Defining Minimal Clinically Important Difference After Open Hip Abductor Repair

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Background: Open repair for gluteus medius and minimus tears is a common surgical treatment for patients with lateral hip pain associated with abductor tears; however, clinically meaningful outcomes have not been described after open surgical treatment.

Purpose: To define the minimal clinically important difference (MCID) in patient-reported outcome measures (PROMs) in patients undergoing open gluteus medius or minimus repair, and to identify preoperative patient characteristics predictive of achieving MCID postoperatively.

Study Design: Case series; Level of evidence, 4.

Methods: A retrospective review of prospectively collected data from a consecutive series of patients undergoing open abductor repair between July 2010 and April 2019 was conducted. Perioperative patient data collected included patient characteristics and preoperative and postoperative modified Harris Hip Score (mHHS) and International Hip Outcome Tool (iHOT-33) score. Paired *t* tests were utilized to compare preoperative and postoperative PROMs and MCID was calculated for both PROMs. Multivariate logistical regression analysis was used to assess the association between preoperative variables and the likelihood for achieving MCID.

Results: A total of 47 patients were included in the study. The majority of patients were female (78.7%), with an average age of 63 ± 10.7 years. The average follow-up for both the mHHS and the iHOT-33 surveys was 37.8 ± 27.9 months (range, 10-102 months). Patients demonstrated statistically significant improvements on the mHHS and iHOT-33 postoperatively ($P < .001$ for both). The MCIDs of mHHS and iHOT-33 were calculated to be 9.9 and 14.3, respectively. Overall, 82.9% of patients achieved MCID for mHHS and 84.1% of patients achieved MCID for iHOT-33 postoperatively. Multivariate logistical analysis demonstrated younger patients were less likely to achieve MCID for both outcome measures. Four patients (8.5%) suffered postoperative complications after open repair.

Conclusion: This study defined MCID for mHHS and iHOT-33 for patients undergoing open repair of hip abductor tears, with a large percentage of patients (>80%) achieving meaningful outcomes for both outcome measures. There was a low complication rate. Younger patients were less likely to achieve MCID compared with older patients.

Keywords: hip; abductor repair; gluteus medius; outcomes; MCID; trochanteric pain syndrome

Tears involving the hip abductors, including both the gluteus medius and gluteus minimus, are a common cause of lateral hip pain. Presenting symptoms often include peritrochanteric pain and tenderness, often exacerbated by long periods of ambulation, ascending and descending stairs, and lying on the affected side.[1,13,16-18,24] Clinical signs specific to hip abductor tears include Trendelenburg gait, weakness with hip abduction, and pelvic tilt with single-leg stance, which may help differentiate hip abductor tears from other causes of lateral hip pain.[1,15,16,18,24]

The true prevalence of hip abductor tears is unknown, but the increasing availability of magnetic resonance imaging (MRI) has resulted in improved recognition over the past 2 decades.[2,11,17,19,20] Several studies report hip abductor tendon tear prevalence as ~10% in middle-aged men and ~25% in middle-aged women.[10,19,25] Howell et al[12] reported degenerative changes in hip abductor tendons in 20% of patients undergoing total hip arthroplasty for osteoarthritis, and Bunker et al[4] found hip abductor tears in 22% of patients with femoral neck fractures. Furthermore, a recent study by Chi et al[7] investigated hip abductor pathology in 185 pelvis MRI scans (370 hips) in patients aged >50 years, demonstrating partial thickness gluteus medius and gluteus minimus tears in 28% and 22% of hips, respectively.

Alpaugh et al[1] performed a systematic review comparing outcomes of endoscopic versus open gluteus medius repairs, with both techniques demonstrating a statistically significant improvement in outcomes and reductions in pain. However, despite a recent shift in the orthopaedic literature toward identifying clinically meaningful (rather than

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statistically significant) outcomes after surgical intervention, few studies have addressed this topic in the setting of hip abductor repair. A recent study by Okoroha et al[24] demonstrated that 77% of patients undergoing endoscopic repair of gluteus medius tears achieved minimal clinically important difference (MCID) or Patient Acceptable Symptom State (PASS) for several patient-reported outcome (PRO) measures (PROMs) at 2 years postoperatively.

To our knowledge, no studies have addressed MCID for PROMs in patients undergoing open hip abductor repair. The purpose of this study was (1) to define the MCID for the modified Harris Hip Score (mHHS) and International Hip Outcome Tool (iHOT-33) in patients undergoing open hip abductor repair and (2) to identify preoperative patient characteristics predictive of achieving MCID.

METHODS

Patient Enrollment and Data Collection

After institutional review board approval, a retrospective review was performed of a consecutive series of patients undergoing open hip abductor repair (either gluteus medius or minimus surgery) between July 2010 and April 2019. Patient characteristics, preoperative and postoperative clinical data, and PROs were prospectively collected in a secure institutional registry. Indications for open gluteus medius repair included lateral hip pain, abduction weakness on physical examination, MRI findings consistent with gluteus medius or minimus complete/partial tear, and failure of 6 months of nonoperative management, which included nonsteroidal anti-inflammatory medications, physical therapy, activity modification, and corticosteroid injections. Exclusion criteria included a history of pediatric hip deformities (congenital hip dislocation, slipped capital femoral epiphysis or Perthes disease) and prior treatment of ipsilateral abductor tears. Figure 1 demonstrates the patient enrollment flowchart. Complication data were collected via a review of available electronic medical records at our institution.

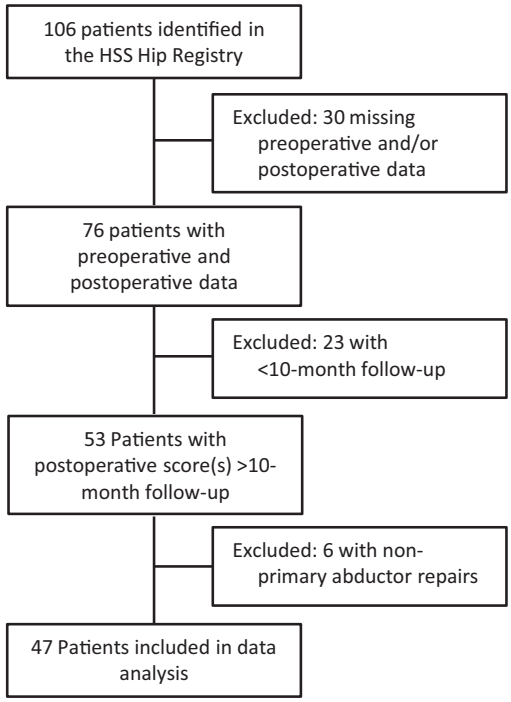

Figure 1. Patient inclusion/exclusion flowchart.

Operative Technique

All open abductor repairs were performed by 2 fellowship-trained hip surgeons (A.S.R. and B.T.K.) at a high-volume tertiary care hospital. The patient was placed in standard lateral decubitus position and a standard lateral approach via an 8-cm incision centered over the greater trochanter and the iliotibial band (ITB) was utilized. The ITB was incised longitudinally and the greater trochanter was exposed via a modified Gibson approach. Trochanteric bursal tissue was excised and once the tear was identified, the edges of the tendons were debrided back to bleeding edges and the insertional footprints on the lateral anterior facets were debrided to create a bed of bleeding bone. In the case of a gluteus medius tear, the distal end of the gluteus medius tendon was identified and the muscle belly mobilized. Corkscrew suture anchors were then inserted into the lateral and anterior facets of the greater trochanter. Sutures were then passed through the tendon edges via a modified Mason Allen and mattress suturing technique. The sutures were then tied, ensuring adequate reapproximation of the tendon to its footprint. In the case of a tear to the gluteus minimus, a similar surgical technique was employed by which the tendon is identified, muscle belly mobilized, and tendon repaired with corkscrew anchors. The ITB and deep fascia were closed with interrupted figure-of-8 0-vicryl sutures. The deep and subcutaneous tissue was closed with

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Ethical approval for this study was obtained from the Hospital for Special Surgery.

TABLE 1
Patient Demographic Characteristics (N = 47)[a]

Laterality	
Left	16 (34.0)
Right	31 (66.0)
Sex	
Female	37 (78.7)
Male	10 (21.3)
Age (years)	63 ± 10.7

[a]Data are reported as n (%) or mean ± SD. SMDCS, Sport Medicine Diagnostic Coding System.

interrupted 0 and 2-0 vicryl sutures and skin was closed with running subcuticular 3-0 monocryl suture and skin adhesive. The hip was gently adducted and abducted to ensure adequate tensioning of the repair.

Postoperative Physical Therapy Protocol

The postoperative rehabilitation regimen was standardized for all hip abductor repairs. During the initial 6 weeks postoperatively, patients were placed in full-time bracing to limit abduction, permitting only gentle passive range of motion and partial weightbearing with assistive devices (walker or crutches). During the subsequent 6 weeks, patients were progressed to full weightbearing and began hip strengthening exercises as the brace was discontinued. After 12 weeks, patients were permitted to ambulate without assistance and return to activities as tolerated.

Patient-Reported Clinical Outcomes

The mHHS and iHOT-33 surveys were assessed preoperatively and at the most recent postoperative visit. To identify differences in meaningful outcome improvement between patients undergoing open gluteus medius repair, the MCID was calculated using a half standard deviation (distribution-based) method of the change in mHHS and iHOT-33 preoperatively to postoperatively, consistent with previous reports.[14,19,21-24] Because of the large surgical date range (2010-2019) and inconsistencies in anchor questions within the institutional registry, we elected to perform a distribution-based MCID. Additionally, we elected for a convenience sample rather than a power analysis due to the paucity of open gluteus medius procedures in the registry.

Statistical Analysis

Means and standard deviations were reported for continuous variables. Paired t tests were utilized to compare preoperative and postoperative PRO scores. Independent-samples t tests were utilized to compare preoperative PRO scores between older and younger patients. Univariate logistical regression analysis was performed to assess the associations between achieving MCID and demographic variables (length of follow-up, laterality, sex, age) and preoperative PRO scores. Multivariate logistical regression analysis was performed on variables demonstrating a P value <.15 during univariate logistical regression analysis. Statistical analyses were conducted using SPSS V 25.0.0 (IBM Corp).

TABLE 2
Preoperative and Postoperative Patient Reported Outcomes[a]

	No. of Patients (%)	Mean ± SD	Range
Follow-up (months)	47 (100.0)	37.8 ± 27.9	10.0 to 102.0
mHHS			
Preoperative	41 (87.0)	52.6 ± 14.0	28.0 to 93.5
Postoperative	47 (100.0)	76.5 ± 18.1	33.0 to 100.0
Net change	41 (87.0)	26.4 ± 19.8	–25.4 to 70.3
Achieved MCID	34 (82.9)	—	—
iHOT-33			
Preoperative	44 (94.0)	31.8 ± 16.0	4.5 to 85.6
Postoperative	47 (100.0)	67.6 ± 26.5	4.0 to 99.8
Net change	44 (94.0)	36.2 ± 28.6	–49.1 to 94.6
Achieved MCID	37 (84.1)	—	—

[a]Dashes indicate not applicable. iHOT-33, International Hip Outcome Tool; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score.

RESULTS

A total of 47 patients were enrolled in the study. The majority of patients were female (n = 37; 78.7%), with an average age of 63 ± 10.7 years (range, 35-82 years) (Table 1). The average preoperative mHHS score was 52.6 ± 14.0 and the average preoperative iHOT-33 score was 31.8 ± 16.0 (Table 2). The average postoperative mHHS score was 76.5 ± 18.1 and the average postoperative iHOT-33 score was 67.6 ± 26.5. The average follow-up for both the mHHS and iHOT-33 surveys was 37.8 ± 27.9 months (range, 10-102 months). Of the 47 patients enrolled, 41 (87%) and 44 (94%) completed both the preoperative and postoperative mHHS and iHOT-33 surveys, respectively.

Paired t-test analysis of preoperative and postoperative reported outcomes demonstrated statistically significant improvements in mHHS (52.6 ± 14.0 vs 76.5 ± 18.1; $P < .001$) and iHOT-33 (31.8 ± 16.0 vs 67.6 ± 26.5; $P < .001$).

The MCID threshold scores of mHHS and iHOT-33 were 9.9 and 14.3, respectively. The distribution of change from preoperative to postoperative mHHS and iHOT-33 is demonstrated in Figure 2. Postoperatively, a total of 34 patients (82.9%) achieved MCID for the mHHS and 37 (84.1%) achieved MCID for the iHOT-33 (Table 2).

Univariate logistical regression analysis demonstrated an association between older age and achieving postoperative mHHS MCID ($P = .009$) (Table 3). Additionally, both older age ($P = .003$) and lower preoperative iHOT-33 ($P = .028$) were significantly associated with achieving postoperative iHOT-33 MCID. Multivariate logistical regression analysis of these variables demonstrated a statistically significant association between age and achieving both

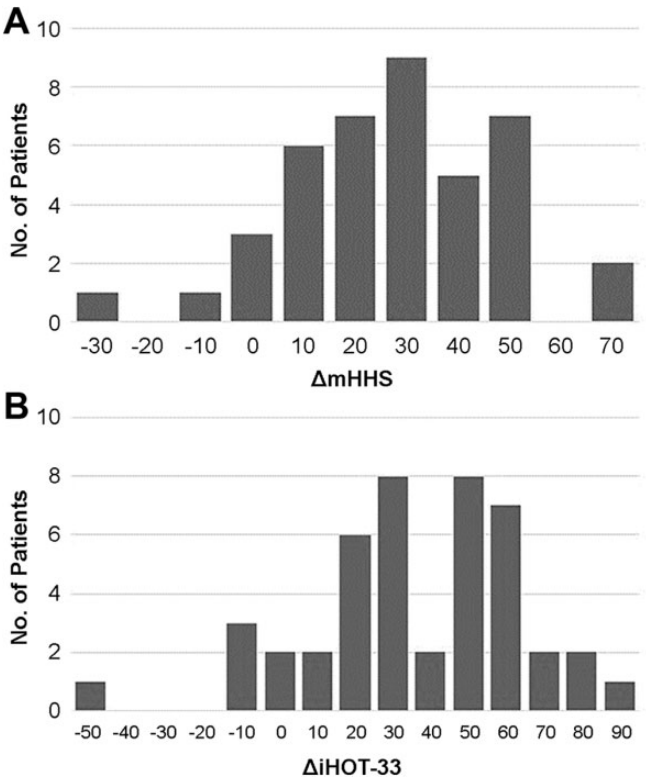

Figure 2. Distribution of preoperative-to-postoperative net change in (A) modified Harris Hip Score (mHHS) scores and (B) international Hip Outcome Tool (iHOT-33) scores.

TABLE 3
Logistic Regression Analysis of Variables Associated with Achieving MCID[a]

	P Value		
	Univariate	Multivariate[b]	Odds Ratio (95% CI)
mHHS			
Follow-up	.763	—	—
Laterality	.453	—	—
Sex	.308	—	—
Age	.009[c]	.021[c]	1.063 (1.009-1.120)
Preoperative score	.180	—	—
iHOT-33			
Follow-up	.418	—	—
Laterality	.998	—	—
Sex	.612	—	—
Age	.003[d]	.015[c]	1.079 (1.015-1.148)
Preoperative score	.028[d]	0.056	0.948 (0.897-1.001)

[a]Dashes indicate not applicable. iHOT-33, international Hip Outcome Tool; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score.

[b]Multivariate logistical regression analysis was performed on variables that achieved a P value $< .15$ during univariate analysis.

[c]Statistically significant under multivariate logistic regression ($P < .05$).

[d]Statistically significant under univariate logistic regression ($P < .05$).

postoperative mHHS ($P = .021$) and iHOT-33 MCID ($P = .015$), with younger patients less likely to achieve MCID for both outcome measures.

A post hoc independent-samples t test was conducted to compare preoperative PRO scores among patients older and younger than the median age of 66 years, which demonstrated no difference in average preoperative mHHS ($P = .31$) and average preoperative iHOT-33 ($P = .45$) between older and younger patients.

A total of 4 patients (8.5%) suffered complications after their initial procedure. Three patients (6.4%) suffered retears of their hip abductor repair, 2 of which required revision open repair. The third patient suffered an incomplete retear and did not require revision surgery. All 3 patients presented with worsening lateral hip pain and pain with resisted hip abduction, with repeat MRI demonstrating retear. Finally, 1 patient (2.1%) developed a noninfected hematoma postoperatively for which the patient underwent surgical irrigation and debridement weeks after open hip abductor repair.

DISCUSSION

This study defined MCID scores for the mHHS (9.9) and iHOT-33 (14.3) PROMs in patients undergoing open hip abductor repair. We demonstrated that hip abductor repair is associated with significantly improved mHHS and iHOT-33 scores at an average follow-up of ~3 years (37.8 ± 27.9 months; range, 10-102). Furthermore, 82.9% of patients achieved MCID for mHHS and 84.1% of patients achieved MCID for iHOT-33 postoperatively. Young age was associated with a lower likelihood of achieving MCID for both PROMs. Finally, the overall complication rate was low at 8.5%, with a retear rate of 6.4% and reoperation rate of 6.4%.

Several studies have demonstrated that open hip abductor repair is associated with statistically significant improvements in PROMs, functional scores, and pain scores.[3,8,9,16,26] Walsh et al[26] demonstrated significant improvements in Merle d'Aubigné score in 72 patients at 6 months and 12 months postoperatively. Similarly, Davies and Davies[8] demonstrated significant improvements in mHHS and Lower-Extremity Activation Score in 22 patients at an average follow-up of 71 months. Bucher et al[3] investigated the use of synthetic tendon graft (Ligament Augmentation and Reconstruction System [LARS]) in 22 patients and demonstrated significant improvement in postoperative Oxford Hip Score, 36-Item Short Form Health Survey, and visual analog scale for pain. These results are consistent with the postoperative improvements in mHHS and iHOT scores demonstrated in our study. However, these studies did not address the proportion of patients achieving MCID for their PROMs, precluding conclusions regarding clinical significance.

As mentioned previously, there has been a recent increase in the utilization of endoscopic gluteus medius

repair, as several studies have raised concerns regarding increased complication rates with open repair.[3,16,26] Two recent systematic reviews have aimed to compare outcomes between the 2 techniques. Alpaugh et al[1] and Chandrasekaran et al[5] conducted systematic reviews investigating open versus endoscopic gluteus medius repairs. The authors of both reviews demonstrated good to excellent mean outcomes in 75% of studies for both open and endoscopic gluteus medius repairs. Complication rates were reported at 13% for open repairs and 3% for endoscopic repairs, with a retear rate of ~10% in open repairs and reportedly 0% in endoscopic repairs, although the heterogeneity of complication reporting among included studies and selection bias are significant limitations, as several endoscopic repair studies did not report retear rates and may be subject to selection bias toward smaller hip abductor tears compared with open repairs.[1,6] Additionally, these studies were limited by small sample sizes and limited follow-up. In our study, the complication rate was 8.5%, with a retear rate of 6.4%, both of which are lower than rates reported for open repair in the aforementioned studies. Interestingly, in discussion with other hip preservation surgeons, we have observed a trend back toward the adoption of open abductor repair, as endoscopic approaches may miss cases of tendon delamination or subtle tears in the gluteus minimus.

To our knowledge, this study is the first to report MCID in PROs and functional scores after open gluteus medius repair. One recent study assessed MCID after endoscopic gluteus medius repairs. Okoroha et al[24] investigated MCID and PASS for several PROs in 60 patients undergoing endoscopic repair of gluteus medius tears. The authors demonstrated an MCID of 14.1 for the mHHS, a slightly higher value than that found in our study for open repair (9.9). Additionally, 75.7% of patients achieved MCID for mHHS postoperatively, which is slightly lower than the rate reported in our study (82.9%). The authors postulate that open repair yielded a higher MCID perhaps as a result of better visualization and comprehensive repair of hip abductor tears. Additionally, the difference in MCID values may be a function of the different patient populations included in the studies. In both studies, the MCID was defined using the half standard deviation, distribution-based method, initially described by Norman et al,[21] and afforded greater ability for direct comparison. Additionally, 87% of patients completed both preoperative and postoperative mHHS and iHOT-33 surveys in our study, allowing for an accurate calculation of standard deviation of the net change in average scores over time.

Interestingly, our study demonstrated that younger patients were less likely to achieve MCID for both outcome scores postoperatively. A post hoc analysis was conducted to assess preoperative PRO scores among patients older and younger than the median age of 66 years, which demonstrated no difference in average preoperative mHHS ($P = .31$) and average preoperative iHOT-33 ($P = .45$) between older and younger patients. One possible explanation for this result is that younger patients may have higher expectations for postoperative outcomes after surgery, thereby affecting their responses to PRO questions. However, future studies with larger sample sizes are required to further address this conclusion. Future studies should also aim to assess the outcomes of abductor repair in acute versus chronic tears and the effect of preoperative activity level and functional status on surgical outcomes.

This study has a number of limitations. First, our sample is a small case series, which may preclude the determination of a statistically significance. Second, the surgical procedures performed in this series were conducted by 2 surgeons at a single tertiary care center, which may limit the study's overall generalizability. It is possible that differences in surgical fixation techniques may produce differences in MCID postoperatively. There was also a high proportion of women in our cohort, which may limit generalizability to male patients; however, this is consistent with prior studies investigating hip abductor repairs and reflects the higher prevalence of this pathology in female patients. Information on symptom duration is currently not recorded in a standardized fashion in our hip registry, which prevented the assessment of outcomes in acute versus chronic tears in this cohort. Complication data are limited to follow-up at our institution, such that the study does not account for instances in which complications were treated at outside facilities. However, at our institution, it is common practice for complications to be treated at our own institution, most often by the same surgeon who performed the index procedure; hence, the frequency of complications treated at outside facilities is likely low. Additionally, despite our average follow-up of >3 years, our minimum follow-up was 10 months.

CONCLUSION

This study defined the MCID in the mHHS and iHOT-33 for patients undergoing open hip abductor repairs. More than 80% of patients achieved MCID for both PROMs, with younger patients demonstrating a lower likelihood for achieving MCID postoperatively. Additionally, open hip abductor repair was associated with a retear rate of 6.4%, slightly lower than that reported in previous studies.

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