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Patient-Reported Outcomes Following Total Hip Arthroplasty: A Multicenter Comparison Based on Surgical Approaches

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Abstract

Background: Comparisons of patient-reported outcomes (PROs) based on surgical approach for total hip arthroplasty (THA) in the United States are limited to series from single surgeons or institutions. Using prospective data from a large, multicenter study, we compare preoperative to postoperative changes in PROs between posterior, transgluteal, and anterior surgical approaches to THA.

Methods: Patient-reported function, global health, and pain were systematically collected preoperatively and at 1, 3, and 6 months postoperatively from patients undergoing primary THA at 26 sites participating in the Comparative Effectiveness of Pulmonary Embolism Prevention After Hip and Knee Replacement (ClinicalTrials.gov: NCT02810704). Outcomes consisted of the brief Hip disability and Osteoarthritis Outcome Score, the Patient-Reported Outcomes Measurement Information System Physical Health score, and the Numeric Pain Rating Scale. Operative approaches were grouped by surgical plane relative to the abductor musculature as being either anterior, transgluteal, or posterior.

Results: Between 12/12/2016 and 08/31/2019, outcomes from 3018 eligible participants were examined. At 1 month, the transgluteal cohort had a 2.2-point lower improvement in Hip disability and Osteoarthritis Outcomes Score (95% confidence interval, 0.40–4.06; $P = .017$) and a 1.3-point lower improvement in Patient-Reported Outcomes Measurement Information System Physical Health score (95% confidence interval, 0.48–2.04; $P = .002$) compared to posterior approaches. There was no significant difference in improvement between anterior and posterior approaches. At

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3 and 6 months, no clinically significant differences in PRO improvement were observed between groups.

Conclusion: PROs 6 months following THA dramatically improved regardless of the plane of surgical approach, suggesting that choice of surgical approach can be left to the discretion of surgeons and patients without fear of differential early outcomes.

Keywords

hip arthroplasty; patient-reported outcomes; transgluteal; posterior; anterior; HOOS

Total hip arthroplasty (THA) offers substantial pain relief and improved quality of life for patients with hip osteoarthritis [1]. Innovations in implant technology, perioperative management, and operative technique have reduced complications, shortened length of stay, decreased costs, and improved patient outcomes. None-theless, the aging US population is expected to drive a 174% increase in procedure volume between 2005 and 2030 [2], indicating the need to innovate toward increased efficiency and improved outcomes.

Surgical approach toward hip arthroplasty may be an important factor in determining clinical outcomes and efficiency. Surgical approach is conventionally classified by the location of the plane of dissection relative to the abductor musculature, an essential muscle to preserve for optimal functional recovery. In the United States, the most common techniques are posterior approaches, variations of which are known as the Southern, Moore, or posterolateral approaches [3,4]. Transgluteal approaches, also known as the direct lateral or Hardinge approaches, are alternatives that provide improved joint access at the expense of violating the abductor musculature [5,6]. More recently, increased interest in anterior approaches, including the Smith-Peterson, Hueter, or Watson-Jones approaches, has been driven by the belief that they may reduce soft tissue trauma and provide more reliable component positioning [7]. These approaches follow internervous and/or intranervous planes with the patient in a supine position with the goal of improved early functional recovery and reduced pain [8].

Previous studies have attempted to determine the superiority of a single surgical approach, but no consensus has emerged [7]. One framework for comparison relies on patient-reported outcomes (PROs), a valuable tool for assessing patient recovery and function after orthopedic procedures [9]. While registries in Norway [10] and the Netherlands [11] have compared nationwide PROs based on surgical approach, similar studies within the United States have been limited to single surgeons or institutions. To improve the understanding of patient recovery after THA based on surgical approach in the United States, we assess longitudinally collected PROs from a multi-institutional consortium.

Methods

Study Design

As part of the Comparative Effectiveness of Pulmonary Embolism Prevention after Hip and Knee Replacement (PEPPER) trial [12], longitudinally collected PROs, baseline demographics, and surgical approach were collected from patients undergoing THA at 27

North American hospitals. All approaches were categorized by the operating surgeon as traversing anterior, through, or posterior to the gluteal abductor musculature, and the approaches were grouped and classified as “anterior,” “transgluteal,” and “posterior,” respectively. We compared preoperative to postoperative changes in PROs among patients undergoing primary or revision THA based on this categorization of surgical approach.

Settings

PROs were collected through the PEPPER trial, a large, pragmatic, multicenter, randomized, clinical trial evaluating safety and effectiveness of prophylactic antithrombotic medication after total hip and knee arthroplasty [12]. While randomization and safety outcomes with respect to antithrombotic regimen were unrelated to our analysis, PEPPER’s longitudinal collection of PROs from study participants enrolled through multiple institutions provided an opportunity to evaluate the influence of surgical approach on PROs. The PEPPER trial is an ongoing study registered with ClinicalTrials.gov (NCT02810704), enrolling subjects from 26 hospitals in North America.

Participants

We included study participants enrolled in PEPPER between 12/12/2016 and 08/31/2019. Appendix A outlines the full inclusion and exclusion criteria for study participants. Briefly, adults undergoing elective primary THA who were able to provide informed consent were included. Patients with comorbidities that confounded the assessment of antithrombotic medication were excluded. All included participants in the study cohort underwent THA using a surgical approach categorized as anterior, transgluteal, or posterior to the abductor musculature. Although PEPPER enrollment included subjects with hip revision or resurfacing procedures, these subjects were excluded from our analysis.

Outcomes

Outcomes included validated measures of hip function, general health, and pain. Function was assessed using the Hip disability and Osteoarthritis Outcome Score (HOOS Jr), which asks 6 questions prompting assessment of pain, function, and quality of daily living within the past week [13]. The HOOS Jr is scored on a 0–100 scale, with a higher score indicating a higher level of function, and a 7-point difference is smallest reported estimate of a minimum clinically important difference (MCID) using an anchor-based approach [14,15]. The Patient-Reported Outcomes Measurement Information System Physical Health Summary (PROMIS-PH) was used to assess global pain and general health. The PROMIS-PH measure is evaluated using a *T*-score set at a mean of 50, with greater scores representing improved health [16]; the MCID for PROMIS-PH scores is estimated to be 7.9 points [14]. The Numeric Pain Rating Scale (NPRS) was scored on a scale of 0–10 with lower values indicating less pain; a difference of 2 points is considered clinically meaningful [17]. The HOOS Jr, PROMIS-PH, and NPRS outcomes were collected due to their common use in joint arthroplasty studies and registries. Outcome surveys with individual items that were missing were not scored. Given our large sample and difference between surgical approaches, we had greater than 80% power to detect a MCID for each outcome. In addition to PROs and baseline characteristics, participant discharge disposition was collected and

categorized as either routine (“home or home health agency”) or transfer (“skilled nursing facility, inpatient rehab, or other facility”).

A web-enabled database maintained by an independent contractor housed eligibility and screening detail, baseline information, and operative data [18]. Postoperative outcomes were centrally collected using telephone interviews, web-based surveys, and postage-paid reply mail surveys. PROs were collected over a 1-month (37 days postoperative −7/+10 days), a 3-month (90 days postoperative −10/+14 days), and a 6-month window (180 days postoperative −28/+28 days). Patients were contacted for follow-up irrespective of complications. Data systems, procedures, and policies were compliant with the Health Insurance Portability and Accountability Act, the Code of Federal Regulations Title 21 Part 11, the Federal Information Security Modernization Act, and computing principles of minimum necessity, separation of duties, and least privilege.

Covariates

Patient demographics and comorbidities were collected at baseline (preoperatively) to adjust for varying patient risk associated with adverse outcomes and poor initial functional status [19–27]. Patient characteristics included age (continuous), sex (female, male), race (white, black, other/multiple), ethnicity (Hispanic, not Hispanic), smoking (never, current, former), alcohol use (never, monthly or less, 2–4 times a month, 2–3 times a week, 4 or more times a week), work status (working, unemployed looking, sick on leave, disabled due to hip or knee, disabled for other reasons, student/homemaker/retired), and the Charlson Comorbidity Index [28]. Participant height and weight were collected to calculate body mass index (BMI) [29].

Statistical Analysis Methods

Differences in patient demographics and comorbidity were summarized based on surgical approach with differences tested using χ-square statistics for categorical data and analysis of variance for continuous variables. A linear mixed-effects regression was used to compare preoperative to postoperative changes in PROs based on surgical approach using the posterior group as the reference and adjusting for baseline measures of participant health, age, sex, race, ethnicity, work status, alcohol use, smoking status, and comorbidity. The standard errors of model coefficients were adjusted for correlation of serially repeated outcomes collected over time within patients, and for patients nested within hospitals. Age, BMI, and baseline health were included as continuous variables; all other covariates, including surgical approach and time (month), were included as categorical variables. Adjusted outcomes were estimated by setting covariates to their mean distributions, and inferences about the effect of surgical approach were based on evaluating the statistical significance of the coefficient of the interaction term between surgical approach and time (month).

Associations between predictor variables and outcomes were examined for influential data points with high leverage and nonlinearity. No other polynomial, transformation, or interaction terms were required. Participants with missing baseline data were dropped from the regression models. Mixed effects regression models implicitly impute outcomes for

participants when missing for a given time point, due to survey nonresponse, due to individual item missingness that prevented scoring, or because they had not passed through the survey window at the time of analysis (eg, had not yet reached the 6-month follow-up window). All analyses were performed using STATA-MP-15 software (College Station, TX) with hypothesis testing based on an alpha level of 0.05. Ethical approval was obtained from the Medical University of South Carolina, which served as a central institutional review board for all but 3 participant sites.

Results

Participants

Of the 3018 participants enrolled in PEPPER who met criteria for this analysis (Fig. 1), 1452 participants (48.1%) underwent THA via posterior approaches, 633 participants (21.0%) via transgluteal approaches, and 933 (30.9%) via anterior approaches. Participants who withdrew at any time during the study were excluded. Those who withdrew were similar in all characteristics and comorbidity except for work status; withdrawn patients were less likely to be working (41% working compared to 44% working in study cohort, $P = .004$). Overall, 2640 of 2847 participants (92.7%) who passed through the 6-month follow-up window at the time of the analysis completed preoperative PRO collection and at least 1 postoperative PRO collection survey (Fig. 1). The median number of days between baseline survey completion and THA was 8 days. Missing responses in baseline characteristics did not exceed 3% for any single survey item. Within the 27 PEPPER participant sites, 26 contributed participants to our study cohort with a mean enrollment of 116 participants per site, ranging from 6 to 280.

Descriptive Data

Table 1 provides baseline demographic information based on surgical approach. Participants undergoing an anterior approach generally had a lower BMI, were more likely to be white and non-Hispanic, and were less likely to drink alcohol than participants undergoing the transgluteal or posterior approaches. Participants undergoing a transgluteal approach were less likely to be a college graduate, currently working, and more likely to have one or more comorbidities. Participants undergoing a posterior THA were generally younger than participants undergoing the other approaches.

Patient-Reported Outcomes

Compared to baseline scores, we observed statistically significant and clinically important improvements in mean patient-reported function, physical health, and pain at 6 months within each approach cohort (Fig. 2). For example, by 6 months, the mean adjusted HOOS Jr improved by 37.8 (95% confidence interval [CI], 36.8–38.8) in the posterior cohort, 35.9 (95% CI, 34.3–37.6) in the transgluteal cohort, and 37.2 (95% CI, 35.9–38.5) in the anterior cohort (Table 2).

At 1 month, mean adjusted HOOS Jr score improved by 28.3 points (95% CI, 27.4–29.3) in the posterior cohort and by 26.1 points (95% CI, 24.6–27.7) in the transgluteal cohort, a 2.2-point smaller improvement for the transgluteal cohort (95% CI, 0.40–4.06; $P = .017$). These

slight differences persisted at 3 and 6 months, although the observed differences at 6 months were not statistically significant. Similarly, PROMIS-PH score improvement at 1 month was 1.3 points less (95% CI, 0.48–2.04; $P = .002$) in the transgluteal cohort compared to the posterior cohort. No significant between-group differences were observed in NPRS improvement. No significant differences were observed in the anterior cohort compared to the posterior cohort in any adjusted PRO measure at any time point (Appendix B).

At 6 months, 95.9% of our study cohort achieved a MCID in HOOS Jr, 78.7% achieved MCID in PROMIS-PH scores, and 80.1% achieved MCID in NPRS scores after THA compared to their preoperative values, irrespective of surgical approach. There were no significant differences in the proportion of participants who achieved MCID in each measure based on surgical approach (Fig. 3).

To ensure that nonresponse had no effect on our results, we performed additional "sensitivity" analyses by limiting our analysis to the subset of participants who had passed through the 6-month follow-up window with or without completing the 6-month follow-up survey and separately for those who had completed the 6-month follow-up survey. These subanalyses (not shown) did not differ from the primary analysis.

Discharge Disposition

Following surgery, routine discharge to home or home health agency was greater in the posterior (93.0%) and anterior groups (94.1%) compared to the transgluteal group (86.6%; χ-squared comparison: $P \leq .001$; Appendix C).

Discussion

Our analysis of prospectively collected outcomes from 3018 patients who underwent THA enrolled at 26 medical centers demonstrated substantial but similar improvements in patient-reported function, global health, and pain in each of the 3 main categories of surgical approach. Collecting follow-up data at 1 month allowed for assessment of early recovery, and patients undergoing transgluteal approaches reported a decreased rate of home discharge and experienced lesser improvements in early PROs.

Proponents of anterior approaches point to evidence of better implant positioning [30,31], fewer postoperative dislocations [32,33], increased frequency of home discharge [34], less narcotic use [31,34,35], and reduced length of stay [31,34,36,37], when compared to other approaches. However, others have found higher complications or blood loss when using anterior approaches [36,38,39]. Thus, there is no clear consensus in the literature concerning the ideal surgical approach to THA. While previous comparisons between posterior, transgluteal, and anterior approaches have produced varied results, many are consistent with our findings of no significant differences in patient-reported function and pain [7,36,40–48]. Rosenlund et al [49] found no difference in improvement in HOOS at 3-, 6-, and 12-month follow-up after randomization to transgluteal or posterior approaches. Similarly, Zomar et al [50] found no difference in patient-reported pain or function at 2, 6, and 12weeks after surgery in a randomized trial comparing anterior and transgluteal approaches. Restrepo et al [45] reported that anterior approaches were associated with improved Western Ontario and

McMaster Universities Osteoarthritis Index scores 1 year postoperatively compared to transgluteal approaches in a randomized trial, but there were no differences at 2 years. Other studies suggest that anterior approaches result in better immediate functional and pain recovery in comparison to the transgluteal and posterior approaches [7,11,37,41,44–46,51–54], which we may not have captured given that our first follow-up window fell at 1 month postoperatively.

This study has several limitations. First, although our data are prospectively collected and statistically controlled, our study is nonrandomized with respect to surgical approaches. The choice of surgical approach was left to the discretion of the surgeon which may introduce confounding. We cannot account for surgeon experience, preferences, or training. Given the individual variation in more specific approach by surgeon, the classification into 3 broad categories might not fully capture the detail in technique used for each case, especially given the pragmatic nature of the PEPPER trial, where perioperative protocols are not specified. Follow-up rates for PRO collection were high; nevertheless, the impact of those lost to follow-up is not fully known. We did not assess outcomes in the immediate postoperative period (before 30 days) or longer term (beyond 6 months). This study includes a broad patient population, and further studies are necessary to understand more subtle differences between outcomes that may exist in the case of particular diagnoses or patient characteristics. Due to the ongoing nature of the PEPPER study, primary safety outcomes like readmission or complications are suppressed until the end of the study and could not be included in this analysis. The comparisons of discharge disposition are potentially biased due to possible concordance of surgical techniques and established discharge pathways at specific hospitals. Finally, data from this study were collected at medical centers with well-developed research infrastructures, which may limit the generalizability of the findings to various practices in the broader orthopedic community.

Conclusions

This study reports similar improvement in PROs at 1, 3, and 6 months after THA using a posterior, transgluteal, or anterior surgical approaches. Likewise, a similar proportion of patients achieved a MCID in all outcomes measured across the approach cohorts. Further studies are necessary to assess longer-term outcomes. Nevertheless, compared to posterior and anterior approaches, transgluteal approaches had a statistically smaller early improvement in function and physical health, no difference in the proportion of patients achieving MCID, and a lower rate of home discharge. Based on our reporting of PROs, the choice of surgical approach for THA remains appropriately determined through patient-provider discussion of patient preferences and the technical expertise of the surgeon.

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Collaborators:

The PEPPER Trial Investigators.

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Appendix A

PEPPER and Approach Cohort Enrollment Criteria.

Inclusion Criteria

- Age 21 or older.
- Undergoing elective primary hip arthroplasty.
- Mental capacity to participate and able to comply with study protocols.
- Able to be randomized to at least 2 of the 3 study prophylaxis regimens.
- Negative pregnancy test on day of surgery or other criteria (ie, sex or reproductive potential) to ensure patient is not pregnant.
- Informed consent.
- Willing to be randomized and to participate.
- Surgeon confirmed eligibility.

Exclusion Criteria

- Revision or second-stage reimplantation total hip surgery, or hip resurfacing arthroplasty.
- Bilateral hip replacement.
- Previously enrolled in PEPPER.
- Pregnant or breastfeeding.
- Chronic (>6 mo) anticoagulation other than with antiplatelet medications.
- Currently enrolled in another active interventional clinical trial testing a drug or intervention known or believed to interact with aspirin, warfarin, or rivaroxaban.
- Documented gastrointestinal, cerebral, or other hemorrhage within 3 months of surgery.
- Known history of defective hemostasis and clinical bleeding requiring transfusion and treatment.
- Undergone operative procedure involving eye, ear, or central nervous system within 1 month of the surgery.
- Severe uncontrolled hypertension with systolic blood pressure greater than 220 mmHg or diastolic blood pressure greater than 120 mmHg.
- Weight less than 41 kg (90.4 pounds).
- Vulnerable patient population, including prisoners and institutionalized individuals.

PEPPER, Comparative Effectiveness of Pulmonary Embolism Prevention After Hip and Knee Replacement.

Appendix B

Regression Models for Total Hip Arthroplasty.

Covariates	HOOS		PROMIS-PH		NPRS	
	β	*P*	*β*	*P*	*β*	*P*
Surgical approach (ref = posterior)	0		0		0	
Transgluteal	1.7	.040[a]	0.9	.051	−0.1	.316
Anterior	0.3	.661	0.2	.636	−0.1	.405
Follow-up (ref = baseline)	0		0		0	
1 mo	28.3	.000[c]	7.7	.000[c]	−4.1	.000[c]
3 mo	35	.000[c]	10.1	.000[c]	−4.4	.000[c]
6 mo	37.8	.000[c]	10.9	.000[c]	−4.5	.000[c]
Approach interaction (ref = posterior)	0		0		0	
Transgluteal, 1 mo	−2.2	.01[a]	−1.3	.002[b]	0.2	.125
3 mo	−1.9	.048[a]	−0.7	.081	0.1	.455
6 mo	−1.8	.063	−1.0	.026[a]	0.1	.514
Anterior, 1 mo	−0.8	.331	−0.1	.679	0.2	.073
3 mo	−0.8	.346	0.1	.679	0.1	.397
6 mo	−0.5	.508	0.2	.558	0	.71
Year	0.1	.000[c]	0	.001[b]	−0.0	.002[b]
Sex (ref = male)	0		0		0	
female	−1.5	.000[c]	−1.4	.000[c]	0.2	.000[c]
Body mass index	−0.1	.033[a]	−0.2	.000[c]	0	.102
Race (ref = white)	0		0		0	
Black	−3.7	.000[c]	−1.2	.001[c]	0.7	.000[c]
Other or multiple	−0.2	.887	0.2	.8	0	.935
Hispanic (ref = No)	0		0		0	
Yes	−5.9	.000[c]	−1.6	.057	0.7	.001[b]
Education (ref = less than college)	0		0		0	
College or higher	2.1	.000[c]	0.8	.000[c]	−0.3	.000[c]
Work status (ref = working)	0		0		0	
Unemployed	−0.2	.901	−1.8	.043[a]	0.2	.35
Sick or disabled	−5.9	.000[c]	−5.0	.000[c]	0.9	.000[c]
Student, homemaker, retired	−0.8	.138	−0.9	.002[b]	0	.633
Alcohol use (ref = never)	0		0		0	
Monthly or less	0.9	.139	0.5	.082	−0.2	.010[b]
2–4 Times a month	0.7	.271	1	.006[b]	−0.1	.174
2–3 Times a week	1.2	.078	1.7	.000[c]	−0.2	.009[b]
≥4 Times a week	2	.004[b]	1.8	.000[c]	−0.4	.000[c]
Smoking status (ref = never)	0		0		0	
Current	−5.7	.000[c]	−2.9	.000[c]	0.7	.000[c]
Former	−2.3	.000[c]	−1.4	.000[c]	0.2	.000[c]
Comorbidity (ref = no)	0		0		0	
COPD	−2.3	.028[a]	−2.0	.000[c]	0.4	.007[b]

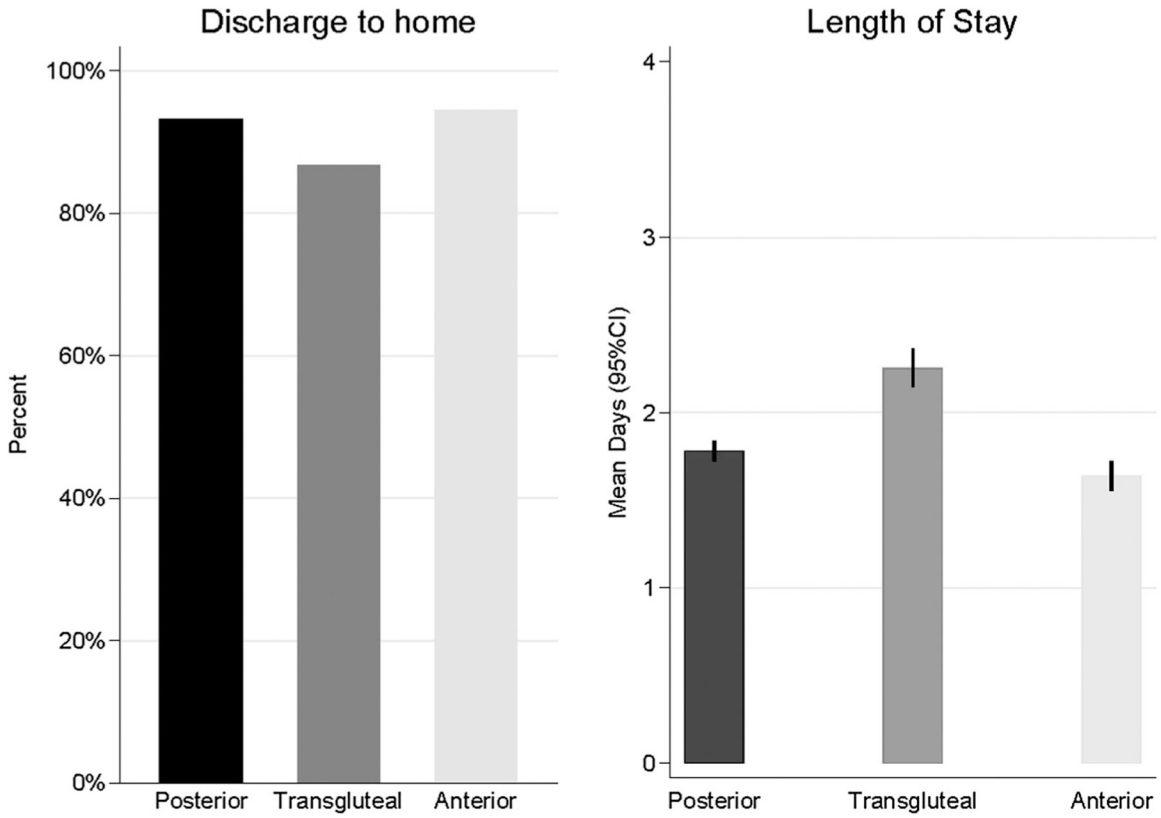
Covariates	HOOS		PROMIS-PH		NPRS	
	β	P	β	P	β	P
Paralysis	−1.2	.663	0.9	.527	−0.7	.049[a]
Heart attack	−0.3	.805	−1.4	.020[a]	0	.945
Carotid artery disease	−3.5	.097	−1.6	.174	0.1	.703
Stroke	−1.9	.177	−2.0	.008[b]	0.3	.145
Rheumatoid arthritis	−2.5	.001[c]	−2.4	.000[c]	0.4	.000[c]
Diabetes	−0.7	.282	−1.0	.004[b]	0.1	.211
Cancer	0.8	.305	−0.2	.585	−0.2	.018[a]
Liver disease	−1.2	.457	−0.6	.459	0.1	.711
Peripheral vascular disease	−0.2	.927	0.3	.713	−0.2	.361
Kidney disease	−2.0	.116	−2.3	.001[b]	0.3	.094
Ulcer disease	−4.3	.005[b]	−1.8	.024[a]	0.8	.000[c]
HIV or AIDS	3.7	.042[a]	1.8	.074	−0.1	.7
Constant	46.4	.000[c]	45.6	.000[c]	6.1	.000[c]
Variance parameters						
Center (se)	1.1	−.66	0.4	−.23	0.06	−.023
Participant (se)	67.8	−3.26	24.9	−.91	1.03	−.06
Residual (se)	137	−2.54	26.6	−.47	2.91	−.05

Based on multivariable mixed effects regression with robust standard errors clustering for observations within individual patients and patients nested within hospitals. HOOS Jr, the brief Hip disability and Osteoarthritis Outcomes Score; PROMIS-PH, Patient-Reported Outcomes Measurement Information System Physical Health Summary; NPRS, Numeric Pain Rating Scale; ref, reference; COPD, chronic obstructive pulmonary disease; HIV, human immunodeficiency virus; AIDS, acquired immune deficiency syndrome.

[a] $P < .05$.

[b] <0.01.

[c] <0.001.



Appendix C.
Length of Stay and Discharge Disposition for Hip Cohort. CI, confidence interval.

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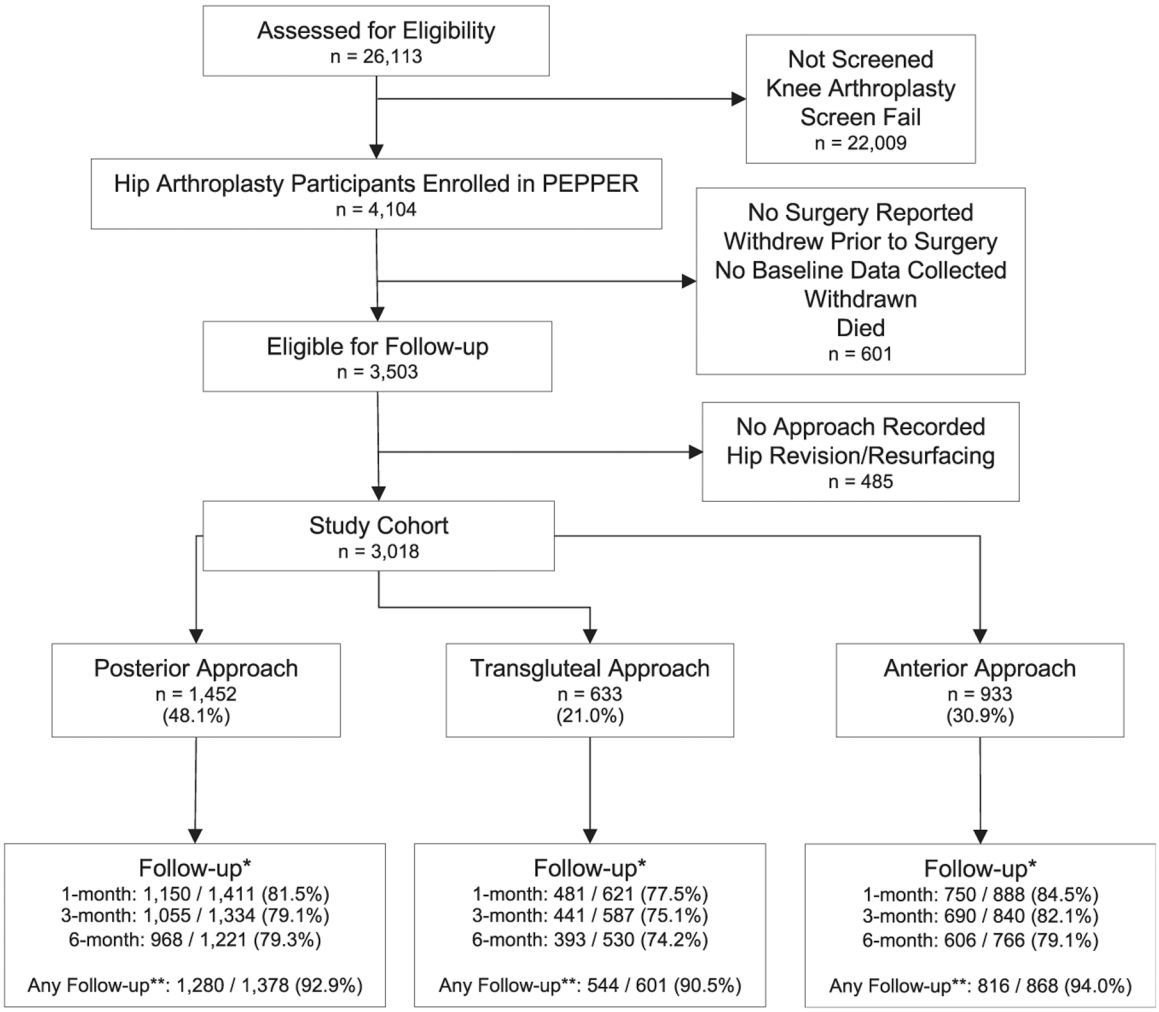

Fig. 1.

Study cohort selection. * Specific time point follow-up rates were calculated using the following formula:

$$\frac{\#\,participants\ completing\ specified\ survey}{\#\ participants\ completing\ specified\ survey\ +\ \#\ participants\ passed\ through\ window\ without\ completing\ survey}$$

**Any follow-up was calculated using the following formula:

$$\frac{\#\,participants\ completing\ any\ survey}{\#\ participants\ completing\ any\ survey\ +\ \#\ participants\ passed\ through\ 6\ month\ window\ without\ completing\ survey}$$

PEPPER, Comparative Effectiveness of Pulmonary Embolism Prevention After Hip and Knee Replacement.

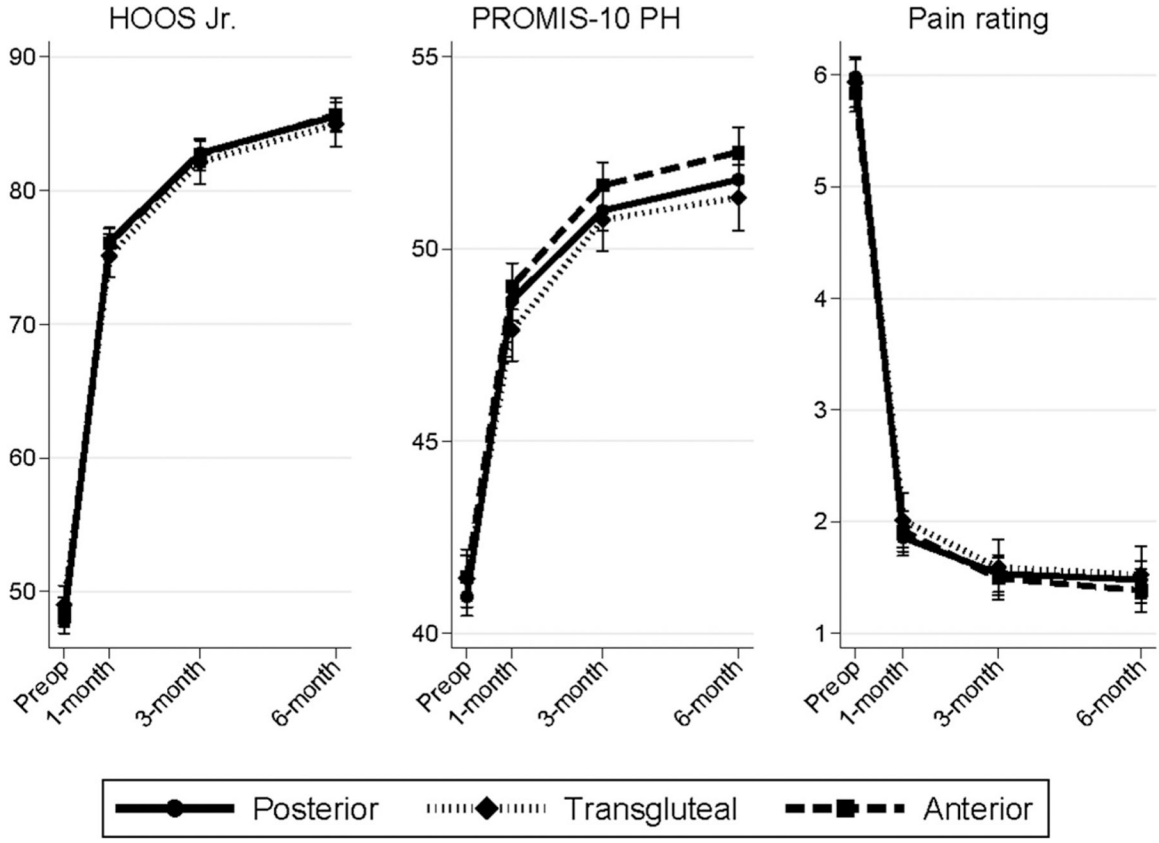

Fig. 2.

Patient-reported outcomes following total hip arthroplasty. Estimates are adjusted for age, sex, race, ethnicity, education, work status, alcohol use, smoking, and comorbidity. Preop, preoperative; HOOS Jr, the brief Hip disability and Osteoarthritis Outcome Score; PROMIS-PH, Patient-Reported Outcomes Measurement Information System Physical Health Summary; NPRS, Numeric Pain Rating Scale.

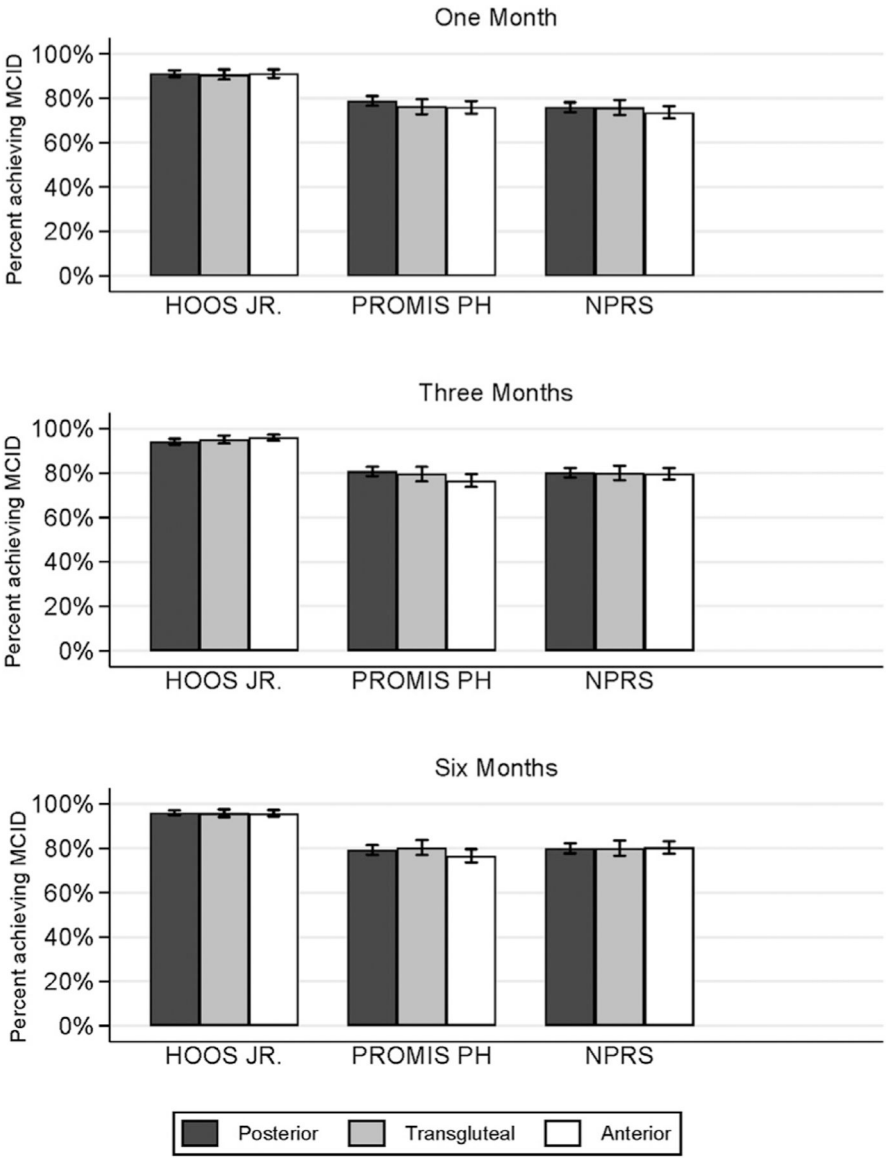

Fig. 3.

Proportion of participants achieving MCID at 1, 3, and 6 months. Calculated using unadjusted differences in each PRO between baseline and given month. MCID, minimum clinically important difference; PRO, patient-reported outcome.

Table 1

Participant Demographics.

Baseline Characteristic	Posterior	Transgluteal	Anterior	All	*P* Value[a]
N (% of total)	1452 (48.1)	633 (20.1)	933 (30.9)	3017	
Age					
Age (mean)	60.7	62.1	62.1	61.4	.004
BMI					
BMI (mean)	30.9	31.3	29.8	30.6	<.001
Sex					
Male (%)	48.1	35.5	48.1	45.5	<.001
Female (%)	51.9	64.5	51.9	54.5	
Race					
White (%)	82.5	76.2	86.9	82.6	<.001
Black (%)	12.9	22.2	10.1	14.0	
Other/multiple (%)	4.6	1.6	3.0	3.5	
Ethnicity					
Not Hispanic (%)	97.6	97.4	99.0	98.0	<.025
Hispanic or Latino (%)	2.4	2.6	1.0	2.0	
Education					
Less than college (%)	54.5	62.1	52.4	55.5	<.001
College graduate (%)	45.5	37.9	47.6	44.5	
Work					
Working (%)	43.7	38.2	44.6	42.8	.003
Unemployed looking (%)	2.4	0.8	1.3	1.7	
Sick of leave or disability (%)	19.4	18.8	16.9	18.5	
Student, homemaker, retired (%)	34.4	41.4	37.1	36.7	
Alcohol					
Never (%)	31.0	30.5	25.8	29.3	.007
Monthly or less (%)	24.0	25.9	21.9	23.8	
2–4 Times a mo (%)	15.2	16.4	16.1	15.7	
2–3 Times a wk (%)	15.4	16.1	19.5	16.8	

Baseline Characteristic	Posterior	Transgluteal	Anterior	All	*P* Value[a]
≥4 Times a wk (%)	15.3	11.7	17.1	15.1	
Smoke					
Never (%)	53.4	52.8	47.5	51.5	.025
Current (%)	6.7	8.7	8.6	7.7	
Former (%)	39.8	38.4	43.9	40.8	
Comorbidity count					.009
0 (%)	66.1	59.5	65.3	64.5	
1 (%)	25.1	37.5	23.7	25.2	
2+ (%)	8.8	13.0	11.0	10.3	

BMI, body mass index.

[a]Significance testing based on χ-square comparisons for categorical variables and analysis of variance for continuous variables.

Table 2

Unadjusted and Adjusted Mean Patient-Reported Outcomes.

Total Hip Arthroplasty			Posterior			Transgluteal			Anterior		
			N	Mean	95% CI	N	Mean	95% CI	N	Mean	95% CI
HOOS Jr	Unadjusted	Baseline	1435	47.4	15.6–73.5	609	48.3	20.8–73.5	911	48	20.8–70.4
		1 mo	1044	76.7	53.0–100	420	75.7	53.0–100	695	76.5	53.0–100
		3 mo	1000	83.3	58.9–100	418	82.6	58.9–100	659	83.2	56.0–100
		6 mo	930	86.3	58.9–100	371	84.9	58.9–100	582	86.3	58.9–100
	Adjusted	Baseline	1404	47.8	46.9–48.7	562	49.0	47.6–50.4	886	48.5	47.4–49.5
		1 mo	1404	76.2	75.1–77.2	562	75.1	73.5–76.7	886	76.0	74.9–77.2
		3 mo	1404	82.8	81.8–83.8	562	82.1	80.5–83.8	886	82.7	81.5–83.9
		6 mo	1404	85.6	84.5–86.6	562	85.0	83.3–86.6	886	85.7	84.4–86.9
PROMIS-PH	Unadjusted	Baseline	1446	40.8	29.6–54.1	627	40.8	29.6–54.1	929	41.2	29.6–54.1
		1 mo	1128	49.0	34.9–61.9	473	47.6	34.9–61.9	735	49.4	37.4–61.9
		3 mo	1029	51.4	37.4–67.7	432	50.8	37.4–61.9	682	52.0	37.4–67.7
		6 mo	951	52.0	37.4–67.7	384	51.1	34.9–67.7	593	52.9	37.4–67.7
	Adjusted	Baseline	1414	41.0	40.5–41.4	581	41.4	40.7–42.2	901	41.5	40.9–42.0
		1 mo	1414	48.7	48.1–49.2	581	47.9	47.1–48.7	901	49.0	48.4–49.6
		3 mo	1414	51	50.4–51.5	581	50.8	49.9–51.6	901	51.7	51.0–52.3
		6 mo	1414	51.8	51.2–52.4	581	51.3	50.5–52.2	901	52.5	51.9–53.2
NPRS	Unadjusted	Baseline	1452	6.0	1.0–10.0	633	6.1	1.0–10.0	933	5.9	2.0–10.0
		1 mo	1142	1.9	0.0–6.0	480	1.9	0.0–6.5	743	1.9	0.0–6.0
		3 mo	1048	1.4	0.0–6.0	440	1.5	0.0–6.0	686	1.4	0.0–5.0
		6 mo	961	1.5	0.0–6.0	389	1.4	0.0–6.0	603	1.3	0.0–5.0
	Adjusted	Baseline	1419	6.0	5.8–6.1	585	5.9	5.7–6.2	905	5.8	5.7–6.0
		1 mo	1419	1.9	1.7–2.0	585	2.0	1.8–2.3	905	2.0	1.7–2.1
		3 mo	1419	1.5	1.4–1.7	585	1.6	1.3–1.8	905	1.5	1.3–1.7
		6 mo	1419	1.5	1.3–1.6	585	1.5	1.3–1.8	905	1.4	1.2–1.6

Missing surveys or surveys with missing responses were dropped from the unadjusted data. Adjusted scores include imputed values to account for survey and individual survey item missingness.

CI, confidence interval; HOOS Jr, the brief Hip disability and Osteoarthritis Outcome Score; PROMIS-PH, Patient-Reported Outcomes Measurement Information System Physical Health Summary; NPRS; Numeric Pain Rating Scale.