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Original Research

A Comparison of Postoperative Outcomes Between Supine and Lateral Patient Positioning in Total Hip Arthroplasty Using the Anterior-Based Muscle Sparing Surgical Approach

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ABSTRACT

Background: To determine any differences in clinical outcomes between patients in the supine vs the lateral position during anterior-based muscle sparing (ABMS) total hip arthroplasty (THA).
Methods: A retrospective review was performed of 368 patients undergoing THA via the ABMS approach (201 lateral vs 167 supine position) at our institution (2015-2019) with a minimum follow-up of 12 months. Inclusion criteria were all patients undergoing primary THA. Exclusion criteria were any revision surgeries and patients who did not undergo the ABMS THA. Outcomes assessed were postoperative complication rates, ambulation distance, length of stay, and Western Ontario and McMaster Universities Osteoarthritis Index pain, stiffness, and physical function scores at 3 time periods (preoperative, 3 months postoperative, and 1 year postoperative).
Results: The supine group had significantly greater postoperative day 0 ambulation distance (150 vs 60 meters; $P < .001$), while no difference was observed on postoperative day 1 (210 meters in supine vs 200 in lateral; $P = .921$). Median length of stay was significantly shorter in the supine group (1; interquartile range 0-1) with respect to the lateral group (1; interquartile range 0-2; $P < .001$). The in-hospital complication rates (2.4% in supine vs 1.5% in lateral; $P = .780$), return to operating room rates (2.4% in supine vs 1.5% in lateral; $P = .780$), and readmission rates (5.4% in supine vs 5.0% in lateral; $P = .631$) were not significantly different between the groups. No significant differences were observed across any Western Ontario and McMaster Universities Osteoarthritis Index scores.
Conclusions: Both supine and lateral patient positioning provide acceptable early surgical outcomes, suggesting that satisfactory results can be obtained via both positions in THAs.

Introduction

Although the current prevalence of total hip arthroplasties (THAs) in the United States is near 1%, an increasing demand for joint replacements among an aging population is expected to only increase this procedure's pervasiveness. [1] Attempts to decrease the postoperative recovery time have led to the development of minimally invasive soft-tissue sparing techniques, which access the hip joint from a landmark anterior to the greater trochanter. [2,3] One such technique is the anterior-based muscle sparing (ABMS) approach, which utilizes the surgical interval between the tensor fasciae latae and the gluteus medius and avoids deliberate detachment of the abductors. [3,4] In the context of the ABMS technique, evidence suggests that patient positioning at the time of surgery may influence the quality of surgical access allowed by this interval, the vector of gravitational force on the femoral neck/head, and the accuracy of the component positioning. [5–7] This in turn has led to many hypotheses that the patient's positioning during an

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ABMS approach to THA may have significant effects clinically, such as postoperative complications, length of stay, and dislocation frequency. [8,9] However, there is a paucity of literature that dives into the clinical differences between the 2 positioning methods, leaving important variables between the supine and lateral positioning, such as outcomes, benefits, and risks of patients, to be unstudied. We hypothesized that there would be no significant differences in the outcomes of patients in the supine compared to the lateral position. Therefore, the purpose of this study was to compare the postoperative ambulation distance, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, length of stay, and postoperative complication rates in patients undergoing ABMS THA in the supine and lateral positions. The authors hypothesize that no significant differences in clinical outcomes will exist between patients undergoing ABMS THA in the supine and lateral positions.

Material and methods

Patient selection and management

This study was approved by our institutional review board (IRB-AAAS7366). We performed a single-center retrospective review of our orthopaedic surgery database of all patients undergoing THA from January 1, 2015, to October 22, 2019. We eliminated all patients thereafter, as our data collection during the COVID pandemic did not accurately reflect normal follow-up and patient oversight. Patients who did not undergo an ABMS approach and those who had previous hip surgery were excluded, leaving a total of 368 patients who had a complete data set of outcomes beyond 12 months of follow-up. All of the included patients received surgery from one of 2 experienced surgeons (J.G. and R.S.), who used flat wedged taper-designed stems as well as collared tapered stems throughout the study period. The electronic medical record of our institution was searched to obtain basic demographic information, preoperative American Society of Anesthesiologists score, position used for surgical technique, length of stay, morphine equivalent consumption, pain scores, and ambulation distance. WOMAC scores were obtained from our institutional implant database. Patients included in this study reported WOMAC scores at 3 different time periods: preoperatively, 3 months postoperatively, and 1 year postoperatively, as well as annually thereafter. Patients were followed for at least 1 year after their surgery. Patients were separated into cohorts based on patient position (supine vs lateral) at the time of surgery. The decision to place patients in either the supine or lateral positions was surgeon-specific and therefore not the result of randomization. Due to the retrospective nature of this study, a power analysis was not performed.

The final study sample consisted of 368 patients (201 lateral vs 167 supine patients), as shown in Figure 1. Attendees exclusively used the lateral patient position from 2015 to 2019 and switched to the supine position at the beginning of 2019.

Statistical analysis

The Kolmogorov-Smirnov test was used to assess the normality of the distribution of continuous data. When normally distributed, continuous variables were reported with a mean ± SD and compared with the Student *t*-test. Otherwise, they were described with medians and interquartile ranges (IQRs) and were compared using the Mann-Whitney *U* test. Categorical variables, which were displayed with numbers and percentages of the total, were compared using the Pearson's chi-squared test and Fisher's exact test as appropriate. Two-sided *P*-values < .05 were considered statistically significant for all tests.

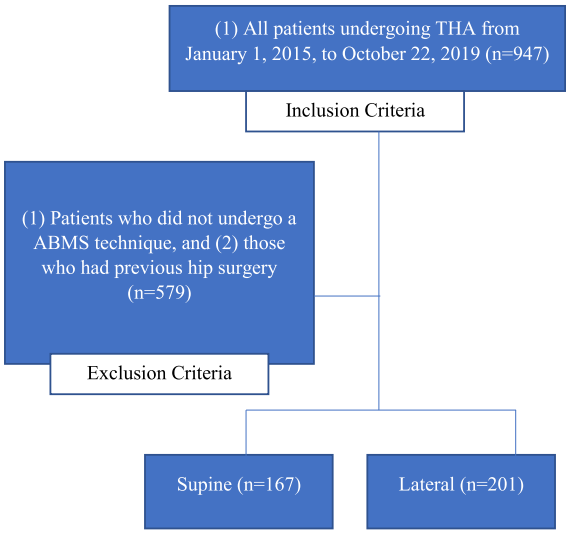

Figure 1. Patient selection.

All statistical analyses were performed with R version 4.1 (The R Foundation, Vienna, Austria).

Results

Of the 368 primary THAs included in the study, 201 (55%) were in the lateral position, whereas 167 (45%) were in the supine position. The preoperative characteristics of the supine and lateral groups are listed in Table 1. No significant differences existed in baseline demographics between the groups, including age, body mass index, gender, and American Society of Anesthesiologists score distribution. Compared to the lateral group, participants in the supine position had a longer median ambulation distance on postoperative day (POD) 0 (150 vs 60 meters; $P < .001$). This ambulation distance on POD 1 was not significantly different (210 meters in supine vs 200 meters in lateral; $P = .921$). The length of hospital stay was not normally distributed, and therefore the median length of hospital was shorter in the supine (1; IQR 0-1) with respect to the lateral group (1; IQR 0-2; $P < .001$) using the Mann-Whitney U test. The mean length of hospital stay was shorter in participants in the supine group (1 ± 0.75 days) compared to lateral group (1 ± 1.5 days) ($P < .001$). Both groups had similar rates of in-hospital complications (2.4% in supine vs 1.5% in lateral; $P = .780$) and return to the operating room (OR) (2.4% in supine vs 1.5% in lateral; $P = .780$). The rates of return to the OR are identical with the in-hospital complication rates because the patients returned to the OR represented the only in-hospital complications

Table 1
Demographic comparison.

Variable	Supine position	Lateral position	*P*-value
Patients	167	201	
Age (y)	68.61 [60.67, 74.31]	67.10 [58.13, 74.88]	.562
BMI	26.70 [24.10, 30.15]	27.90 [24.00, 30.75]	.142
Female, n (%)	89 (53.3)	107 (53.2)	1
ASA score			.18
I	12 (7.4)	16 (8.1)	
II	109 (69.0)	114 (57.9)	
III	41 (25.9)	68 (34.5)	
IV	1 (0.6)	3 (1.5)	

ASA, American Society of Anesthesiologists; BMI, body mass index.
P values < .05 are considered statistically significant.

in the overall cohort. The readmission rate was similar between the groups (5.4% in supine vs 5.0% in lateral; $P = .631$). Moreover, 28.6% of in-hospital complications/returns to the OR and 78.9% of readmissions were medical in nature and unrelated to the THA procedure. Reasons for in-hospital complications/returns to the OR and reasons for readmission are listed in Table 2 and Table 3, respectively.

In both cohorts, the mean WOMAC scores showed improvements at the 3-month and 1-year follow-ups compared to their respective preoperative reports (Table 4). The mean preoperative WOMAC scores were not significantly different between the 2 groups for pain (10.3 in supine vs 11.0 in lateral; $P = .294$), physical function (37.4 in supine vs 37.6 in lateral; $P = .939$), and stiffness (4.6 in both; $P = .906$). The mean 3-month follow-up WOMAC pain score was not significantly different between the 2 groups (2.2 in supine vs 2.1 in lateral; $P = .822$). No significant difference was observed between the 2 groups for the WOMAC scores of stiffness (1.6 in supine vs 2.1 in lateral; $P = .399$) or physical function (11.3 in supine vs 12.2 in lateral; $P = .561$). Similarly, at the 1-year follow-up, there were no significant differences in pain (1.4 in supine vs 2.3 in lateral; $P = .069$), stiffness (1.1 in supine vs 1.5 in lateral; $P = .062$), and physical function (7.6 in supine vs 10.3 in lateral; $P = .102$).

Table 3
Reasons for readmission.

Symptom/diagnosis	Supine position		Lateral position	
	# of patients	% of total patients	# of patients	% of total patients
Pain control with no associated complication	1	0.6%	0	0.0%
Upper respiratory infection[a]	0	0.0%	1	0.5%
Joint infection	1	0.6%	0	0.0%
Systemic infection (ie, influenza)[a]	1	0.6%	1	0.5%
Acute coronary syndrome[a]	2	1.2%	0	0.0%
Pneumonia[a]	0	0.0%	2	1.0%
Arrhythmia[a]	1	0.6%	0	0.0%
Acute gait instability	1	0.6%	0	0.0%
Diabetic ketoacidosis[a]	0	0.0%	1	0.5%
Fall	0	0.0%	1	0.5%
Gastrointestinal bleed[a]	0	0.0%	1	0.5%
Hypertension[a]	1	0.6%	0	0.0%
Myasthenic crisis[a]	0	0.0%	1	0.5%
Sickle cell crisis[a]	0	0.0%	1	0.5%
Small bowel obstruction[a]	0	0.0%	1	0.5%
Urinary tract infection[a]	1	0.6%	0	0.0%
Total	9	5.4%	10	5.0%

[a] Medical concern unrelated to THA operation.

Discussion

In comparing the clinical outcomes of patients in the supine vs lateral positions at the time of ABMS THA, our results demonstrated only a significant difference between mean length of stay (1 ± 0.75 in supine vs 1 ± 1.5 in lateral, $P < .001$) and POD 0 ambulation distance (150 m in supine vs 60 m in lateral, $P < .001$), with no differences between groups in POD 1 ambulation distance, in-hospital complications, return to OR rates, readmission rates, same day discharge rates, and WOMAC pain, stiffness, and physical function scores. The limited literature comparing supine vs lateral patient positioning during ABMS THA has primarily focused on cup placement, which has been suggested to influence clinical outcomes such as postoperative dislocation rates and pain. [6,10–12]

More accurate cup positioning may be obtained in the supine compared to the lateral position as a result of the improved pelvic stability and intraoperative visualization of critical anatomic landmarks. [10,13–15] Among 300 THAs, Lewinnek and colleagues found a significant association between anteversion of the acetabular component and anterior dislocations. [16] Moreover, they defined an architectural "safe zone" of cup inclination and anteversion, which ostensibly minimizes postoperative dislocation risk and may predict surgical success. [16] In 195 THAs (99 direct anterior vs 96 mini-posterior approach), Nakata et al. found higher rates of cup placement in the safe zone in the direct anterior approach compared to the mini-posterior approach (99% vs 91%, $P = .008$). [15] The direct anterior approach was also associated with a shorter time to 5-second single leg stance (16.6 vs 22.9, $P = .004$), lower rates of the Trendelenburg sign at 3 weeks postoperatively (29% vs 67%, $P \leq 0.001$), and a shorter hospital stay (22.2 vs 30.4, $P = .003$). Among the Merle d'Aubigne and Postel outcome scores of mobility, ability to walk, and pain at 2 and 6 months, the direct anterior group had a higher ability to walk score at 2 weeks (5 vs 4.3, $P = .023$), with no other significant outcome score differences between groups. [15] The increased risk of intraoperative pelvic rotation and tilt in the lateral position has been implicated in the outcome differences between groups. Indeed, the increased visualization of bony landmarks such as the anterior superior iliac spines and the pelvic tubercles may improve the ability to identify and therefore prevent intraoperative pelvic tilt [10,13]. In addition to potential pelvic obliquity in the lateral position, fluoroscopic imagery of the acetabular component at the time of surgery may also have led to improved component positioning.

Table 2
Reasons for return to OR/in-hospital complications.

Reason	Supine position		Lateral position	
	# of patients	% of total patients	# of patients	% of total patients
Revision of THA	3	1.8%	2	1.0%
Myocardial infarction[a]	1	0.6%	0	0.0%
Small bowel obstruction[a]	0	0.0%	1	0.5%
Total	4	2.4%	3	1.5%

[a] Medical concern unrelated to THA operation.

Table 4
Postoperative outcomes.

	Supine position	Lateral position	*P*-value
Length of stay (d)	1 (IQR 0-1)	1 (IQR 0-2)	<.001
Percent discharged home	78.70%	83.50%	.256
POD #0 ambulation distance (m)	150 IQR (50-270)	60 IQR (12-150)	<.001
POD #1 ambulation distance (m)	210 IQR (100-300)	200 IQR (97.5-300)	.921
In-hospital complications	2.4%	1.5%	.780
Return to OR rate	2.4%	1.5%	.780
Readmission rate	5.4%	5.0%	.631
WOMAC pain			
Preoperative	10.3 ± 4.2	11.0 ± 4.5	.294
3-mo	2.2 ± 3.0	2.1 ± 2.6	.822
1-y	1.4 ± 2.8	2.3 ± 3.4	.069
WOMAC stiffness			
Preoperative	4.6 ± 1.8	4.6 ± 2.0	.906
3-mo	1.9 ± 1.8	2.1 ± 1.6	.399
1-y	1.1 ± 1.4	1.5 ± 1.5	.062
WOMAC physical function			
Preoperative	37.4 ± 12.7	37.6 ± 14.5	.939
3-mo	11.3 ± 11.1	12.2 ± 10.1	.561
1-y	7.6 ± 10.0	10.3 ± 11.8	.102

IQR, interquartile range.

While the potential relationship between cup placement and postoperative dislocation rates suggests that differences in patient positioning at the time of ABMS THA may influence postoperative clinical outcomes, to our knowledge, no literature currently exists comparing postoperative outcomes of supine vs lateral patient positioning in this context. Consequently, our single-center cohort study represents the first report to compare the clinical outcomes of supine vs lateral ABMS THAs. Similarly, in this study, we found no difference in rate of dislocation between positions at the time of surgery.

Our results suggest that both positions may provide satisfactory outcomes, as there were no differences aside from POD 0 ambulation distance and length of stay. Indeed, both groups had similar rates of same-day discharge (78.7% in supine vs 83.5% in lateral, $P = .256$), in-hospital complications (2.4% in supine vs 1.5% in lateral, $P = .78$), return to OR rates (2.4% in supine vs 1.5% in lateral, $P = .78$), and readmission rates (5.4% in supine vs 5.0% in lateral, $P = .631$). Although current literature provides little guidance regarding the effect of patient positioning following ABMS THA, our results suggest that safe and similar outcomes can be obtained with patients in both the supine and lateral positions during surgery.

Limitations

This is a single-center retrospective study with a high volume of patients, which may decrease external validity. The cohorts were consecutive groups of patients done in each respective position, introducing time-based effects to the results. Moreover, the decision to place patients in either the supine or lateral positions was surgeon-specific and therefore not the result of randomization, which could have introduced bias. While our findings suggest that cup positioning may be impacted by patient positioning at the time of ABMS THA, we did not include a radiographic analysis between the 2 groups. Radiographic differences showing malposition, for example, would be expected to have an impact on clinical outcomes and complications; however, we did not find a difference in our clinical outcome scores or in complications like dislocation or fracture. While it is less likely that we have relevant differences in component positioning or other radiographic parameters between groups, this lack of radiographic data represents a study limitation. A future follow-up study using radiographic data from this same cohort should be conducted to further inform how patient positioning may affect clinical outcomes. Furthermore, the lack of data describing intraoperative complications is another study limitation. However, since there were no significant differences across the study's comprehensive endpoints of in-hospital complications, return to OR rates, readmission rates, ambulation distances, and WOMAC scores between the 2 groups, it is unlikely that significant differences would be observed for intraoperative complications if these data were available. In general, from 2015 to 2019, there was a decreased length of stay and increased day 0 physcial therapy. Additionally, the surgeries were all performed by only 2 experienced surgeons, which may contribute to a lack of generalizability. Despite being a large study spanning 4 years, differences may be observed if patients were followed for a longer period. Hospital protocols improved over the duration of study to include more POD 0 physical therapy, which may explain the early ambulation differences. Moreover, intergroup differences in hospital length of stay may be due to the increased variability in the lateral group (1 ± 0.75 in supine vs 1 ± 1.5 in lateral; $P < .001$), which may be a function of the small sample size and not indicative of differences between the groups aside from the year of surgery. The rate of ABMS cases between 2015 and 2018 was slower than after 2019. This was due, in part, to the concurrent use of posterior approaches in the earlier period, as well as to the movement of cases to another hospital within our system but that was not covered by our institutional review board. This is further suggested by the findings of no significant difference between the groups for in-hospital complications (2.4% in supine vs 1.5% in lateral; $P = .778$), returns to the OR (2.4% in supine vs 1.5% in lateral; $P = .778$), and readmission rates (5.4% in supine vs 5.0% in lateral; $P = .631$).

Conclusions

Our comparison of supine vs lateral patient positioning at the time of ABMS THA demonstrated a significantly different mean length of stay and POD 0 ambulation distance, with no other differences in clinical outcomes including POD 2 ambulation distance, in-hospital complications, return to OR rates, readmission rates, or WOMAC scores at 3 months or 1 year. Our findings suggest that satisfactory clinical outcomes can be obtained using both orientations. Future prospective studies are required to corroborate the experience at our single center.

Conflicts of interest

R.P. Shah is a paid consultant for Link Orthopaedics, Monogram, and Zimmer; is an unpaid consultant for OnPoint; has stock options in Parvizi Surgical Innovations; and is a board/committee member of the American Association of Hip and Knee Surgeons and the US Food and Drug Administration. J. A. Geller is a speaker bureau of Smith & Nephew; receives royalties from Smith & Nephew; is a paid consultant for Nimble Health and Smith & Nephew; has stock options in Zimmer; receives research support from Orthopaedic Scientific Research Foundation, OrthoSensor, and Smith & Nephew; and is a board/committee member of Clinical Orthopaedics and Related Research, Journal of Arthroplasty, and Journal of Bone and Joint Surgery—British. All other authors declare no potential conflicts of interest.

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