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Does Obesity Affect Outcomes in Hip Arthroscopy?

A Matched-Pair Controlled Study With Minimum 2-Year Follow-up

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Background: Hip arthroscopy has gained popularity over the past decade, and its indications have broadened as newer techniques have been developed. However, there has been a paucity of literature evaluating the outcomes of hip arthroscopy in obese patients.

Purpose: To compare 2-year clinical outcomes of obese patients undergoing primary hip arthroscopy with matched nonobese controls.

Study Design: Cohort study; Level of evidence, 3.

Methods: From February 2008 to February 2012, data were collected prospectively on all obese patients undergoing primary hip arthroscopy. A matched-pair nonobese control group was selected at a 1:2 ratio. All patients were assessed pre- and postoperatively with 4 patient-reported outcome (PRO) measures: the modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score–Activities of Daily Living, and Hip Outcome Score–Sport Specific Subscale. Pain was estimated on the visual analog scale, and satisfaction was measured on a scale from 0 to 10.

Results: Sixty-two hips (62 patients) were included in the obese group and 124 hips (124 patients) in the control group. At preoperative baseline, the obese group had significantly lower PRO scores when compared with the control group. Both groups demonstrated statistically significant postoperative improvement in all scores ($P < .05$). Absolute scores were significantly lower in the obese group for all PRO measures, pre- and postoperatively. However, the improvement (delta) in PRO scores from pre- to postoperative time was not significantly different between groups. The rate of conversion to total hip arthroplasty, the rate of revision, and the complication rate were not significantly different between the 2 groups; however, rates of conversion to total hip arthroplasty and revision tended to be twice as high in the obese patients, but the study was not powered for these 2 outcomes.

Conclusion: Overall, obese patients had lower absolute PRO scores preoperatively and at 2-year follow-up. Both obese and nonobese patients demonstrated significant improvement in all PRO scores, and the change in scores were similar between groups. These results indicate that while obese patients may not have similar absolute scores after hip arthroscopy, they may show similar gains in improvement when compared with baseline. Hip arthroscopy appears to be a viable treatment option in the obese patient as long as expectations are adjusted accordingly.

Keywords: hip arthroscopy; obesity; overweight; femoroacetabular impingement; hip preservation

Worldwide obesity has nearly doubled since 1980, and overweight and obesity are the fifth-leading risk for global deaths.[34] In 2005, the United States spent an estimated $190 billion on obesity-related health care expenses[2]; this can be considered one of the direct costs of obesity. Indirect costs include the fact that obese employees miss more work days because of short-term absences, long-term disability, and premature death than do nonobese patients.[4] Several investigators have evaluated the cost of obesity on an individual level. Finkelstein et al[9] found in 2006 that per capita medical spending for obese individuals was an additional $1429 (42% higher) when compared with nonobese individuals. Thompson et al[27] concluded that over the course of a lifetime, per-person costs for obesity were similar to those for smoking.

Body mass index (BMI) is used to classify overweight and obese adults. Healthy weight is defined as a BMI of 18.5 to 24.9, and obesity is defined as BMI $\geq$30. Note that BMI does not account for the wide variation in body fat distribution and may not correspond to the same degree of fatness and associated health risks in different

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individuals and populations.[26] Obesity presents a challenging problem in orthopaedics, as studies have shown that obesity results in a 2-fold increased risk of surgical site infections.[35] Poorer postoperative outcomes have been associated with obesity in a variety of orthopaedic surgeries.[16,30] Harrison et al[11] found that obese patients had worse physical functioning on Short Form–36 when compared with nonobese patients after arthroscopic debridement of the knee or partial meniscectomy. In the setting of anterior cruciate ligament reconstruction surgery, obesity has been shown to have poorer outcomes.[6,10,12,17] While the majority of literature has focused on outcomes after arthroscopy in the knee and shoulder, there has been a paucity of studies focused on hip arthroscopy in the obese patient.

The purpose of this study was to compare 2-year clinical outcomes of obese patients undergoing primary hip arthroscopy to those of a matched control group of patients with healthy weight. Primary hip arthroscopy was defined as those patients who have not undergone prior hip arthroscopy in the affected hip. We hypothesized that obese patients who underwent primary hip arthroscopy would have similar outcomes to the control group of patients.

MATERIALS AND METHODS

During the study period, February 2008 to February 2012, data were collected prospectively on all patients undergoing primary hip arthroscopy by the senior surgeon (B.G.D.). Patients who met inclusion criteria underwent primary hip arthroscopy during the study period and had a minimum 2-year follow-up with radiographs and patient-reported outcome (PRO) scores. Exclusion criteria were revision surgeries, Tönnis grade >1, and previous hip conditions, such as Legg-Calves-Perthes disease, avascular necrosis, and prior surgical intervention. The PRO scores—the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS),[3] Hip Outcome Score–Activities of Daily Living (HOS-ADL), and Hip Outcome Score–Sport Specific Subscale (HOS-SSS)—were collected preoperatively and at the 3-month, 1-year, and 2-year follow-ups. All 4 questionnaires were used, as it has been reported that there is no conclusive evidence for the use of a single PRO questionnaire for patients undergoing hip arthroscopy.[19,28] Pain was estimated on a visual analog scale (VAS) from 0 to 10 (10 being the worst), and satisfaction was based on the question "How satisfied are you with your surgery results?" (1 = not at all, 10 = the best it could be). Groups were divided according to BMI: <25 (nonobese control group) and ≥ 30 (obese group). The matched-pair control group was selected on a 1:2 ratio (obese:nonobese) on the basis of matching criteria: patient sex, age within 5 y, Tönnis grade 0 or 1, crossover percentage <20 or >20, workers' compensation claim, and labral procedure.

Statistical Analysis

To determine the necessary power for our study, an a priori power analysis was performed. A previously published study estimated that a clinically significant difference between groups for mHHS would be 6.0, with a standard deviation of 8.0 for the preoperative group.[18] Based on our a priori power analysis, to obtain a power of 0.80 or higher with a ratio of 1:2, we need a minimum of 22 hips in the obese group and 44 hips in the control group. A 2-tailed paired *t* test assessed differences between preoperative and postoperative scores for the individual groups. The independent *t* test compared the mean change in PRO scores from preoperative to postoperative time between the obese and matched-pair control groups. A *P* value $<.05$ was considered significant. Statistical analysis was performed with Microsoft Excel 2007 (Microsoft Corp) and IBM SPSS 12.0 for Windows (SPSS Inc).

Plain radiographs included an anteroposterior pelvic view, Dunn view, cross-table lateral view, and false-profile view.[5,20,29] Measurements were made from these views, including the Tönnis angle (acetabular inclination angle) based on the method described in Jessel et al,[15] the lateral center-edge angle of Wiberg,[33] joint space at its lowest point,[29] ischial prominence size in millimeters,[32] crossover sign,[13,24,32] alpha angle (Dunn view),[1] and offset in millimeters.[7] The alpha angle was measured on the Dunn view according to the method described by Notzli for magnetic resonance imaging and modified by Meyer.[5,20,21] Cam impingement was defined as an alpha angle $>60°$. Hips that were classified as having pincer impingement had a crossover sign, coxa profunda, or protrusion acetabula. The crossover sign size was quantified according to its percentage from the superior edge of the acetabulum; for instance, crossover at the middle of the acetabulum was quantified at 50%. The same orthopaedic surgeon (B.G.D.) made all the measurements using a picture archiving and computer system. All radiographs were evaluated for arthritis and graded with Tönnis classification of osteoarthritis.[29] Magnetic resonance imaging was obtained in all patients to evaluate for labral and articular cartilage injuries. Acetabular cartilage damage and labral tears were classified intraoperatively. Cartilage damage was

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TABLE 1
Demographics for Obese and Control Groups[a]

Variable	Control Group (n = 124)	Obese Group (n = 62)	*P* Value
Female sex, No. (%)	90 (72.6)	45 (72.6)	.999
Body mass index, mean (range)	22.7 (17.7-25)	33.1 (30.1-48.71)	**<.001**
Age, y, mean (range)	41.9 (17-65)	42 (17-61)	.95
Traction time, min, mean	57.7	64.5	.12
Follow-up time, y, mean	2.5	2.7	.19
Right hip, No.	63	37	.25

[a]Bolding represents statistically significant differences between groups ($P < .05$).

classified according to the Outerbridge and Acetabular Labrum Articular Disruption classification systems.[22]

Surgical Technique

All hip arthroscopies were performed by the senior author (B.G.D.) at a tertiary referral center dedicated to hip preservation. All surgeries were performed in the modified supine position with a minimum of 2 portals (standard anterolateral and midanterior).[21-23] After establishment of portals and capsulotomy, a diagnostic arthroscopy was performed.

Bony lesions were corrected under fluoroscopic guidance. Acetabuloplasty was performed for pincer impingement, and femoral neck osteoplasty was performed for cam impingement. Labral tears were repaired when indicated or selectively debrided until a stable labrum was achieved while preserving as much labrum as possible. If there was full-thickness cartilage damage present, a microfracture was performed according to the technique of Steadman et al.[25]

Rehabilitation Protocol

For the first 2 weeks, the patients were placed in a hip brace with limited range of motion from 0° to 90° of flexion at all times. Patients were limited to 20-lb flat-foot weightbearing with crutches for a minimum of 2 weeks. All patients start physical therapy on the first postoperative day to initiate range of motion. This was accomplished by 4 hours per day using a continuous passive motion machine or 2 hours per day on a stationary bike. Two weeks postoperatively, the brace was discontinued with emphasis on range of motion exercises.

RESULTS

During the study period, there were 87 patients in the obese group and 364 patients in the control group who met our inclusion criteria. After using our matching criteria with a 1:2 ratio (obese:control), we had 62 patients in the obese group and 124 patients in the control group. The majority of the patients were female (72.6%). The average age was 42 years (range, 17-62) in the obese group and 41.9 (range, 17-65) in the control group. The mean BMI in the control group was 22.7 ± 3.54 kg/m^2 and 33.1 ± 5.09 kg/m^2 in the obese group. Table 1 presents the demographics for both groups. Table 2 presents preoperative physical examination findings. Obese patients had significantly lower flexion and internal rotation ($P < .05$) when compared with controls. Table 3 presents preoperative radiographic measurements of both groups. There were not significant differences with regard to preoperative radiographic measurements between both groups. Table 4 presents preoperative diagnoses, which were not significantly different. Table 5 describes all concomitant procedures performed for the obese group. According to the matching criteria described above, 124 patients were allocated to the control group. Surgical procedures performed in the control group are presented in Table 5. All patients undergoing hip arthroscopy had a capsular repair, unless there is an indication for a capsular release, such as stiffness in the hip. The obese group had a significantly higher rate of capsular release and synovectomy. The baseline preoperative PRO scores were all significantly lower for the obese group. Mean preoperative scores for both groups are presented in Table 6.

In the obese group, the score improvement from preoperative time to 2-year follow-up was 53.5 ± 13.1 to 74.5 ± 20.7 for mHHS, 45.7 ± 18.9 to 69.5 ± 21.7 for NAHS, 51.9 ± 20 to 70.3 ± 23.9 for HOS-ADL, and 25.4 ± 22.3 to 55.5 ±32.4 for HOS-SSS. In the control group, the score improvement from preoperative time to 2-year follow-up was 63.3 ± 15.2 to 81.4 ± 18.4 for mHHS, 60.6 ± 17.7 to 81.7 ± 16 for NAHS, 66.3 ± 17.3 to 84.7 ± 17.4 for HOS-ADL, and 42 ± 24.2 to 71.4 ± 27.1 for HOS-SSS. All improvements in both groups were statistically significant at the 2-year postoperative follow-up ($P < .001$) (Table 7). When the change in PRO scores (delta) was compared from preoperative time to 2-year follow-up, there was no significant difference between the obese group and the control group.

Mean preoperative VAS pain score was significantly higher for the obese group. Both groups had a significant improvement in VAS scores at the 2-year postoperative visit; however, VAS scores were not significantly different between groups (Figure 1). Postoperative patient satisfaction at the 2-year time interval was 7.57 ± 2.51 for the obese group and 7.83 ± 2.25 for the control group, which was not significantly different.

Complications

Two patients in the control group and 3 in the obese group had postoperative superficial wound infections, which

TABLE 2
Preoperative Physical Examination Findings[a]

	Body Mass Index		
	<25 (n = 124)	>30 (n = 62)	*P* Value
Impingement			
Anterior	107 (86)	58 (94)	.14
Lateral	67 (54)	37 (60)	.46
Posterior	38 (31)	28 (45)	**.05**
Positive FABER	70 (56)	33 (53)	.68
Hip click			
External	3 (2)	2 (3)	.75
Internal	21 (17)	5 (8)	.10
Range of motion, deg, mean			
Internal rotation	28.1	22.4	**.01**
External rotation	54.4	51.4	.19
Flexion	124.5	113.1	**.00**
Abduction	48.1	45.1	.07

[a]Values are reported as No. (%) unless otherwise indicated; bolding represents statistically significant differences between groups ($P < .05$). FABER, flexion, abduction, and external rotation.

TABLE 3
Preoperative Radiographic Measurements[a]

	Body Mass Index		
	<25 (n = 124)	>30 (n = 62)	*P* Value
Crossover, %	9.36	8.78	.83
Center-edge angle, deg			
Lateral	29.2	30.8	.19
Anterior	30.4	34	.1
Acetabular inclination	4.61	3.88	.48
Alpha angle, deg	56.4	56.6	.95
Joint space, mm			
Medial	0.35	0.35	.8
Central	0.42	0.41	.58
Lateral	0.43	0.42	.61

[a]Values are reported as means.

resolved with a course of oral antibiotics. One patient in the control group reported perineal numbness, which resolved within 6 weeks. One patient in the obese group had heterotopic ossification on postoperative radiographs that was asymptomatic.

Clinical Endpoints

With regard to conversion to total hip arthroplasty, 6 patients in the control group and 6 in the obese group underwent total hip arthroplasty during the study period, giving a conversion rate of 4.8% and 9.7%, respectively ($P = .21$). Five patients in the control group and 5 in the obese group underwent revision hip arthroscopy during the study period, for a revision rate of 4.03% and 8.06%, respectively. All revisions were for recurrent pain postoperatively. In the control group, one patient sustained a motor vehicle accident and underwent labral debridement with loose body removal; the 4 other patients all had recurrent pain and underwent labral debridement with loose body removal as well. In the obese group, all 5 patients underwent labral debridement and loose body removal. Patient satisfaction for revision arthroscopy was 7.6 for the control group and 4 for the obese group at final follow-up. Patient satisfaction was graded on a scale from 0 to 10, with 10 being the highest satisfaction.

DISCUSSION

To our knowledge, this is the first matched-pair controlled study assessing 2-year outcomes of hip arthroscopy in obese versus nonobese patients. The results offer new insight into a procedure that has been validated as a tool for the treatment of various intra- and extra-articular hip disorders. Our results show that obese patients preoperatively start with lower PRO scores when compared with a nonobese population and have significantly lower scores at the 2-year postoperative time point. Our study does demonstrate, however, that the magnitude of change in these scores is not significantly different between groups. These results indicate that while obese patients may have lower absolute results when compared with a nonobese patient population, they may still benefit from hip arthroscopy.

We found that obese patients had higher rates of capsular release and synovectomies performed during the time of hip arthroscopy. At our institution, we routinely perform capsular repair, unless a capsular release is indicated, such as for decreased preoperative range of motion of the hip. Since the obese patients had decreased preoperative flexion and internal rotation, it follows that this group would also have higher rates of capsular release. Higher rates of synovectomies for the obese patients could be theorized as being due to increased intra-articular inflammation at the time of their surgery.

Interestingly, we found that the rate for conversion to total hip arthroplasty or revision hip arthroscopy was almost twice that in the obese group when compared with the controls. This value was not statistically significant; however, this may be due to our relatively small sample size. Note that our a priori power analysis was based on the change in PRO scores and not on conversion rate to total hip arthroplasty or revision arthroscopy. Therefore, when these data are examined, there is the possibility of the study being underpowered.

While there are limited data on hip arthroscopy in the obese patient population, numerous studies within the orthopaedic sports literature have evaluated this subgroup. Warrender et al[31] recently examined the outcomes of arthroscopic rotator cuff repair in obese patients. They found a statistically significant correlation between obesity and worse functional outcomes, longer operative times, and longer length of hospital stay. Similar to our study, theirs revealed that obese patients showed significant improvement postoperatively when compared with their baseline preoperative scores.

More recently, Erdil et al[8] performed a retrospective cohort analysis on the functional results of arthroscopic partial meniscectomy in the obese population. They found

TABLE 4
Preoperative Diagnoses[a]

Diagnosis	Control Group (n = 124)	Obese Group (n = 62)	*P* Value
Femoroacetabular impingement	87 (70)	48 (77)	.27
Labral tear	124 (100)	62 (100)	.99
Internal snapping	21 (17)	5 (8)	.10
External snapping	3 (2)	2 (3)	.75
Trochanteric bursitis	16 (13)	14 (23)	.09
Piriformis syndrome	3 (2)	0 (0)	.21
Intra-articular loose body	12 (10)	9 (15)	.33
Gluteus medius tear	4 (3)	6 (10)	.07
Sciatic nerve entrapment	3 (2)	0 (0)	.21

[a]Values are reported as No. (%).

TABLE 5
Hip Procedures Performed for Obese and Control Groups[a]

Procedure	Control Group (n = 124)	Obese Group (n = 62)	*P* Value
Acetabuloplasty	82 (66)	48 (77)	.11
Femoroplasty	87 (70)	38 (61)	.22
Labral repair	72 (58)	37 (60)	.83
Ligamentum teres debridement	64 (52)	23 (37)	.06
Capsular repair	59 (48)	16 (26)	**.019**
Capsular release	62 (52)	44 (71)	**.004**
Labral debridement	52 (42)	25 (40)	.83
Iliopsoas fractional lengthening	33 (27)	16 (26)	.91
Synovectomy	22 (18)	19 (31)	**.045**
Trochanteric bursectomy	16 (13)	14 (23)	.09
Removal of loose body	12 (10)	9 (15)	.33
Acetabular notchplasty	6 (5)	1 (2)	.28
Gluteus medius repair	4 (3)	6 (10)	.07
Piriformis release	3 (2)	0 (0)	.21
Sciatic nerve neurolysis	3 (2)	0 (0)	.21

[a]Values are reported as No. (%). Bolding represents statistically significant differences between groups ($P < .05$).

that patients with BMI >26 had inferior short-term (1 year) outcomes as compared with nonobese patients. They also found that obese patients had a significant improvement when compared with their preoperative scores; however, the change in scores was significantly lower when compared with the nonobese group.

Jameson et al[14] evaluated the influence of BMI upon patient outcomes and complications after total hip arthroplasty across a national cohort of patients. They found large improvements in patient outcomes, irrespective of BMI; however, improvements were marginally smaller and complication rates higher in obese patients. Obese class I and II patients had statistically significantly increased levels of wound complication rates and readmission/reoperation rates (class II/III). Interestingly, we also found increased rates of revision hip arthroscopy and conversion to total hip arthroplasty in our obese population; however, possibly because of our small sample size, we were unable to find any statistically significant difference.[11]

The major strength of this study is the matched-pair control design, based on prospectively collected data in a cohort comparison. To our knowledge, this study is the first to directly compare an obese group and a control nonobese group at 2 years. This study used 4 PRO tools, addressing the psychometric evidence that no single PRO is adequate for assessing outcomes in hip preservation surgery.[19,28] The capture of preoperative data provides the ability to demonstrate similar magnitudes of improvement between the 2 groups.

Weaknesses of the study include limited sample size and short-term follow-up. In addition, multiple procedures were

TABLE 6
Average Preoperative Patient-Reported Outcome Scores[a]

	Obese Group	Control Group	*P* Value
Modified Harris Hip Score	53.5	63.3	**.001**
Non-Arthritic Hip Score	45.65	60.62	**<.001**
Hip Outcome Score			
Activities of Daily Living	51.9	66.3	**<.001**
Sport Specific Subscale	25.35	41.99	**<.001**

[a]Bolding represents statistically significant differences between groups ($P < .05$).

TABLE 7
Patient-Reported Outcome Scores for Both Groups: Obese (n = 62) and Control (n = 124)[a]

				Postoperative								
	Preoperative			3 Mo			1 Y			2 Y		
Measure	Mean	SD	*P*	Mean	SD	*P*	Mean	SD	*P*	Mean	SD	*P*
Modified Harris Hip Score												
Obese	53.5	13.1	**.001**	71.85	23.1	**.004**	70	18.2	**.001**	74.5	20.7	**.03**
Control	63.3	15.2		81.4	14.6		82.7	15.2		81.4	18.4	
Δ Obese										20.1	19.4	0.19
Δ Control										16.3	23.6	
Non-Arthritic Hip Score												
Obese	45.7	18.9	**<.001**	65.26	23.7	**.005**	63.5	25.9	**<.001**	69.6	21.7	**<.001**
Control	60.6	17.7		76.3	19.6		80.1	16.6		81.7	16	
Δ Obese										24.2	21.6	0.17
Δ Control										19.1	23.9	
Hip Outcome Score–Activities of Daily Living												
Obese	51.9	20	**<.001**	75.6	19.1	**.008**	69.4	23	**.001**	70.3	23.9	**<.001**
Control	66.3	17.3		84	15.9		85.7	18.7		84.7	17.4	
Δ Obese										19.2	21	0.44
Δ Control										16.4	23.1	
Hip Outcome Score–Sport Specific Subscale												
Obese	25.4	22.3	<.001	51.7	35.4	0.3	43.8	36.6	**<.001**	55.5	32.4	**.001**
Control	42	24.2		58.1	31.5		71.5	28.2		71.4	27.1	
Δ Obese										30.4	32	0.54
Δ Control										27	35.2	

[a]The change in patient-reported outcome scores (Δ) was calculated at the 2-year postoperative time point. Bolding represents statistically significant differences between groups ($P < .05$).

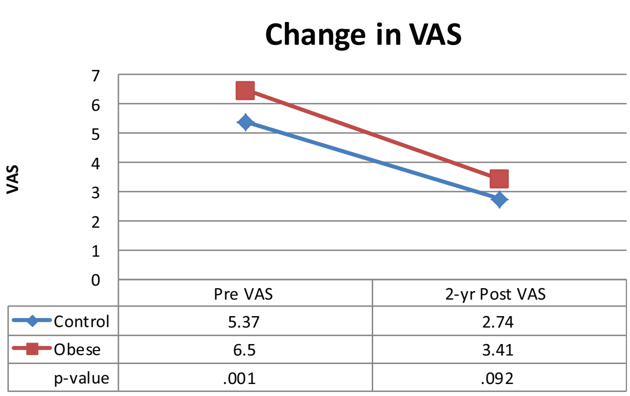

Figure 1. Change in visual analog pain scale (VAS) from preoperative time to 2-year follow-up.

performed in all cases such that the improvement in PRO scores cannot be specifically attributed to increased BMI. As discussed, our study may have been underpowered in evaluating the rates of conversion to total hip arthroplasty and revision arthroscopy between groups. Calculating BMI itself has been shown to have its deficiencies. BMI is an indirect measure of body fat and does not necessarily reflect the changes that occur with age. Thus, sensitivity and specificity of BMI have been poor.[23] While no 2 patients are exactly alike and perfect matching is not possible, the matched-pair controlled study design helps control for confounding variables. Further study at our institution will focus on the longer-term outcomes of these procedures.

CONCLUSION

Our study demonstrated that obese patients overall had lower absolute PRO scores preoperatively and at 2-year follow-up. Both groups demonstrated significant improvement in all PRO scores, and the changes in scores were similar between groups. These results show that while obese patients may not have similar absolute scores after hip arthroscopy, they may show similar gains in improvement compared with baseline. Hip arthroscopy appears to be a viable treatment option in the obese patient as long as expectations are adjusted accordingly.

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