Arthroplasty Today 6 (2020) 1033–1037

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original research

The Effect of Travel Distance on Outcomes for Hip Resurfacing Arthroplasty at a High-Volume Center

Tony S. Shen, MD [a,*], Patawut Bovonratwet, MD [a], Rachelle Morgenstern, MPH [a], Aaron Z. Chen, BA [b], Edwin P. Su, MD [a]

[a] *Adult Reconstruction and Joint Replacement Service, Hospital for Special Surgery, New York, NY, USA*
[b] *Weill Cornell Medical College, New York, NY, USA*

ARTICLE INFO

Article history:
Received 23 July 2020
Received in revised form
5 October 2020
Accepted 17 October 2020
Available online 24 November 2020

Keywords:
Hip resurfacing
Minimal clinically important difference
Patient-reported outcome measures
Travel distance
High-volume
Arthroplasty

ABSTRACT

Background: Patients are increasingly traveling greater distances to receive care at high-volume centers. The effect of travel distance on patient-reported outcomes after hip resurfacing arthroplasty has not been described.

Methods: Patients undergoing HRA by a single surgeon from January 2007 to April 2018 with minimum 2-year follow-up were reviewed retrospectively. Five hundred ninety-nine patients were identified and divided into 2 cohorts: home-to-hospital distance >100 miles and ≤100 miles from our institution. Preoperative and 2-year postoperative patient-reported outcome measures (PROMs) were assessed, including the modified Harris Hip Score and Hip disability and Osteoarthritis Outcome Score. The minimal clinically important difference (MCID) for each PROM was calculated using the distribution-based method. Chi-square tests were used for univariate comparison. Poisson regressions controlling for demographic variables were performed to determine the effect of travel distance on whether patients achieved the MCID. Multivariate linear regressions were used to determine association between distance and improvement in PROMs.

Results: A total of 599 patients met criteria for inclusion. There were 113 (18.9%) with a home-to-hospital distance >100 miles and 486 (81.1%) with distance ≤100 miles. Age was the only demographic factor different between these groups (mean: 1.1-year difference, $P < .001$). There were no significant differences in reaching the MCID on any PROM between these groups. Multivariate linear regressions revealed no associations between travel distance and improvement in PROMs.

Conclusions: Travel distance to a high-volume center did not affect 2-year patient-reported outcomes or rate of achieving the MCID in patients undergoing hip resurfacing arthroplasty.

Introduction

Recently, healthcare reform in the United States has focused on improving the quality of care while concurrently reducing overall costs [1,2]. To achieve this goal, healthcare policy experts have advocated for the development and increased utilization of centers of excellence or care institutions that meet evidence-based quality criteria, including high volume, physician training, and staff ratios [3]. With respect to joint replacement surgery and in line with these developments in healthcare reform, patients are increasingly electing to have their joint replacement performed at such high-volume centers [4]. As a result, the number of joint replacements performed at high-volume surgical centers, defined as greater than 400 arthroplasties annually, rose from 29% to 66% of total arthroplasties from 2000 to 2012 [4]. Moreover, several studies have demonstrated that having a joint replacement at a high-volume center improves overall outcomes and decreases healthcare costs when compared with low-volume sites [2,5,6].

Certain patients who may not have a high-volume surgical center nearby are faced with a decision about whether to travel the greater distance to have their procedure performed at a high-volume institution. Increased travel distance may be associated with difficulty with follow-up or with attending rehabilitation

* Corresponding author. 535 East 70th Street, New York, NY 10021, USA. Tel.: +1 630 696 5805.
E-mail address: shent@hss.edu

https://doi.org/10.1016/j.artd.2020.10.005

sessions. In addition, there may also be inherent differences between local and referral patients that may also have an impact on their outcomes. Thus, recent studies have focused on the effect of travel distance on postoperative surgical outcomes but have demonstrated conflicting results. In patients undergoing surgical resection for gastrointestinal cancer, those traveling a greater distance had a lower 90-day and 5-year mortality [7]. However, in a separate study, patients living further from a tertiary care center had an increased risk of postoperative complication after a general surgery procedure compared with those closer by [8]. In the orthopaedic surgery literature, the results have been more consistent as several studies have demonstrated that travel distance has no effect on both short-term and long-term postoperative outcomes in patients undergoing total joint arthroplasty and hip arthroscopy [9-11]. No study, however, has examined the impact of travel distance on outcomes after hip resurfacing arthroplasty (HRA).

HRA, an alternative to conventional total hip arthroplasty, typically attracts a younger patient population looking to engage in high-impact activities after surgery [12,13]. Advantages of HRA compared with total hip arthroplasty include preservation of the proximal femoral bone stock and lower rates of postoperative dislocation, while disadvantages include the generation of metal debris and the potential for early revision owing to the use of a metal-on-metal implant [12,13]. While both have similar indications, some studies suggest differences in the complication rate and patient-reported outcomes between the 2 procedures [12,14,15].

Thus, with the increasing utilization of high-volume joint replacement centers for patients undergoing HRA, we sought to determine the impact of increasing travel distance on 2-year patient-reported outcomes after HRA. We hypothesize that there is no statistically significant difference in postoperative outcomes for patients traveling greater than 100 miles to our high-volume orthopaedic specialist hospital than for patients traveling less than 100 miles.

Material and methods

Patient population

The available medical records for patients who underwent HRA by a single surgeon from January 2007 to April 2018 were retrospectively reviewed. Patients who underwent primary HRA during the study period with minimum 2-year follow-up were included in the study. Exclusion criteria included patients with missing demographic information, patients without a documented home address, and patients without preoperative patient-reported outcome measures (PROMs). Approval from the institutional review board was obtained. No funding was used for this study.

Surgical technique

All surgeries were performed by a single fellowship-trained surgeon at a high-volume academic center using the Birmingham Hip Resurfacing as the standard implant. A standard well-described operative technique utilizing the posterolateral approach was used in all cases [16-18]. Briefly, the surgery was performed with the patient in the lateral position. A posterolateral incision was used. The gluteus maximus tendon was released as needed to aid in exposure and repaired at the end of the case. The plane between the gluteus minimus and capsule was developed. The piriformis, short external rotators, obturator externus, and quadratus femoris were released, tagged, and eventually repaired at the end of the case. A circumferential capsulotomy was used to expose and mobilize the femoral head starting with an L-shaped posterior capsulotomy. Acetabular exposure was facilitated by retracting the femoral head under the gluteus minimus as well as placement of additional retractors. The acetabulum was sequentially reamed, followed by placement of a trial cup, followed by impaction of the acetabular component. The femoral head was then prepared using standard Birmingham Hip Resurfacing instrumentation. The appropriate femoral component was then cemented in place. The capsule was repaired, followed by repair of the piriformis, short external rotators, and quadratus femoris. Postoperatively, both the local and referral groups received the same initial rehabilitation protocol and venous thromboembolism prophylaxis. Upon discharge, patients who were expecting a flight longer than 3 hours were given one dose of enoxaparin.

Patient-reported outcome measures

The modified Harris Hip Score (mHHS) and Hip disability and Osteoarthritis Outcome Score (HOOS) were used as the primary outcomes for this study. All patients completed preoperative and postoperative questionnaires at minimum 2-year follow-up. The Harris Hip Score was initially designed as a 100-point instrument with questions regarding function, pain deformity, and range of motion [19]. The mHHS includes only the function and pain sections, which is then scaled to 100 points [20]. The HOOS was developed as a hip-specific instrument using components of the Western Ontario and McMaster Universities Osteoarthritis Index and Knee injury and Osteoarthritis Outcome Score [20,21]. This instrument has been validated in patients undergoing hip surgery with high internal consistency [22,23].

To further characterize the clinical significance of changes as measured on these PROMs, the minimal clinically important difference (MCID) was determined for each instrument. The distribution-based method, as previously described in the literature, was used in this study [9,24,25]. Briefly, the threshold for achieving the MCID for each instrument was determined by calculating the change in outcome equal to 0.5 standard deviation over a 2-year period. We considered any patient who met this threshold at 2-year follow-up to have reached the MCID. The minimum sample size required to detect the MCID between the local and referral groups was calculated to be 56 (80% power, $\alpha = 0.05$).

Measuring geographic distance

The home address of each patient was extracted to a database. Using the geocoding function built into SAS®, version 9.4 (SAS Institute Inc., Cary, NC), the corresponding geographic coordinates were determined. The travel distance between the patient's home coordinates and the coordinates for our institution was then calculated [26]. A threshold of 100 miles was selected, as this distance was previously used in a study from our institution [10]. A parallel analysis using a threshold of 50 miles was also performed to assess for any differences between these 2 distance thresholds (Appendix 1).

Statistical analysis

All statistical analysis was performed using Stata®, version 13 (StataCorp, LLC, College Station, TX). The first set of statistical analyses involved unadjusted comparisons between the referral and local groups for preoperative characteristics, preoperative and postoperative PROMs, and whether the patient achieved the MCID in these PROMs at 2-year follow-up. Pearson's chi-square tests were used for categorical variables, and Student's *t*-tests were used for continuous variables. The second set of statistical analyses involved Poisson regressions with robust error variance that controlled for demographic variables found to be statistically different in Table 1 [27]. This was used to determine the effect of home-to-hospital distance on whether patients achieved the MCID in either the mHHS or HOOS. Finally, multivariate linear regressions controlling for demographic variables found to be statistically different in Table 1 were used to assess for associations between the home-to-hospital distance and improvement in PROMs at 2-year follow-up.

Results

A total of 599 patients who underwent primary hip resurfacing arthroplasty were included in the study. There were 486 (81.1%) patients in the local group with home-to-hospital distance less than or equal to 100 miles. The referral group, with home-to-hospital distance greater than 100 miles, had 113 (18.9%) patients. The average home-to-hospital distance was 980.0 miles for the referral group and 27.1 miles for the local group. Demographic information for these 2 groups is found in Table 1. Age was the only demographic factor with a statistically significant difference between groups (mean: 1.1-year difference, $P < .001$).

There were no statistically significant differences in preoperative and 2-year postoperative PROMs between the local and referral groups ($P > .05$ for all, Table 2). The mean change in the mHHS was 34.5 for the referral group and 33.7 for the local group. The mean change in the HOOS was 40.5 for the referral group and 37.8 for the local group. Multivariate linear regressions revealed no associations between home-to-hospital distance and improvement in PROMs (Figs. 1 and 2).

There were no statistically significant differences between the local and referral groups in the rate of achieving the MCID on either PROM ($P > .05$, Table 3). The overall rate of achieving the MCID was greater than 95% for all PROMs in both groups. The differences remained nonsignificant after controlling for the difference in age using Poisson regression. In our parallel analysis using 50 miles as the threshold between the local and referral groups, there were also no differences in preoperative and postoperative PROMs or rate of achieving the MCID after controlling for demographic factors (Supplemental Tables 1-3 and Supplemental Figures 1 and 2).

Table 1
Preoperative characteristics of the study population.

Total	Patient groups				P-value[a]
	Referral (>100 miles)		Local (≤100 miles)		
	Number = 113		Number = 486		
Age (y)	Average: 55.6 ± 11.8		Average: 54.5 ± 10.7		**<.001**
<55	45	39.82%	219	45.06%	
55-64	38	33.63%	210	43.21%	
≥65	30	26.55%	57	11.73%	
Gender					0.381
Male	90	79.65%	404	83.13%	
Female	23	20.35%	82	16.87%	
BMI (kg/m^2)	Average: 26.1 ± 4.4		Average: 28.9 ± 16.8		.216
18-25	39	34.51%	156	32.10%	
25-30	58	51.33%	222	45.68%	
30-35	13	11.50%	74	15.23%	
>35	3	2.65%	34	7.00%	
Distance (miles)	Average: 980.0 ± 931.8		Average: 27.1 ± 19.6		**<.001**

BMI, body mass index.
Bolding indicates statistical significance.
[a] Chi-squared tests or Student's t-tests were used to compare these variables (significant at $P < .05$).

Table 2
Preoperative and 2-y postoperative functional scores by distance group.

	Patient groups		P-value[a]
	Referral (>100 miles)	Local (≤100 miles)	
Preoperative			
mHHS	Average: 60.1 ± 12.5	Average: 60.8 ± 12.3	.628
HOOS	Average: 57.2 ± 13.6	Average: 57.5 ± 14.8	.383
Postoperative			
mHHS	Average: 94.6 ± 8.5	Average: 94.5 ± 9.0	.936
HOOS	Average: 97.7 ± 5.6	Average: 95.3 ± 10.1	.062

[a] Student's t-tests were used to compare these variables (significant at $P < .05$).

Discusssion

Given the focus of healthcare reform on value-based care and the increasing utilization of high-volume joint replacement centers, it has become crucial to evaluate the impact of travel distance on clinical outcomes after surgical procedures at these sites. We analyze 599 HRAs performed by a single surgeon at our high-volume orthopaedic specialist hospital. In doing so, we determine that travel distance has no effect on 2-year patient-reported outcome scores, including the mHHS and HOOS, or the rate of achieving the MCID.

Our results are consistent with those of previous studies in the orthopaedic surgery literature that have thus far shown that travel distance has no effect on clinical outcomes. In a single-institution study of 38,887 total joint arthroplasties, Nwachukwu et al. demonstrated that travel distance had no effect on the development of short-term complications including medical complications, readmission, and reoperation [10]. Similarly, in a study of 22,614 total knee arthroplasties performed at a separate tertiary referral center, Maradit Kremers et al. stratified patients into 5 groups based on travel distance [11]. They noted that patients traveling a greater distance had different baseline demographics and clinical characteristics compared with local patients, as the former tended to be younger, male, have a lower body mass index, and more likely to have had previous surgeries on the same knee [11]. However, they determined that there were no differences in complication rate and revision rate between groups at a mean follow-up of 7.6 years [11]. While these studies examined overall complications, a recent study explored the impact of travel distance on patient-reported outcome measures in the field of sports medicine. Beck et al. stratified 647 patients undergoing hip arthroscopy into those traveling greater than and less than 50 miles to their high-volume surgical center [9]. In addition to noting that there were no differences in baseline demographics between the groups, they also determined that both groups had similar 2-year patient-reported outcome scores [9].

Our finding that there were no differences in patient-reported outcomes at 2 years among patients that traveled greater than and less than 100 miles for their HRA supports the rationale behind the increasing utilization of high-volume joint replacement centers. In general, the literature has demonstrated that high-volume joint replacement centers provide better outcomes and reduce overall costs compared with low-volume centers [2,5,6]. In an analysis of more than 2 million total joint arthroplasties from 1991 to 2006, Dy et al. [5] determined that the complication rate was lower in patients who had their procedure performed at a high-volume hospital, defined as performing more than 200 joint arthroplasties per year. Similarly, Courtney et al. [2] demonstrated that high-volume hospitals performing more than 100 arthroplasties a year had not only a

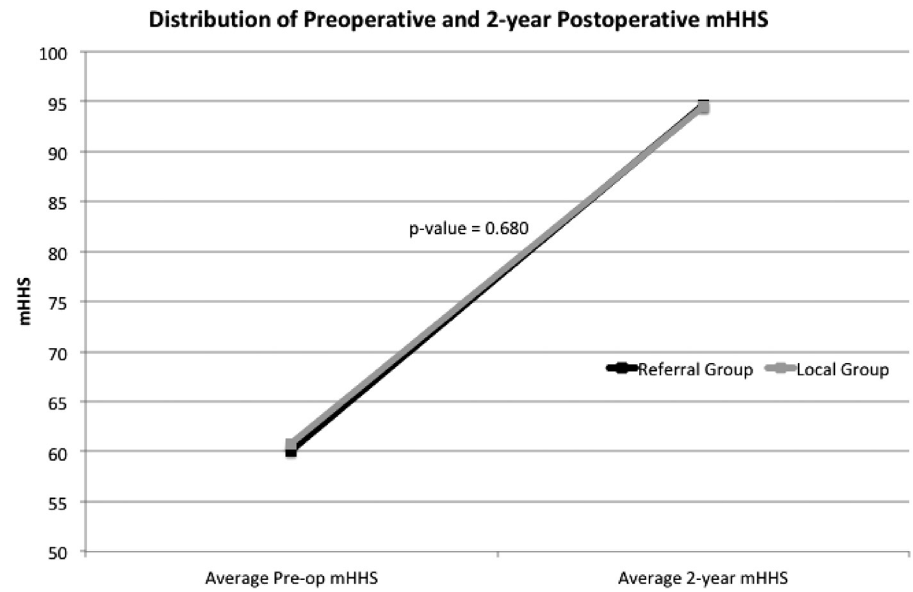


Figure 1. Distribution of preoperative and 2-y postoperative mHHS.

lower complication score but also lower mean hospital-specific charges and Medicare inpatient payments. In a separate study, Jeschke et al. [6] showed using a retrospective database that patients undergoing total knee arthroplasty at a hospital with greater than 252 cases per year had a lower 2-year revision risk. Altogether, these findings have led authors to conclude either that patients should be referred to a high-volume joint replacement center or that low-volume centers should adopt similar protocols and policies as their counterparts [2,5,6].

With respect to hospital volume on outcomes after HRA, the literature is mixed. In a series of 3076 HRAs performed at their specialist hospital, Matharu et al. [28] demonstrated a lower rate of postoperative femoral neck fracture than that reported by other institutions. They attribute the improved performance to their high volume of cases [16]. Despite this finding, in a retrospective study of 5098 HRAs, Seppänen et al. noted that status as a high-volume hospital (>100 arthroplasties per year) had no effect on overall 10-year revision rate [29]. However, it is unclear as to why the number 100 arthroplasties per year was chosen as the threshold for high-volume hospital status, and it is entirely plausible that an alternative threshold would have shown significant differences [29]. Nonetheless, although there is a need for additional studies that compare the outcomes after HRA between high- and low-volume centers, our results show that there is no difference in outcomes in patients who travel from farther distances to our specialist hospital compared with those who live closer even after controlling for baseline demographics such as age. We thus argue that distance traveled should not be a limitation to seeking care for patients undergoing HRA.

Our study has several notable limitations. First, owing to the nature of our institutional database, additional clinical data such as infection rate, readmissions, or other complications were not

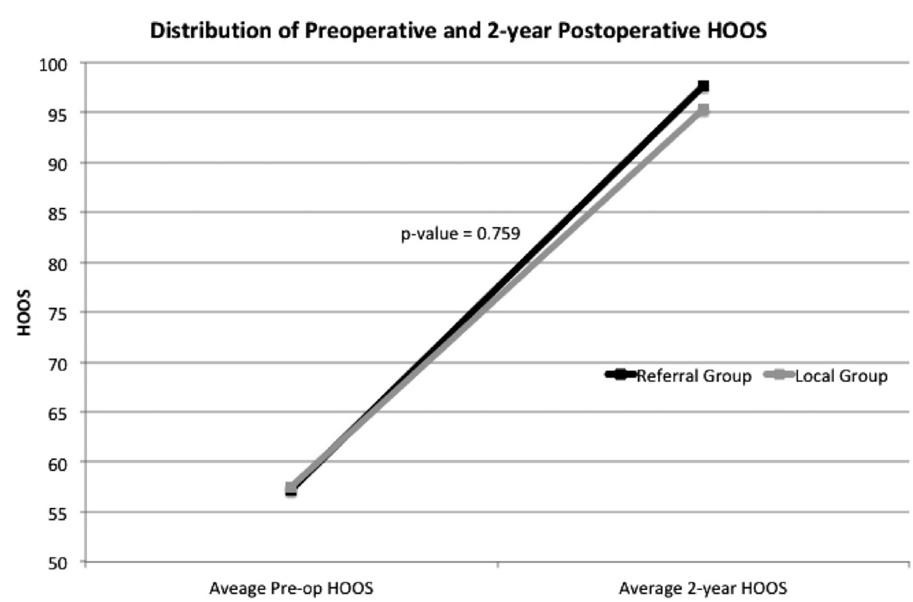


Figure 2. Distribution of preoperative and 2-y postoperative HOOS.

Table 3
Chi-square analysis of patients who achieved the MCID by distance group.

	Patient groups				P-value[a]
	Referral (>100 miles)		Local (≤100 miles)		
Achieved MCID for mHHS					0.443
Yes	80	97.56%	383	95.75%	
No	2	2.44%	17	4.25%	
Achieved MCID for HOOS					.457
Yes	68	98.55%	283	96.92%	
No	1	1.45%	9	3.08%	

[a] Chi-squared tests were used to compare these variables (significant at $P < .05$).

available. Although a review of other complications associated with increased travel distance is outside the scope of this article, this information would have nonetheless been of interest. As the entirety of the HRA procedures were performed by a single surgeon at a single high-volume orthopaedic institution in a large metropolitan area, our results may not be generalizable to the entirety of patients undergoing HRA. This limitation may hold especially true at rural, lower-volume centers. However, this study design has its strengths in that it eliminates the variation between different surgeons and maintains consistency among postoperative rehabilitation protocols, both of which lend additional validity to our conclusions. Furthermore, the distance of one hundred miles was chosen based on the specific characteristics of our hospital's metropolitan area and is thus not a validated distance. While Beck et al. chose 50 miles as the distance threshold in their study of hip arthroscopies, the previous study examining travel distance on outcomes after total joint arthroplasty by Nwachukwu et al. was performed at the same institution as ours and also used a 100-mile radius [9,10].

Conclusions

We found that travel distance to a high-volume surgical center did not affect 2-year patient-reported outcomes or rate of achieving the MCID in patients undergoing HRA after controlling for age, gender, and body mass index. This finding is consistent with those of previous investigations on the impact of travel distance on outcomes after hip arthroscopy and total joint arthroplasty [9,10].

Conflict of interest

E.P. Su reports receiving royalties from Kyocera Corporation, OrthAligh, and United Orthopedic Corporation; is a paid consultant for Smith & Nephew and United Orthopedic Corporation; holds stock in Engage Uni and Insight Medicl Systems, Inc; receives research support for being a principal investigator from Smith & Nephew and United Orthopedic Corporation; receives other financial or material support from Engage Uni (designer, inventor, and founder) and Kyocera Corporation (designer and receives royalties); is a member of the medical/orthopaedic publications editorial/governing board of Techniques in Orthopedics (Wolters Kluwer); the other authors declare no potential conflicts of interest.

References

[1] Bozic KJ. What's important: preparing for the transition to value-based health care: an American orthopaedic association (AOA) 2016 OrthoTalk. J Bone Jt Surg Am 2017;99:1150.
[2] Courtney PM, Frisch NB, Bohl DD, Della Valle CJ. Improving value in total hip and knee arthroplasty: the role of high volume hospitals. J Arthroplasty 2018;33:1.
[3] Mehrotra A, Sloss EM, Hussey PS, Adams JL, Lovejoy S, Soohoo NF. Evaluation of centers of excellence program for knee and hip replacement. Med Care 2013;51:28.
[4] Laucis NC, Chowdhury M, Dasgupta A, Bhattacharyya T. Trend toward high-volume hospitals and the influence on complications in knee and hip arthroplasty. J Bone Joint Surg Am 2016;98:707.
[5] Dy CJ, Marx RG, Ghomrawi HMK, Pan TJ, Westrich GH, Lyman S. The potential influence of regionalization strategies on delivery of care for elective total joint arthroplasty. J Arthroplasty 2015;30:1.
[6] Jeschke E, Citak M, Günster C, et al. Are TKAs performed in high-volume hospitals less likely to Undergo revision than TKAs performed in low-volume hospitals? Clin Orthop Relat Res 2017;475:2669.
[7] Wasif N, Chang YH, Pockaj BA, Gray RJ, Mathur A, Etzioni D. Association of distance traveled for surgery with short- and long-term cancer outcomes. Ann Surg Oncol 2016;23:3444.
[8] Etzioni DA, Fowl RJ, Wasif N, Donohue JH, Cima RR. Distance bias and surgical outcomes. Med Care 2013;51:238.
[9] Beck EC, Nwachukwu BU, Lee EK, et al. Travel distance does not affect outcomes in hip preservation surgery: a case for centers of excellence. Orthop J Sport Med 2020;8:1.
[10] Nwachukwu BU, Dy CJ, Burket JC, Padgett DE, Lyman S. Risk for complication after total joint arthroplasty at a center of excellence: the impact of patient travel distance. J Arthroplasty 2015;30:1058.
[11] Maradit Kremers H, Salduz A, Schleck CD, Larson DR, Berry DJ, Lewallen DG. Referral bias in primary total knee arthroplasty: retrospective analysis of 22,614 surgeries in a tertiary referral center. J Arthroplasty 2017;32:390.
[12] Calkins TE, Suleiman LI, Culvern C, et al. Hip resurfacing arthroplasty and total hip arthroplasty in the same patient: which do they prefer? Hip Int 2019. 1120700019882922.
[13] Sershon R, Balkissoon R, Valle CJ. Current indications for hip resurfacing arthroplasty in 2016. Curr Rev Musculoskelet Med 2016;9:84.
[14] Marshall DA, Pykerman K, Werle J, et al. Hip resurfacing versus total hip arthroplasty: a systematic review comparing standardized outcomes. Clin Orthop Relat Res 2014;472:2217.
[15] Oxblom A, Hedlund H, Nemes S, Brismar H, Fellander-Tsai L, Rolfson O. Patient-reported outcomes in hip resurfacing versus conventional total hip arthroplasty: a register-based matched cohort study of 726 patients. Acta Orthop 2019;90:318.
[16] Treacy RBC, McBryde CW, Pynsent PB. Birmingham hip resurfacing arthroplasty. J Bone Joint Surg Br 2005;87-B:167.
[17] Treacy RBC, McBryde CW, Shears E, Pynsent PB. Birmingham hip resurfacing. J Bone Joint Surg Br 2011;93-B:27.
[18] Amanatullah DF, Cheung Y, Di Cesare PE. Hip resurfacing arthroplasty: a review of the evidence for surgical technique, outcome, and complications. Orthop Clin North Am 2010;41:263.
[19] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969;51:737.
[20] Ramisetty N, Kwon Y, Mohtadi N. Patient-reported outcome measures for hip preservation surgery-a systematic review of the literature. J Hip Preserv Surg 2015;2:15.
[21] Klässbo M, Larsson E, Mannevik E. Hip disability and osteoarthritis outcome scoreAn extension of the Western Ontario and McMaster Universities osteoarthritis Index. Scand J Rheumatol 2003;32:46.
[22] Kempegowda H, Maniar HH, Richard R, et al. Posterior malleolar fractures associated with tibial shaft fractures and sequence of fixation. J Orthop Trauma 2016;30:568.
[23] Nilsdotter AK, Lohmander S, Klässbo M, Roos EM. Hip disability and osteoarthritis outcome score (HOOS)-validity and responsiveness in total hip replacement. BMC Musculoskeletal Disorders 2003. Accessed June 13, 2020.
[24] Katz NP, Paillard FC, Ekman E. Determining the clinical importance of treatment benefits for interventions for painful orthopedic conditions. J Orthop Surg Res 2015;10:24.
[25] Levy DM, Cvetanovich GL, Kuhns BD, Greenberg MJ, Alter JM, Nho SJ. Hip arthroscopy for Atypical posterior hip pain: a comparative matched-pair analysis. Am J Sports Med 2017;45:1627.
[26] O'Day J. Distances : let SAS® do the heavy lifting. Sas® Glob Forum 2017;2017:1.
[27] Bovonratwet P, Fu MC, Adrados M, Ondeck NT, Su EP, Grauer JN. Unlike native hip fractures, delay to periprosthetic hip fracture stabilization does not significantly affect most short-term perioperative outcomes. J Arthroplasty 2019;34:564.
[28] Matharu GS, McBryde CW, Revell MP, Pynsent PB. Femoral neck fracture after Birmingham Hip Resurfacing Arthroplasty: prevalence, time to fracture, and outcome after revision. J Arthroplast 2013;28:147.
[29] Seppänen M, Karvonen M, Virolainen P, et al. Poor 10-year survivorship of hip resurfacing arthroplasty. Acta Orthop 2016;87:554.

Appendix

Table 1
Preoperative characteristics of the study population.

Total	Patient groups				P-value[a]
	Referral		Local		
	Number = 162		Number = 437		
Age (y)	Average: 54.6 ± 11.8		Average: 54.7 ± 10.5		**0.006**
<55	71	43.83%	193	44.16%	
55-64	*56*	*34.57%*	*192*	*43.94%*	
≥65	35	21.60%	52	11.90%	
Gender					**.020**
Male	124	76.54%	370	84.67%	
Female	38	23.46%	67	15.33%	
BMI (kg/m^2)	Average: 26.4 ± 4.8		Average: 29.1 ± 17.6		0.138
18-25	54	33.33%	141	32.27%	
25-30	*81*	*50.00%*	*199*	*45.54%*	
30-35	23	14.20%	64	14.65%	
>35	4	2.47%	33	7.55%	
Distance (miles)	Average: 704.5 ± 883.2		Average: 22.4 ± 13.4		**<0.001**

BMI, body mass index.
Bolding indicates statistical significance.
Italic rows are the median group.
[a] Chi-squared tests or Student's *t*-tests were used to compare these variables (significant at $P < .05$).

Table 2
Preoperative and 2-y postoperative functional scores by distance group.

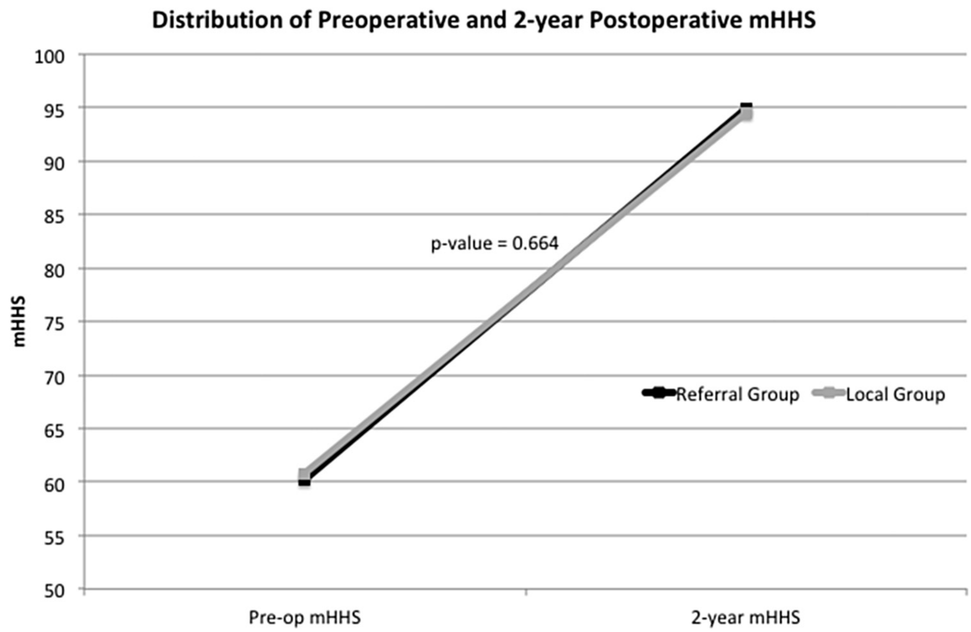
	Patient groups		P-value[a]
	Referral	Local	
Preoperative			
mHHS	Average: 60.2 ± 12.0	Average: 60.8 ± 12.5	.653
HOOS	Average: 58.2 ± 13.4	Average: 57.7 ± 15.0	.765
Postoperative			
mHHS	Average: 94.9 ± 8.4	Average: 94.5 ± 9.1	.662
HOOS	Average: 97.4 ± 7.1	Average: 95.2 ± 10.0	.056

Underlined rows are the median group.
[a] Student's *t*-tests were used to compare these variables (significant at $P < .05$).

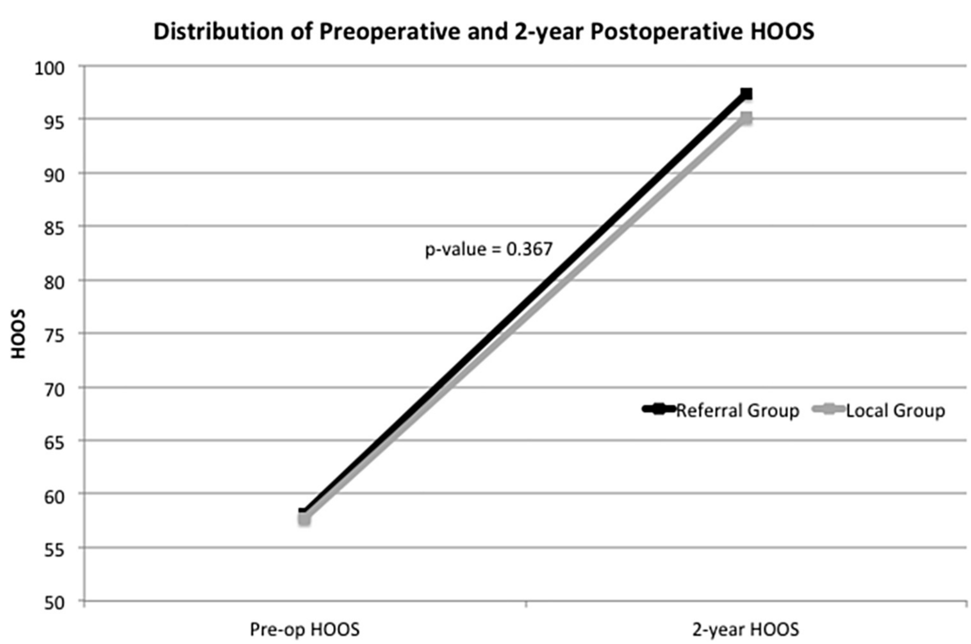
Table 3
Chi-square analysis of patients who achieved the MCID by distance group.

	Patient groups				P-value[a]
	Referral		Local		
Achieved MCID for mHHS					0.330
Yes	119	97.54%	344	95.56%	
No	3	2.46%	16	4.44%	
Achieved MCID for HOOS					.261
Yes	90	98.90%	261	96.67%	
No	1	1.10%	9	3.33%	

[a] Chi-squared tests were used to compare these variables (significant at $P < .05$).



Supplementary Figure 1. Distribution of preoperative and two-year postoperative mHHS.



Supplementary Figure 2. Distribution of preoperative and two-year postoperative HOOS.