Perioperative complications and causes of 30- and 90-day readmission after direct anterior approach primary total hip arthroplasty

Eric Sali, Jean-Luc Marmorat, Fabrice Gaudot, Christophe Nich*

Department of Traumatology and Orthopaedic Surgery, Raymond Poincaré Hospital, Versailles Saint Quentin en Yvelines University, Assistance Publique - Hôpitaux de Paris 104, Boulevard Raymond Poincaré, 92380, Garches, France

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ABSTRACT

Objective: We aimed to report causes of readmission 30 and 90 days following a total hip arthroplasty (THA) using the direct anterior approach (DAA). **Methods:** Three hundred and two patients (335 hips) underwent a DAA-THA for primary osteoarthritis. **Results:** The main reasons for 30 and 90-day readmission were wound related problems, dislocation (rate: 0.9%) and deep infection. The readmission rates at 30 and 90 days were 1.8% and 2.7%, respectively. Age over 60 years and morbidly obese patients were at risk for complications. **Conclusion:** The DAA-THA was associated with low readmission rates. Obesity should be addressed pre-operatively.

1. Introduction

Total joint arthroplasty is the most effective procedure for relieving pain and restoring function in hip advanced degenerative diseases. Improvements in surgical techniques, patient selection, and optimization of implant fixation and bearing surfaces have allowed for a consistent increase in implant durability, with 10-year survivorship exceeding 90%.¹ However, perioperative complications may result in early hospital readmission, in up to 9% cases.^{2–5} Procedure-related readmissions may not only compromise function but also are associated with patient morbidity and significant cost increases.^{2,4,5} Therefore, understanding factors associated with readmission may enable to mitigate risk and limit costs.

Although standard approaches to the hip have been shown to result in similar function after 6 months to one year,⁶ the influence of the approach on the risk of early readmission is debated. In a metaanalysis of studies comparing anterior and posterior approaches in primary THA, Miller et al.⁷ found anterior approach was associated with lower rates of infection, dislocation and reoperation. Conversely, another systematic review revealed that complication rates were similar between anterior, posterior and lateral approaches in primary THA.⁸ The direct anterior approach (DAA) is associated with limited soft tissue trauma and offers the potential for optimal postoperative hip stability. In our Department, it is the routine approach to the hip.⁹ We hypothesized that primary THA using the DAA would be associated with

limited rates of perioperative complications and early readmissions.

Therefore, our aims were to evaluate (1) the in-hospital complications following DAA primary THA; (2) the causes of 30-day and 90-day readmission following this procedure; and (3) to analyse patient-related risk factors associated with readmission, in a single tertiary teaching institution.

2. Materials and methods

2.1. Study population

Investigational review board approval was not required for this study because it was a retrospective review of patients who were followed up as part of routine clinical care. Data were obtained from hospital files and local databases. We evaluated all elective DAA-standard THAs performed for osteoarthritis between January 2011 and December 2013. All surgeries were performed by one of four senior surgeons, each having a background of more than 100 DAA procedures. Exclusion criteria were secondary arthritis, rheumatoid arthritis, revision THA for any reason, and cases treated with a dual-mobility system. A total of 302 patients (335 hips) were enrolled, including 171 women and 131 men, with a mean age of 67.2 ± 9 years (range, 38–100 years). Using Charnley classification, 269 patients were classified as «A», and 33 as «B» at the time of the arthroplasty. None was classified as «C». Thirty-three patients underwent a bilateral staged procedure.

* Corresponding author.

E-mail addresses: eric.v.sali@gmail.com (E. Sali), jean-luc.marmorat@aphp.fr (J.-L. Marmorat), docteur.gaudot@gmail.com (F. Gaudot), chrnich@gmail.com (C. Nich).

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Mean body mass index (BMI) was $26 \pm 4.2 \text{ kg/m}^2$ (range, 16.7–44.1 kg/m^2). The mean American Society of Anesthesiologists (ASA) score was 1.55 ± 0.67 (range, 1–3). One hundred and sixty-one patients (53%) were free of any comorbidity, whereas 71 patients (24%) had a severe medical condition, such as heart arrhythmia, coronary artery disease, diabetes mellitus or chronic obstructive pulmonary disease. High blood pressure was the most frequent comorbidity, and was found in 103 patients (34%).

2.2. Surgical technique

All subjects enrolled in the study received a non cemented Meije stem (Tornier, Montbonnot Saint Martin, France). In 253 cases, a Dynacup cup (Tornier) with a ceramic insert (BioloX Delta, Ceram Tec GmbH, Plochingen, Germany) was used and articulated with a ceramic femoral head (BioloX Delta), size 28, 32 or 36 mm. In 83 cases, a RM cup (Robert Mathys, Bettlach, Switzerland) was used and articulated with a stainless steel femoral head, size 28 or 32 mm. The bearing couple was chosen according to the age of the patient (ceramic-on-ceramic below 70 years of age, metal-on-polyethylene over 70 years).

All procedures were performed in vertical laminar air flow operating rooms. Skin preparation was done using povidone iodine, following scrub lavage. The successive steps of the DAA primary total hip arthroplasty on a traction table have been described formerly.⁹ Briefly, the incision started approximately 2 cm distally and 2 cm laterally to the anterior superior iliac spine, 10–14 cm long. The interval between the tensor fascia lata and the sartorius muscle was identified. The fascia lata was then incised and split from the muscle fibers, to, then, access the interval between the rectus femoris muscle medially and the gluteus medius muscle laterally. Two sharp Hohman retractors were placed around the superior and inferior femoral neck edges. The anterior portion of the capsule was excised. The femoral neck was cut according to the preoperative planning, either before or after the hip was dislocated, depending on the preference of the surgeon. After retractors were placed, the acetabulum was sequentially reamed, up to the planned diameter. The definitive cup was inserted and tested for initial stability. The femoral side was visualized with the femur in external rotation, adduction and extension, with the aid of the traction table. Broaching of the femoral canal was then proceeded up to the appropriate size. A trial reduction was done and the hip tested for stability manually. The trial components were then removed, the prostheses placed with pressfit fixation and the hip reduced. Routine closure was performed. The mean length of surgery was $66.35 \pm 25 \text{ min}$ (range, 35–120 min). All patients were given a second generation cephalosporin peri-operatively according to the Institution's protocol at the time. In the absence of contraindication, patients received thrombosis prophylaxis using low molecular weight heparin for a mean of 26 days (range, 10–45 days), eventually relayed by a direct oral anticoagulant up to the 35th postoperative day. Full weight-bearing was allowed from the day after surgery. Patients were discharged from the hospital after a mean stay of 6.1 days (range, 4–11 days). Postoperatively, 48% of patients were discharged to home while 52% were transferred to a rehabilitation or skilled care facility.

2.3. Outcome

Medical records were reviewed by one observer (E.S.) who did not participate in surgery. Function was evaluated using the Merle d'Aubigné hip score. We defined a readmission as any unplanned inpatient admission to the hospital spanning at least 12 h.¹⁰ Readmissions were categorized as 30- or 90-day readmissions based on the delay from the index procedure. Also, peri-operative complications and readmissions were determined to be of medical or orthopaedic etiology.⁵

2.4. Statistics

Continuous variables (age, BMI, and functional score) were expressed as mean $\pm$ standard deviation and range. Categorical variables (sex, complications, and Charnley classification) were expressed as frequency and percentage. We evaluated differences in categorical variables using the chi-square test or Fisher's exact test where appropriate. The differences between pre operative and postoperative functional scores were analyzed using the paired Wilcoxon test. The level of statistical significance was set at $P < 0.05$. Univariate and multivariate logistic regression analysis were used to determine the influence of patient-related factors such as age, gender, BMI, comorbidity, and ASA score on the occurrence of postoperative medical and orthopaedic complications, and 30 or 90-day readmissions. Analysis was performed using XLSTAT software (Addinsoft, Paris, France), an add-on for MS Excel (Microsoft Corp, Redmond, WA, USA).

3. Results

Of the initial group, two patients (2 hips) were lost during the study period. The mortality rate was zero within the 3 postoperative months.

At the 3 month-followup, the Merle d'Aubigné functional score significantly improved from 11 ± 1.6 (range, 7–15) preoperatively to $16.7 \pm$ (range, 9–18) postoperatively ($p < 0.01$). The functional result was rated at least good in 95% cases.

There were 3 intraoperative fractures of the calcar (3 hips), resulting in a 0.9% risk of intraoperative femur fracture in this series. Fractures were fixed with a cerclage wire. Full weight bearing was allowed after 6 weeks in these cases.

During hospital stay, there were 20 medical complications (5.9%), including urinary retention (UR) or urinary tract infection (UTI) (11 patients, 3.2%), deep venous thrombosis or pulmonary embolism (4 patients, 1.2%), heart arrhythmia (2 patients, 0.6%), and others (2 patients, 0.6%) (Table 1).

During hospital stay, there were 10 orthopaedic complications (2.9%), including wound haematoma or prolonged drainage (8 hips, 2.4%), dislocation (1 hip, 0.3%) and cup early failure (1 hip, 0.3%). Among 8 hips with a wound problem, none required a reoperation, all were treated with local wound care (Table 2).

There were 6 hospital readmissions within 30 days (1.8%), and 3 readmissions between 30 and 90 days, resulting in a total of 9 readmissions (2.7%) during the 90 postoperative days. During the first 30 postoperative days, patients were admitted for a dislocation, including one for a recurrent dislocation (2 hips, 0.6%), a deep wound haematoma (3 hips, 0.9%), or a periprosthetic joint infection (PJI) (1 hip, 0.3%). Dislocations necessitated a closed reduction under general anaesthesia. Hematomas required debridement and cleaning, whereas the cases of PJI was treated with one stage implant exchange associated with adapted antibiotics prolonged at least 6 weeks.

Between the 30th and the 90th postoperative days, two patients were readmitted for a hip dislocation (including one for a recurrent dislocation). The overall rate of dislocation in this series was 0.9%.

Table 1

List of postoperative medical complications.

UTI = Urinary tract infection; DVT = Deep venous thromboembolism

Type of complication	N (events)	Rate (%)
During Hospital Stay	20	5.9
- UTI/Retention	11	3.2
- DVT/Pulmonary Embolism	4	1.2
- Heart arrhythmia	2	0.6
- Other medical complications	2	0.6
Within 90 days	0	0

Table 2

List of perioperative orthopaedic complications and causes of readmissions within 30 and 90 days of surgery.

Type of complication	N (hips)	Rate (%)
Intraoperative complication	3	0.9
- Fracture of the calcar	3	0.9
During Hospital Stay	10	2.9
- Wound haematoma/swelling	8	2.4
- Dislocation	1	0.3
- Cup instability	1	0.3
Readmissions within 30 days	6	1.8
- Deep wound haematoma	3	0.9
- Dislocation	2	0.6
- PJI	1	0.3
Readmission between 30 and 90 days	2	0.6
- Dislocation	2	0.6

PJI = Periprosthetic joint infection; Note that some patients had more than 1 complication.

3.1. Analysis

Multivariate analysis revealed that postoperative medical complications correlated with age > 60 years ($p < 0.001$) and with number of comorbidities > 3 ($p = 0.04$). The risk of medical complications correlated with the difference between preoperative and postoperative haemoglobin with a threshold found at 3 g/dL ($p = 0.045$). Other preoperative parameters such as gender, BMI, smoking history, operating time and ASA score were not associated with the risk of medical complications. Postoperative surgical complications correlated with BMI > 30 kg/m² ($p = 0.01$). There was also a trend toward younger patients at increase risk of postoperative surgical complications, but this did not reach statistical significance ($p = 0.06$) (Table 3).

The risk of readmission within 30 days was associated with higher BMI (> 30 kg/m²), but this did not reach statistical significance ($p = 0.07$). The other studied parameters (gender, age, tobacco use, number of comorbidities, operative time, ASA score) did not correlate with the risk of 30-day readmission. The risk of readmission between 30 and 90 days correlated with the difference between pre and postoperative haemoglobin > 3 g/dL ($p = 0.03$) (Table 4).

4. Discussion

The direct anterior approach to THA has been associated with faster functional recovery, decreased length of hospital stay and low blood transfusion rates.^{11,12} However, in terms of complications (dislocation, infection, and fracture) and readmission rates, it is still unclear whether the DAA is as safe as other approaches. In a recent metaanalysis,

Table 3

Multivariate logistic regression analysis assessing independent risk factors for medical and orthopaedic perioperative complications.

Risk factors	Medical complication	P Value	Orthopaedic complication	P Value
	Odds Ratio (95% CI)		Odds Ratio (95% CI)	
Age > 60 years	1.74 (1.27–2.7)	< 0.001 ^a	1.09 (0.94–1.24)	0.22
Age < 60 years	1.04 (0.91–1.16)	0.12	1.49 (0.98–1.97)	0.06
Male Gender	1.14 (0.54–2.12)	0.54	1.03 (0.88–1.18)	0.17
Female Gender	0.69 (0.21–1.88)	0.56	0.98 (0.56–1.76)	0.6
BMI > 30	1.13 (0.69–1.53)	0.85	1.51 (1.08–1.98)	0.01 ^a
Comorbidities > 3	1.42 (1.12–1.78)	0.04 ^a	1.06 (0.94–1.28)	0.12
Smoking history	0.86 (0.62–1.05)	0.91	1.22 (0.87–1.39)	0.18
ASA class 3/4	1.12 (0.65–2.24)	0.16	1.18 (0.98–1.99)	0.19
Hb drop > 3 g/dL	2.17 (1.08–4.2)	0.045 ^a	1.05 (0.67–1.43)	0.75

Hb = Haemoglobin.

^a Indicates significance at $P < 0.05$.

Table 4

Multivariate logistic regression analysis assessing independent risk factors for 30 and 90 day-readmission.

Risk factors	30 day readmission	P Value	90 day readmission	P Value
	Odds Ratio (95% CI)		Odds Ratio (95% CI)	
Age > 60 years	1.17 (0.67–2.05)	0.28	1.06 (0.57–1.96)	0.78
Age < 60 years	1.43 (0.28–4.3)	0.77	1.24 (0.70–2.17)	0.36
Male Gender	1.0 (0.89–1.12)	0.24	0.95 (0.47–1.89)	0.16
Female Gender	1.05 (0.37–2.04)	0.76	1.34 (0.45–3.03)	0.25
BMI > 30	1.48 (1.02–3.46)	0.07	1.42 (1.0–2.78)	0.15
Comorbidities > 3	0.96 (0.45–1.79)	0.70	0.99 (0.91–1.03)	0.73
Smoking history	1.25 (0.66–3.21)	0.15	0.89 (0.52–1.53)	0.68
ASA class 3/4	1.08 (0.40–2.17)	0.61	0.69 (0.22–2.19)	0.79
Hb drop > 3 g/dL	1.57 (1.22–2.59)	0.09	2.83 (1.24–4.47)	0.03 ^a

Hb = Haemoglobin.

^a Indicates significance at $P < 0.05$.

Putananon et al.¹³ reported the DAA had higher risk of having complications compared to the lateral and the posterior approaches. Conversely, the 30-day readmission rates were similar in studies comparing the DAA and the posterior approach.^{6,14} To further explore these apparently contradictory data, we aimed to report (1) the in-hospital complications following DAA primary THA; (2) the causes of 30-day and 90-day readmission following this procedure; and (3) to analyse patient-related risk factors associated with readmission, in a single tertiary teaching institution.

In our series, there was a 0.9% risk of intraoperative periprosthetic fractures. All were localized to the femoral calcar and were treated with cerclage wiring. None involved the greater trochanter. These fractures did not necessitate any further intervention nor negatively impacted clinical outcome. Overall, our rate of intraoperative femur fractures compares favorably with the previously reported rates ranging from 0.8% to 6.5%.^{15–17} We advocate for a thorough soft tissue release to limit the risk of trochanteric fracture, specifically in osteoporotic patients.

Among medical complications during hospital stay, venous thromboembolism (VTE) events were not unfrequent (1.2%). Although they were not associated with an increase in mortality rate, the incidence of these events remains of concern. Hence, the pooled in-hospital incidence rate of symptomatic postoperative VTE was found to be 0.53% in a metaanalysis recruiting 21,369 patients undergoing primary THA.¹⁸ The relatively long duration of hospital stay (6.1 days) may bring some explanation in the higher rate of in-hospital VTE in our series. Currently, our practice has evolved toward standardized low molecular weight heparin thromboprophylaxis, verticalization at day-0, and earlier discharge from hospital. A further controlled study is needed to determine if any difference exists in VTE rates between the DAA and other conventional approaches to THA. Not surprisingly, age over 60 years and number of comorbidities > 3 were independent risk factors for developing medical complications, such as UR or UTI, VTE events, and heart arrhythmia, leading to prolonged hospital stay or readmission. These results corroborate previous reports that lower extremity arthroplasty patients with increased age and preexistent comorbidities increase the risk of sustaining systemic complication.¹⁹ Among preventable risk factors, we found high haemoglobin drop between the pre and the postoperative period correlated with the risk of medical complication. Blood loss and subsequent blood transfusion following THA are associated with increased morbidity and cost.²⁰ Among measures developed to reduce blood loss, tranexamic acid (TXA) has been proven to reduce transfusion rates after THA.²¹ We are assuming TXA, that has been used in our Department since 2015, is efficient in terms of haemoglobin drop in DAA-THA, and thus would limit subsequent morbidity.

Postoperative wound complications in THA result in morbidity, increased length of hospital stay and can lead to the development of PJI. In the current series, wound haematoma or prolonged drainage were noted in 2.4% cases and were treated conservatively during hospital stay. This observation is in line with the 0–11.5% reported rates of wound complications in DAA to hip arthroplasty.^{15,17,22,23} There have been some concerns that DAA-THA could be associated with a higher risk of wound problems comparatively to other approaches.^{22,24} Results of studies comparing the DAA and the posterolateral approach (PA) have been controversial.^{22,25} In line with our observations, Jahng et al.²³ showed that obesity was a substantial risk factor for development of wound complications. Also, obesity could be a stronger risk factor for wound complications in DAA patients, compared with PA patients.²⁴

The readmission rate was 1.8% in the 30 postoperative days, and reached 2.7% at 90 days in our study. Patients were readmitted for an orthopaedic complication in almost all cases, including wound complications, PJI, and dislocation. These rates compare favorably with the overall readmission rates of 4–11% reported in the 90 days following a THA.^{2,4,5,26,27} Specifically, the 30-day readmission rate ranged from 2.84 to 6.8% after DAA-THA in recent reports,^{6,14} with wound problems, eventually associated with a deep infection, being a substantial cause of readmission and return to theater. The current dislocation rate of 0.9% is in line with a previous report evaluating a similar technique.⁹ The risk of 30-day readmission correlated well with obesity, whereas haemoglobin drop correlated with the risk of readmission up to 90 days. Although BMI > 35 kg/m² (morbid obesity) is usually recognized as a risk factor for postoperative complications after THA,^{19,27} our results suggest this threshold could be lower (30 kg/m²) in DAA-THA. While the current study reveals an increase in readmission rates for obese patients in comparison with non-obese patients, these rates compare favorably to the reported rates for other operative approaches.⁵ This suggests that increased readmission rate in obese patients following DAA-THA may not be directly attributable to the DAA itself. Based on our findings, it is hypothesized most readmissions should be preventable, by addressing obesity before the procedure and limiting blood loss at the time of surgery.

The present study has some important limitations. Due to its retrospective design, some important data may have been missed at the time of the review, although clinical and radiological follow up are well-standardized in our Department. In addition, common risk factors for complications and readmission after THA were thoroughly analyzed. Then, in the absence of a control group, it is somehow difficult to conclude on the influence of the approach itself on the complication and readmission rates. Last, it is probable that the relative high length of hospital stay in our study had an impact on the rate of early readmissions.

In the current series, the DAA-THA was associated with limited specific complications, and subsequent low 30- and 90-day readmission rates. Older age, comorbidities and haemoglobin drop were risk factors for medical complications, including thromboembolic events. Therefore, meticulous care should be taken perioperatively to optimize comorbidities, to limit blood loss and to favor standardized anticoagulation protocol. Obese patients should be informed of the increased risk for wound complications and readmission. Preoperatively, weight loss should be strongly considered.

Conflicts of interest

The authors declare they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jor.2019.08.006>.

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