

# Comparison of early complications for primary total hip arthroplasty using modified direct anterior approach and lateral approach

## *Comparación de complicaciones tempranas en artroplastia total de cadera primaria entre abordaje anterior directo modificado y abordaje lateral*

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### Abstract

**Background:** Total hip arthroplasty is a surgical procedure with reliable results, regardless of the approach used. The anterior approach has advantages by respecting muscle insertions, reflected in the lower number of complications and shorter recovery time compared to other approaches. **Objective:** The goal of the study was to assess the progression of 150 total hip arthroplasty procedures in the first 90 postoperative days. 75 patients underwent a modified direct anterior approach (MDAA) using a minimally invasive technique with a special table, and 75 patients underwent a direct lateral approach (DLA). **Methods:** An observational retrospective study was conducted, including 150 arthroplasties, performed by the same surgeon, using two surgical approaches. 75 cases with direct lateral approach (DLA) and 75 cases with modified direct anterior approach (MDAA), between January 2007 and December 2020. Baseline characteristics, surgical variables, and postoperative complications were compared between the two groups. **Results:** At 90 days, both groups presented a similar percentage of minor complications (32% vs. 42%), however, there was a higher number of major complications due to DLA (40% vs. 12%  $p < 0.0001$ ) overall, where motor neurological complications have a higher incidence (14 [18.6%]). No differences were found in terms of the Harris functional scale. **Conclusion:** MDAA is a safe and reliable technique with satisfactory results. It presents predictable early complications, such as other approaches. Although it allows a faster recovery, at 90 days, the evolution and satisfaction are similar between both approaches with excellent and good outcomes in > 90% of cases.

**Keywords:** Total hip arthroplasty. Anterior approach. Lateral approach. Minimally invasive. Complications

### Resumen

**Antecedentes:** La artroplastia total de cadera es un procedimiento quirúrgico con buenos resultados, independientemente del abordaje empleado. El abordaje anterior presenta ventajas al respetar las inserciones musculares, lo que se refleja en un menor número de complicaciones y menos tiempo de recuperación en comparación con otros abordajes. **Objetivo:** El objetivo del estudio fue valorar la evolución de 150 reemplazos totales de cadera en los primeros 90 días comparando 75 pacientes operados por abordaje anterior directo y 75 pacientes operados por abordaje lateral. **Método:** Se realizó un estudio retrospectivo observacional, incluyendo 150 artroplastias realizadas entre enero de 2007 y diciembre de 2020 por el mismo cirujano empleando dos abordajes quirúrgicos: 75 casos con abordaje lateral directo y 75 casos con abordaje anterior directo modificado. Se compararon las características basales, las variables quirúrgicas y las complicaciones posoperatorias entre ambos grupos. **Resultados:** A 90 días, ambos grupos presentaron un porcentaje similar de complicaciones menores (32 vs. 42%); sin embargo, hubo un mayor número de complicaciones mayores con el abordaje lateral directo (40 vs. 12%;  $p < 0.0001$ )

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de forma global, siendo las complicaciones neurológicas motoras las que presentaron mayor incidencia (14; 18.6%). No se encontraron diferencias en cuanto a la escala funcional de Harris. **Conclusiones:** El abordaje anterior directo modificado es una técnica segura y confiable, con resultados satisfactorios. Presenta complicaciones tempranas predecibles y similares a las de otros abordajes. Aunque permite una más rápida recuperación, a 90 días la evolución y la satisfacción son similares para ambos abordajes, con desenlaces excelentes y buenos en más del 90% de los casos.

**Palabras clave:** Artroplastia total de cadera. Abordaje anterior. Abordaje lateral. Mínima invasión. Complicaciones.

## Introduction

Total hip arthroplasty (THA) is regarded as one of the world's most effective surgeries and is one of the most often performed procedures by orthopedic surgeons. Due to the affected anatomical structures and complications associated with each one, as well as a trend toward smaller incisions and less invasive treatments, the surgical approach directly affects the patient's development<sup>1</sup>. Numerous studies have described the benefits and drawbacks of the three main surgical techniques employed, highlighting potential risks for each<sup>2</sup>. The posterior and lateral approaches have been the most popular, each with its advantages and disadvantages<sup>3</sup>. For instance, residual claudication and abductor muscle weakness are linked to the anterolateral and direct lateral approaches (DLAs). The posterior technique does not have a direct influence on the hip abductor muscles, however, it is associated with a larger chance of dislocation but does not have as much of an impact on walking quality<sup>3,4</sup>. The modified direct anterior approach (MDAA) favors a faster recovery, with less pain and a shorter hospital stay since no muscle is affected directly, however, it may require special equipment and a learning curve that can predispose to major complications in the first cases<sup>5</sup>.

The anterior technique has attracted attention among hip surgeons over the past 15 years, accounting for up to 30% of interventions in both Europe and North America, with a high uptake among younger generations<sup>6,7</sup>. For a surgeon, shifting from one approach to another is challenging because it necessitates a period of adjustment and a learning curve that not everyone is comfortable going through because of the direct risks that this implies for their patients. Nevertheless, for a hip surgeon with experience, the change in technique does not appear to present a significant challenge<sup>8,9</sup>. The advantages of the anterior approach over the lateral approach are substantial in patients treated for femoral neck fractures as well as in geriatric patients<sup>9-11</sup>. Improving care at home, there appears to be less pain and faster mobilization. The

need for physical therapy at home appears to decline by more than 50% across all age groups<sup>12,13</sup>. The patient resumes regular activities more quickly, such as driving and working. There is no need for conventional universal hip surgery therapy and patients' satisfaction is superior<sup>14,15</sup>.

The current study's objective was to examine 90-day main complications following primary THA using the direct anterior and lateral approaches. Minor complications were also evaluated as an additional outcome.

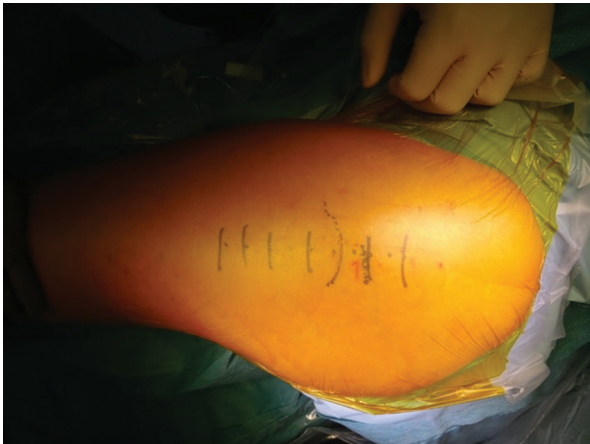
## Objective

The goal of the study was to assess the progression of 150 THA procedures conducted by the same surgeon, who has more than 22 years of experience in hip surgery, in the first 90 postoperative days. Of these procedures, 75 patients underwent a MDAA using a minimally invasive technique with a special table, and 75 patients underwent a DLA.

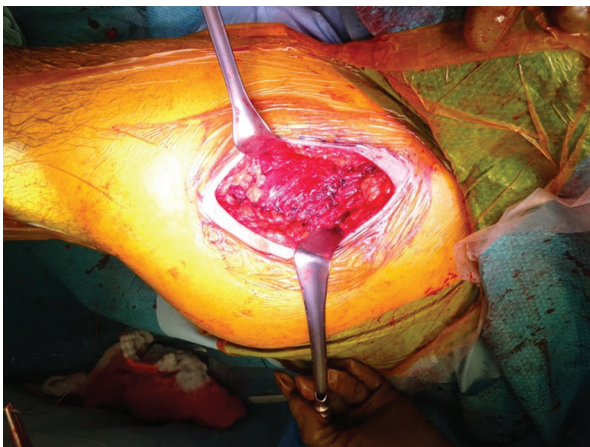
## Patients and methods

Following approval from our hospital's research ethics committee, a single surgeon with 22 years of experience using the DLA before switching to the MDAA performed a retrospective, observational study with a sequential series of 150 THA in 138 patients with a diagnosis of osteoarthritis, avascular necrosis, or subcapital fracture of the femur. Patients with a diagnosis of transtrochanteric fracture of the proximal femur, previous hip surgery and/or infection were excluded.

Two groups of seventy-five patients each were established out of the patients. Between January 2007 and December 2020, the first 75 THA procedures were completed using a DLA, while the next 75 procedures used an MDAA. Pre-, intra-, and postoperative information were collected for both groups, including diagnosis, sex, age, afflicted side, surgical time, blood loss, and minor and major early complications. All patients received the same standard perioperative treatment, which included anesthesia,



**Figure 1.** Direct lateral approach. (Left hip). Lateral decubitus position. The incision begins 3 cm proximal to the greater trochanter and 5-7 cm distal along the femoral diaphysis.



**Figure 2.** Repair of the gluteus medius and vastus lateralis in the greater trochanter after the placement of definitive implants in the direct lateral approach.

analgesics, physical therapy, rehabilitation standards, and discharge planning. In both groups, non-cemented systems were employed for acetabular and femoral components.

For the DLA group, the same system was used in all cases, consisting of a Summit femoral stem and a Pinnacle cup with a polyethylene liner (DePuy, USA) and a ceramic or metal head with diameters according to the size of the cup. For the MDAA group, the same hip replacement system with AMIS-H femoral stem and Versafit acetabular cup (Medacta, Castel San Pietro, Switzerland) with polyethylene liner and ceramic or metal head was used in all cases. Both stems are a type 2 double wedge metaphyseal filling system<sup>16</sup>, the main difference between them lies in the



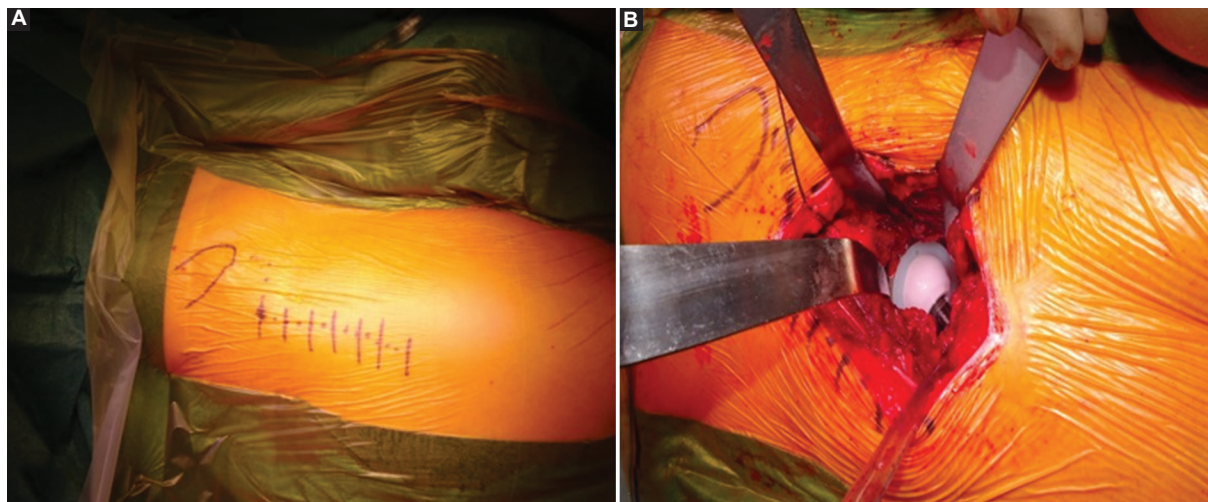
**Figure 3.** Position of the patient in the supine position with the pelvic limb placed on a special table with a fluoroscope.

preparation of the femoral canal; Summit uses conical reamers, while AMIS works through direct compaction of the cancellous bone and endosteum. It is beyond the specific objectives of this study to associate surgical complications with femoral reaming.

The modified Hardinge approach was utilized to the DLA (Fig. 1)<sup>17,18</sup>. An incision measuring 10-12 cm in length was made on the lateral surface of the thigh, 2 cm proximal to the greater trochanter, and it followed the axis of the femur towards the distal end. A control radiograph was taken in each case to confirm the components' positions and the length of the limb. The gluteus medius and vastus lateralis tendons were repaired onto on the greater trochanter after completing stability tests (Fig. 2).

The Hueter technique was used in the group of patients who had MDAA treatment, with the patient in the supine position and the pelvic limb resting on a specific traction table (Fig. 3)<sup>19</sup>. In all instances, radiographs with fluoroscopy were used to confirm the components' positions during surgery as well as the length of the extremities in relation to the contralateral hip and the preoperative plan.





**Figure 4.** **A:** modified direct anterior approach (right hip) supine position. The incision begins 2 cm distal and 3 cm lateral to the anterior superior iliac spine and follows the course of the belly of the tensor fasciae latae muscle 8 cm distally. **B:** final stability tests with definitive components. Anterior approach: Intermuscular plane between tensor fasciae latae and anterior rectus.

Hueter's interval was used between the tensor fasciae latae muscle and the anterior rectus with the minimally invasive anterior approach technique, which is a modification of the direct anterior approach, making an oblique skin incision 2 cm distal and 3 cm lateral to the anterior superior iliac spine directed following the center of the palpable belly of the tensor fasciae latae muscle in the thigh to avoid injuring the lateral femoral cutaneous nerve (Fig. 4). Stability is verified under direct vision and by fluoroscopy. Repair of the hip capsule and closure of the superficial fascia of the tensor fasciae latae, cellular tissue, and skin were performed.

In all cases in both groups, a plain pelvic radiographic image was obtained in anteroposterior projection before moving the patient from the operating table to the surgery recovery room.

### Outcomes

Between the two groups, patient baseline characteristics were evaluated. They were divided into surgical variables and demographics. The demographics were etiology, age, and gender; intraoperative and postoperative factors included time taken for the surgical procedure (minutes), amount of blood loss (mL), need for transfusion within 72 h following surgery, and mortality during the same hospitalization.

All patients underwent postoperative evaluations at 15-, 30-, 60-, and 90 days during follow-up consultation in an outpatient clinic. A radiological control was

done in every case between 30 and 60 days, and a final one was done at 90 days. To look for loosening, heterotopic ossification, or migration, the radiographs taken immediately following surgery were compared to those taken during the first 90 days. Clinical evolution evaluation was conducted at 30 and 90 days using the Harris hip score (HHS)<sup>20</sup>.

The main result was 90-day major complications, which included death, readmission, reoperation for any reason, wound complications (infection or dehiscence), pneumonia, pulmonary embolism, stroke or neurological deficit, cardiac arrest, deep infection, sepsis, or septic shock. Note that readmission included any admittance into a hospital after surgery for any reason.

The secondary outcome was 90-day minor complications, which included symptomatic deep vein thrombosis, superficial wound infections, leg length discrepancy > 5 mm, sensitive neurologic symptoms on the operated leg and/or thigh, heterotopic ossification, and asymptomatic migration < 1 cm.

### Statistical analysis

The IBM SPSS Statistics version 25.0 was used for all data analysis (IBM SPSS Statistics, Chicago, IL, USA). Counts were used to summarize categorical variables (Table 1). Within each sub-cohort, odds ratios (OR) were calculated with 95% confidence intervals for the corresponding postoperative outcome. For continuous variables, (blood loss, surgical time) the mean and standard

**Table 1. Characteristics of study population**

| Variables     | MDAA (n = 75) | DLA (n = 75) | p-value |
|---------------|---------------|--------------|---------|
| Gender        |               |              | 0.3472  |
| Male          | 23 (30%)      | 31 (41%)     |         |
| Female        | 52 (70%)      | 44 (59%)     |         |
| Age           | 62.4 ± 11.1   | 69.1 ± 11.4  | 0.4922  |
| Affected side |               |              | 0.1304  |
| Right hip     | 41 (54%)      | 37 (49%)     |         |
| Left hip      | 34 (46%)      | 38 (51%)     |         |

MDAA: modified direct anterior approach; DLA: direct lateral approach.

**Table 2. Characteristics of surgery**

| Etiology               | MDAA       | DLA        | p-value |
|------------------------|------------|------------|---------|
| Osteoarthritis         | 50 (66%)   | 59 (78%)   |         |
| Fracture               | 14 (18%)   | 9 (12%)    |         |
| Rheumatoid arthritis   | 2 (2.6%)   | -          |         |
| Avascular necrosis     | 8 (10%)    | 7 (9.3%)   |         |
| villonodular synovitis | 1 (1.3%)   | -          |         |
| OR time (min)          | 156 ± 30.9 | 176 ± 20.3 | 0.0787  |
| IO bleeding (ml)       | 513 ± 28.5 | 680 ± 80.2 | 0.0677  |

MDAA: modified direct anterior approach; DLA: direct lateral approach; OR: odds ratios.

deviation as well as the frequencies and percentages of categorical variables were calculated. Using Student's t-tests, the average differences between the anterior and lateral groups were examined for the continuous variables. To report OR and investigate relationships between surgical methods and the various postoperative complications, generalized linear models with a log link (linear regression) were utilized, Pearson's Chi-square test was used for categorical variables. Statistics were considered statistically significant at a  $p < 0.05$ .

## Results

Table 1 provides a comparison of perioperative and surgical traits. Gender, age, or afflicted side differences across groups were negligible. 138 individuals received 150 complete hip replacements. Seventy-one in the anterior approach group and 67 in the lateral approach group (8 bilateral) (4 bilateral). Surgery was performed on 48 men (34.8%) and 90 women (65.2%), with 78 (52%) from the right side and 72 (48%) from the left. The age range for the lateral approach group was 21-99 years, with a mean of 62 years, while for the anterior approach group, it was 28-96 years, with a mean of 69 years. None of these characteristics were found to differ between groups in a statistically significant way.

**Table 3. 90 days major complications by surgical approach**

| Complication            | MDAA    | DLA      | p-value  |
|-------------------------|---------|----------|----------|
| Infection               | 2       | -        | 0.2840   |
| Calcar fracture         | 2       | 4        | 0.3881   |
| Trochanteric fracture   | -       | 2        | 0.3244   |
| Acetabular fracture     | -       | 3        | 0.1951   |
| Motor neurologic lesion | -       | 14       | < 0.0001 |
| Pulmonary embolism      | -       | 1        | 0.6605   |
| Fat embolism            | -       | 1        | 0.6605   |
| Dislocation             | 1       | 1        | 0.9259   |
| Death (within 48/h)     | 1       | 1        | 0.9259   |
| Reintervention          | 3       | 3        | 0.8484   |
| Total                   | 9 (12%) | 30 (40%) | < 0.0001 |

MDAA: modified direct anterior approach; DLA: direct lateral approach.

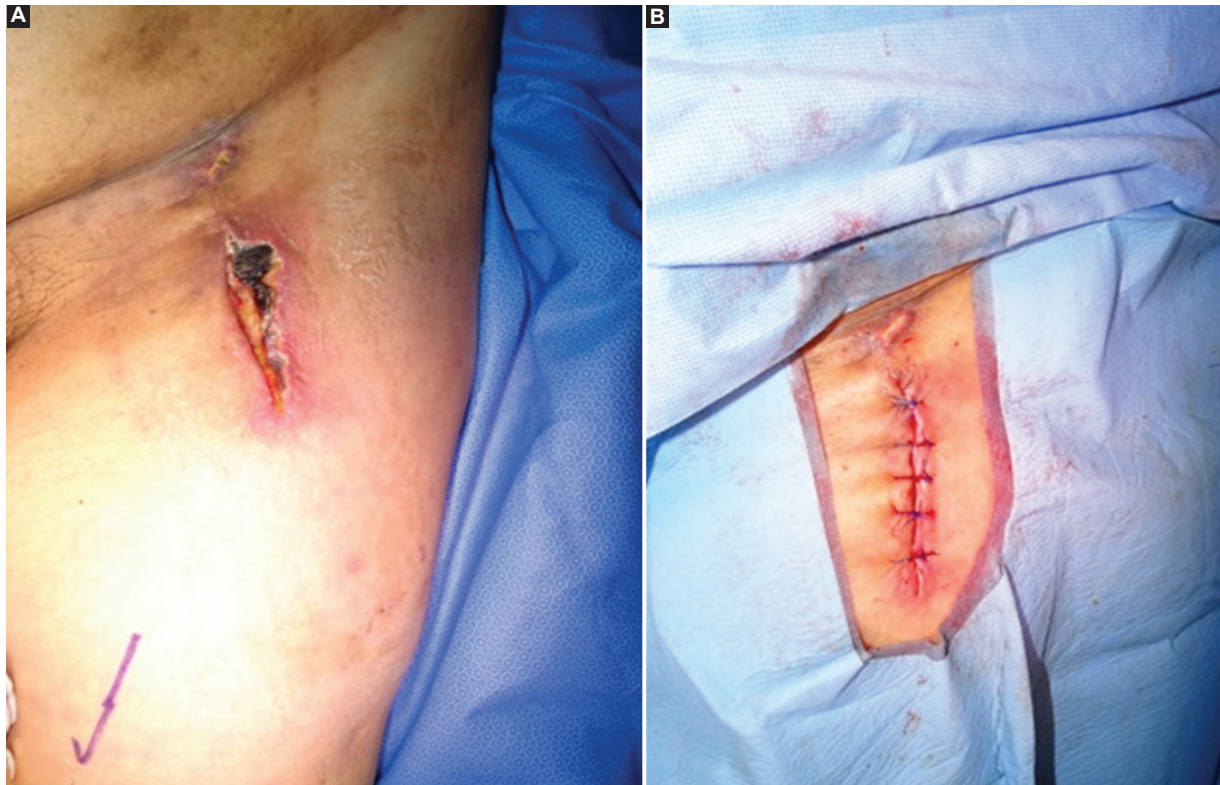
**Table 4. 90 days minor complications by surgical approach**

| Complication                | MDAA     | DLA      | p-value |
|-----------------------------|----------|----------|---------|
| Wound infection             | 5        | 7        | 0.8971  |
| Wound lesion                | 9        | 8        | 0.4203  |
| Hematoma                    | 8        | 2        | 0.1602  |
| Leg length discrepancy*     | 2        | 4        | 0.3504  |
| Sensitive neurologic lesion | 8        | -        | 0.0124  |
| Heterotopic ossification    | -        | 1        | 0.3422  |
| Migration (< 1 cm)          | -        | 2        | 0.2203  |
| Deep vein thrombosis        | 1        | 2        | 0.8971  |
| Total                       | 33 (44%) | 26 (34%) | 0.2899  |

\*Leg length discrepancy was factored as a minor complication when &gt; 5 mm.

MDAA: modified direct anterior approach; DLA: direct lateral approach.

Table 2 explains the etiology and surgical characteristics. The most common diagnosis was osteoarthritis (109 patients; 72%), which was followed by fracture and avascular necrosis (23 patients; 15% and 15 cases; 10%, respectively). The documented surgical time from the time of incision to wound closure ranged from 1 h 20 min-5 h, with an average of 2 h 36 min (156 min) in the MDAA group and 1 h 10 min-4 h and 56 min in the DLA group, with an average of 2 h 60 min (176 min), with no statistical significance ( $p = 0.0787$ ). Although the MDAA had reduced intraoperative bleeding (IOB), it also did not have statistical significance. Recorded IOB for the lateral approach ranged from 250 to 1,800 mL



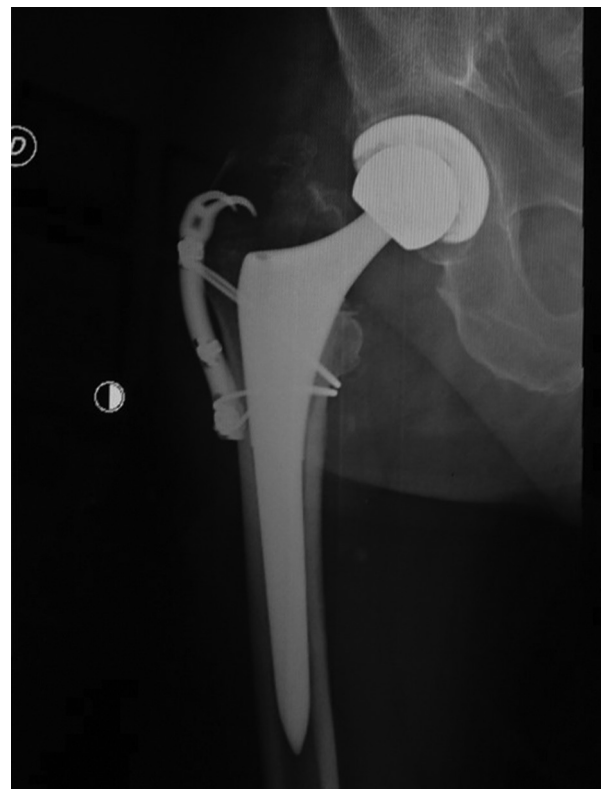
**Figure 5.** A: surgical wound infection. Ten postoperative days. B: debridement, surgical lavage, and wound closure.

with a mean of 680 mL, and from 100 to 1,100 mL with a mean of 513 mL for the anterior approach ( $p = 0.0677$ ).

Both techniques' initial 90-day complications were recorded. There were two categories: major and minor complications (Tables 3 and 4). For the MDAA, 12 percent of patients experienced 90-day major complications, whereas the DLA had a much higher incidence (40%) related to a motor neurological lesion (0 vs. 14;  $p = 0.0001$ ).

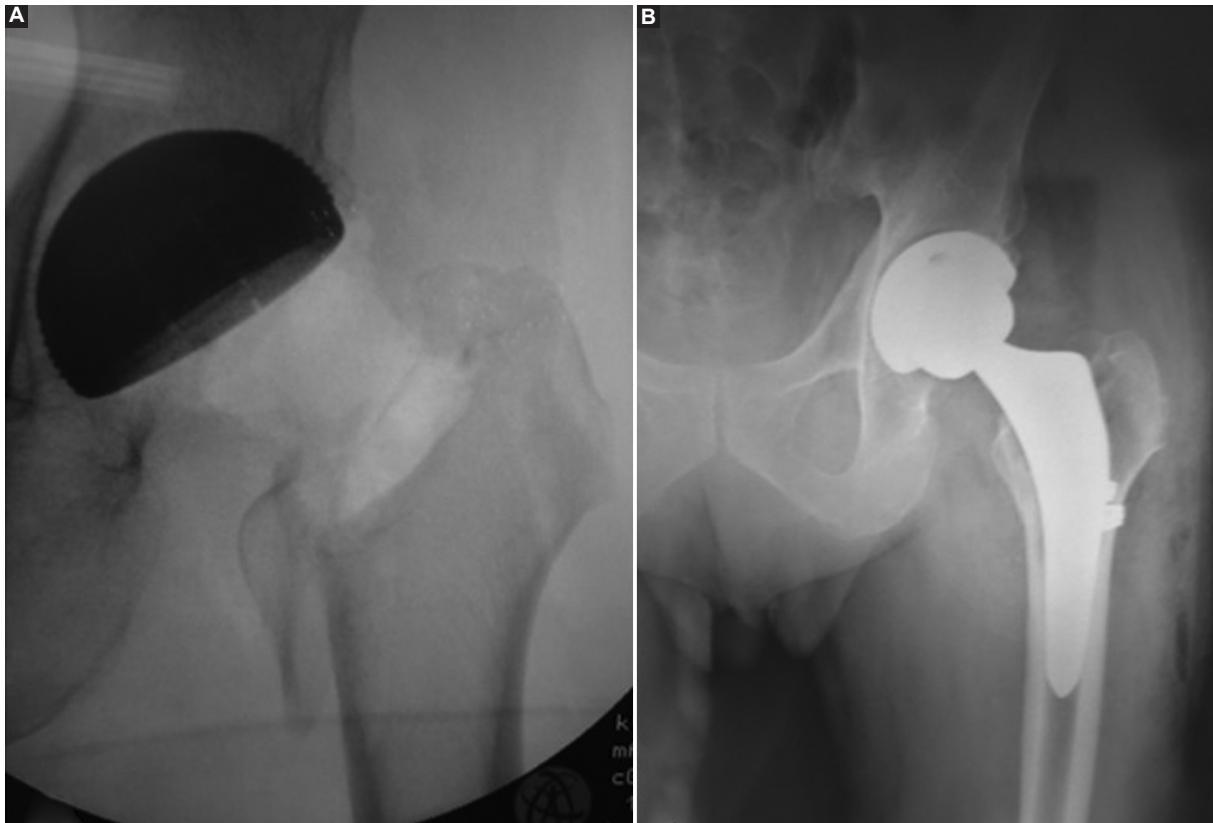
The three most common major complications were motor neurologic lesion, reintervention, and calcar fracture, occurring in 9.3%, 4%, and 4% of patients, respectively. Deep infections, wound problems, instability, and fracture were among the reasons for reoperation. Following multivariable analysis (Table 3), there was a difference in 90-day major complications between both approaches, favoring the MDAA (12% vs. 40%,  $p < 0.0001$ ).

The most usual minor complications in terms of frequency were superficial wound lesions (11.3%), followed by superficial wound infections and hematomas (8% and 6.6%, respectively) (Fig. 5). Patients undergoing THA with an MDAA had a considerably higher chance of sensitive nerve lesion (transitory femoral



**Figure 6.** Fracture of the greater trochanter in the lateral approach. Osteosynthesis with hook plate.





**Figure 7.** A: lesser trochanter fracture in anterior approach seen perioperative with fluoroscopy. B: osteosynthesis with supercable (Kinamed Inc., Camarillo, CA, USA).

cutaneous nerve palsy)<sup>20</sup>, according to the statistical model that used each complication under study as a dependent variable (8 vs. 0, 10%,  $p = 0.0124$ ). However, when considering all complications, there was no appreciable difference in the risks of minor complications between the two surgical techniques (33 vs. 26, 44/34%,  $p = 0.2899$ ).

One fatality from cardiac problems occurred 48 h after surgery in each group. In addition, two patients (2.98%) of the women treated for fracture in pathological terrain in the lateral approach group died within 90 days as a result of the primary malignancy. In the DLA group, there were six cases (9%) of transoperative femoral periprosthetic fractures, including two cases of the greater trochanter and 4 cases of the femoral calcar. One of them required subsequent revision with fixation with a special plate and cables 1 week after surgery (Fig. 6) and with the MDAA 2 cases (2.8%) with calcar fracture, all identified during surgery and treated with immediate cerclage (Fig. 7), in all of them, support on said leg was deferred for 6-8 weeks. There were four acetabular fractures (5.9%) during drilling in the

**Table 5. Outcomes by surgical approaches**

| Harris hip score | MDAA (%) | DLA (%) |
|------------------|----------|---------|
| Excellent        | 64 (85)  | 54 (72) |
| Good             | 6 (8)    | 11 (14) |
| Regular          | 4 (5)    | 7 (9)   |
| Bad              | 1 (1)    | 3 (4)   |

MDAA: modified direct anterior approach; DLA: direct lateral approach.

DLA group that required bone autograft obtained from the femoral head, none in the MDAA group.

The functional outcomes of both approaches using the HHS were found to be remarkably similar. There were a total of 93% versus 86% excellent/good result, and 1% versus 4% of bad result from the MDAA and DLA, respectively (Table 5).

All patients followed a similar postoperative protocol, except for the cases with intraoperative fracture; assisted ambulation with a walker was started in the first 24 h. In 60 patients in the anterior approach group, ambulation with tolerance support was started

in the first 8 h after surgery. The drains, when it was necessary to place them, were removed at 24 h and in most cases, the intravenous solutions and bladder catheter were removed at 48 h.

## Discussion

In the context of contemporary THA with a rising focus on speedy recovery and minimization of postoperative problems, the surgical method chosen has come under intense study<sup>21,22</sup>.

Similar to the DLA, the MDAA in primary THA causes few intraoperative and postoperative concerns immediately and in the first 90 days. With less discomfort and less need for physical therapy, it enables a quicker recovery and integration of the patient into daily activities, which lowers the overall cost. It is an effective strategy that is safe and dependable. Using a special table, the process is made easier for the surgeon and allows for a secure intraoperative assessment of the length of the operated limb and the positioning of its components<sup>23,24</sup>.

Excellent postoperative outcomes are seen right away, and morbidity is minimal. There was no discernible difference in major and minor 90-day postoperative problems between DLA and MDAA techniques conducted by the same surgeon, indicating that this technique is a safe and effective choice. Further evidence for the efficacy and general safety of contemporary hip arthroplasty surgery comes from the low incidence of perioperative problems for both approaches.

While there have been many studies comparing the various surgical techniques for THA, data on complications have not been as readily available. These studies usually compare functional recovery, gait analyses, and patient-reported outcomes<sup>2,5</sup>. While several randomized controlled trials have compared the direct anterior with the posterior approach<sup>25</sup>, comparisons with the lateral approach are scarce<sup>26,27</sup>. The most recent metanalysis<sup>27</sup> comparing these surgical approaches concluded that the available evidence suggests that DAA may be associated with better early postoperative functional rehabilitation, lower levels of perceived pain, and shorter hospitalization time. On the other hand, DAA may be associated with longer surgery times. Both arthroplasty approaches appear to be associated with similar rates of perioperative surgical complications and transfusion, similar results on radiographic and gait analyses, and similar serum levels of inflammation and muscle damage markers. The present study aims to shed a light to the possible major and minor complications between

surgical approaches, as well as helping younger hip surgeons to make a conscious choice between existing approaches for their patients. While our study is not adequately powered to draw comparisons between specific complications within these 2 groups because of the relatively small sample of patients and utilizes different femoral stems between groups, it is sufficient to guide future hip surgeons to know and understand the MDAA.

## Conclusion

Surgeons should use their preferred strategy given that functional recovery is similar for most patients many months after THA<sup>27-33</sup>, similar perioperative complication rates were seen in the current study, and 90-day major and minor problems were similar regardless of surgical approach. A larger trial that recruits participants prospectively, using the same material, and has a comparable number of patients in each group would be necessary to further validate our findings.

The author uses the anterior approach as the preferred method for primary THA in any patient with hip osteoarthritis, a femoral neck fracture, or any inflammatory condition, regardless of their physical appearance or habits, based on his expertise and the findings of numerous studies already described, including this one. The presence of osteosynthesis material on the lateral surface of the femur, wounds, or scars in the anterior region of the thigh, burns or morbid obesity that compromises exposure in this area, severe acetabular deformities caused by dysplasia that require a more extended exposure, or proximal femoral deformities are some absolute indications that still exist for performing surgery by the lateral approach. We draw the conclusion that the information now available does not permit us to decide whether MDAA or the DLA is superior; additional significant, well-designed studies are required to fully explore these findings, with a larger sample of patients.

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## Conflicts of interest

The authors declare that they have no conflicts of interest.



## Ethical disclosures

**Protection of humans and animals.** The authors declare that no experiments on humans or animals were performed for this research.

**Confidentiality of data.** The authors declare that they have followed their center's protocols on the publication of patient data.

**Right to privacy and informed consent.** The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

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