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Original Research

Early Outcome Comparison of the Posterior Approach and the Superior Approach for Primary Total Hip Arthroplasty

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ABSTRACT

Background: The superior approach for total hip arthroplasty (THA) is a minimally invasive, tissue-sparing technique that may have clinical and economic benefits. The purpose of this study was to compare early outcomes between the posterior approach and the superior approach in primary THA. Our hypothesis was that the superior approach would have a noninferior length of stay (LOS), discharge destination, and blood loss compared with the posterior approach.

Methods: All primary THAs performed by a single surgeon at one institution were retrospectively reviewed over a 2-year period (2015-2017). There were 676 patients, 40.4% of whom underwent a posterior approach and 59.6% underwent a superior approach. LOS, discharge destination, blood loss, and operating room time were analyzed. Gender, body mass index, and American Society of Anesthesiologists status were recorded and controlled.

Results: The posterior approach was independently associated with an almost threefold higher risk of prolonged LOS (>2 days, $P < .001$) (odds ratio: 2.90, 95% confidence interval: 1.87-4.49; $P < .001$). The mean LOS for the superior approach was 1.71 days vs 2.17 days for the posterior group ($P < .001$). Fewer patients in the superior approach cohort were discharged to a rehabilitation facility (8.9% vs 17.9%, $P < .001$). The mean operative time was shorter in the superior group (91.8 vs 95.8, $P = .001$). There was no statistically significant difference in acute postoperative blood loss. There were no dislocations or reoperations in either group.

Conclusions: The superior approach to THA was associated with a significantly shorter length of hospital stay and lower rate of discharge to rehab than the posterior approach. This approach can be used as a safe, minimally invasive, and tissue-sparing variation of a standard posterior approach for THA and has promising early outcomes.

Introduction

Total hip arthroplasty (THA) is a successful, effective, and reproducible surgical procedure that can predictably provide patients with significant pain relief, mobility, and improvement in quality of life. Generally, complication rates are low, and as the population ages, more total hip replacements will be performed than ever before. The volume of THAs performed in the United States is expected to grow by at least 76%-174% by 2030 [1,2]. In addition, the percentage of outpatient joint replacement surgeries is expected to increase 77% in the next decade [3]. Improvements in the surgical technique and postoperative rehabilitation are paramount to facilitate quicker recovery and improved function. Decreasing hospital stays and emphasizing discharges to home, rather than rehab, should lower overall costs and can greatly impact health-care expenditures [4,5].

Over the past few decades, changes in surgical approaches and instrumentation have been implemented to decrease intraoperative soft-tissue disruption, allow for an easier recovery, and

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potentially improve patient satisfaction. More often, patients are seeking out minimally invasive and tissue-sparing techniques to return more quickly to activities of daily living and work. These techniques may have societal, economic, and psychological impacts that are clinically significant [6-8].

The posterior approach is a widely used approach for both primary and revision THA. The approach is familiar to many hip surgeons, is extensile, and is reproducible. Alternative approaches have used anterior-based exposures and are widely published in the literature [9,10]. In 2000, Murphy et al developed and described another approach to THA using a superior capsulotomy, often referred to as the “SuperCap” [11]. The SuperCap approach is a tissue-sparing approach that avoids release of the conjoint tendon of the superior and inferior gemellus and obturator internus, and occasionally the piriformis tendon. Additional features include in situ femoral preparation, no need for hip dislocation, and the ability to extend the approach into the larger posterior approach if necessary. This approach is facilitated by minimally invasive surgery (MIS) retractors.

The purpose of this study was to evaluate the early postoperative outcomes between the posterior approach and the superior approach for primary THA. Our hypothesis was that the superior approach would not be inferior to the posterior approach with regard to postoperative length of stay (LOS), discharge disposition, operative time, or blood loss. Secondary outcomes were reoperation and dislocation.

Material and methods

Study sample

Study approval was obtained through the hospital’s institutional review board. A retrospective review was performed evaluating all patients who underwent a primary THA for the diagnosis of osteoarthritis, avascular necrosis, or posttraumatic arthritis by a single surgeon during the study period of January 2015 to January 2017. The surgeon is fellowship-trained in arthroplasty and performs approximately 300-500 THAs per year. The posterior approach was used as the primary approach in the senior author’s practice until 2015. In 2015, the senior author began using the superior approach in addition to the posterior approach. Both the posterior and superior approaches were used concurrently in the senior author’s practice. There were 24 patients excluded for incomplete medical records or for conversion arthroplasty procedure.

Data collection

Patient and surgical data were collected by the standard form from the institutional electronic medical records. Patient demographics included in the study were age, gender, body mass index (BMI), and American Society of Anesthesiologists (ASA) score. Surgical and hospitalization data include operative time, LOS, postoperative blood loss as defined by change in preoperative to postoperative change in hematocrit, transfusion rates, and discharge location. In addition, reoperation and dislocations were recorded.

Perioperative management

All patients were given the same preoperative and perioperative pain and rehab protocols. All patients received a standardized postoperative pain protocol that included oral acetaminophen, IV ketorolac, and oral narcotics as needed. Ketorolac IV was given for 48 hours postoperatively unless medically contraindicated. In addition, all patients received a periarticular joint mix, which consisted of morphine, ketorolac, and bupivacaine. Unless patients were deemed to be at high risk for venous thromboembolism , they were placed on aspirin 325 mg BID for 4 weeks. Patients at high risk of venous thromboembolism were placed on adjusted-dose warfarin for 4 weeks postoperatively. Postoperative hip precautions were not used in either group. Physical therapy (PT) began on the day of surgery and consisted of twice-daily regimens during their hospital stay, which includes getting in and out of the bed, ambulating with assistance, and going up and down stairs. Patients were deemed stable for discharge when they could safely mobilize in and out of the bed, walk 100 feet, and go up and down the number of stairs they have at home. Patients would be discharged once their pain was controlled on oral medications and they were medically stable. Standard postdischarge instructions were given. Patients were seen in follow-up at 6 weeks, 3 months, and 1 year postoperatively. Plain radiographs were obtained at 6 weeks and 1 year postoperatively.

Surgical technique

All THAs were performed by a single, fellowship-trained arthroplasty surgeon. The decision to perform either a posterior or superior approach was determined primarily after an informed preoperative discussion with the patient. Any patient requesting a nonposterior THA was offered this approach. In addition, instrumentation (retractors) at the time was specialized during the time of introduction of the superior approach. The superior approach was performed on patients when instrumentation was available. There were no exclusion criteria for the superior approach, other than instrument availability. BMI was not an exclusion criterion for the superior approach.

The superior approach used in this study, a variation of the superior capsulotomy as described previously [11], was performed with the use of a posterosuperior capsular flap, rather than a superior capsulotomy. The superior approach was performed in the lateral position on a pegboard. An 8-cm skin incision was used, starting at the vastus ridge aiming toward the posterior superior iliac spine. The gluteus maximus was split in line with its fibers, and the iliotibial band was spared. The piriformis was released, and then the conjoint tendon of the distal external rotators was released or retained on a case-by-case basis, depending on the adequacy of exposure. The quadratus femoris was left intact. Capsulotomy was made from the superior femoral neck to the edge of the acetabulum. From there, it was continued down along the edge of the acetabulum, approximately half way. The flap was then released from the intertrochanteric line to the inferior neck. This capsulotomy allowed for later direct repair. A femoral neck osteotomy was made in situ—without dislocating the hip joint. The acetabulum and femoral preparations occurred with the leg in physiologic position of sleep of 45 degrees of hip flexion and 15 degrees of internal rotation. Trial reductions and final reductions were performed without significant manipulation of the leg. An intraoperative digital radiograph was performed to assess the component position as well as the leg length and offset. All patients had a repair of the posterior capsule. Other factors such as anesthesia technique and implants used were standardized for both groups.

Length of stay

LOS was defined as the number of days spent in the hospital from the day of surgery to the day of discharge. This was quantified by the total number of days and a “prolonged length of stay,” defined as LOS greater than 75th percentile, or greater than 2 days.

Discharge destination

This was recorded as discharge either to home or to an interim rehabilitation facility.

Operative time

This was defined as time from incision to time of closure.

Data analysis

To compare characteristics of patients undergoing the superior or posterior approach, Pearson's chi-square tests were used for categorical variables and independent samples *t*-tests for continuous variables. Continuous variables were presented in terms of the mean and standard deviation, and categorical variables were reported with frequencies and percentages.

To minimize potential confounding, multivariable regression models were used to identify the independent effect of the surgical approach on prolonged LOS, non–homebound discharge, prolonged operative time, and need for blood transfusion. Each of these regression models were adjusted for age, sex, ASA score, and BMI. All variables were entered into the model simultaneously, without further selection. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). In addition, multivariable linear regression modeling was performed to examine the independent contribution of the surgical approach to LOS as a continuous variable, while accounting for the same variables as in the logistic regression models.

Results

Between December 2015 and December 2017, 700 THAs were performed by the senior surgeon. Of these, 24 patients were excluded for incomplete records or nonprimary THA. The remainder of the 676 patients were included in the study. Both the superior and posterior approaches were used concurrently during the study period. Patients who underwent the posterior approach had a higher ASA status and a higher BMI ($P < .001$) (Table 1). Age and gender did not differ between the 2 groups (Table 1). There was a statistically significant difference in LOS between the groups, with the patients in the superior approach THA group having a lower average LOS than those in the posterior approach THA group (1.71 days, standard deviation: 0.82 vs 2.17 days, standard deviation: 1.0 day, respectively, $P < .001$). In addition, 8.9% of patients in the superior approach group were discharged to a rehabilitation facility, compared with 17.9% in the posterior cohort ($P < .001$) (Fig. 1).

Table 1
Characteristics of the study population.

Parameter	All patients	Surgical approach		*P*
		Posterior	Superior	
Total[b]	676	273 (40.4)	403 (59.6)	
Age[a] (yr)	63.4 ± 9.7	63.4 ± 10.4	63.4 ± 9.2	.999
Sex[b]				
Female	348 (51.5)	135 (49.5)	213 (52.9)	.385
Male	328 (48.5)	138 (50.5)	190 (47.1)	
ASA[b]				
≤2	571 (84.5)	212 (77.7)	359 (89.1)	**<.001**
3	105 (15.5)	61 (22.3)	44 (10.9)	
BMI[a]	29.5 ± 6.0	31.6 ± 6.6	28.1 ± 5.1	**<.001**

Bold values represents statistical significance.
[a] The values are given as the mean and the standard deviation.
[b] The values are given as the number of patients, with the percentage in parentheses.

There were no differences in the rate of blood transfusion between the 2 groups, which was 2.2% in each group (Fig. 1). The mean operative time in the superior approach was 91.8 minutes and 95.8 minutes in the posterior approach cohort ($P = .001$).

After controlling for age, sex, ASA, and BMI, the posterior approach was independently associated with a higher risk of prolonged LOS than the superior approach (OR: 2.90, 95% CI: 1.87-4.49; $P < .001$) (Fig. 1). A prolonged LOS was defined as >2 days. The unadjusted LOS was 0.46 days shorter for the superior approach, and this difference largely persisted (−0.37 days; $P < .001$) after adjusting for covariates in multivariable linear regression modeling. There were no differences in other outcome measures between the groups after multivariate analysis including discharge to a rehabilitation facility (OR: 1.66, 95% CI: 0.97-2.83; $P = .062$), prolonged OR time (OR: 1.25, 95% CI: 0.86-1.82; $P = .251$), or blood transfusion (OR: 0.67, 95% CI: 0.21-2.16; $P = .502$). There were no dislocations or reoperations in either group.

Discussion

In this retrospective study, we compared the early outcomes of primary THA using the posterior approach vs the superior approach in a high-volume, single-surgeon practice over a 2-year period. During this time, the surgeon began using the superior approach in an increasing number of patients. All of the cases were performed after cadaver-based training and live surgical training by the developer of the superior approach. There was a learning curve associated with the approach because of the smaller incision size, fewer soft-tissue releases, and a less manipulation of the operative leg. We found that the superior approach is associated with a significantly shorter length of hospital stay compared to the posterior approach without increased complications. The superior approach is a safe, minimially invasive, tissue-sparing technique that is noninferior to the posterior approach.

The superior approach is a minimally invasive, tissue-sparing approach that may lead to reduced postoperative pain and earlier mobilization, facilitating a decreased LOS and overall medical costs associated with THA. This study demonstrated that patients who underwent the superior approach were discharged from the hospital earlier than those who underwent the posterior approach even when controlled for age, ASA, and BMI. This finding has significant economic impacts, even considering the difference in discharge was a portion of a day. Patients who underwent a superior approach were 3 times as likely to have a shortened hospital stay, which was statistically significant. There was no change in the postoperative rate of blood transfusions or operative time.

The results found in this study were not confounded by age or gender. However, before controlling for demographic factors, patients in the superior approach cohort were more likely to be ASA 2 vs ASA 3 category. They also had a lower average BMI (28.1 vs 31.6) (Table 1). These differences were found to be statistically significant. This may represent an inherent selection bias of the study. However, even when results were controlled for ASA and BMI, the superior approach cohort had a shorter LOS (OR: 2.9) (Fig. 1). In this study, there were no known dislocations, wound infections, or neuropraxias at the time of the most recent follow-up.

The optimal surgical approach in primary THA remains controversial. Although the posterior approach is the most commonly performed approach, recent literature suggests an increasing utilization of the anterior approach [9,10]. There have been a number of studies demonstrating less-invasive approaches for THA are associated with decreased blood loss, smaller incisions, and shorter hospital stays [7,12,13]. Zawadsky et al. compared discharge destination of the direct anterior approach (DAA) with the posterior approach and found that patients undergoing the DAA

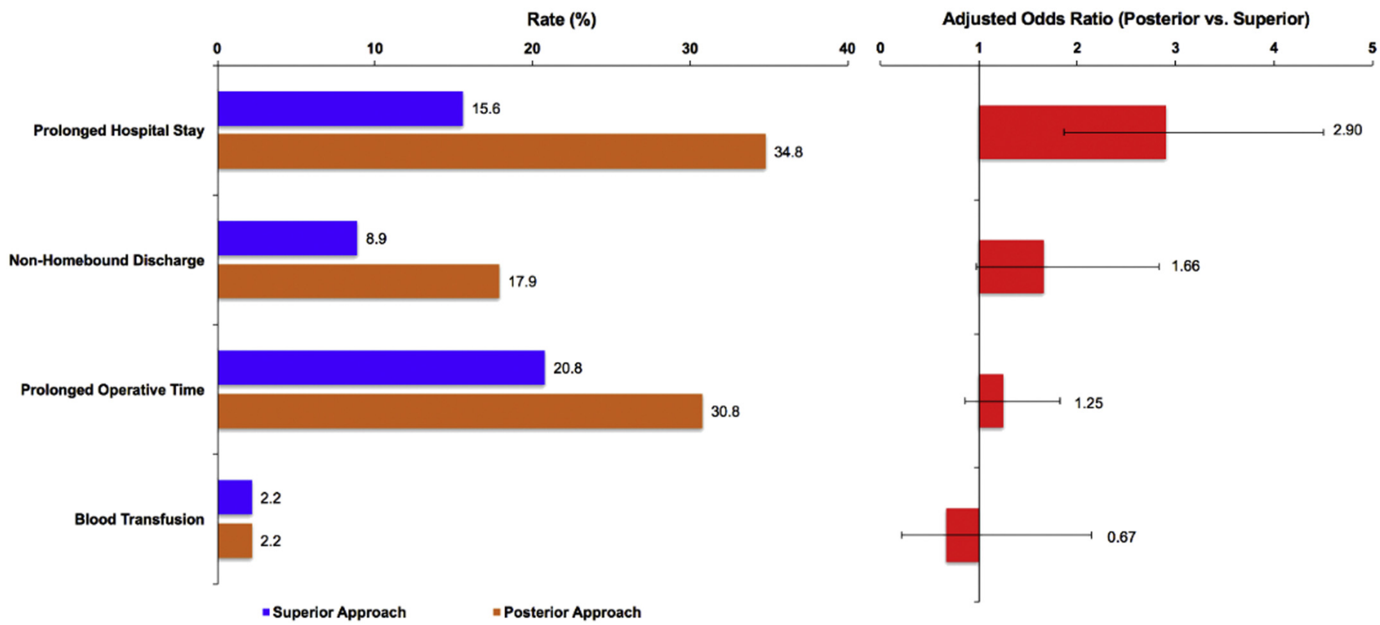

Figure 1. Comparison of the superior approach with the posterior approach: the frequency of length of stay, non–homebound discharge, operative time, and the blood transfusion rate in THAs undergoing 2 different approaches.

were more likely to go home rather than rehab [7]. This finding was also supported by Free et al. who showed a shorter hospital LOS and greater percentage of patients who were discharged home after a DAA [14]. In addition, there are potential benefits in surgical recuperation associated with a less-invasive approach [15]. Nakata et al showed a more rapid recovery postoperatively for hip function and gait stability for patients who underwent an MIS THA than for those who underwent a standard posterior approach [15].

Despite early outcome reports for the anterior approach demonstrating decreased time to ambulation, hospital stay, and dislocation rates, there have been more recent data demonstrating significant shortcomings associated with the anterior approach [16-21]. Intraoperative complications include calcar fractures, trochanteric fractures, acetabular fractures, and femoral canal perforations. These complications are reported to occur in up to 3.2% of cases [18]. Furthermore, postoperative complications include dislocation, wound healing and wound dehiscence, and prosthetic joint infection [18,19,21,22].

Owing to the concerns of the anterior approach and the stated complications, the superior approach was developed by Murphy in 2002 to reduce or eliminate these complications [11]. The main technical aspects of the superior approach that make this approach distinct include preserving the structural integrity of the abductors, the anterior and posterior capsules, and most of the short external rotators. Additional features include in situ femoral canal preparation and femoral head excision, rather than dislocation. To date, there is little available literature on outcomes of the superior approach. The largest series is a study of 1454 consecutive THAs performed by the developing surgeon using the superior approach, with 1026 patients available with 2-year follow-up [23]. In this study by Murphy, similar rates of dislocation (0.21%), greater trochanter fracture (0.14%), and calcar fractures (0.28%) were found compared with other surgical techniques [23].

There are generally conflicting results on operative time and acute blood loss when comparing THA approaches. Many studies show that less-invasive approaches, especially the DAA, have a steep learning curve and are fraught with increased complications such as intraoperative fracture, wound healing issues, larger blood loss, and increased operative time [24,25]. There are, however, conflicting results, and these findings have been refuted in multiple recent publications. Barnett et al demonstrated low complication rates in the 90-day postoperative period in more than 5000 DAA THAs [26]. Other studies comparing standard approaches with "less-invasive" approaches have also showed improved functional outcomes and a good safety profile [27]. In the study by Khan et al., they used a 6-cm incision and spared the piriformis tendon and had earlier discharges as well as decreased blood loss [27]. Despite the conflicting results and the prolonged learning curves, "less-invasive" approaches appear to be safe and effective.

There are several limitations to this study. It is a retrospective design and may be impacted by selection bias as the patient population was not randomized between the 2 groups. Over time, PT and pain management protocols may have become more aggressive and have improved patient LOS. However, PT did not alter the protocol based on the surgical approach and therefore should not bias these results. This is a short-term follow-up study without the benefit of long-term follow-up or formal outcome scores. Other investigations of minimally invasive approaches have demonstrated advantages selectively in the early postoperative period. In addition, this study focused on early outcomes rather than component position or patient-reported outcome measures. A radiographic analysis would be more appropriate for mid- or long-term follow-up.

Conclusions

In summary, we demonstrated that patients undergoing a superior approach for primary THA have a statistically significant shorter length of hospital stay than those undergoing the posterior approach without increased complications. The superior approach is a safe, minimally invasive, and tissue-sparing variation of a standard posterior approach for THA that may lead to earlier discharge from hospitals. Further investigations with longer term outcomes and complication rates of the superior approach to THA are necessary.

Conflict of interest

The authors declare there are no conflicts of interest.

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