacy by design.

Methods This retrospective cohort study compared the clinical effects of no ASS, single-threaded ASS, and double-threaded ASS in preventing shortening in displaced femoral neck fractures treated with FNS. Patients aged 18–65 years with Garden III/IV fractures and a minimum follow-up of 12 months were included. Primary outcome was femoral neck shortening distance, with secondary outcomes including hip function recovery (Harris Hip Score and Parker Score), surgical time, intraoperative blood loss, and complication rates.

Results A total of 147 patients were included (49 in each group). The double-threaded ASS group had significantly less shortening at all follow-up time points ($p<0.05$). At 1 year, mean shortening distances were 2.4 ± 0.3 mm (double-threaded), 3.8 ± 0.6 mm (single-threaded), and 4.8 ± 0.7 mm (traditional) ($p=0.007$). Incidence of moderate to severe shortening (≥ 5 mm) was 2.0% (double-threaded), 14.3% (single-threaded), and 28.6% (traditional) ($\chi^2 = 16.390$, $p=0.003$). The double-threaded group had higher Harris Hip Scores (median: 93.9 vs. 90.7 and 88.7; $p<0.001$) and Parker Mobility Scores (median: 9.0 vs. 9.0 and 8.0; $p=0.002$). Complication rates were similar among groups.

Conclusion Double-threaded ASS is more effective in reducing shortening and improving hip function than single-threaded ASS and traditional FNS fixation. Future research should include long-term follow-up and randomized trials.

Keywords Anti-Shortening screw, Femoral neck fracture, Femoral neck shortening, Femoral neck system

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Introduction

Proximal femoral fractures, including those of the femoral neck and intertrochanteric regions, occur frequently, with an estimated 250,000 cases annually in the US and 70,000 to 75,000 in the UK, imposing considerable burdens on healthcare systems [1–5].Femoral neck fractures represent a prevalent and clinically challenging type of fracture within the field of orthopedics, particularly among young and middle-aged adults, where the incidence of complications is notably high [6]. These fractures not only impose severe functional limitations on patients but also place a substantial burden on healthcare resources [7]. Surgical internal fixation remains the primary treatment modality for femoral neck fractures; however, clinical studies have highlighted a persistently high incidence of early postoperative femoral neck shortening [8]. Moderate to severe shortening (≥ 5 mm) is associated with abnormal gait, decreased hip joint function, and an increased risk of avascular necrosis of the femoral head [9–11].

With advancements in internal fixation techniques, the Femoral Neck System (FNS) has gained widespread clinical application due to its superior resistance to rotation and shear forces [12]. While FNS facilitates fracture healing, it also carries a significant risk of postoperative femoral neck shortening. Studies have reported that the incidence of femoral neck shortening after FNS fixation can reach 23.3–39.1% [8, 13, 14], which is closely linked to functional decline and increased risk of avascular necrosis.

To mitigate this issue, the Anti-Shortening Screw (ASS) has been introduced into clinical practice [13, 15]. By providing additional fixation points, ASS enhances the anti-shortening force, thereby reducing the occurrence of postoperative shortening. However, despite its promising results in some studies, the efficacy of ASS varies among different designs, such as single-threaded and double-threaded screws. Notably, Lin et al. [13]. reported in their 2024 study that even with the use of ASS, up to 15.1% of patients still experienced moderate to severe shortening. This highlights the necessity for further optimization of ASS design and application strategies to improve clinical outcomes.

This study aims to compare the clinical effects of no ASS, single-threaded ASS, and double-threaded ASS in preventing postoperative shortening in femoral neck fractures through a retrospective cohort study. The primary objective is to assess the differences among the three approaches in terms of postoperative femoral neck shortening distance, incidence of shortening, hip joint function recovery, and complication rates. We anticipate that this study will provide more scientific guidance for the clinical application of ASS and offer valuable insights for future research directions.

Patients and methods

Study design

This retrospective cohort study compared the effects of different anti-shortening screws (single-threaded vs. double-threaded) on postoperative shortening in displaced femoral neck fractures treated with the Femoral Neck System (FNS). The study was conducted in accordance with the STROBE guidelines [16], approved by the hospital's ethics committee (approval number: 2021185), and complied with the 2013 revised Helsinki Declaration [17]. Informed consent was waived due to anonymized data processing and the non-harmful nature of the study.

Sample size

To ensure the reliability and validity of the results in assessing the efficacy of anti-shortening screws (ASS) in reducing the incidence of postoperative femoral neck shortening, a sample size calculation was performed. Based on previous literature, the incidence of moderate to severe shortening was set at 40% for the non-ASS group, 15% for the single-threaded ASS group, and less than 5% for the double-threaded ASS group. Utilizing a logistic regression model formula, a minimum of 46 samples per group was calculated, totaling 138 samples. This calculation ensured the ability to detect the effect of ASS on the incidence of postoperative femoral neck shortening at a significance level of 0.05 and a power of 0.80.

Inclusion criteria

Patients aged 18–65 years with displaced femoral neck fractures (Garden III/IV) treated with FNS between January 2021 and December 2023 were included. Patients had complete clinical and radiological follow-up data with a minimum follow-up period of 12 months. They were divided into three groups: traditional (no ASS), single-threaded ASS, and double-threaded ASS.

Exclusion criteria

Exclusion criteria included pathological fractures (e.g., osteoporotic or tumor-related), fractures older than 2 weeks, poor reduction quality (Garden Index III/IV), multiple fractures, incomplete follow-up data, pre-existing conditions affecting hip function (e.g., hip osteoarthritis), and postoperative follow-up data were incomplete. Patients who refused participation or were unable to comply with follow-up were also excluded.

Initial screening

A total of 487 patients were screened. After applying exclusion criteria, 235 patients were included and divided into three groups (single-threaded ASS: 51, double-threaded ASS: 49, traditional: 135). Matching based on age and gender resulted in 49 patients per group.

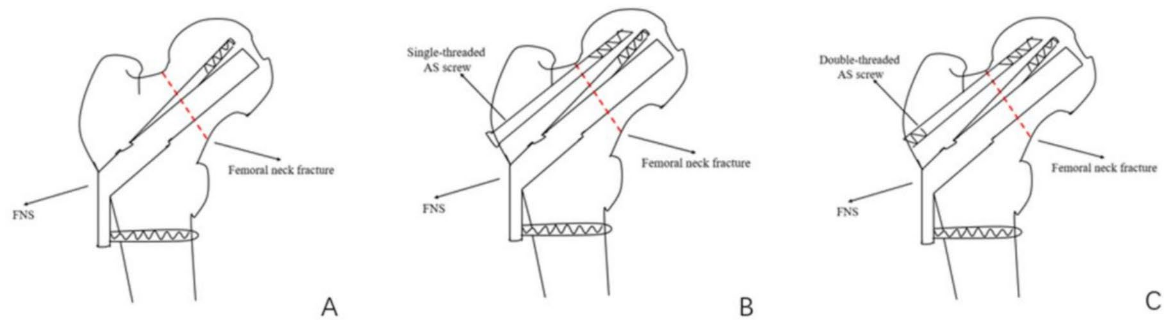

Fig. 1 Schematic Representation of Three Different Fixation Techniques (**A**) The Traditional Group employs a standard approach without the use of an AS screw. (**B**) The Single-threaded Group utilizes a single-threaded screw to secure the fracture. (**C**) The Double-threaded Group enhances stability with a double-threaded screw

Surgical procedure

Patients were positioned supine with the healthy hip and knee flexed to optimize surgical access. Following anesthesia and sterilization, closed reduction was performed, and the quality of reduction was confirmed using intraoperative fluoroscopy. Two Kirschner wires were temporarily inserted for fixation. Subsequently, in accordance with the guidelines of the Femoral Neck System (FNS), a series of steps were carried out, including guide pin insertion, depth measurement, drilling, and installation of the FNS device. For the ASS groups, additional steps of guide pin insertion, depth measurement, and drilling were performed, followed by implantation of the ASS, which could be either single-threaded or double-threaded(Fig. 1). The correct position was confirmed by fluoroscopy, after which wound debridement and closure were completed.

Postoperative management

Postoperatively, all patients received first-generation cephalosporins for infection prophylaxis and low molecular weight heparin for thromboprophylaxis. Partial weight-bearing was cautiously initiated at 6–8 weeks postoperatively, based on radiographic findings. Follow-up appointments were scheduled at 1, 3, 6 months, and 1 year postoperatively, involving radiographs to assess healing and functional scoring to evaluate clinical outcomes.

Data collection and outcome measures

Initial information collected included demographic and injury-related details, such as sex, age, Body Mass Index (BMI), the cause of injury, and fracture classification based on the Garden and Pauwels systems.

Primary outcome measures

Shortening Distance: The femoral neck shortening was measured using an anteroposterior (AP) radiograph of both hips. The healthy side was mirrored to the affected

Fig. 2 Illustration of femoral neck shortening measurement

side, and the horizontal (X-axis) and vertical (Y-axis) shortening of the femoral head were measured. The axial shortening of the femoral neck (Z-axis) was calculated using the formula $Z = Y\sin(\theta) + X\cos(\theta)$, where θ is the angle between the Y-axis and the femoral neck axis. Shortening was categorized as mild (< 5 mm), moderate (5–10 mm), and severe (> 10 mm) based on the Z value [11](Fig. 2).

Secondary outcome measures

Surgical Time: Defined as the duration from the initial incision to the completion of surgical wound closure.

Intraoperative Blood Loss: Quantitative assessment of blood loss during surgery.

Reduction quality assessment

Garden index This widely used classification system grades femoral neck fractures into four levels based on the degree of displacement and reduction quality. It helps predict the difficulty of fracture healing and potential complications [18].

Gotfried System This system further refines the assessment of reduction quality into three levels: anatomical reduction (neutral support), positive support, and negative support. Anatomical reduction is considered the most stable, while negative support indicates the least stable [19].

Tip apex distance (TAD)

Immediately postoperatively, on the anteroposterior and lateral views of the hip joint, the distance from the tip of the screw (Tip) to the apex of the intersection extended from the femoral head-neck axis and the articular surface of the femoral head (Apex) was measured. The anteroposterior distance (Xap) and lateral distance (Xlat) were measured, and the actual screw width (Dtrue) was used to correct the magnification factor of the screw width measured on the anteroposterior (Dap) and lateral (Dlat) views. The sum of these corrected distances gives the TAD value (TAD = Xap×Dap/Dtrue + Xlat×Dlat/Dtrue) [20].

Fracture healing assessment criteria

No significant tenderness on percussion of the surgical hip joint and lower limb, and radiographic or CT evidence of blurred fracture lines with continuous trabecular bone bridging the original fracture site [21].

Harris hip score (HHS)

At the final follow-up, the HHS [22] was used to assess hip function. This scoring system covers pain, function, range of motion, and deformity, with a total score of 100 points. The grading is as follows: excellent (90–100 points), good (80–89 points), fair (70–79 points), and poor (< 70 points).

Parker mobility score

The Parker mobility score [23] is a tool for assessing hip function, ranging from 0 to 9 points. The assessment items mainly include pain level, walking ability, activities of daily living (such as washing, dressing, toileting), and functional independence. A score of 9 indicates that the patient can independently complete all daily activities, while a score of 0 indicates complete dependence on others.

Complication [24]

This includes deep incisional infection, implant penetration through the femoral head into the joint cavity, implant displacement relative to the bone (without femoral head penetration), implant failure (such as fracture or deformation), delayed union or nonunion, avascular necrosis in the femoral head region, and the need for secondary total hip arthroplasty.

Statistical analysis

In this study, X-ray image measurements were performed simultaneously by two researchers (D. Lin and J. Liu), both of whom have extensive experience and expertise in relevant fields. They received standardized training prior to the study to ensure consistent interpretation and measurement standards, and any discrepancies were resolved through discussion.

All statistical analyses were conducted using IBM SPSS Statistics software (version 26.0). Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data or median (interquartile range, IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was used to assess data normality. For comparisons among the three groups, one-way ANOVA with Tukey's HSD post-hoc test was applied to normally distributed continuous variables, while the Kruskal-Wallis test with Dunn's correction was used for non-normally distributed continuous variables. Categorical variables were compared using the Chi-square test or Fisher's exact test where appropriate. A two-sided p-value less than 0.05 was considered statistically significant.

Results

A total of 147 patients were included in the study, with 49 patients in each of the three groups: the double-threaded group, the single-threaded group, and the traditional group. The mean age of the patients was 47.1 years (range: 18–65 years).Follow-up duration was uniformly distributed across groups, with a minimum of 12 months and a maximum of 28 months. Mean follow-up times were 19.16 ± 4.317 months for the double-threaded group, 19.35 ± 4.571 months for the single-threaded group, and 19.61 ± 4.382 months for the traditional group, resulting in an overall mean follow-up time of 19.37 ± 4.398 months. There were no significant differences in baseline characteristics among the three groups, including age, gender, BMI, smoking and drinking history, mechanism of injury, side of injury, Garden and Pauwels classifications, presence of cortical comminution, and time from injury to surgery (Table 1). These results indicate that the three groups were well-balanced at baseline, which is crucial for the validity of subsequent comparative analyses.

Table 1 Comparison of baseline data and surgical data between three groups

Groups		Double-threaded Group($n=49$)	Single-threaded Group($n=49$)	Traditional Group ($n=49$)	Test statistic	*P*-value
Age	M(Q1,Q3)	48.0(30.0,59.0)	54.0(37.0,58.0)	52.0(40.5,59.0)	1.619	0.445
Gender	Male	32 (55.3%)	27(55.1%)	32(65.3%)	1.442	0.489
	Female	17 (34.7%)	22 (44.9%)	17 (34.7%)		
BMI	M(Q1,Q3)	23.8(22.0,25.4)	23.8(22.3,24.4)	22.4(21.3,24.4)	5.194	0.074
Smoking	No	45 (91.8%)	43 (87.8%)	45 (91.8%)	0.632	0.729
	Yes	4 (8.2%)	6 (12.2%)	4 (8.2%)		
Drinking	No	42 (85.7%)	45 (91.8%)	45 (91.8%)	1.336	0.513
	Yes	7 (14.3%)	4 (8.2%)	4 (8.2%)		
Mechanism of injury	Low energy	21 (42.9%)	18 (36.7%)	16 (32.7%)	1.104	0.576
	High energy	28 (57.1%)	31 (63.3%)	33 (67.3%)		
Side of Injury	Left	23 (46.9%)	28 (57.1%)	19 (38.8%)	3.327	0.189
	Right	26 (53.1%)	21 (42.9%)	30 (61.2%)		
Garden Classification	Garden III	22 (45.45%)	18 (32.2%)	15 (30.77%)	2.150	0.341
	Garden IV	27 (54.55%)	31 (67.8%)	34(69.23%)		
Pauwels Classification	Pauwels I	7 (14.3%)	18 (36.7%)	13 (26.5%)	6.905	0.141
	Pauwels II	20 (40.8%)	17 (34.7%)	17 (34.7%)		
	Pauwels III	22(44.9%)	14 (28.6%)	19 (38.8%)		
Cortical Comminution	No	11 (22.4%)	16 (32.7%)	21 (42.9%)	4.640	0.098
	Yes	38 (77.6%)	33 (67.3%)	28 (57.1%)		
Time from injury to surgery (days)	M(Q1,Q3)	3.0(2.0,4.0)	4.0(2.5,5.0)	3.0(2.0,4.0)	3.660	0.160
Surgical time (min)	($\bar{x}$±s)	61.3 ± 16.8	61.3 ± 16.3	60.6 ± 18.0	0.033	0.968
Bleeding (ml)	M(Q1,Q3)	60.0(48.5,76.5)	60.0(54.0,72.5)	59.0(45.0,78.0)	2.109	0.348
Reset Grading	Garden index I	44 (89.8%)	42 (85.7%)	43 (87.8%)	0.380	0.827
	Garden index II	5 (10.2%)	7 (14.3%)	6 (12.2%)		
Reduction Quality	Neutral Support	35 (71.4%)	33 (67.3%)	33 (67.3%)	2.095	0.718
	Positive Support	10 (20.4%)	14 (28.6%)	11 (22.4%)		
	Negative Support	4 (8.2%)	2 (4.1%)	5 (10.2%)		
TAD(mm)	M(Q1,Q3)	12.0(11.0,14.2)	13.0(11.6,22.5)	13.4(11.8,19.0)	4.215	0.122
Healing time (weeks)	M(Q1,Q3)	8.0(6.0,10.0)	6.0(6.0,10.0)	8.0(6.0,12.0)	3.017	0.221
Harris score	M(Q1,Q3)	93.9(89.5,96.5)	90.7(87.6,94.4)	88.7(82.1,93.7)	17.910	<0.001
Paker score	M(Q1,Q3)	9.0(8.0,9.0)	9.0(8.0,9.0)	8.0(8.0,9.0)	12.020	0.002

Table 2 Comparison of shortening between between three groups

Groups		Double-threaded Group($n=49$)	Single-threaded Group($n=49$)	Traditional Group ($n=49$)	Test statistic	*P*-value
Shortening distance(1 day, mm)	($\bar{x}$±s)	0.6 ± 0.1	1.2 ± 0.3	1.4 ± 0.3	2.377	0.096
Shortening distance(3 month, mm)	($\bar{x}$±s)	2.2 ± 0.2	3.5 ± 0.5	4.5 ± 0.7	3.820	0.024
Shortening distance(6 months, mm)	($\bar{x}$±s)	2.4 ± 0.3	3.7 ± 0.6	4.7 ± 0.7	5.295	0.006
Shortening distance(1 year, mm)	($\bar{x}$±s)	2.4 ± 0.3	3.8 ± 0.6	4.8 ± 0.7	6.133	0.007
Shortening grading(1 year)	Mild(>0,≤5 mm)	48 (98.0%)	41 (83.7%)	34 (69.4%)	16.390	0.003
	Moderate(>5-≤10 mm)	1 (2.0%)	5 (10.2%)	6 (12.2%)		
	Severe(>10 mm)	0 (0%)	3 (6.1%)	9 (18.4%)		

In terms of femoral neck shortening, significant differences were observed among the three groups at various time points (Table 2). On the first postoperative day, the shortening distance was significantly different among the groups (F = 2.377, $p = 0.096$), with the double-threaded group exhibiting the least shortening (mean ± SD: 0.6 ± 0.1 mm), followed by the single-threaded group (1.2 ± 0.3 mm) and the traditional group (1.4 ± 0.3 mm). At 3 months postoperatively, the shortening distance continued to increase and showed significant differences

Table 3 Comparison of shortening between between three groups

Groups		Double-threaded Group($n=49$)	Single-threaded Group($n=49$)	Traditional Group ($n=49$)	Test statistic	*P*-value
Cut-out	N (%)	48 (98.0%)	48 (98.0%)	48 (98.0%)	0	1.000
		1 (2.0%)	1 (2.0%)	1 (2.0%)		
Nonunion	N (%)	48 (98.0%)	49(100.0%)	48 (98.0%)	1.014	0.602
		1 (2.0%)	0(0%)	1 (2.0%)		
Avascular necrosis of the femoral head	N (%)	47 (95.9%)	47 (95.9%)	46 (93.9%)	0.300	0.861
		2 (4.1%)	2 (4.1%)	3 (6.1%)		
secondary total hip arthroplasty	N (%)	48 (98.0%)	47 (95.9%)	48 (98.0%)	0.541	0.773
		1 (2.0%)	2 (4.1%)	1 (2.0%)		

among the groups ($F=3.820$, $p=0.024$). The double-threaded group had a mean shortening distance of 2.2 ± 0.2 mm, compared with 3.5 ± 0.5 mm in the single-threaded group and 4.5 ± 0.7 mm in the traditional group. At 6 months postoperatively, the shortening distance further increased in all groups, with significant differences among them ($F=5.295$, $p=0.006$). The double-threaded group had the least shortening (2.4 ± 0.3 mm), followed by the single-threaded group (3.7 ± 0.6 mm) and the traditional group (4.7 ± 0.7 mm). At 1 year postoperatively, the shortening distance remained significantly different among the groups ($F=6.133$, $p=0.007$). The double-threaded group had a mean shortening distance of 2.4 ± 0.3 mm, compared with 3.8 ± 0.6 mm in the single-threaded group and 4.8 ± 0.7 mm in the traditional group. In terms of shortening grading at 1 year, the double-threaded group had the highest proportion of mild shortening (98.0%), while the traditional group had the highest proportion of severe shortening (18.4%). The incidence of moderate to severe shortening (≥ 5 mm) was significantly lower in the double-threaded group compared with the other two groups (χ^2 = 16.390, $p=0.003$). Double-threaded Group exhibited significantly lower rates of moderate to severe shortening compared to Single-threaded (χ^2=6.217, $p=0.045$) and Traditional Group (χ^2=14.962, $p<0.001$), as determined by chi-square analysis. No significant difference was found between Single-threaded and Traditional Group (χ^2=3.744, $p=0.154$). These findings suggest that the double-threaded technique may be more effective in reducing femoral neck shortening compared with the single-threaded and traditional techniques.

Regarding surgical outcomes, the surgical time was similar among the three groups ($F=0.033$, $p=0.968$), with a mean of 61.3 ± 16.8 min in the double-threaded group, 61.3 ± 16.3 min in the single-threaded group, and 60.6 ± 18.0 min in the traditional group. Intraoperative blood loss did not significantly differ among the groups ($H=2.109$, $p=0.348$), with a median of 60.0 ml (IQR: 48.5–76.5) in the double-threaded group, 60.0 ml (IQR: 54.0–72.5) in the single-threaded group, and 59.0 ml (IQR: 45.0–78.0) in the traditional group. The Harris Hip Score at the final follow-up was significantly different among the groups ($H=17.910$, $p<0.001$). The double-threaded group had the highest score (median: 93.9, IQR: 89.5–96.5), indicating better hip function, followed by the single-threaded group (median: 90.7, IQR: 87.6–94.4) and the traditional group (median: 88.7, IQR: 82.1–93.7). The Parker Mobility Score also showed significant differences among the groups ($H=12.020$, $p=0.002$). The double-threaded group had the highest score (median: 9.0, IQR: 8.0–9.0), indicating better mobility, followed by the single-threaded group (median: 9.0, IQR: 8.0–9.0) and the traditional group (median: 8.0, IQR: 8.0–9.0). These results suggest that the double-threaded technique may lead to better functional outcomes and mobility compared with the other two techniques (Table 1).

In terms of complications, the incidence of implant cut-out was low and similar among the three groups (χ^2 = 0, $p=1.000$), with 1 case (2.0%) in each group. The incidence of nonunion was also low and not significantly different among the groups (χ^2 = 1.014, $p=0.602$), with 1 case (2.0%) in the double-threaded group and the traditional group, while no cases were observed in the single-threaded group. Avascular necrosis of the femoral head occurred in 2 cases (4.1%) in the double-threaded group, 2 cases (4.1%) in the single-threaded group, and 3 cases (6.1%) in the traditional group, with no significant differences among the groups (χ^2 = 0.300, $p=0.861$). The need for secondary total hip arthroplasty was also low and not significantly different among the groups (χ^2 = 0.541, $p=0.773$), with 1 case (2.0%) in the double-threaded group and the traditional group, while 2 cases (4.1%) were observed in the single-threaded group. These findings indicate that the three techniques had similar safety profiles in terms of the incidence of complications (Table 3).

Discussion

Our study aimed to compare the efficacy of no Anti-Shortening Screw (ASS), single-threaded ASS, and double-threaded ASS in reducing femoral neck shortening following fixation with the Femoral Neck System (FNS) in displaced femoral neck fractures. The results demonstrated that the double-threaded ASS group exhibited significantly less femoral neck shortening and a lower incidence of moderate to severe shortening (≥5 mm) compared with the single-threaded ASS and traditional groups. Additionally, the double-threaded ASS group had superior functional outcomes, as indicated by higher Harris Hip Scores and Parker Mobility Scores. These findings suggest that the double-threaded ASS is more effective in reducing femoral neck shortening and improving hip function.

The observed reduction in femoral neck shortening in the double-threaded ASS group can be attributed to the enhanced stability provided by the additional fixation point. This increased stability likely reduces the compressive forces at the fracture site, thereby minimizing shortening. Our findings are consistent with previous studies that have reported the efficacy of ASS in reducing shortening. For instance, Lin et al. [13]demonstrated that the use of ASS significantly reduced the incidence of femoral neck shortening in patients treated with FNS. However, our study extends these findings by comparing different types of ASS and showing that the double-threaded design is superior.

In contrast, the traditional group and single-threaded ASS group exhibited higher rates of shortening, which may be due to the lack of sufficient anti-shortening mechanisms. This is supported by studies that have reported higher rates of shortening in patients treated with traditional FNS without ASS [8, 15, 24]. The clinical significance of reducing femoral neck shortening is evident in the improved functional outcomes observed in the double-threaded ASS group. Shortening has been shown to negatively impact hip function and mobility, leading to decreased quality of life [10, 11]. Therefore, the use of double-threaded ASS may have a substantial impact on patient outcomes(Fig. 2).

Shortening is a prevalent issue following the use of the FNS for fixation, influenced by multiple factors. The fracture type and the extent of comminution are key determinants; specifically, Garden III and IV fractures, characterized by substantial initial displacement and severe bone destruction, are known to impact the stability and healing process of femoral neck fractures [25–27]. Additionally, the quality of reduction correlates significantly with the occurrence of shortening, with inadequate reduction potentially leading to increased shortening [8, 26, 28].The application of anti-shortening screws (ASS) is indicated under certain conditions. In cases of displaced fractures with cortical comminution (Garden III or IV types), the use of ASS can provide extra stability where the FNS may lack sufficient anti-shortening properties, thereby reducing the likelihood of shortening [13]. Moreover, for patients with a higher risk for shortening, ASS could serve as a beneficial addition. However, in instances of stable fractures (Garden I or II types), where a stable internal fixation can be established, the use of additional screws may not be necessary. However, in cases of displaced femoral neck fractures often associated with cortical comminution, the FNS may lack sufficient anti-shortening capabilities. The use of Anti-Shortening Screws (ASS) can enhance the compressive and anti-shortening stability provided by FNS. There is currently no consensus on whether ASS is the optimal implant for osteoporosis, poor reduction, or basicervical fractures. Further research is needed to ascertain its efficacy and appropriateness in the treatment of these femoral neck fractures.

Limitations

Despite the promising results, our study has several limitations. First, the retrospective design may introduce selection bias, as patients were not randomly assigned to the different treatment groups. Future randomized controlled trials are needed to confirm our findings. Second, the follow-up period was limited to 1 year, which may not capture long-term outcomes. Longer follow-up studies are necessary to assess the durability of the benefits observed with double-threaded ASS. Third, our study did not account for all potential confounding factors, such as patient bone density and fracture complexity. Future studies should consider these factors to provide a more comprehensive understanding of the effects of ASS.

Future research

Future research should focus on long-term follow-up studies to assess the durability of the benefits observed with double-threaded ASS. Additionally, randomized controlled trials with larger sample sizes are warranted to provide more robust evidence for the clinical application of ASS in the treatment of displaced femoral neck fractures. Further investigations could explore the biomechanical properties of different ASS designs and their impact on fracture healing. Finally, studies should consider the potential role of patient-specific factors, such as bone density and fracture complexity, in the efficacy of ASS.

Conclusion

In conclusion, our study demonstrates that the double-threaded ASS is more effective in reducing femoral neck shortening and improving hip function compared with single-threaded ASS and traditional FNS fixation. These findings highlight the potential benefits of double-threaded ASS in the treatment of displaced femoral neck fractures. Future research should aim to address the limitations of our study and further explore the clinical application of ASS.

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Author contributions
Fengfei Lin is the first author and led the research project, providing strategic guidance and finalizing the manuscript. Dongze Lin and Jiajie Liu were instrumental in data collection and analysis. Ke Zheng provided critical insights into the study design and clinical relevance. Chaohui Lin contributed to data acquisition and interpretation. All authors participated in the manuscript preparation and have reviewed and approved the final version of this manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Competing interests
The authors declare no competing interests.

Conflict of interest
The authors declare no competing interests.

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