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Перспективное сравнение функциональных результатов прямого переднего и заднего доступов при тотальном эндопротезировании тазобедренного сустава

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Аннотация

Введение. Тотальное эндопротезирование тазобедренного сустава (ТЭТС) является высокоэффективным методом лечения пациентов с запущенными заболеваниями тазобедренного сустава. Современные исследования все чаще сравнивают хирургические подходы для оптимизации восстановления и улучшения результатов. Прямой передний доступ (ППД) обеспечивает преимущества в плане сохранения мышц и более быстрого раннего восстановления, но является технически сложным и требует более длительного обучения. Задний доступ (ЗД) остается широко используемым, но имеет более высокий риск вывиха.

Цель работы — определить, сохраняются ли преимущества раннего восстановления, отмеченные при применении ППД, в течение года наблюдения, и как эти преимущества соотносятся с возросшими техническими требованиями и потенциальными рисками, связанными с этим методом.

Материалы и методы. В данном одноцентровом проспективном исследовании (январь 2024 г. – июнь 2025 г.) сравнивали результаты лечения 36 пациентов, которым проводили первичное эндопротезирование тазобедренного сустава с использованием ППД или ЗД. Все процедуры выполняла одна хирургическая бригада с применением стандартизированного операционного пособия. В исследование включены пациенты с первичным эндопротезированием тазобедренного сустава (18 пациентов в группе ППД и 18 в группе ЗД) с сопоставимыми исходными гендерно-возрастными характеристиками. Наблюдение за пациентами проводили в течение одного года. С использованием слепой оценки и статистического анализа оценивали следующие параметры: боль (VAS), функция (HHS), рентгенологическая точность и осложнения.

Результаты. Продолжительность операции была больше в группе ППД, но срок пребывания в стационаре, прогрессирование послеоперационной боли, функциональное восстановление и рентгенологические результаты были схожими. В группе ЗД произошло два интраоперационных перелома, а в группе ППД — одна ранняя инфекция, все случаи были успешно купированы. Оба подхода показали эквивалентные результаты с низким уровнем осложнений.

Обсуждение. Схожие функциональные результаты эндопротезирования тазобедренного сустава с использованием ЗД и ППД через год наблюдения указывают на то, что квалификация хирурга и отбор пациентов имеют большее значение, чем выбор метода операции.

Заключение. Оба подхода показали сопоставимые результаты через год после операции; ППД обеспечивал более раннее восстановление, но более длительное время операции, при этом частота осложнений была аналогичной.

Ключевые слова: эндопротезирование, шкала Харриса для оценки состояния тазобедренного сустава, тазобедренный сустав, прямой передний доступ, задний доступ

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INTRODUCTION

Total hip arthroplasty (THA) is a well-established and highly effective surgical intervention for the management of advanced hip pathology. It has consistently demonstrated the ability to significantly reduce pain and restore mobility in individuals suffering from osteoarthritis, avascular necrosis, or femoral neck fractures [1]. As THA has become increasingly common worldwide, continuous improvements in implant design, biomaterials, and operative techniques have reshaped the expectations for both surgeons and patients. Modern research no longer focuses solely on implant survival; instead, it places strong emphasis on achieving rapid postoperative recovery, improvement of early and long-term functional outcomes, enhancing patient satisfaction, and minimizing complications [2, 3]. Among the numerous variables that influence these goals, the choice of surgical approach is particularly relevant. In this context, comparison between the direct anterior approach (DAA) and the posterior approach (PA) has emerged as a central theme in contemporary literature [4, 5].

Historically, the PA became the most widely adopted approach for THA because it provides excellent visualisation of the joint structures, facilitates straightforward component placement, and is easy to reproduce reliably across surgeons with varying levels of experience [6, 7]. This familiarity has made the PA a mainstay in orthopedic practice for decades. However, the PA necessitates detachment or manipulation of the short external rotator muscles and the posterior capsule during the procedure. This disruption of soft tissues may place patients at a higher risk for postoperative instability and dislocation, which remains one of the most concerning complications following THA [8].

In contrast, the DAA accesses the hip joint through an internervous and intermuscular plane, theoretically reducing damage to muscles and surrounding soft-tissue structures [9, 10]. This tissue-sparing characteristic has been associated with reduced postoperative pain, quicker mobilisation, earlier achievement of independent ambulation, and shorter hospital stays. For these reasons, the DAA has gained considerable popularity over the past decade, especially in centres focused on enhanced recovery protocols. Nevertheless, despite these advantages, the DAA presents its own set of challenges. It is technically more demanding, often requires specialised traction tables or specific instrumentation, and is associated with a steep learning curve. Surgeons performing the DAA must also be cautious of approach-specific complications such as LFCN neuropraxia, a recognised issue due to the nerve's anatomic course, as well as an increased risk of intraoperative fractures and prolonged surgical duration [11, 12].

The last ten years have witnessed a surge in high-quality studies, randomised controlled trials (RCTs), retrospective cohort studies, and numerous meta-analyses that seek to determine whether one approach offers distinct advantages over the other in terms of function, recovery, and durability [13]. A meta-analysis published in 2020 that synthesised outcomes from more than 600 patients found that the DAA was associated with lower early postoperative pain and higher Harris Hip Scores (HHS) at six weeks. However, by the one-year mark, both approaches produced comparable functional outcomes [14]. Although the DAA consistently required longer operative time, it did not show higher rates of complications or lengthier hospitalisations when compared with the PA.

Another large meta-analysis evaluating more than 14,000 THAs reported that the DAA resulted in more accurate acetabular component positioning, particularly a higher proportion of components placed within the Lewinnek safe zone. In addition, these studies noted shorter hospital stays and reduced early postoperative pain among patients treated with the DAA. However, this same body of evidence also indicated a higher incidence of intraoperative fractures and longer average surgical time, reinforcing the notion that the DAA demands significant technical expertise [15].

Contemporary comparisons of these two methods have been further influenced by the development of enhanced recovery after surgery (ERAS) guidelines. Multiple studies spanning 2012 to 2024 have consistently shown that when combined with ERAS pathways, the DAA often correlates with lower transfusion requirements, decreased biochemical markers of muscle injury, and shorter hospital stays (approximately one day shorter on average) without an increase in overall complication rates [16].

Long-term follow-up data have also begun to clarify the durability and outcomes associated with each approach. Several studies indicate that both DAA and PA achieve comparable Harris Hip Scores, long-term function, and patient-reported satisfaction. However, an elevated risk of dislocation has been reported more frequently in the PA cohort, likely attributable to posterior soft-tissue disruption [17].

When evaluating specific populations, such as elderly patients undergoing THA for displaced femoral neck fractures, research has shown that while complication and revision rates are similar between approaches, the DAA may support faster early mobilisation and lower one-year mortality. Technological advancements, including robotic assistance and computer navigation, have also entered the comparison landscape, with early findings suggesting that precise component positioning can be accomplished with either approach when such technologies are employed [18].

Although early functional benefits of the DAA are well documented, numerous studies demonstrate that these differences diminish over time. Radiographic parameters such as acetabular cup inclination, femoral offset, and leg-length restoration tend to show minimal differences between DAA and PA when surgeries are performed by experienced surgeons [19]. Even so, DAA continues to be associated with a longer learning curve, longer operative times, and approach-specific complications including LFCN neuropraxia and intraoperative fractures [20].

Despite a substantial and growing body of literature, significant heterogeneity persists across studies. Variations in patient selection, surgical experience, perioperative protocols, implant choices, and postoperative rehabilitation strategies complicate direct comparisons. Additionally, relatively few studies offer consistent long-term data beyond five years, leaving several questions unresolved regarding late dislocations, prosthetic survival, and long-term function.

Given these ongoing uncertainties, the present prospective randomised study was designed to provide a comprehensive comparison of DAA and PA in THA with one-year follow-up. The study evaluates operative duration, postoperative pain with VAS, functional recovery with HHS, hospital stay, radiographic accuracy including cup positioning, leg-length equality, and offset and overall complication rates.

The **purpose** was to determine whether the early recovery advantages reported with DAA persist over one-year follow-up and how these benefits compare with the increased technical demands and potential risks associated with the approach.

MATERIALS AND METHODS

This single-centre, prospective observational study was carried out at a tertiary-care Orthopaedic teaching institute between January 2024 and June 2025 to compare functional, radiological, and clinical outcomes following total hip arthroplasty (THA) performed using either the direct anterior approach (DAA) or the posterior approach (PA). Approval for the study was granted by the Institutional Ethics Committee, and written informed consent was obtained from every participant before enrolment.

Eligible patients were those older than 20 years undergoing primary THA for primary osteoarthritis, neglected femoral neck fracture, or avascular necrosis of the femoral head. Individuals were excluded if they had inflammatory arthritis, previous surgery on the ipsilateral hip, proximal femoral deformity requiring a corrective osteotomy, body mass index greater than 40 kg/m², ongoing local or systemic infection, neuromuscular or cognitive disorders, contralateral hip involvement, or if they required revision surgery.

A total of 36 consecutive patients met the inclusion criteria: 18 were treated with THA via the DAA and 18 via the PA. The sample size was based on practicality rather than a formal power computation and was intended to provide preliminary information for future larger-scale studies.

Surgical Technique

All procedures were performed by a senior arthroplasty surgeon with substantial experience in both approaches (more than 75 prior cases of each technique). A combined spinal–epidural anaesthetic technique was used for all surgeries, along with uniform perioperative antibiotic administration and thromboembolism prophylaxis.

For the PA group, patients were positioned in the lateral decubitus position. A minimally invasive posterolateral incision was used, with release and subsequent repair of the short external rotators and the posterior capsule.

For the DAA group, patients were positioned supine on a traction table. The modified Hueter interval was utilised to access the hip through an internervous and intermuscular plane. No intraoperative fluoroscopic guidance was used, and special attention was given to protection of the lateral femoral cutaneous nerve.

Implants

All participants received uncemented femoral stems and uncemented acetabular cups, with metal-on-polyethylene bearing surfaces.

Postoperative Care

Postoperative management was standardised for both groups. Multimodal analgesia was provided, and physiotherapist-guided mobilisation commenced on the first postoperative day. Thromboprophylaxis with low-molecular-weight heparin continued for 14 days. Discharge criteria consisted of the ability to mobilise independently, walk at least 20 metres with an assistive device, climb stairs, and maintain adequate pain control. Physiotherapists determining discharge readiness were blinded to the surgical approach.

Outcome Measures

Patients were reviewed at 2 weeks (for suture removal), 6 weeks, 3 months, 6 months, and one year. Functional status was measured using the Harris Hip Score (HHS), and pain levels were assessed using the Visual Analogue Scale (VAS). Standardised anteroposterior and lateral radiographs of the hip were obtained at each follow-up to evaluate acetabular cup inclination and anteversion using the Lewinnek method, as well as limb length discrepancy and femoral offset. Radiographs were interpreted independently by two observers who were blinded to the surgical approach.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 25 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean \pm standard deviation and were compared using the Student's t-test for normally distributed data or the Mann – Whitney U test for non-parametric data. Categorical variables were analysed using the chi-square test or Fisher's exact test where appropriate. A *p*-value < 0.05 was considered statistically significant.

As this investigation was designed as a prospective exploratory study, the sample size was determined by the number of eligible patients undergoing primary total hip arthroplasty at our institution during the study period rather than by a formal a priori power calculation. Consecutive patients meeting the inclusion criteria were enrolled to minimise selection bias. The findings are therefore intended to provide preliminary comparative data and generate effect-size estimates to inform future adequately powered studies.

A total of 36 patients underwent total hip arthroplasty (THA) during the study period from January 2024 to June 2025. Of these, 18 patients were treated using the direct anterior approach (DAA) and rest using the posterior approach (PA). Baseline demographic variables including age, sex distribution, and body mass index were comparable between both cohorts (Table 1). All participants completed the 1-year postoperative follow-up.

Regarding surgical indications, avascular necrosis was the predominant diagnosis in the DAA group, accounting for 50 % of cases, whereas primary osteoarthritis was most common in the PA group, also representing 50 %. Femoral neck fractures comprised 11 % of cases in each group. Each arm of the study included exactly 18 patients (Table 2).

Table 1

Demographic data

	DAA (n = 18)	PA (n = 18)	<i>P</i> -value
Age, yr, mean \pm SD	39.9 \pm 8.4	38.1 \pm 7.8	0.52
BMI, mean \pm SD	24.5 \pm 4.4	25.5 \pm 3.3	0.45
Gender	Male	10 (55.55 %)	9 (50 %)
	Female	08(44.45 %)	9 (50 %)
Side	Right	10 (55.55 %)	9 (50 %)
	Left	08(44.45 %)	9 (50 %)

Table 2

Indication for surgery

Indication	DAA	PA
Hip primary osteoarthritis	7 (39 %)	9 (50 %)
Avascular necrosis of femoral head	9 (50 %)	7 (39 %)
Neck femur fracture	2 (11 %)	2 (11 %)
Total	18 (100 %)	18 (100 %)

RESULTS

Postoperative recovery parameters showed no significant differences in hospitalization duration, with the PA group staying an average of 3.5 \pm 2.2 days and the DAA group 3.8 \pm 1.8 days (*p* = 0.53). Operative time, however, differed markedly: procedures performed via the DAA required significantly more time (59.9 \pm 12.7 minutes) compared with the PA (45.7 \pm 17.9 minutes; *p* = 0.002). Preoperative pain levels, assessed using VAS, were higher among PA patients (6.9 \pm 2.1) than those undergoing DAA (5.0 \pm 2.4; *p* = 0.029). After surgery, pain trajectories were similar between groups across all postoperative intervals. Early functional improvement (2–6 weeks) tended to favor the DAA cohort, although this early advantage did not translate into statistically significant differences at 3 months, 6 months, or one year (Table 3).

Table 3

VAS and Harris Hip Score (HHS) over time

Timepoint	VAS (PA)	VAS (DAA)	HHS (PA)	HHS (DAA)
2 weeks	2.1 \pm 2.0	2.0 \pm 2.0	60.0 \pm 15.1	66.9 \pm 17.1
6 weeks	1.6 \pm 1.9	1.4 \pm 2.0	68.7 \pm 16.8	76.7 \pm 16.4
3 months	1.1 \pm 1.9	1.0 \pm 1.7	83.3 \pm 15.1	88.4 \pm 11.8
6 months	0.4 \pm 1.0	0.4 \pm 0.8	90.3 \pm 12.3	90.1 \pm 11.3
1 year	0.6 \pm 1.2	0.3 \pm 0.5	91.4 \pm 13.0	94.4 \pm 8.0

Table 4

Radiological outcomes

Variable	PA (n = 18)	DAA (n = 18)	p value
Cup anteversion, °	21.9 ± 13.4	26.9 ± 8.6	0.10
Cup abduction, °	39.8 ± 5.4	43.3 ± 8.4	0.06
Planned leg length discrepancy, mm	1.0 ± 5.6	-2.2 ± 6.8	0.06

Radiographic assessments demonstrated comparable postoperative leg length restoration between the two approaches ($p = 0.061$). All prosthetic components remained stable throughout follow-up, with no evidence of migration or progressive radiolucent lines (Table 4).

Complications were infrequent. Two intraoperative periprosthetic fractures occurred in the PA group: one acetabular and one femoral, both treated conservatively. In the DAA group, one patient developed an early prosthetic joint infection caused by *Streptococcus*, which resolved after debridement, lavage, and intravenous antibiotic therapy. Overall, aside from longer operative durations associated with the DAA, clinical, functional, and radiological outcomes were largely equivalent between the two approaches, with a low overall complication profile.

DISCUSSION

This prospective study compared one-year clinical, functional, and radiographic outcomes of total hip arthroplasty performed using the direct anterior approach (DAA) and the posterior approach (PA). While DAA required a longer operative duration, both techniques ultimately delivered similar improvements in pain, mobility, implant positioning, and complication rates. These results align with current evidence showing that multiple THA approaches can achieve excellent outcomes when performed by surgeons experienced with their respective technique.

Operative Characteristics

In our cohort, DAA procedures took longer to complete than PA procedures. This is consistent with the observations of von S. Hertzberg-Boelch et al. [21], who note that the anterior approach presents technical challenges, particularly during early adoption when surgeons are still refining femoral exposure and soft-tissue handling. K.K. Andersson et al. [22] further reported that operative times tend to decrease significantly once surgeons surpass approximately 40–60 anterior cases, suggesting that the increased duration in our study reflects a typical early-to-mid learning-curve performance. Estimated blood loss did not differ meaningfully between groups, in agreement with J. Parvizi et al. [23], who reported comparable intraoperative hemodynamic profiles for both approaches.

Pain and Functional Recovery

Although preoperative VAS scores were higher in the PA cohort, postoperative pain trajectories were similar between the two groups. This mirrors findings by J.E. Nassar et al. [5], indicating that neither technique provides a substantial long-term analgesic advantage. A short-term functional benefit was observed in the DAA group at 2–6 weeks, likely attributable to its muscle-sparing interval. This pattern corresponds with evidence suggesting that early gait recovery may be faster with DAA. However, by three months, functional outcomes were equivalent, supporting the conclusions from the meta-analyses by M.E. Awad et al. [24], L.A. Stalk et al. [25], and J.T. Moskal et al. [26], which demonstrate that Harris Hip Scores align after the initial rehabilitation period.

Radiological Findings

Radiographic evaluation did not demonstrate any significant differences between DAA and PA in cup orientation, stem alignment, or restoration of limb length. These findings are consistent with work of T.J. Lin et al. [27] and H. Wang et al. [28], who report that accurate component placement can be reliably achieved with either approach when anatomical landmarks and appropriate instrumentation are used. The absence of radiolucent lines or component migration within the first postoperative year suggests satisfactory early fixation and stable osseointegration in both groups.

Complications

Complication rates were low across both cohorts. Two intraoperative fractures occurred in the PA group, while one early postoperative infection was recorded in the DAA group. Although previous studies have associated DAA with a higher femoral fracture risk, particularly during the surgeon's learning curve, this was not evident in our study. Similarly, despite registry data suggesting a slightly higher early dislocation risk with PA, no dislocations were observed. The infection in the DAA group resolved with timely debridement and antibiotic therapy and falls within expected rates reported in contemporary literature. Importantly, no cases required revision surgery, underscoring the overall safety of both approaches under standardized perioperative care.

Interpretation and Clinical Implications

Overall, both DAA and PA proved effective in achieving favorable clinical and radiographic outcomes when performed by a skilled surgeon. The early functional advantage observed with DAA may be particularly useful in ERAS pathways or in younger, active patients who prioritize faster mobility. However, the increased technical complexity and longer operative time associated with DAA emphasize the importance of structured training, mentorship, and appropriate case selection during its adoption. Given that mid-term outcomes were equivalent, approach selection should be based on surgeon expertise, patient anatomy, comorbidities, and institutional workflow rather than inherent superiority of either technique.

Study Limitations

This study's relatively small sample size may limit its ability to detect more subtle functional differences or rare complications. The single-surgeon design enhances internal consistency but may constrain generalizability to broader practice settings. Additionally, the follow-up was limited to one year, preventing evaluation of long-term complications such as late dislocation, infection, wear, and implant survival. Larger, multicentre studies with an extended follow-up would provide more comprehensive comparative data.

CONCLUSION

Although DAA was associated with longer operative times, both approaches yielded comparable pain relief, functional recovery, radiographic accuracy, and complication rates at one year. These findings reinforce the principle that optimal THA outcomes depend more on surgical expertise, meticulous patient selection, and structured rehabilitation than on the specific surgical approach chosen.

Conflict of interest There are no conflicts of interest.

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Statement of Authorship All authors certified fulfilment of ICMJE authorship criteria.

Ethics approval and consent to participate Ethics committee approval was granted by the institutional review board.

Consent for publication Consent was taken from all the participants.

Availability of data and materials The datasets used in and analyzed in the current study are available from the corresponding author upon reasonable request.

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