The Journal of Arthroplasty 30 (2015) 419–434

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Anterior vs. Posterior Approach for Total Hip Arthroplasty, a Systematic Review and Meta-analysis

Brendan T. Higgins, MD, MS [a,b], Daniel R. Barlow, MS [b,c], Nathan E. Heagerty, MPH [b], Tim J. Lin, MD, MS [a,b]

[a] Department of Orthopaedic Surgery, Dartmouth Hitchcock Medical Center, Lebanon, New Hampshire
[b] The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, New Hampshire
[c] Geisel School of Medicine at Dartmouth, Hanover, New Hampshire

ARTICLE INFO

Article history:
Received 26 August 2014
Accepted 13 October 2014

Keywords:
total hip arthroplasty
patient reported outcomes
anterior
posterior
approach

ABSTRACT

The objective of this study is to compare the clinical, radiographic and surgical outcomes among patients undergoing primary THA performed via the anterior versus posterior approach. We searched numerous sources and eventually included 17 studies, totaling 2302 participants. In terms of post-operative pain and function, the anterior approach was significantly favored in 4 studies at short-term follow-up. Pooled estimates showed a significant difference in favor of the anterior approach in terms of length of stay and dislocations. Current evidence comparing outcomes following anterior versus posterior THA does not demonstrate clear superiority of either approach. Until more rigorous, randomized evidence is available, we recommend choice of surgical approach for THA be based on patient characteristics, surgeon experience and surgeon and patient preference.

Total hip arthroplasty (THA) has been shown to be a cost-effective treatment for osteoarthritis of the hip and offers patients relief of pain, improved function and substantial improvement in quality of life [1–3]. Driven by the aging of the United States population, the demand for THA is expected to grow exponentially in the next two decades. Kurtz et al noted a 50% increase in the prevalence of THA from 1990 to 2002 [4] and projected a 174% increase, in THA from 208,600 in 2005 to 572,000 in 2030 [5].

There are several surgical approaches that are used in primary THA. Currently, the posterior approach is the most common approach utilized in the United States [6]. Recently, however, there has been increased interest in the anterior (Hueter) approach for THA in the orthopedic community and public due the belief that the intermuscular anterior approach may result in decreased pain, faster recovery, improved hip stability and decreased risk of dislocation following surgery when compared to the more commonly used, muscle-splitting, posterior approach. In addition, since the patient is placed supine on the operating table, the anterior approach allows the use of fluoroscopic image intensification allowing intraoperative assessment and correction of component positioning which may permit more accurate final component position. Preliminary series of patients who have undergone THA using the anterior approach have suggested decreased narcotic consumption, decreased length of hospital stay, decreased 30-day readmission, higher percent discharged to home vs. rehabilitation facility, earlier independent mobilization and improved radiographic component positioning [7–10]. However, others suggest that it is not the surgical approach, but rather factors such as patient selection, patient and family education, accelerated rehabilitation and improved analgesia protocols that play a more important role in influencing THA outcomes [11–13]. As of this time, we are unaware of any published systematic reviews comparing the efficacy of the anterior versus posterior approach to THA.

With the projected rise in demand for THA and its economic implications, it is of the utmost importance to maximize the delivery of efficient and valuable care. Clearly, improvements in THA technique that reduce length of stay, hasten the return of joint function and improve patient comfort would likely have a positive impact on the cost-effectiveness of THA, and may reduce the cost of the procedure to the healthcare system. Conversely, alterations in the surgical technique that cause increased technical difficulty or require specialized equipment without providing benefit or lead to increased rates of complications or revisions, would likely have a negative impact on cost-effectiveness. The purpose of this study was to systematically review the available evidence to compare clinical and surgical outcomes among patients undergoing primary THA performed by the anterior versus posterior approach.

Materials and Methods

Prior to beginning the review, we wrote a protocol outlining our search strategy, inclusion criteria, and outcomes of interest. We conducted the review using standard methodology outlined in the Cochrane Handbook [14] and reported the findings in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.10.020.
Reprint requests: Brendan T. Higgins, MD, MS.

http://dx.doi.org/10.1016/j.arth.2014.10.020
0883-5403/

Analyses (PRISMA) statement guidelines [15]. Any modifications to the original protocol were tracked and can be found in Appendix A. Published studies were included in the analysis if: (1) the design was a comparative study; (2) patients underwent primary total hip arthroplasty; (3) one group received single-incision, anterior approach THA; (4) another group received posterior approach THA; and (5) at least one quantifiable pre-specified outcome measure was reported. Appendix B contains further details of each criterion.

We pre-specified the primary outcome of interest as validated, patient reported outcome measures focusing on pain and function following THA. Accepted Validated Patient Reported Outcome Measures included: Harris Hip Score (HHS) [16], Medical Outcome Study (SF-12 [17] or SF-36 [18]), Visual Analog Pain Scale (VAS) [19], Hip Outcome Score (HOS) [20], Western Ontario & McMasters University Arthritis Index (WOMAC) [21], Hip disability and Osteoarthritis Outcome Score (HOOS) [22], Merle d'Aubigne and Postel score [23], UCLA Activity Scale [24], Oxford Hip Score (OHS) [25], and Japanese Orthopedic Association Hip Score (JOAHS) [26]. Secondary outcome measures included intra-operative, post-operative and radiographic comparisons. Appendix C contains further details of each outcome measure.

Working with a professional librarian in February 2014, we conducted a literature search of Medline (PubMed), the Cochrane Library, and CINAHL. We used exploded MeSH terms and key words to generate sets for the following themes: Total Hip Arthroplasty and Surgical Approach. We then used the Boolean term "AND" to find their intersection. No limits were used, including no language limits. This basic approach was modified as necessary to search each electronic database. To identify additional studies and unpublished data we searched for registered trials on ClinicalTrials.gov and reviewed the "Adult Hip" abstracts from the annual meetings of the American Academy of Orthopaedic Surgeons (AAOS) for the past 2 years (2012–2013) and all abstracts from the American Association of Hip & Knee Surgeons (AAHKS) for the past 5 years (2008–2012). Additionally, we reviewed the reference lists of all included studies and contacted subject-matter experts in the field of THA. See Appendix D for complete search strategy and results.

Two reviewers divided the results from our literature search and conducted an independent initial review for eligibility based on title and abstract. Studies that were clearly not related to our research question were immediately excluded. The remaining studies were then divided among all four reviewers such that two reviewers independently assessed each to confirm final eligibility. We developed and piloted a standardized form for collecting data related to study methodology, participant characteristics, and outcomes of interest. All four reviewers were involved in data collection such that two reviewers independently extracted data from each study. See Appendix E for variables captured in the data collection form. Seven studies were missing relevant data [27–33]. We contacted those authors and were able to acquire missing data from all but one study [30]. We excluded this study from any component of our analysis for which it provided insufficient data. When studies provided data with standard error (SE) we converted to standard deviation (SD) via the formula $SD = SE \times \sqrt{n}$.

Due to the variability in design of our included studies (randomized trials, prospective comparison studies and retrospective comparison studies), we incorporated elements of validated tools—the Cochrane Risk for Bias Assessment Tool [34], the Newcastle-Ottawa Tool [35] and the ECRI Before–After Assessment Tool [36] into a single methodological quality assessment tool. Each included study was independently reviewed for methodological rigor by two separate authors. See Appendix F for our risk of bias assessment tool. For all above methods, any disagreements were resolved by consensus reached through discussion with all four authors.

Data Analysis and Synthesis

As anticipated, we found substantial variability in the design and outcome measures of our included studies. Our primary outcome—measures of patient-reported pain and function—was assessed using a wide range of outcome measures at various follow-up periods and reported in a variety of formats. As a result, we have provided a qualitative synthesis by reviewing the direction, magnitude and statistical significance of each of the contributing study findings to arrive at a final determination of which arm, if either, was favored. For secondary outcomes amenable to meta-analysis, we used RevMan 5.2 to calculate pooled summary estimates and generate forest plots [37]. For continuous variables of length of stay, operative time and estimated blood loss we utilized random effect models to calculate weighted mean differences (WMD) and 95% confidence intervals (CI). Due to the rare occurrence and similar number of patients in each arm of our two dichotomous variables—post-operative dislocations and intra-operative fractures, we utilized Peto fixed effect odds ratios and 95% CI [14]. For outcomes regarding percentages of patients discharged to home and percentage of acetabular cups placed within the Lewinnek safe zone we used random effect models to calculate relative risk (RR) and 95% CI. For secondary outcomes that could not be pooled quantitatively—gait analysis, post-operative markers of inflammation and muscle damage, and post-operative narcotic consumption, we provided a qualitative summary of the general trends we observed based on the reported findings.

Source of Funding

No external or internal funds were received in the conduct of this review. The authors of this study have no disclosures or conflicts of interest to report.

Results

Study Selection

Of the 998 unique records identified by our database searches, 869 were excluded based on title and abstract review, and two were excluded due to inability to translate or obtain full text [38,39]. An additional 110 were excluded based on full text review leaving 17 studies that met all inclusion criteria [27–33,40–49]. Fig. 1 details the study selection flow.

Appendix G presents the characteristics of the 17 studies included in this review—two randomized control trials, five prospective comparative studies and ten retrospective comparative studies. All were published in peer-reviewed journals between 2006 and June 2014. Ten studies were conducted in the United States, three in the Netherlands, three in Japan and one in Switzerland. A total of 2302 individuals were studied, among whom 980 underwent an anterior approach, 1129 a posterior approach, and there were 193 controls utilized. Two studies [31,49] utilized patients in a "learning curve" period of the anterior approach as controls, we have excluded those patients from our analysis. The study sizes ranged from 20 to 675 patients. Mean age ranged from 55.1 to 69 years. There was a statistically significant difference in patient age between approaches in two studies [41,43]. Patient gender varied substantially among studies. In particular, the three studies from Japan [28,42,47] all had less than 16% male participation. There was also a statistically significant difference in gender (67% of patients in the anterior group were male as opposed to only 43% of patients in the posterior group) in the RCT by Barrett et al [27]. Mean body mass index (BMI) ranged from 21.0 to 34.1 kg/m^2. There was a statistically significant difference in BMI in three studies [30,33,41]. Duration of follow-up ranged from immediate post-operatively in studies assessing markers of inflammation and muscle damage to 12–24 months in studies assessing clinical outcomes. A wide variety of patient reported and objective outcome measures were utilized. Appendix H provides additional details of each included study and an assessment of its Level of Evidence rating [50].

Primary Outcome—Patient Reported Measures of Pain and Function

As shown in Table 1, nine studies provided data on patient reported pain and function outcomes [27,29,32,33,41,42,44,47,49]. Measures and