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Forgotten Joint Score in THA: Comparing the Direct Anterior Approach to Posterior Approach

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ABSTRACT

Background: The direct anterior approach (DAA) in total hip arthroplasty (THA) has gained popularity because of potential decreased postoperative pain and quicker recovery after surgery in comparison to the posterior approach (PA). With a growing focus on patient-reported outcome (PRO) measurements after surgery, we sought to determine if one approach led to better PRO scores as determined by the Forgotten Joint Score-12 (FJS-12) questionnaire.

Methods: A retrospective chart review of primary THAs between September 2016 and September 2019 at a single academic hospital was conducted. Demographic and clinical data in addition to FJS-12 scores were collected. Two groups were created based on THA approach. Frequency rates, means, and standard deviations were used to describe baseline patient characteristics. Differences in demographic data were accounted for using linear regression models.

Results: A total of 1469 cases were identified, with 830 using the DAA and 639 the PA. Significant demographic differences were observed between the 2 groups. However, when controlling for this, there were no differences in FJS-12 scores between approaches at 1 and 1.75 years ($P = .232$ and $P = .486$, respectively). At 12 weeks, DAA patients had higher satisfaction (59.21 vs 46.8; $P = .006$). When controlling for surgeon case volume, no differences in FJS-12 were observed at any of the time points ($P = .536$, $P = .452$, and $P = .967$, respectively).

Conclusion: DAA THA patients trended toward better PRO scores than their PA counterparts. However, when controlling for surgeon case volume, no differences were observed, which suggests that surgeon case volume and experience have an important effect on patient satisfaction and FJS-12 scores.

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Total hip arthroplasty (THA) has been shown to be the premier treatment for osteoarthritis of the hip as well as for the improvement of hip function and pain [1,2]. It has been previously reported that nearly 7%-15% of patients were dissatisfied with their THA because of postoperative pain and delayed functional recovery [3,4]. Failure of fixation and intraoperative soft tissue damage have been thought to play a role in postoperative pain in THA patients [5]. Although there are various potential causes of intraoperative soft tissue damage, the surgical approach is considered to be one of

the most influential factors [6,7]. It follows that surgical technique, skill, and surgical approach could minimize the severity of pain and improve hip function [8] leading to high patient satisfaction.

The direct anterior approach (DAA) and posterior approach (PA) are 2 of the most common surgical approaches used for THA in the United States [9–11]. The popularity of PA is derived from its historically well-established presence as the approach of choice in multiple residency and fellowship programs. During the past decade, the DAA has gained popularity because of multiple physician-driven and patient-driven factors [12–15]. Although controversy exists, the DAA has been shown to have lower pain scores, earlier functional recovery, and a lower dislocation rate postoperatively in comparison to the PA in a number of studies [11,16–19].

Despite our focus on improving functional outcomes and recovery from THA, patients and surgeons continue to have different perceptions of the patients' own recovery [20,21]. The limitation of many patient-reported outcome (PRO) tools is the difficulty to differentiate between patients with good and an excellent outcome

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(ceiling effect) [22–24]. Although many PRO tools do not combine patient and surgeon outcome ratings, the Forgotten Joint Score-12 (FJS-12) questionnaire combines both ratings, which helps to reduce bias in the outcome evaluation [25]. The FJS-12 questionnaire, which is based on the concept that the ultimate goal of THA is for patients to forget their artificial joint, is a PRO scale that was developed to evaluate outcome beyond the traditional measures [26,27]. It assesses joint awareness in hips and knees during various activities of daily living after joint replacement with a maximal obtainable score of 100 [22,28].

The purpose of this study was to (1) evaluate postoperative THA patient satisfaction as measured with the FJS-12 questionnaire as the primary PRO tool, (2) compare these patients' FJS-12 scores based on surgical approach, and (3) determine whether a difference in FJS-12 scores holds any clinical relevance in short-term outcome. The 2 surgical approaches being compared in this study are the DAA and PA. We hypothesized that the FJS-12 scores between the 2 cohorts would be negligible at 1-year follow-up.

Methods

A retrospective review of patients who underwent primary THA between September 2016 and September 2019 and responded to the FJS-12 questionnaire was conducted at a tertiary and urban academic institution. All contributing surgeons in the PA cohort used the mini-PA specifically. Intraoperative fluoroscopy and a specialized surgical table were used for all but 39 cases (4.7%) included in the DAA cohort. Variables collected during this review include FJS-12 scores at 12 weeks, 1 year, and 1.75 years postoperatively; baseline patient demographics and surgical data (age, gender, body mass index [BMI], race, smoking status, American Society of Anesthesiologists [ASA] score, and length of stay [LOS]).

Forgotten Joint Score-12

The FJS-12 is a 12-question questionnaire, which measures patient satisfaction. Scores based on each of the questions are summed and converted to a 100-point scale. Higher satisfaction and better outcomes are indicated by higher scores. In comparison to other satisfaction and pain scales such as the Normalized The Western Ontario and McMaster Universities Osteoarthritis Index and Knee Injury and Osteoarthritis Outcome Score subscales, the FJS has high test-retest consistency and lacks a ceiling effect, which provides it with greater discriminatory ability [29].

Patient Population

Our cohort consisted of 1469 patients who underwent a THA between September 2016 and September 2019. Patients who were included in this study included all consecutive THA patients who were operated with either a DAA or a PA and completed the FJS-12 on at least one of the given time points: 12 weeks, 1 year, or 1.75 years. The cohort was divided into 2 groups: DAA THA patients ($n = 830$) and PA THA patients ($n = 639$). The DAA group comprises 58% women and 42% men with an average age of 65.25 years (Table 1). In contrast, the PA cohort consisted of 53% females and 47% males with an average age of 64.79 years (Table 1). The DAA operations were performed by 4 surgeons with the highest volume surgeon performing 696 (83%) of the cases. One of these 4 surgeons used both DAA and PA; therefore, was included in both cohorts. The PA cohort was represented by 12 surgeons with 2 surgeons contributing 245 (38%) of the cases. Aside from the one surgeon who was included in both cohorts because of the use of both approaches, all remaining surgeons included in the study used only their respective approach technique. Our institution uses the same

rehabilitation and precaution protocol for both DAA and PA patients. This universal hip precaution protocol for all patients includes instructions on avoiding extreme range of motion positions and avoiding low seating positions.

Statistical Analysis

Descriptive data are represented as means $\pm$ standard deviation (SD). Statistical differences in numeric and continuous variables were detected using independent-sample 2-sided *t* tests. Chi-square tests were used for categorical variables. Multiple linear regressions were used to compare FJS-12 scores at each of the set time points (12 weeks, 1 year, and 1.75 years) between approach types. Multiple linear regressions were used to account for the significant differences in demographic data found between the 2 cohorts. To account for case volume, the average number of cases among the surgeons in a cohort was determined. Those who were 1 SD above the mean were considered high volume, whereas those who were 1 SD below the mean were considered low volume. All others were considered average volume. These values were then entered into a multiple linear regression analysis to determine if surgeon volume affected FJS-12 scores. A *P* value of less than .05 was considered to be significant. All statistical analyses were performed using SPSS, version 25 (IBM Corporation, Armonk, NY).

Results

The primary objective of this study was to compare postoperative satisfaction in patients who underwent DAA vs PA THA using the FJS-12 questionnaire. Between September 2016 and September 2019, 830 DAA and 639 PA patients were identified with FJS-12 scores recorded at least at 1 of 3 periods postoperatively. At 12 weeks postoperatively, the DAA cohort had 278 respondents, whereas the PA cohort had 274 respondents. The number of respondents for the DAA increased to 312 at 1 year, whereas for the PA cohort, 259 patients responded. At 1.75 years, the number of respondents for the DAA cohort decreased to 242, and for the PA, there were 193 respondents.

To account for the significant differences in demographic data between the approach cohorts, multivariate linear regressions were used to measure the association between THA approach and patient

Table 1
Demographic Data ($n = 1469$).

Characteristics	DAA ($n = 830$)	PA ($n = 639$)	<i>P</i>
Age	65.25 $\pm$ 9.65	64.79 $\pm$ 10.96	.399
Gender			.049
Female	483	339	
Male	347	300	
BMI (kg/m ²)	27.54 $\pm$ 4.94	29.16 $\pm$ 6.18	<.001
Race			<.001
White	771	157	
Other	119	482	
Smoking status			.002
Never	476	321	
Former	292	241	
Current	62	77	
ASA			<.001
1	80	40	
2	546	350	
3	143	169	
4	1	8	
LOS (d)	0.86 $\pm$ 1.13	1.96 $\pm$ 1.29	<.001

P values are derived from 2-tailed *t* test for numerical values or chi-square tests for categorical values.

DAA, direct anterior approach; PA, posterior approach; BMI, body mass index; ASA, American Society of Anesthesiologists; LOS, length of stay.

Table 2
FJS by Approach.

Time Period	DAA	PA	P
12 wk Postoperatively	59.21 ± 29.55	46.8 ± 29.05	.006
1 y Postoperatively	69.62 ± 27.60	60.91 ± 30.23	.232
1.75 y Postoperatively	76.63 ± 24.26	68.68 ± 29.41	.486

P values are derived from a multilinear regression, which accounts for demographic differences between groups.

FJS, Forgotten Joint Score; DAA, direct anterior approach; PA, posterior approach.

satisfaction as measured by the FJS-12. Significant differences in demographic data between approach included gender, BMI, race, smoking status, ASA, and LOS. It was determined that at 12 weeks there was a significant difference in patient satisfaction between the DAA and PA when accounting for variance in demographic data (59.21 vs 46.8, $P = .006$; Table 2). At 1 and 1.75 years postoperatively, we found no statistically significant difference in FJS-12 scores ($P = .232$, $P = .486$, respectively; Table 2) although the scores consistently trended in favor of the DAA cohort at all time points. In addition, we conducted a subanalysis in which we compared only patients who answered the questionnaire at 2 or more periods (Table 3). We found that patients who answered at 12 weeks and 1 year postoperatively had mean delta changes of 7.7 in the DAA cohort and 9.57 in the PA cohort ($P = .868$). Patients who only answered at 12 weeks and 1.75 years postoperatively had mean delta changes of 12.85 and 25.43 in the DAA and PA cohorts, respectively ($P < .001$), and those who answered only at 1 year and 1.75 years postoperatively had mean delta changes of 1.56 and 10.62 in the DAA and PA cohorts, respectively ($P = .811$). Table 3 summarizes delta FJS-12 score of patients who responded at 2 time points.

Post hoc analysis of the 12-week, 1-year, and 1.75-year postoperative FJS-12 scores using multiple linear regression analysis revealed that longer LOS led to worse patient satisfaction at each time point regardless of approach. Every increase in 1 day of inpatient stay led to an average decrease of 3.7 points in the FJS-12 score at 12 weeks and 3.39-point decrease at 1 year postoperatively (Table 4). LOS was not associated with a change of FJS-12 scores at 1.75 years. In addition, preoperative ASA was not found to have a significant effect on patient satisfaction scores (Table 4).

Although differences in FJS-12 scores were shown at 12 weeks between the 2 approaches, when we controlled for surgeon case volume, we found no statistical difference in FJS-12 scores at 12 weeks, 1 year, and 1.75 years ($P = .536$, $P = .452$, $P = .967$, respectively). When comparing the surgeons with the highest FJS-12 scores in the DAA and PA groups, we again saw no significant difference in scores at any of the given time intervals ($P = .379$, $P = .525$, $P = .148$, respectively). Surgeon volume was analyzed by determining the mean number of cases among the surgeons, then dividing them into those who were 1 SD above the mean, those 1 SD below the mean, and those within 1 SD of the mean. These groupings were then used in a multiple linear regression analysis examining the dependent variable, which was the FJS-12 score.

Discussion

Currently, there is no universally accepted definition for the ultimate success of THA. PRO scores have begun to gain attention because of their ability to both reflect patients' self-assessed satisfaction levels and provide an accurate evaluation of quality of life [30]. Any-cause revision rate alone is insufficient to provide a complete and accurate assessment of outcome after joint replacement surgery. Joint awareness, or the ability of patients to forget about their joint arthroplasty in their everyday life and during recreational activity, is a new dimension of PRO that can be measured using the FJS-12. The forgotten joint phenomenon is a

Table 3
Delta FJS-12 Scores of Patients Who Responded at 2 Time Points.

FJS-12 Response Times	Delta FJS-12 Score	P
12 wk + 1 y		.868
DAA (n = 72)	7.7	
PA (n = 32)	9.57	
12 wk + 1.75 y		<.001
DAA (n = 18)	12.85	
PA (n = 5)	25.43	
1 y + 1.75 y		.811
DAA (n = 16)	1.56	
PA (n = 11)	10.62	

FJS, Forgotten Joint Score; DAA, direct anterior approach; PA, posterior approach.

simple, valuable, and tangible parameter to assess joint function postjoint arthroplasty subjectively [26,29,31,32]. The primary purpose of this study was to compare postoperative patient-reported satisfaction using the FJS-12 between patients undergoing THA using the DAA vs the PA. Our analysis showed that there was a statistical difference between FJS-12 scores between the 2 cohorts in the short term (12 weeks); however, as time progressed, the difference became statistically insignificant although continued to trend in the direction of the DAA cohort. In addition, increased LOS led to worse patient satisfaction (lower FJS-12) at each time point regardless of approach.

Many authors have reported that differences in the clinical outcome of primary THA via the PA or DAA were undetectable by 6–12 months after surgery [33,34]. Given that in the present study the maximum follow-up time was at 1.75 years, further collection of data at a longer follow-up period is warranted. Because of the trend that was observed in our study, we predict that at a 3-year follow-up with the patients included in our study, the FJS scores between the 2 cohorts will remain statistically insignificant. However, Ozaki et al [35] reported that FJS-12 score at a 3-year follow-up was statistically higher in the DAA group in their study than that in the PA group (75.2 ± 15.9 vs 60.1 ± 24.4).

The FJS-12 revealed a significant difference in the short-term outcome between the DAA and PA groups in the present study. This may suggest that although patients may be able to perform certain motions, those who underwent THA via the PA are at a higher likelihood of being aware of the prosthesis in the few months directly after their surgery. This awareness could be because of the approach and healing process of the posterior structures as well as posterior hip precautions, which the patient must maintain [8]. Previous literature has shown moderate to severe atrophy of the repaired short external rotators and incomplete healing of tendon in about 60% of the patients when magnetic resonance imaging (MRI) was performed at 2 years after THA via PA [36]. Bremer et al [37] reported similar findings, which showed that less soft tissue damage was seen on MRI in patients who underwent the DAA as compared with patients who underwent the PA at 1 year postoperatively. In addition, another study reported scar tissue between the piriformis and the adjacent tendons, with bone remodeling to show MRI signal intensity resembling the native tendon in most patients at 4 years after THA via the PA [38]. Although we found no statistically significant difference between approaches at 1 year (69.62 ± 27.60 vs 60.91 ± 30.23 ; $P = .232$) and 1.75 years (76.63 ± 24.26 vs 68.68 ± 29.41 ; $P = .486$), FJS scores were consistently higher for patients in the DAA cohort compared with the PA cohort.

In contrast to the PA, the gluteus maximus is not split when the DAA is used. Gluteus maximus muscle is of high importance for many everyday activities, such as hip extension, standing up out of a chair or a car, and climbing stairs [39]. The short external rotators play a vital role in hip function and dynamic hip stabilization. Exposure of the femoral medullary canal can be cumbersome, thus

Table 4
Multivariate Linear Regressions of FJS.

	12 wk		1 y		1.75 y	
	Unstandardized B	P	Unstandardized B	P	Unstandardized B	P
Approach	−7.356	.01	−3.603	.176	−4.946	.172
Gender	1.786	.509	1.638	.506	−2.406	.424
Race	9.16	.012	12.387	<.0001	14.171	<.0001
BMI	−0.135	.566	−0.45	.051	−1.602	.351
Smoking status	−3.125	.076	−3.149	.052	1.64	.576
ASA	−0.747	.758	1.616	.462	0.066	.818
LOS	−3.7	.001	−3.395	.002	1.304	.477

Adjusted multiple linear regression model studies the relationship between the dependent variable, FJS-12 score, demographic data (gender, race, BMI, smoking status, and ASA score), LOS, and approach.

FJS, Forgotten Joint Score; BMI, body mass index; ASA, American Society of Anesthesiologists; LOS, length of stay.

posterolateral release of the external rotators may be required when using the DAA [15,40]. van Oldenrijk et al [40] showed that the piriformis was better protected when the DAA was used compared with other approaches. However, it has also been previously reported that no significant changes to the piriformis compared with before surgery was shown by MRI at 1 year after THA via DAA [41]. Agten et al [42] purposed that damage to the external rotator tendons was substantially worse with the PA compared with other approaches including the DAA. Dynamic hip stability may be better maintained with the DAA vs the PA and may explain why patients in the DAA cohort had a higher FJS in the short term.

Although nerve injury is a potential complication for all THAs, Goulding et al [43] reported an 81% incidence of lateral cutaneous nerve deficits in operations using a DAA. In addition, Martin et al [34] reported that lateral femoral cutaneous nerve (LFCN) neuropraxia occurred in 7 (17%) in the anterior group and 0 in the posterior group. Homma et al [44] concluded that this complication can lead to awareness of the prosthesis postoperatively and influence the FJS-12 score. LFCN injury was observed in 7 patients from the DAA group. However, in a subsequent study by Homma et al [45], it was concluded that LFCN injury via DAA resolves spontaneously as time progresses. This may be a contributing factor when analyzing the progressive improvement in FJS scores for the DAA cohort in our study.

We observed mean delta changes of 7.7 in the DAA cohort and 9.57 in the PA cohort ($P = .868$) in patients that answered at 12 weeks and 1 year postoperatively, 12.85 in the DAA cohort and 25.43 in the PA cohort ($P \leq .001$) in those who answered at 12 weeks and 1.75 years postoperatively and 1.56 in the DAA cohort and 10.62 in the PA cohort ($P = .811$) in those who answered at 1 year and 1.75 years postoperatively. This appears to show that the FJS-12 score plateaus faster in the DAA cohort compared with the PA cohort. Although all patients seem to be reaching similar endpoint results, the patients in the DAA cohort are reporting higher FJS-12 scores at an earlier time point. Patients in the PA cohort seemingly have a more gradual increase in FJS-12 score during a longer period.

Although differences in FJS-12 score were seen at 12 weeks between the 2 approaches, when we controlled for surgeon case volume, we found no difference in FJS-12 scores at 12 weeks, 1 year, and 1.75 years ($P = .536$, $P = .452$, $P = .967$, respectively). In addition, when the surgeons with the highest FJS-12 scores in the DAA and PA were compared, we again saw no significant difference in scores at any of the given time intervals ($P = .379$, $P = .525$, $P = .148$, respectively). These results suggest that additional factors other than approach play a role in FJS-12 scores and patient satisfaction. Potential intraoperative factors, such as surgeon experience, skill, and case difficulty, could be affecting pain and subsequently FJS-12 scores. It follows that approach may matter less than a surgeon's experience, case volume, and comfort using said approach.

There are limitations to this study that should be considered. The retrospective nature of this study represents an area where bias may have been introduced. THA was performed by multiple surgeons with different levels of experience in both the DAA group and the PA group. All the cases included in this study were performed at an orthopedic specialty hospital. Hence, the results we gathered may not be generalizable to surgeons who perform THA at a lower volume center. The 2 cohorts were not homogenous with regard to implants making it difficult to evaluate whether implant choice was an additional confounding factor. A statistically significant difference in BMI and ASA score between study cohorts is an important confounder as obese patients and patients with inherent comorbidities may require more assistance with early mobilization, thereby influencing the difference in LOS and FJS between the groups [46]. Previous literature has demonstrated that numerous factors other than the surgical approach, such as patient pre-conditioning, pre-emptive analgesia, and rehabilitation protocol significantly impact the outcome of THA [47]. All of which may ultimately play a role in patient satisfaction and thus determining FJS score. We investigated FJS at only 3 periods postoperatively. Significant differences may appear in a longer period and with a larger cohort in both groups. In addition, utility of preoperative FJS would have established a patient's baseline score to further demonstrate the scale of improvement over time for both cohorts. The most obvious bias in this study, which we tried to account for in our analysis, is that the vast majority (83%) of the DAA cases were performed by a single surgeon, whereas the PA cases included 12 surgeons. The bias of surgeon experience and volume is difficult to overcome here, and therefore, we performed an analysis accounting for surgeon volume. Prospective surveys should be continued with these patients in the future to gain a better understanding of the long-term outcomes when comparing the DAA to the PA.

Conclusion

This study presents FJS-12 questionnaire scores of patients who underwent THA via either the DAA or the PA. These scores were compared with each other at 3 periods (12 weeks, 1 year, and 1.75 years) postoperatively. Our study has shown that patients in the present study who underwent THA via DAA reported a statistically higher FJS score only at the 12-week postoperative period with a trend toward similar findings at each of the other intervals. When controlling for surgeon differences in volume, there was no statistical difference in patient FJS scores. Although all patients seemed to reach similar long-term FJS-12 scores, those in the DAA cohort reported higher scores at an earlier time point compared with their counterparts. We can conclude that although short-term outcome of patients who underwent THA via DAA is better when compared with patients who underwent the PA, surgeon experience and volume play a key role in the ultimate patient satisfaction with the procedure.

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