Wang et al. Journal of Orthopaedic Surgery and Research (2025) 20:512
https://doi.org/10.1186/s13018-025-05941-7

Journal of Orthopaedic Surgery and Research

RESEARCH Open Access

Direct anterior approach enhances early recovery outcomes in total hip arthroplasty among elderly individuals with femoral neck fractures: a propensity-matched cohort study

Yansong Wang[1], Jianwei Hou[1], Jun Feng[1], Hongbin Li[1] and Xiaodong Wang[1*]

Abstract

Objective Enhanced recovery after surgery protocols have been increasingly adopted to optimize postoperative functional restoration. This propensity score-matched cohort study quantified the impact of the direct anterior approach during THA on ERAS efficacy in patients with femoral neck fractures and analyzed outcomes such as functional recovery acceleration and perioperative complications. Methods The consecutive cohort comprised 231 patients who underwent primary arthroplasty for femoral neck fractures and were stratified by surgical approach: direct anterior (DAA, $n=59$) versus posterolateral (PLA, $n=172$). The clinical outcomes, such as patient statistics, details of perioperative management, length of stay, pain, Harris hip score, and in-hospital complications, were recorded. This retrospective observational study mitigated the risk of confounding bias by applying propensity score matching. Results With PSM, 51 pairs of well-matched patients were generated for comparison between the DAA group and the PLA group. The incision length decreased to 10.7 ± 1.4 cm in the DAA group, whereas it was 13.1 ± 1.3 cm in the PLA group. Compared with the PLA cohort, the DAA cohort had a significantly shorter postoperative length of stay ($P=0.001$) but superior limb-length discrepancy control ($P<0.001$). Compared with the PLA group, the DAA group demonstrated superior early pain control (VAS score reduction: 3/7/14 days, $P<0.05$) and accelerated functional gains (HHS improvement: 7/14 days/1 month, $P<0.05$), although the 6-month outcomes were similar between groups ($P=0.675$). The DAA group exhibited superior 1-month outcomes in terms of pain control, device independence, and ambulation ($P<0.05$), but there were similar complication profiles between the groups. Conclusions Compared with the posterolateral approach, DAA enhances early recovery outcomes in THA among elderly patients with femoral neck fractures undergoing ERAS protocols. DAA demonstrated superior short-term functional gains and similar long-term outcomes compared with the posterolateral approach. These findings support the strategic use of DAA for optimizing early recovery for this patient population.

Keywords Enhanced recovery after surgery, Propensity score matching, Total hip arthroplasty, Femoral neck fractures, Direct anterior approach

*Correspondence:
Xiaodong Wang
stonewys@ntu.edu.cn
[1]Department of Orthopedics, Nantong Third People's Hospital, Affiliated Nantong Hospital 3 of Nantong University, Nantong 226006, Jiangsu Province, China

Femoral neck fractures are a common orthopedic injury, accounting for approximately 3.58% of all fractures and 50% of proximal femoral fractures. The incidence of femoral neck fractures is particularly high among elderly individuals, and due to the increasing age of the global population, the prevalence of femoral neck fractures continues to rise [1–3]. The elevated mortality rate observed in elderly patients stems from diminished physiological reserves and is compounded by preexisting comorbidities, prolonged immobilization postinjury, and complications arising from trauma-related systemic stress and fracture sequelae [4]. Treatment strategies differ by age group. In younger patients, closed reduction and internal fixation are routinely employed, yielding satisfactory outcomes. Conversely, in elderly patients, internal fixation is associated with a heightened risk of avascular necrosis of the femoral head. Therefore, total hip arthroplasty is frequently preferred, as this procedure enables early postoperative ambulation and is associated with high patient satisfaction [5]. Despite these advantages, postoperative complications remain a concern. Research indicates that THA performed for femoral neck fractures is associated with higher rates of complications and reoperations than THA for hip osteoarthritis [6, 7]. Several factors influence these outcomes, among which the choice of surgical approach is a critical determinant [8].

Traditionally, total hip arthroplasty for the treatment of femoral neck fractures has been performed using two well-established surgical approaches: the posterolateral approach, as described by Moore, and the anterolateral approach, as outlined by Hardinge [9]. In recent years, advancements in minimally invasive techniques have led to a growing adoption of the direct anterior approach in clinical practice [10]. The DAA accesses the hip joint through the interval between the tensor fasciae latae and sartorius muscles, thus avoiding detachment of any muscle tissue. This technique minimizes intraoperative trauma and promotes faster postoperative recovery, which may be particularly advantageous for elderly patients with femoral neck fractures. Emerging evidence suggests that, compared with other surgical approaches, the DAA may significantly enhance early postoperative functional rehabilitation [11].

Since the 1990s, the concept of enhanced recovery after surgery has been increasingly emphasized [12]. The integration of ERAS protocols has revolutionized perioperative care, employing multimodal strategies to mitigate surgical stress responses and accelerate functional restoration [13]. In arthroplasty, ERAS implementation reduces the length of stay while improving 30-day mobility scores [14, 15]. However, the synergistic potential between the anatomical advantages of the DAA and ERAS principles remains underexplored in the context of fragility fractures.

Materials and methods

This retrospective propensity score-matched cohort study analyzed 231 consecutive patients who underwent THA for femoral neck fractures at Nantong Third People's Hospital from December 2021 to December 2023. We compared ERAS efficacy metrics (time from injury to surgery, LOS, TUG, VAS, HHS), radiographic outcomes (limb-length discrepancy, implant positioning) and safety profiles (180-day complications, readmissions). Our findings elucidate how the DAA's tissue-preserving philosophy synergizes with ERAS objectives, providing evidence to refine surgical strategy selection in geriatric hip fracture management.

The inclusion criteria were as follows: (1) patients over 60 years old; (2) unilateral low-energy femoral neck fractures; (3) radiographically confirmed Garden III/IV fractures undergoing primary total hip arthroplasty; (4) protocol adherence to ERAS guidelines; (5) absence of severe osteoporosis; (6) no cognitive impairment, ensuring compliance with postoperative rehabilitation; and (7) no severe systemic comorbidities. Patients with Garden I/II fractures or younger patients were typically considered for percutaneous cannulated screw fixation, whereas those with advanced age, severe osteoporosis, or cognitive impairment were prioritized for hemiarthroplasty.

The exclusion criteria were as follows: (1) preexisting symptomatic hip osteoarthritis or inflammatory arthropathy; (2) polytrauma or ipsilateral lower extremity fractures; (3) pathological fractures (metastatic or metabolic etiology); (4) other hip procedures (cannulated screw fixation, hemiarthroplasty); or (5) uncontrolled systemic comorbidities (ASA grade $\geq$ 4) or cognitive impairment precluding protocol adherence.

Ethical approval for this study was granted by the Institutional Review Board of Nantong Third People's Hospital (EK2023015). Written informed consent was obtained from all participants following comprehensive protocol disclosure, with signature documentation archived in electronic medical records. This retrospective cohort study analyzed 231 consecutive patients who underwent primary total hip arthroplasty for femoral neck fractures at our hospital. After screening the patients based on the inclusion/exclusion criteria, they were stratified based on the surgical approach: direct anterior approach (DAA, $n = 59$) versus the posterolateral approach (PLA, $n = 172$). Propensity score matching was implemented to mitigate the risk of indication bias and incorporated 9 clinical covariates: age, sex, BMI, operative side, preoperative Hb, operating time, blood loss, ASA grade, and Garden classification. Propensity score matching was employed to mitigate confounding in this observational surgical study, a methodologically robust approach for addressing selection bias when randomized controlled trials are ethically or logistically prohibitive [16].

Surgical procedure

All procedures were conducted under general anesthesia following standardized protocols. To control for technical variability, the lead surgeon demonstrated procedural mastery, with > 100 cases per approach (DAA and PLA). A dedicated arthroplasty team maintained surgical continuity across all patients.

Direct Anterior Approach Group (DAA): The patient was positioned supine on an adjustable operating table that allows breaking at the pubic symphysis to facilitate femoral elevation during surgery. An 8–10-cm incision was made, starting 2 cm lateral to the anterior superior iliac spine and directed toward the fibular head. The fascia was incised, and dissection continued through the interval between the tensor fasciae latae and sartorius muscles. The ascending branch of the lateral circumflex femoral artery was ligated. Part of the reflected head of the rectus femoris was released, and a T-shaped capsulotomy was performed to expose the joint. The acetabular labrum, soft tissues within the fossa, and osteophytes are removed. The acetabulum was reamed, and the cup and liner were implanted. The superior and posterior capsules around the femoral neck were released, and in some cases, the adductor magnus tendon was released. The proximal femur was elevated, the canal was reamed, and the stem and head were implanted. The joint was reduced, and stability and limb length were assessed. The wound was irrigated and closed in layers.

Posterior–Lateral Approach Group (PLA): Patients were positioned in the lateral decubitus position with the affected side up. The incision began at the posterior superior iliac spine and extended distally toward the greater trochanter and femoral shaft, typically measuring 10 to 14 cm in length. The fascia lata was incised sharply, and the gluteus maximus fibers were split bluntly along their natural orientation. The approach proceeded between the posterior border of the gluteus medius and the short external rotators, using the piriformis tendon as a landmark. The short external rotators were detached from their insertion on the greater trochanter to expose the joint capsule. The subsequent steps, including capsulotomy, acetabular preparation, and prosthesis implantation, mirrored those in the direct anterior approach group.

ERAS protocol

All surgical patients followed a standardized perioperative enhanced recovery after surgery protocol [17]. This included preoperative education and daily use of anti-inflammatory analgesics. Anesthesia comprised general anesthesia with local infiltration. Antibacterial prophylaxis was administered throughout the surgical procedure and for 4 h postoperatively, with a total duration of 24 h. A drainage tube was placed, clamped for 6 h postsurgery, and removed on the second postoperative day. Postoperative pain was managed with an analgesia pump and celecoxib every 12 h. Anticoagulation therapy with rivaroxaban began within 24 h postsurgery and was combined with lower extremity pneumatic compression to prevent venous thrombosis. Rehabilitation focused on muscle strengthening, coordination enhancement, and gait training with hip precautions. Passive flexion and extension of the hip, knee, and ankle joints were performed with physician assistance.

Postoperative efficacy evaluation

Clinical Assessment: For each patient, we recorded detailed data, including the incision length, operative time, intraoperative blood loss, and postoperative length of stay. The Timed Up and Go test [18] was conducted at 2 weeks postsurgery to assess mobility. Pain levels were evaluated using the visual analog scale at 3, 7, and 14 days after surgery. Functional outcomes were assessed at 1 week, 2 weeks, 1 month, and 6 months postoperatively using the Harris Hip Score. Given the substantial emphasis on pain and functional activity within this scoring system, five specific parameters—postoperative pain, use of ambulatory aids, presence of limping, walking distance, and stair-climbing ability—were analyzed at 1 month postoperatively.

Imaging Assessment: All patients underwent routine postoperative imaging, comprising anteroposterior (AP) pelvic radiographs, AP and lateral hip radiographs, and hip CT scans. The acetabular abduction angle was measured from X-rays, the acetabular anteversion angle from CT scans, and the limb length discrepancy (affected versus unaffected side) from AP pelvic radiographs.

Postoperative Complications: The incidence of complications within 6 months postoperatively was compared between the two groups. The recorded complications included intraoperative fractures, surgical site complications, prosthetic infections, hip dislocations, nerve injuries, and reoperations.

Statistical analysis

In this retrospective cohort study, propensity score matching was utilized to minimize treatment selection bias in assessing the causal effects of the direct anterior approach versus the posterolateral approach. The PSM model incorporated nine covariates: age, sex, body mass index, operative side, preoperative hemoglobin, operative time, blood loss, ASA grade, and Garden classification of femoral neck fractures. Using logistic regression-derived propensity scores, one-to-one nearest neighbor matching was performed to pair patients from the DAA and PLA groups without replacement, with a caliper width of 0.2 to ensure match precision. This process resulted in 51 matched pairs for analysis. The data were analyzed using

IBM SPSS 25.0. For continuous variables, normality and homogeneity of variance were assessed with the Shapiro–Wilk and Levene tests, respectively. If normally distributed with equal variance, the independent samples t test was applied. Categorical variables were compared using the chi-square test. A P value <0.05 was considered statistically significant.

Results

Before propensity score matching (PSM), the mean time from injury to surgery was 2.8 ± 1.2 days in the DAA group and 3.0 ± 1.3 days in the PLA group, with no significant difference between the groups ($P=0.384$). Significant differences in preoperative hemoglobin levels, operative time, or blood loss ($p<0.05$) were observed between the two groups. After PSM, 51 matched pairs were analyzed, and the aforementioned differences were no longer statistically significant ($p>0.05$) (Table 1).

Compared with the PLA group, the DAA group presented a significantly shorter surgical incision length and shorter postoperative hospital stay (both $P<0.05$). Postoperative imaging revealed no significant difference in the acetabular abduction angle between the groups ($P>0.05$); however, the PLA group had greater acetabular anteversion, whereas the DAA group demonstrated smaller limb length discrepancies (both $P<0.05$). In the functional assessments, the DAA group completed the TUG test faster at 2 weeks postoperatively ($P<0.05$) and reported lower VAS scores at 3, 7, and 14 days ($P<0.05$) (Fig. 1). HHS outcomes favored the DAA group at 1 week, 2 weeks, and 1 month ($P<0.05$), with no significant difference at 6 months ($P>0.05$) (Fig. 2). At 1 month, the DAA group outperformed the PLA group in terms of pain relief, use of assistive devices, gait quality, and walking distance ($P<0.05$) (Table 2).

In the DAA group, one patient sustained an intraoperative greater trochanter fracture, with one developing postoperative lateral femoral cutaneous nerve injury and another showing erythema at the incision site at one week, which was resolved by debridement and suturing. In the PLA group, one patient experienced joint dislocation two weeks postoperatively, which was managed successfully with manual reduction and immobilization, whereas two patients experienced incision-related complications—one complication resolved with dressing changes, and the other complication required debridement and suturing. No cases of periprosthetic infection occurred in either group. The complication rates did not differ significantly between the groups ($P>0.05$, Table 3).

Discussion

Comparative merits and technical considerations of the direct anterior approach

The direct anterior approach for total hip arthroplasty offers distinct advantages over the posterior lateral approach, most notably the accelerated recovery of early postoperative function. Since the early 2000s, modern DAA techniques have consistently demonstrated faster restoration of mobility, with patients often discontinuing assistive devices and regaining the ability to walk and navigate stairs more rapidly [19]. As a true internervous approach, DAA preserves muscle integrity, thus yielding higher functional scores, lower pain scores, and a marked reduction in postoperative analgesic use [20]. Previous studies suggested that shorter hospital stays with DAA reduce medical costs [21]. Furthermore, compared with

Table 1 Characteristics of patients in the propensity score-matched groups

	Before propensity matching			After propensity matching		
	DAA group *n* = 59	**PLA group** *n* = 172	**p -value**	**DAA group** *n* = 51	**PLA group** *n* = 51	**p -value**
Age (year)	70.6 ± 8.5	71.9 ± 9.5	0.567	71.4 ± 8.63	70.9 ± 9.2	0.538
Gender (Male), n (%)	30.5	33.7	0.770	31.4	37.1	0.677
BMI	24.8 ± 3.4	24.1 ± 2.8	0.283	24.1 ± 2.8	24.1 ± 2.2	0.915
Operative side (R)	61.0	57.0	0.697	58.8	51.0	0.551
Time to surgery(days)	2.8 ± 1.2	3.0 ± 1.3	0.384	2.9 ± 1.2	3.0 ± 1.2	0.472
Preoperative Hb(g/L)	117.4 ± 14.1	122.9 ± 16.0	0.014	116.8 ± 14.1	119.4 ± 16.4	0.390
Operating time (min)	88.2 ± 12.8	92.9 ± 12.7	0.032	90.6 ± 12.1	94.9 ± 12.8	0.107
Blood loss (ml)	232.6 ± 31.6	244.5 ± 35.02	0.027	233.7 ± 30.5	243.3 ± 35.2	0.176
ASA grade, n (%)			0.620			0.828
I	3(5.1)	6(3.5)		3(5.9)	3(5.8)	
II	32(54.2)	105(61.0)		27(52.9)	24(47.1)	
III	24(40.7)	61(35.5)		21(41.2)	24(47.1)	
Garden classification			0.210			0.111
III	44(74.6)	143(83.1)		39(76.5)	46(90.2)	
IV	15(25.4)	29(16.9)		12(23.5)	5(9.8)	

BMI, body mass index; Hb, hemoglobin; ASA, American Society of Anesthesiologists

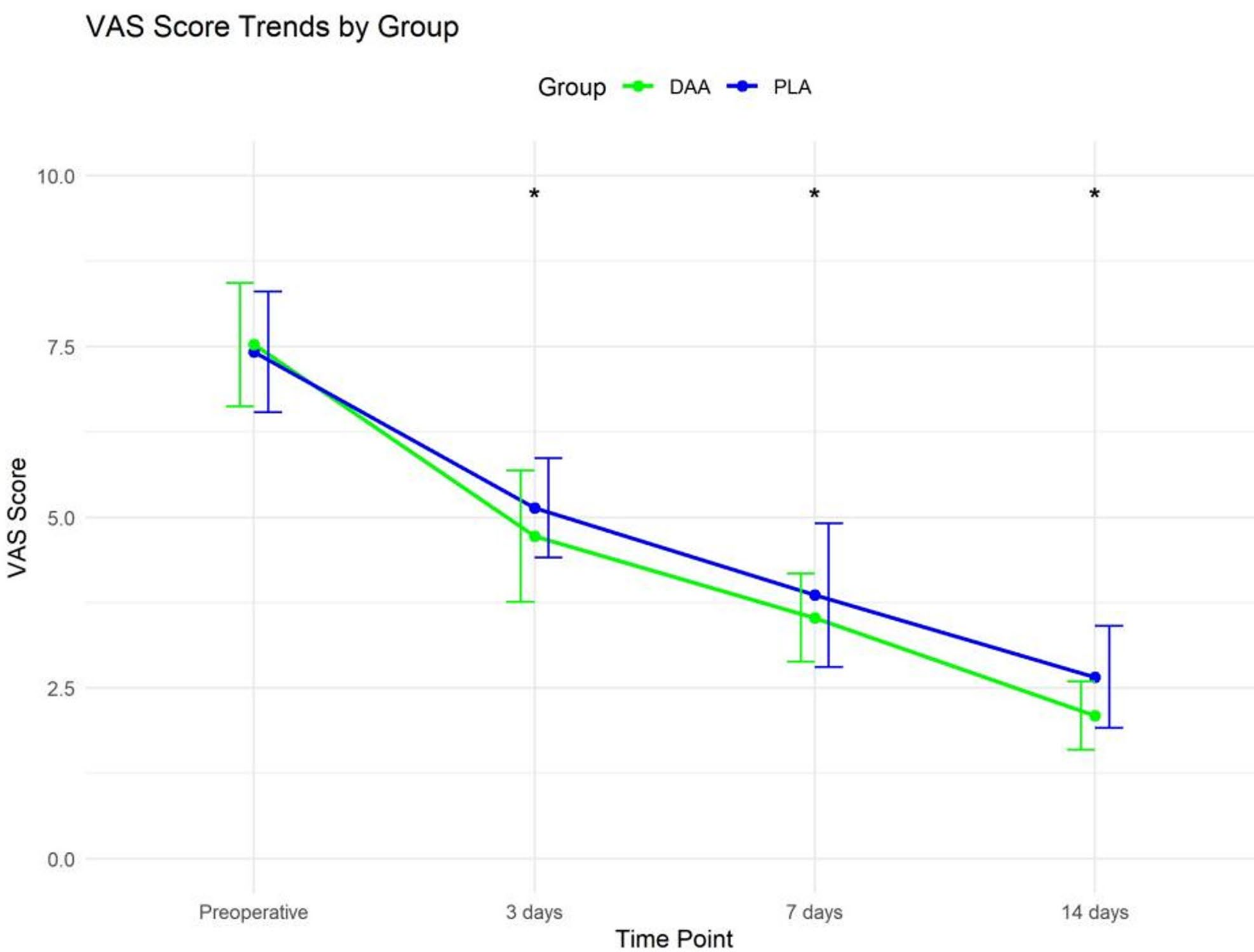

Fig. 1 Pre- and postoperative visual analog scale (VAS) scores in the DAA and PLA groups. The y-axis represents the VAS score, and the x-axis represents the time points. *$p < 0.05$ indicates a significant difference from the PLA group

PLA, DAA is associated with a lower dislocation rate (approximately 0.46%) [22].

Despite its benefits, the direct anterior approach for total hip arthroplasty has notable drawbacks, limiting its widespread use. Compared with standard techniques, it is a technically demanding procedure with a steep learning curve, defined as the number of cases a surgeon must perform to achieve consistent outcomes [23, 24]. Reviews confirm that proficiency is strongly correlated with surgical volume [25]. Exposure of the proximal femur is challenging, often requiring the release of soft tissues such as the joint capsule and adductor magnus tendon to elevate the femur, with inadequate exposure risking greater trochanter fractures in osteoporotic patients [26]. The risk of prosthetic joint infection is a significant concern, with early studies reporting higher wound complication rates (1.4% vs. 0.2% in posterior approaches) due to the proximity of the incision to the groin, a region prone to gram-negative bacteria [27]. In patients with a BMI exceeding 40, infection rates are elevated (4% vs. 2.5%) [28], suggesting increased risk of PJI and wound complications in obese individuals. Additionally, the approach's proximity to the lateral femoral cutaneous nerve poses a risk of injury during exposure or closure, potentially causing anterior–lateral thigh numbness [29].

The technical limitations of the direct anterior approach necessitate particular vigilance regarding six intraoperative considerations. (1) Careful patient selection is critical, with cautious application in morbidly obese individuals. (2) Optimal femoral exposure requires downward angulation of the operating table at the pubic symphysis level. (3) identification of the obturator internus muscle prevents incorrect intermuscular plane entry. (4) Careful protection of the lateral femoral cutaneous nerve combined with systematic coagulation of the superior gluteal artery's ascending branch minimizes lateral thigh hypoesthesia and reduces hematoma risk. (5) Controlled release of proximal femoral soft tissues, including capsular structures and conjoined tendons, with optional piriformis tendon release when needed, to ensure safe

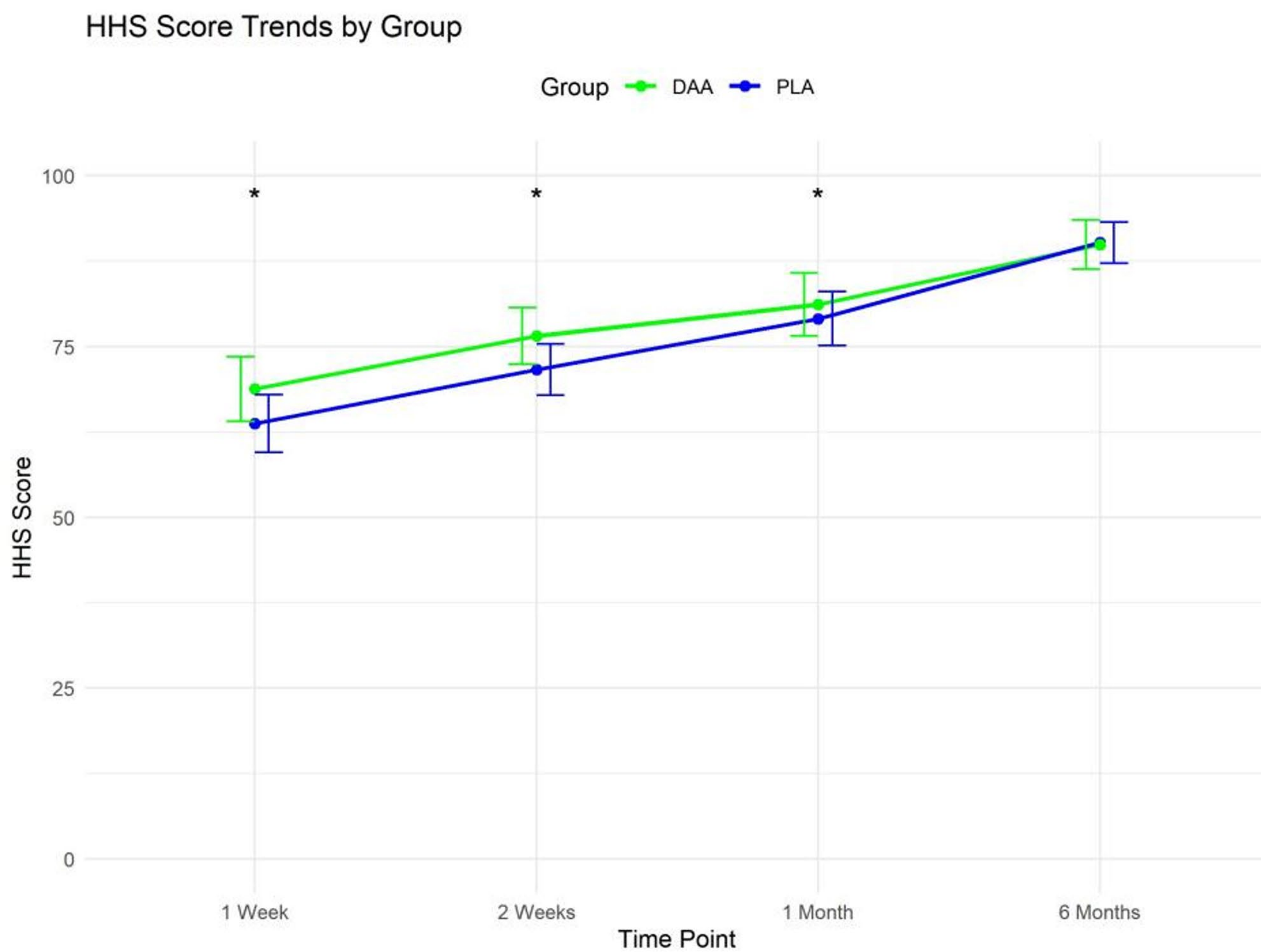

Fig. 2 Postoperative Harris hip scores (HHSs) in the DAA and PLA groups. The y-axis represents HHSs, and the x-axis represents the time points. $^{*}p < 0.05$ indicates a significant difference from the PLA group

femoral elevation while preventing calcar fracture. (6) Safe soft tissue preservation, with an eye toward maintaining the integrity of the obturator externus, is essential for preventing iatrogenic posterior instability through excessive proximal release.

Comparison of clinical, imaging, and functional outcomes between the two groups

Compared with the PLA group, the DAA group presented significantly shorter incision lengths and postoperative hospital stays, which is consistent with findings from domestic and international studies [30, 31]. The PLA requires transection of short external rotators to expose the hip joint, whereas the DAA utilizes an internervous plane, preserving muscle integrity and minimizing soft tissue trauma. This results in reduced intraoperative blood loss, faster functional recovery, and shorter hospital stays with DAA. For elderly patients with femoral neck fractures, shorter hospital stays are critical to reduce nosocomial complications and conserve medical resources.

The postoperative radiological findings in this study confirmed that the artificial hip prosthesis was positioned within the ideal range for both the DAA and PLA groups. The target acetabular abduction angle was 40–45° [32], with no significant difference between the groups. However, acetabular anteversion differed significantly: in the DAA group, the mean angle was 12.8 ± 2.1°, whereas it was 20.0 ± 3.5° in the PLA group. This disparity arises from the surgical technique used. In PLA, transection of short external rotators requires meticulous repair to prevent posterior dislocation, prompting placement of the acetabular component with anteversion parallel to or 5° greater than the transverse acetabular ligament, minimizing postoperative posterior dislocation risk. Conversely, the DAA preserves posterior structures but compromises the anterior capsule, increasing anterior dislocation risk during external rotation and abduction; thus, anteversion is set at 10–15° to reduce this likelihood.

In most patients, following total hip arthroplasty, the leg length discrepancy is less than 10 mm. The literature indicates that an LLD of 5–10 mm is generally well

Table 2 Comparison of outcome indicators between the DAA and PLA groups

	DAA group *n* = 51	PLA group *n* = 51	*p* -value
Length of incision(cm)	10.7 ± 1.4	13.1 ± 1.3	< 0.001
LOS(days)	5 ± 1.2	5.8 ± 1.1	0.001
Abduction angle	43.4 ± 1.6	42.7 ± 2.6	0.263
Anteversion angle	12.7 ± 2.2	20.1 ± 2.7	< 0.001
LLD(mm)	2.9 ± 1.5	6.1 ± 2.6	< 0.001
TUG	38.4 ± 5.4	41 ± 5.4	0.016
VAS preoperative	7.5 ± 0.9	7.4 ± 0.9	0.571
VAS 3(days)	4.7 ± 1	5.2 ± 0.7	0.012
VAS 7(days)	3.5 ± 0.6	3.9 ± 1.1	0.026
VAS 14(days)	2.1 ± 0.5	2.7 ± 0.7	< 0.001
HHS 1(week)	68.8 ± 4.7	63.7 ± 4.2	< 0.001
HHS 2(weeks)	76.5 ± 4.1	71.6 ± 3.8	< 0.001
HHS 1(month)	81.2 ± 4.6	79.1 ± 4	0.017
HHS 6(months)	89.9 ± 3.6	90.2 ± 3	0.675
Pain	41.4 ± 1.7	40.6 ± 2.1	0.046
Walking Aids	8.9 ± 1.3	7.5 ± 1.4	< 0.001
Gait	8.1 ± 1.9	7.1 ± 1.6	0.007
Walking Distance	9.2 ± 1.2	7.9 ± 1.7	< 0.001
Stairs	2.1 ± 0.6	2.1 ± 0.5	0.765

LOS, postoperative length of stay; LLD, limb–length discrepancy; TUG, timed up and go test; VAS, visual analog scale

Table 3 Comparison of complications between the DAA and PLA groups

Group	Intraoperative fracture	Prosthetic infection	Incision complications	Postoperative dislocation	Nerve injury	Reoperation
DAA group *n* = 51	1(2.0%)	0	1(2.0%)	0	1(2.0%)	1(2.0%)
PLA group *n* = 51	0	0	2(3.9%)	1(2.0%)	0	1(2.0%)
p -value	0.315	1	0.558	0.315	0.315	1

tolerated by patients [33]. In our study, 98% of patients exhibited an LLD below 10 mm postoperatively, reflecting high satisfaction with leg length outcomes. Compared with the PLA group, the DAA group had a significantly smaller LLD, likely because of the supine position in the DAA, which simplifies the intraoperative comparison of the bilateral patellar or medial malleolar positions. Additionally, this position facilitates fluoroscopic assessment of the lateral condyles, enabling more precise leg length control.

Comparative postoperative pain analysis revealed significantly lower VAS scores in the DAA cohort than in the PLA group at days 3, 7, and 14. This disparity likely stems from the minimally invasive nature of the DAA, which uses an internervous plane access with reduced capsular innervation in the anterior superior region, thereby causing less iatrogenic muscle and soft tissue disruption than the rotator muscle division that is required for PLA. Bergin et al. corroborated this mechanistic advantage through biochemical evidence, showing that DAA procedures yield lower serum creatine kinase levels (indicative of muscular trauma) and attenuated inflammatory mediator responses, particularly TNF-α [34]. These physiological preservation benefits collectively account for the DAA group's superior early functional mobility and reduced perioperative discomfort.

A systematic review of 109 studies (2012–2016) evaluating DAA for the treatment of femoral neck fractures revealed superior early functional recovery compared with alternative approaches, with four studies demonstrating statistically significant advantages in initial mobility outcomes. Subgroup analysis demonstrated a sevenfold reduction in dislocation rates with DAA (1.1%) versus PLA (7.8%) [35]. Consistent with these findings, the DAA cohort exhibited enhanced functional performance at the 1-week, 2-week, and 1-month postoperative assessments, including faster TUG tests at 2 weeks postoperatively and superior ambulatory capacity at the 1-month evaluation. Notably, this early functional advantage equilibrated by the 6-month follow-up, with comparable hip scores observed between groups, suggesting that approach-related differences primarily affect short-term rehabilitation phases rather than long-term arthroplasty outcomes.

Postoperative complications

Comparative analysis revealed equivalent overall complication rates between the groups. The DAA cohort exhibited one intraoperative greater trochanter fracture in an osteoporotic elderly patient during femoral exposure using a double-hook retractor, potentially attributable to insufficient capsular release, which was successfully managed with Kirschner wire tension band fixation. Notably, the PLA group sustained one postoperative dislocation (absent in DAA patients), underscoring the biomechanical significance of preserving external rotators for hip stability. Both approaches showed comparable wound morbidity profiles: DAA-related complications included one case of lateral femoral cutaneous nerve neuropraxia that resolved spontaneously within six months and a hematoma requiring debridement; PLA-related complication involved fat liquefaction managed conservatively, and one case of delayed healing requiring revision. No periprosthetic infections occurred in either group, possibly reflecting the study's sample size limitations and 6-month follow-up duration. Our institutional preference for the posterolateral approach in obese patients likely contributed to equivalent incision-related outcomes between techniques.

This study has two principal limitations. First, the retrospective single-center design with a limited sample size necessitates validation through prospective trials featuring extended follow-up periods to establish robust evidence for femoral neck fracture management. Second, while propensity score matching mitigated selection bias regarding patient comorbidities, residual confounding from unmeasured variables remains possible. Notwithstanding these constraints, the methodology demonstrates clinical applicability across orthopedic practices. Future multicenter prospective trials should further validate these findings through standardized outcome assessments.

Conclusions

This study demonstrated that the direct anterior approach (DAA) for total hip arthroplasty enhances early recovery outcomes in elderly patients with displaced femoral neck fractures who are undergoing ERAS protocols, with reduced soft tissue trauma, lower dislocation rates, and accelerated short-term functional recovery. DAA shows comparable long-term function to that of the posterolateral approach, supporting its integration into surgical strategies for optimizing early recovery.

Acknowledgements
The authors would like to acknowledge Dr. Qigang Zhou, Nanjing Medical University.

Author contributions
WYS completed the design and writing of the article, FJ completed the data collection, LHB was responsible for data statistics, WXD revised and proofread the article, and HJW designed the pictures and tables. All the authors reviewed the manuscript.

Funding
This research was supported by the Scientific Research Project of Nantong Health and Health Commission (Item number: MSZ2022044).

Data availability
The datasets are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study protocol was established according to ethical guidelines and was approved by the Ethics Committee of the Affiliated Nantong Hospital 3 of Nantong University (EK2023015).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 5 April 2025 / Accepted: 18 May 2025
Published online: 24 May 2025

References

1. Sundkvist J, Brüggeman A, Sayed-Noor A, et al. Epidemiology, classification, treatment, and mortality of adult femoral neck and basicervical fractures: an observational study of 40,049 fractures from the Swedish fracture register. J Orthop Surg Res. 2021;16:561.
2. Sundkvist J, Hulenvik P, Schmidt V, et al. Basicervical femoral neck fractures: an observational study derived from the Swedish fracture register. Acta Orthop. 2024;95:250–5.
3. Maffulli N, Aicale R. Proximal femoral fractures in the elderly: A few things to know, and some to forget. Med (Kaunas Lithuania). 2022;58(10):1314.
4. Han X, Han L, Chu F, et al. Predictors for 1-year mortality in geriatric patients following fragile intertrochanteric fracture surgery. J Orthop Surg Res. 2024;19:701.
5. Kim HS, Yoo JH, Lee YK, et al. Treatment of femoral neck fractures in the elderly: A survey of the Korean hip society surgeons. Hip Pelvis. 2023;35:157–63.
6. Ravi B, Pincus D, Khan H, et al. Comparing complications and costs of total hip arthroplasty and hemiarthroplasty for femoral neck fractures: A propensity Score-Matched, Population-Based study. J Bone Joint Surg Am Volume. 2019;101:572–9.
7. Stronach BM, Bergin PF, Perez JL, et al. The rising use of total hip arthroplasty for femoral neck fractures in the united States. Hip International: J Clin Experimental Res Hip Pathol Therapy. 2020;30:107–13.
8. van der Sijp MPL, van Delft D, Krijnen P, et al. Surgical approaches and hemiarthroplasty outcomes for femoral neck fractures: A Meta-Analysis. J Arthroplast. 2018;33:1617–e16271619.
9. Saba BV, Cardillo C, Haider MA et al. Does surgical approach in total hip arthroplasty affect postoperative corticosteroid injection requirements? J Arthroplast. 2025 24:S0883-5403(25)00257-8.
10. Driesman A, Yang CC. Clinical outcomes of DAA and related techniques in hip arthroplasty. Arthroplasty (London England). 2023;5:42.
11. Di Martino A, Pederiva D, Brunello M, et al. Outcomes of direct anterior approach for uncemented total hip replacement in medial femoral neck fractures: a retrospective comparative study on the first 100 consecutive patients. BMC Musculoskelet Disord. 2023;24:776.
12. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth. 1997;78:606–17.
13. Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: A review. JAMA Surg. 2017;152:292–8.
14. Huang Z, Zhang J, Di Z, et al. A comprehensive program for enhanced management of femoral neck fractures including an enhanced recovery after surgery program: A retrospective study. Medicine. 2021;100:e24331.
15. Morrell AT, Layon DR, Scott MJ, et al. Enhanced recovery after primary total hip and knee arthroplasty: A systematic review. J Bone Joint Surg Am Volume. 2021;103:1938–47.

16. D'Agostino RB Jr. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. Stat Med. 1998;17:2265–81.
17. Götz J, Maderbacher G, Leiss F, et al. Better early outcome with enhanced recovery total hip arthroplasty (ERAS-THA) versus conventional setup in randomized clinical trial (RCT). Arch Orthop Trauma Surg. 2024;144:439–50.
18. Barry E, Galvin R, Keogh C, et al. Is the timed up and go test a useful predictor of risk of falls in community dwelling older adults: a systematic review and meta-analysis. BMC Geriatr. 2014;14:14.
19. Wilson JM, Hadley ML, Larson D, et al. Outcomes following direct anterior approach total hip arthroplasty: A contemporary multicenter study. J Bone Joint Surg Am Volume. 2025;107:356–63.
20. Miller LE, Gondusky JS, Bhattacharyya S, et al. Does surgical approach affect outcomes in total hip arthroplasty through 90 days of Follow-Up? A systematic review with Meta-Analysis. J Arthroplast. 2018;33:1296–302.
21. Petis SM, Howard JL, Lanting BA, et al. In-Hospital cost analysis of total hip arthroplasty: does surgical approach matter?? J Arthroplast. 2016;31:53–8.
22. Horberg JV, Coobs BR, Jiwanlal AK, et al. Dislocation rates following total hip arthroplasty via the direct anterior approach in a consecutive, non-selective cohort. Bone Joint J. 2021;103–b:38–45.
23. Stone AH, Sibia US, Atkinson R, et al. Evaluation of the learning curve when transitioning from posterolateral to direct anterior hip arthroplasty: A consecutive series of 1000 cases. J Arthroplast. 2018;33:2530–4.
24. Werner JA, Schwarz J, Werner LA. The evolution of anterior total hip arthroplasty the past, present, and future. Bull Hosp Jt Dis. 2021;79:51–7.
25. Meermans G, Konan S, Das R, et al. The direct anterior approach in total hip arthroplasty: a systematic review of the literature. Bone Joint J. 2017;99–b:732–40.
26. Lamb JN, Matharu GS, Redmond A, et al. Risk factors for intraoperative periprosthetic femoral fractures during primary total hip arthroplasty. An analysis from the National joint registry for England and Wales and the Isle of man. J Arthroplast. 2019;34:3065–e30733061.
27. Buchalter DB, Teo GM, Kirby DJ et al. Surgical Approach to Total Hip Arthroplasty Affects the Organism Profile of Early Periprosthetic Joint Infections. *JB & JS open access*. 2020;5.
28. Shohat N, Goswami K, Clarkson S, et al. Direct anterior approach to the hip does not increase the risk for subsequent periprosthetic joint infection. J Arthroplast. 2021;36:2038–43.
29. Giang DH, Dao TX, Hoang DG. The lateral femoral cutaneous nerve is at high risk during direct anterior approach to the hip joint due to proximity and anatomic variations: A cadaveric study. Medeniyet Med J. 2025;40:12–7.
30. Jin MW, Zhang L, Chu XB, et al. Comparison of clinical efficacy between direct anterior approach and posterolateral approach in primary total hip arthroplasty. Eur Rev Med Pharmacol Sci. 2023;27:5604–13.
31. Tarabichi S, Verhey JT, Randelli PS, et al. Does surgical approach impact outcomes in primary total hip arthroplasty?? J Arthroplast. 2025;40:S128–9.
32. Meermans G, Fawley D, Zagra L, et al. Accuracy of cup placement compared with preoperative surgeon targets in primary total hip arthroplasty using standard instrumentation and techniques: a global, multicenter study. J Orthop Traumatology: Official J Italian Soc Orthop Traumatol. 2024;25:25.
33. Austin DC, Dempsey BE, Kunkel ST, et al. A comparison of radiographic leg-length and offset discrepancies between 2 intraoperative measurement techniques in anterior total hip arthroplasty. Arthroplasty Today. 2019;5:181–6.
34. Bergin PF, Doppelt JD, Kephart CJ, et al. Comparison of minimally invasive direct anterior versus posterior total hip arthroplasty based on inflammation and muscle damage markers. J Bone Joint Surg Am Volume. 2011;93:1392–8.
35. Kunkel ST, Sabatino MJ, Kang R, et al. A systematic review and meta-analysis of the direct anterior approach for hemiarthroplasty for femoral neck fracture. Eur J Orthop Surg Traumatology: Orthopedie Traumatologie. 2018;28:217–32.

Publisher's note