Full-Thickness Gluteus Medius Tears With or Without Concomitant Hip Arthroscopy

Minimum 2-Year Outcomes Using an Open Approach and Contemporary Tendon Repair Techniques

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Background: Gluteus medius (GM) tears are a well-established source of pain and disability. An open approach has been recognized with complete full-thickness and large GM tears, yet the current literature provides few reports on outcomes for this specific situation.

Purpose: To report and analyze minimum 2-year patient-reported outcomes (PROs) from patients who underwent open GM repair in the setting of a full-thickness tear with or without concomitant hip arthroscopy through use of contemporary tendon repair techniques.

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

Methods: Prospectively collected data were retrospectively reviewed for patients who underwent hip preservation surgery and total hip arthroplasty (THA) between April 2008 and May 2017. Patients were included in this study if they underwent open repair of GM full-thickness tears. The exclusion criteria were incomplete follow-up, workers' compensation status, repair regarding size and pattern of the GM, open repair of partial GM tear, open repair with allograft or autograft augmentation, and/or additional gluteus maximus transfer. Pre- and postoperative PROs for the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score Sport-Specific Subscale (HOS-SSS), and visual analog scale (VAS) score for pain and satisfaction were recorded. Statistical significance was set at $P < .05$.

Results: A total of 36 patients were included, of whom 12 received concomitant hip arthroscopy for intra-articular procedures. The mean ± SD age, body mass index, and follow-up time were 65.18 ± 12.69 years, 28.97 ± 4.95 kg/m^2, and 40.8 ± 26.19 months, respectively. At minimum 2-year follow-up, the following outcome measures improved significantly: mHHS (from 54.72 ± 15.89 to 73.12 ± 19.47; $P < .0001$), NAHS (from 56.05 ± 12.47 to 75.22 ± 19.15; $P < .0001$); HOS-SSS (from 20.30 ± 20.21 to 44.23 ± 35.85; $P < .0001$), and VAS (from 4.95 ± 2.70 to 2.67 ± 2.81; $P < .0001$). There was 1 (2.8%) conversion to THA at 48 months after the index procedure.

Conclusion: Patients who underwent open repairs in the setting of full-thickness GM tears via contemporary tendon repair techniques, with or without concomitant hip arthroscopy, achieved favorable results in several PRO scores at minimum 2-year follow-up.

Keywords: gluteus medius; gluteus medius tear; outcomes; hip

Lateral hip pain, commonly referred to as greater trochanteric pain syndrome (GTPS),[28] is a prevalent and debilitating clinical complaint. Affecting women with a higher incidence compared with men, GTPS has a peak incidence between the fourth and sixth decades of life.[10] This condition traditionally has been attributed to greater trochanteric bursitis. However, more recently, the literature on GTPS has shifted to abductor tendinopathy, as patients with GTPS have a higher incidence of gluteal tendinopathy (18%-50%) as opposed to bursitis (4%-46%).[31,38,39] In the

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past, abductor tendinopathy was often misdiagnosed or underdiagnosed; however, the use of magnetic resonance imaging (MRI) and other classic diagnostic imaging, such as ultrasound, has increased recognition of this condition.[10-12,25] Improved recognition combined with the aging population will likely result in an overall increased incidence of gluteal tendinopathy.

Most GTPS cases resolve through nonoperative treatment, with success rates greater than 90%.[3,37] These treatments include physical therapy, functional modifications, peritrochanteric cortisone injections, local anesthetic injections, and anti-inflammatory medications.[22,29] Biologic alternative treatments such as platelet-rich plasma injections have been proposed for partial gluteus medius (GM) tears; however, more research is needed to support the routine use of these treatments.[20] Clinical suspicion of abductor tendon tears should be raised when patients who were previously diagnosed as having trochanteric bursitis develop insidious lateral hip pain that is recalcitrant to nonoperative treatment.[8] A common complaint in patients with abductor tendinopathy or tendinitis is worsening pain with activity and lying on the affected side, especially at night.[8] Further, a Trendelenburg gait, pelvic tilt while standing on 1 leg, and reduced resisted abduction strength accompanied by pain on physical examination may suggest gluteal tendon dysfunction that necessitates surgical management.[8,10]

With the failure of nonoperative treatment, GM tendon tears are typically treated by either an open or an endoscopic surgical approach. Both techniques have been described in the literature with good and comparable patient outcomes.[6,34,36] Classically, the open surgical approach was predominantly used because it allows for full visualization of the footprint as well as accessibility and easy preparation of the bony surfaces for fixation of the tendon. Nevertheless, technological advancements have allowed for the steady increase in a minimally invasive endoscopic approach to GM repairs.[7,15] Depending on the size of the tear and retraction length of the tendon, either surgical approach may be indicated to optimize results.

The purpose of this study was to report and analyze minimum 2-year patient-reported outcomes (PROs) in patients who underwent open GM repair in the setting of full-thickness tears via contemporary tendon repair techniques, with or without concomitant hip arthroscopy. We hypothesized that patients who undergo open GM repair with or without concomitant hip arthroscopy will have favorable postoperative outcomes at minimum 2-year follow-up.

METHODS

Patient Selection

Data for all patients who underwent hip preservation surgery and total hip arthroplasty (THA) by the senior surgeon (B.G.D.) between April 2008 and May 2017 were prospectively collected. Patients were included if they underwent open GM full-thickness tear repairs. Exclusion criteria were as follows: incomplete follow-up, workers' compensation status, arthroscopic GM repair regarding size or pattern of the tear,[18] open repair of partial GM tear, open repair with allograft or autograft augmentation, and/or additional gluteus maximus transfer. PROs were recorded for patients with minimum 2-year follow-up. These included the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), Hip Outcome Score Sport-Specific Subscale (HOS-SSS), 12-item International Hip Outcome Tool (iHOT-12), and visual analog scale (VAS) score for pain and satisfaction. Full-thickness GM tears were defined as type 4 or 5 according to Lall et al.[28] Patient selection criteria are shown in Figure 1.

Participation in the American Hip Institute Hip Preservation Registry

Although some patients in this study may have been analyzed in another study, the present study represented a unique analysis of a unique cohort. This study was approved by an institutional review board.

Preoperative Physical Examination

All patients underwent preoperative physical examination that evaluated abnormal gait, defined as antalgic and/or Trendelenburg gait.[8] Tenderness around the greater trochanter was assessed bilaterally. While the patient was lying in the lateral position, abductor strength was assessed through extension of the hip and knee and internal rotation at the hip.

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Ethical approval for this study was obtained from Advocate Health Care Institutional Review Board (ID No. AHC-5276).

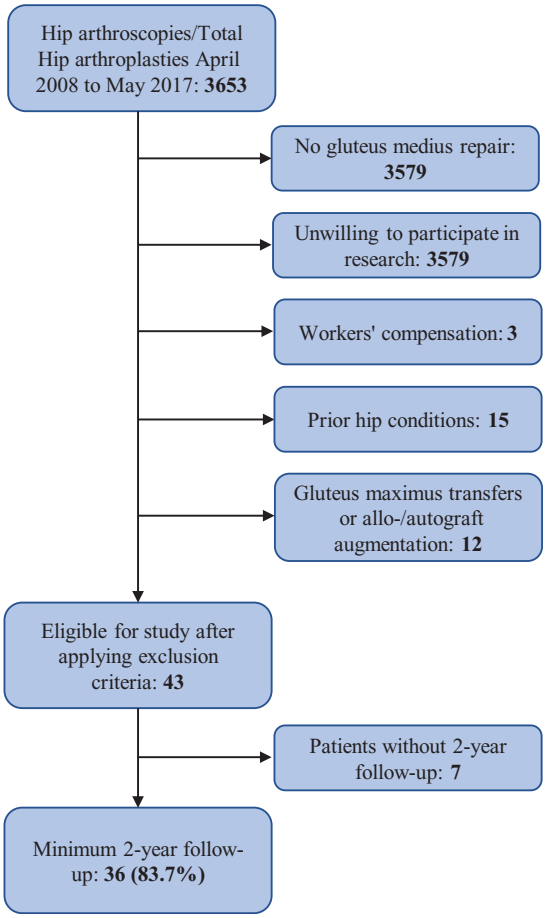

Figure 1. Patient selection criteria.

TABLE 1
Medical Research Council Grading of Muscle Power

Grade	Interpretation
0	No movement
1	Only a trace or flicker of movement
2	Active movement with gravity eliminated
3	Active movement against gravity without resistance
4	Active movement against gravity with resistance
5	Normal power

Routinely, the modified resisted internal rotation test was also used.[42] Hip strength was evaluated with the Medical Research Council grading scale from 0 (complete weakness) to 5 (full strength) (Table 1).[19,40] Care was taken during preoperative evaluation to confirm that the peritrochanteric space was an independent pain source, and ultrasound-guided diagnostic injections were used when necessary.[2] Patients suspected of having GM tears underwent further diagnostic MRI.[24,30]

Surgical Indications

Candidates for open GM repair were patients who had been evaluated preoperatively with peritrochanteric pain and/or tenderness and abductor weakness that did not improve with nonsurgical management (rest, nonsteroidal anti-inflammatory drugs, and physical therapy) for at least 3 months, MRI findings of full-thickness gluteal tears, and the presence of substantial gluteal retraction. Assessment was thorough to ensure that the peritrochanteric space was the source of the pain.[2] In cases of additional intra-articular sources of pain, such as labral tears and femoroacetabular impingement (FAI), concomitant hip arthroscopy for intra-articular procedures (eg, labral repair, FAI correction) was indicated.

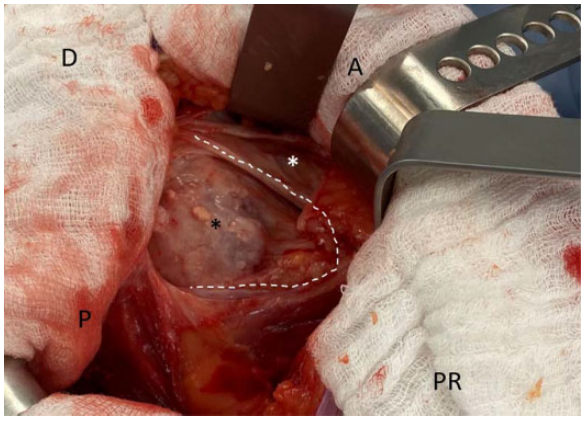

Figure 2. Retracted full-thickness gluteus medius tear. Left hip with patient positioned in the lateral decubitus position. A, anterior; D, distal; P, posterior; PR, proximal; black asterisk, greater trochanter; white asterisk, gluteus medius muscle; white dotted line, border of full-thickness gluteus medius tear.

Surgical Technique

Concomitant Hip Arthroscopy and Open GM Repair. All concomitant hip arthroscopy and open GM repairs were performed with the patient in the supine position on a well-padded perineal post. Under traction and after hip joint venting,[33] the standard anterolateral, midanterior, and distal anterolateral accessory portals were used to perform intra-articular procedures.[16,27] Upon completion of intra-articular procedures, traction was released, and the 70° arthroscope was moved to the distal anterolateral accessory portal to assess the peritrochanteric space. If a full-thickness tear that was not amendable to an endoscopic repair was found after examination of the GM insertions (Figure 2), an open approach was undertaken without changing the patient's position.[24] Open surgical approach was the same regardless of position of the patient (supine vs lateral decubitus).[28]

Open GM Repair Without Intra-articular Hip Arthroscopic Procedures. Patients with a source of pain exclusively at the peritrochanteric space received open GM repairs without the addition of hip arthroscopy. Patients were placed on the operating table in the lateral decubitus position. The incision was made over the Gibson interval and was carried through the subcutaneous tissues to identify the fascia lata, which was also incised in the

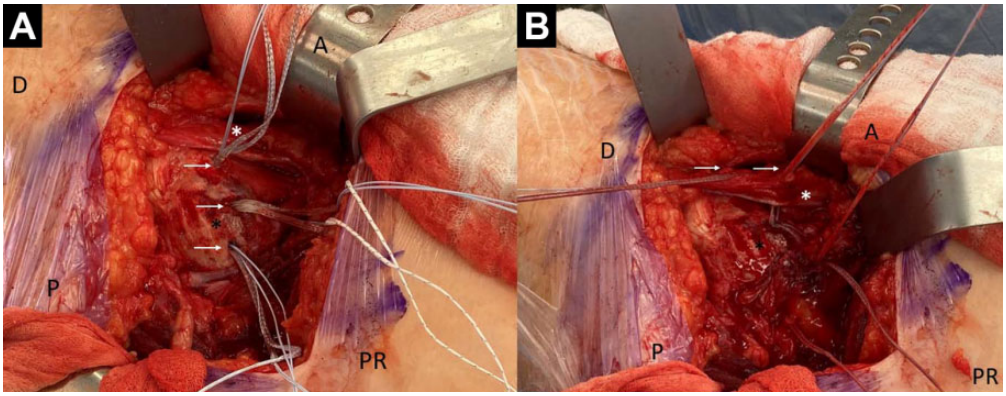

Figure 3. Proximal row of the gluteus medius repair construct. Left hip with patient positioned in the lateral decubitus position. (A) Three knotless suture anchors have been placed for the medial row (white arrows). (B) Tapes from each knotless suture anchor (white arrows) are passed through the gluteus medius tendon. A, anterior; D, distal; P, posterior; PR, proximal; black asterisk, greater trochanter; white asterisk, gluteus medius muscle.

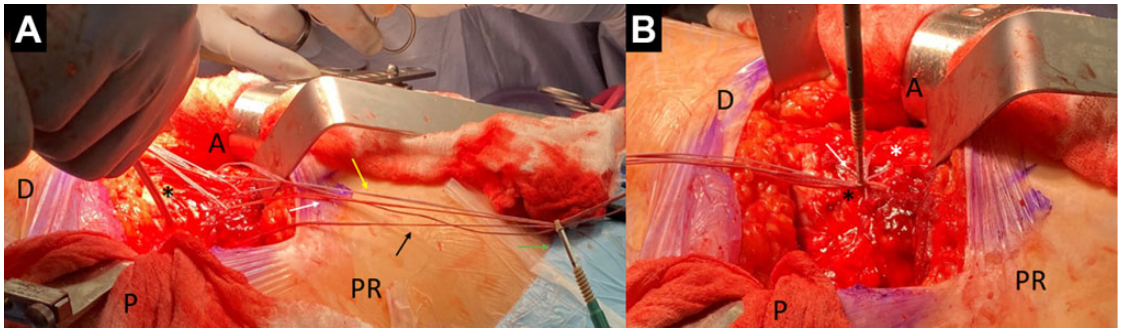

Figure 4. Lateral row of the gluteus medius repair construct. Left hip with patient positioned in the lateral decubitus position. (A) One pair of each previous anchor (anterior, yellow arrow; center, white arrow; posterior, black arrow) is passed through the knotless suture anchor (green arrow) to create a suture bridge construct. (B) The suture bridge construct is shown. A, anterior; D, distal; P, posterior; PR, proximal; black asterisk, greater trochanter; white asterisk, gluteus medius muscle.

Gibson interval between the tensor fascia lata and gluteus maximus.[35] The GM tendon was identified, and the tear pattern and tissue condition were assessed. To improve visualization, trochanteric bursa and/or nonviable tissues were debrided. Attention was taken to achieve as much tendon mobilization as possible by releasing any surrounding scar tissue, especially at the inferior tendon. The greater trochanter lateral facet was decorticated to create a bleeding bed of bone for healing.

Repair Technique. Once the GM tendon was exposed and mobilized and clear visualization was achieved, a double-row transosseous equivalent was constructed as follows: Proximal row fixation was performed with 2 or 3 knotless anchors (PEEK SwiveLock 5.5 mm; Arthrex), loaded with 2 pairs of FiberTape sutures (Arthrex) each placed in the proximal portion of the tendon footprint in the lateral facet (Figure 3A). The 4 limbs of the sutures from each anchor were passed through the tendon in a horizontal mattress fashion without tying (Figure 3B). For the distal row, 2 additional knotless anchors (PEEK SwiveLock 5.5 mm) were used and assembled with 1 pair of each previous anchor to create a suture bridge construct (Figure 4). This provides additional compression of the tendon against the bone in the footprint (Figure 5).[14]

Rehabilitation

Postoperatively, patients who underwent full-thickness GM tear repair were instructed to use crutches with partial weightbearing (20 lb) while remaining in a low-profile abduction brace (DJO Global) for 8 weeks. Patients were instructed to avoid hip abduction, adduction, internal rotation, and external rotation while in the brace. After removal of the brace, patients were instructed to wean off crutches and begin physical therapy to regain strength and mobility.

Patient-Reported Outcomes

Preoperative and minimum 2-year postoperative outcomes were evaluated with the mHHS, NAHS, HOS-SSS, iHOT-12, and VAS.[21] The VAS, which was used to evaluate pain and satisfaction, was recorded on a 10-point scale, with 10 being the highest level of each outcome (ie, 0, no pain; 10,

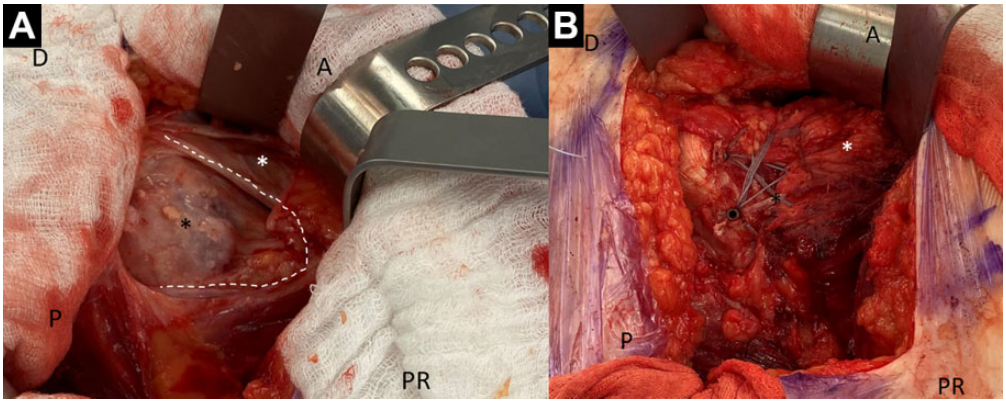

Figure 5. Before and after open full-thickness gluteus medius repair. Left hip with patient positioned in the lateral decubitus position. (A) Full-thickness gluteus medius tear. (B) Final double-row repair construct. A, anterior; D, distal; P, posterior; PR, proximal; black asterisk, greater trochanter; white asterisk, gluteus medius muscle; white dotted line, border of full-thickness gluteus medius tear.

highest pain; 0, lowest satisfaction; 10, highest satisfaction). The American Hip Institute Research began collecting iHOT-12 scores in 2014, and they were available for only a subset of patients. The proportions of patients who achieved the minimal clinically important difference (MCID) for mHHS and patient acceptable symptomatic state (PASS) for mHHS and iHOT-12 were also reported.[23,26] The questionnaires were completed either during a clinic appointment, through encrypted email, or by telephone. Any secondary arthroscopies, conversions to THA, or postoperative complications were recorded.

Statistical Analysis

Microsoft Excel was used to perform all analyses. The Shapiro-Wilks test was used to assess the parametricity of continuous outcomes, with $P > .05$ indicating a normal distribution. A paired 2-tailed t test was then used to compare pre- versus postoperative outcomes. Statistical significance was considered as $P < .05$.

RESULTS

Patient Demographics and Characteristics

After all inclusion and exclusion criteria were applied, 36 patients were included in the study. Of the 36 patients, 24 patients underwent an open GM repair without any additional procedures whereas 12 patients received concomitant hip arthroscopy to address additional intra-articular pathologies. No patients underwent concomitant THA. A total of 4 patients had prior ipsilateral THAs, and 5 patients had prior ipsilateral hip arthroscopies. The mean age and body mass index were 65.18 ± 12.69 years and 28.97 ± 4.95 kg/m^2, respectively. The mean follow-up time was 40.8 ± 26.19 months (Table 2). No revision arthroscopies were performed. One patient converted to THA 48.2 months after the index procedure; that patient's outcomes were not included in the analysis of PROs.

TABLE 2
Demographics of Patients With Full-Thickness Gluteus Medius Tears Receiving Open Repairs

Parameter	Data
Hips, n (%)	
Left	21 (58.3)
Right	15 (41.7)
Sex, n (%)	
Female	31 (86.1)
Male	5 (13.9)
Age at surgery, y, mean ± SD (median; range)	65.18 ± 12.69 (68.4; 57.78-73.66)
Body mass index, kg/m^2, mean ± SD (median; range)	28.97 ± 4.95 (28.8; 26.41-31.17)
Follow-up time, mo, mean ± SD (median; range)	40.8 ± 26.19 (28.35; 24.16-46.20)
Follow-up rate, %	100
Procedure type, n (%)	
Open	24 (66.7)
Arthroscopic and open	12 (33.3)
Future reoperations and endpoints, n (%)	
Arthroscopy/endoscopy	0 (0)
Conversion to total hip arthroplasty after gluteus medius repair	1 (2.8)

Patient-Reported Outcomes

All outcome measures showed significant improvements from the preoperative assessment to a minimum of 2 years postoperatively (Table 3 and Figure 6). The preoperative to postoperative outcomes were as follows: mHHS, from 54.72 ± 15.89 to 73.12 ± 19.47 ($P < .0001$); NAHS, from 56.05 ± 12.47 to 75.22 ± 19.15 ($P < .0001$); HOS-SSS, from 20.30 ± 20.21 to 44.23 ± 35.85 ($P < .0001$); and VAS pain, from 4.95 ± 2.70 to 2.67 ± 2.81 ($P < .0001$). The subset of patients for whom the iHOT-12 was reported (15/36) showed improvement from 26.89 ± 13.28 preoperatively to 60.31 ± 25.39 postoperatively ($P < .001$). Of the 36 patients,

TABLE 3
Preoperative and Minimum 2-Year Patient-Reported Outcomes Scores[a]

Outcome Measure	Preoperative	Minimum 2-Year	*P* Value
Modified Harris Hip Score	54.72 ± 15.89 (54.5) [39-64.25]	73.12 ± 19.47 (74) [58-90]	**<.0001**
Non-Arthritic Hip Score	56.05 ± 12.47 (55.13) [45-67.875]	75.22 ± 19.15 (73.75) [61.56-93.12]	**<.0001**
Hip Outcome Score Sport-Specific Subscale	20.30 ± 20.21 (15.28) [2.77-27.08]	44.23 ± 35.85 (33.33) [11.1-83.33]	**<.0001**
12-item International Hip Outcome Tool[b]	26.89 ± 13.28 (22.42) [16.89-33.31]	60.31 ± 25.39 (57.35) [40.20-79.72]	**<.0001**
Visual analog scale for pain[c]	4.95 ± 2.70 (5.35) [2.52-7.5]	2.67 ± 2.81 (2) [0-5]	**<.0001**
Visual analog scale for satisfaction[c]	—	7 ± 3.49 (8) [6-10]	

[a]Values are expressed as mean ± SD (median) [95% CI]. Boldface indicates statistically significant difference ($P < .05$).
[b]Scores available for 15 patients.
[c]On a scale from 0 to 10, with 10 being maximum pain and maximum satisfaction.

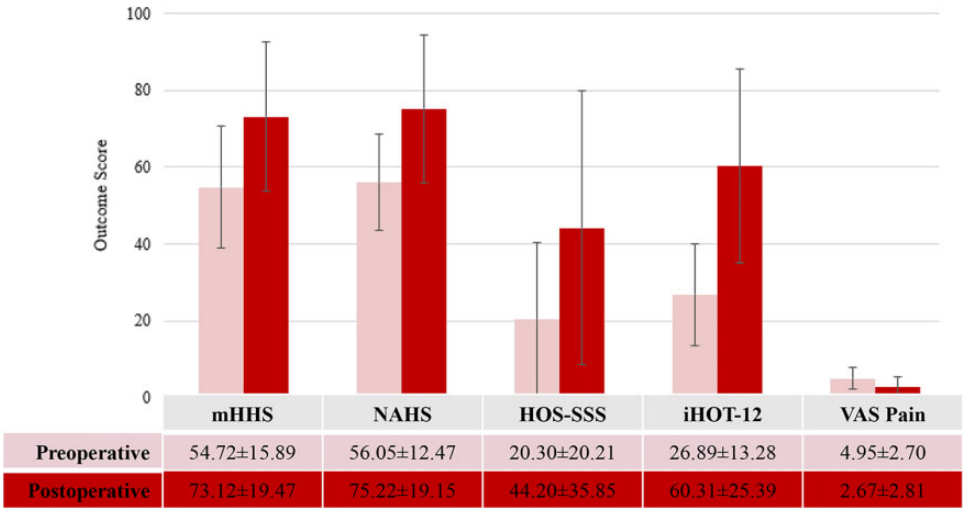

Figure 6. Patient-reported outcomes at baseline and minimum 2-year follow-up. All differences between pre- and postoperative scores were statistically significant ($P < .0001$ for all). Error bars represent standard deviation. HOS-SSS, Hip Outcome Score Sport-Specific Subscale; iHOT-12, 12-item International Hip Outcome Tool; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale.

TABLE 4
Minimal Clinically Important Difference (MCID) and Patient Acceptable Symptomatic State (PASS)

Measure	n
Modified Harris Hip Score	
MCID (≥8)	
Achieved	17
Did not achieve	19
PASS (≥74)	
Achieved	25
Did not achieve	11
12-item International Hip Outcome Tool	
PASS (≥72)	
Achieved	15
Did not achieve	0

25 (69.4%) achieved the PASS and 17 (47.2%) achieved the MCID for mHHS. All 15 patients for whom the iHOT-12 was reported achieved PASS for the iHOT-12 (100%) (Table 4).

Abductor Strength Test

Of the 36 patients examined, data were available for 35 patients who underwent preoperative and postoperative abduction strength tests, ranging from 3 to 6 months postoperatively. There were 7 patients who had a grade of 5 preoperatively and could not improve. Of the remaining 28 patients, 16 improved abductor strength scores by at least 1 grade, 5 patients remained at the same strength grade preoperatively to postoperatively, and 7 patients decreased in strength grade postoperatively. A significant improvement in pain was noted for this group overall ($P = .029$), with 71.43% of patients experiencing no pain upon abductor strength testing, an increase from 45.71% preoperatively.

DISCUSSION

In this ongoing study, full-thickness GM tears treated with an open approach and contemporary tendon repair techniques showed statistically significant improvement

with respect to 4 validated functional hip PROs and VAS pain scores at minimum 2-year follow-up. Of 36 patients, 25 (69.4%) achieved the PASS and 17 (47.2%) achieved the MCID for mHHS. All 15 patients for whom iHOT-12 scores were reported achieved PASS for the iHOT-12 (100%). Patient satisfaction, on average, was 7.0 out of 10. Of the 36 patients, 16 (44%) increased their strength by at least 1 grade on manual muscle testing, however, 7 patients had decreased abduction strength postoperatively. Moreover, 71.43% of patients experienced no pain upon abductor strength testing, an increase from 45.71% preoperatively. Pain on abductor strength testing decreased significantly from preoperatively to postoperatively ($P = .029$).

The literature indicates that GM tears have been shown to contribute to chronic lateral hip pain to a greater extent than was previously known.[9] Technological advancement in diagnostic imaging studies and targeted physical examinations have led to the increased recognition and management of abductor pathology.[24] Despite this, GM tears are quite often missed, highlighting the difficulty of managing lateral hip pain.[10,34] Nonetheless, once tears are correctly identified, treatment of abductor tears often leads to positive results.[7,34]

Some studies have reported clinical improvement and favorable PROs after GM repair. In their retrospective study, Makridis et al[32] examined 67 patients who underwent open GM repair with the double-row technique at an average of 4.6 years of follow-up (range, 1-8 years). Those investigators found good clinical results in 85% of patients, as indicated by significantly improved symptoms and a disappearance of abnormal MRI findings that are suggestive of abductor tear pathology. However, the investigators noted 11 treatment failures, 4 of which entailed significant muscle atrophy. When assessing potential predictors of outcomes, Makridis et al found muscle atrophy to be a negative prognostic factor ($P < .05$) and thus advocated caution in using this technique in patients with preoperative signs of muscle atrophy on MRI. Nonetheless, the investigators did not effectively report the type of GM tear treated, and it seems—based on the description provided—that mostly partial GM tears were included, which differs from the present investigation.

Walsh et al[43] conducted a study on 72 patients who underwent open GM tendon repair with nonabsorbable sutures in a vertical mattress configuration and bone tunnels; 67 of the patients were women, the average age was 62 years, and the minimum follow-up was 12 months. Outcomes were assessed with the Merle d'Aubergine–Postel hip scoring system.[13] Significant improvement was seen at 12-month follow-up, and 95% of patients had minimal or absent pain by 6 months postoperatively. Further, normal walking ability increased from 5% preoperatively to 78% by 6 months postoperatively. Nonetheless, only 7% of the original group described by Walsh et al had a full-thickness GM tear, whereas all patients in the current study had full-thickness GM tears. Our study showed similar improvement in outcome scores; however, in the Walsh et al study, approximately half of patients achieved the PASS and 69.4% of patients achieved the MCID for mHHS. Included among the patients in the current study who did not reach PASS were the 7 patients who had a decreased abductor strength grade postoperatively. Because of the variability of GM pathology and the time at which patients are treated, the success of the procedure may be limited. Moreover, progression of GM muscle fiber deterioration may continue after repair. Nonetheless, although MCID and PASS represent clinically significant improvement, patients in the current study were ultimately satisfied with the procedure (VAS satisfaction score of 7).

With the advancement of minimally invasive techniques, the use of endoscopic GM repair has increased. Although literature on the outcomes of endoscopic gluteal repairs is limited to small series and short-term follow-up periods, the procedure has been shown to produce positive results.[17,36] Chandrasekaran et al[6] evaluated the outcomes of endoscopic GM repair along with correction of intra-articular pathology in 34 patients with minimum 2-year follow-up. Those investigators noted significant improvement in PRO scores and a high satisfaction rating of 8.5. Further, 58% of patients who had a gait deviation preoperatively regained normal gait. Voos et al[41] similarly reported on 10 patients after endoscopic GM repair and found that at an average of 25 months, all patients had resolution of lateral hip pain, and 9 patients who had weakness in hip abduction preoperatively regained full strength.

With both approaches showing clear benefit, choice of treatment of abductor tears may become challenging. Studies have compared open versus endoscopic repair of abductor tendon tendinopathy; however, the conclusions have been inconclusive. Although a more technically demanding procedure, endoscopic repair has been shown to provide good results, with decreased overall morbidity compared with open repair.[7] Chandrasekaran et al[7] performed a systematic review to compare the outcome of open versus endoscopic gluteal tendon repair. The review analyzed 3 studies reporting on 127 patients who underwent open procedures and 4 studies reporting on 40 patients who underwent endoscopic procedures. The cohorts had similar outcome scores and improvement in abduction strength, however the open techniques had a higher reported complication rate. More specifically, the combined retear incidence was 10 of 127 patients in the open cohort compared with 0 of 40 patients in the endoscopic repair cohort. This finding may be related to more severe tears requiring the open approach.[1]

The choice of modality for GM repairs should be determined based on the size of the tear and retraction length of the tendon, as well as surgeon preference and expertise, to optimize results. This recommendation is corroborated by Nawabi et al,[34] who retrospectively examined 27 patients who underwent repair of the GM tendon. The study included 9 patients (9 hips) with open repair and 18 patients (21 hips) with endoscopic repair. The investigators found large and significant improvements in PROs as well as similar clinical outcomes between the 2 groups. Of note, the surgical time for the open technique was significantly shorter than that for the endoscopic technique, and it was suggested that open techniques are preferred for patients who have no intra-articular pathology requiring hip arthroscopy or when the tears are large and retracted. The open technique seems to be much more suitable for these

larger tears because of its ability for full footprint exposure, release of the retracted tear, and conversion to salvage procedure such as gluteus maximus and tensor fascia lata transfer if needed.[5]

Limitations

Limitations must be acknowledged for this ongoing study. First, this was a nonrandomized study without a control group. Second, data collection was performed in a prospective manner; nonetheless, this was a retrospective study, which introduces bias. Third, although this study is one of the largest case series of open management of full-thickness GM tears with minimum 2-year follow-up reported in current literature, the sample size was still small. Nonetheless, our sample was representative of the population of interest. Fourth, longer follow-up is required to demonstrate longevity of the results. Fifth, the inclusion of those patients who underwent GM repair with concomitant hip arthroscopy may act as a confounder on the overall effects of each procedure on patient outcomes.

Strengths

The inclusion of multiple validated functional hip outcome scores is a strength of this case series study. Currently, this is one of the few studies to report PROs specifically for patients with open repair of full-thickness GM tear (1) with minimum 2-year follow-up and (2) using modern tendon repair techniques.[4]

CONCLUSION

Patients who underwent open repairs, in the setting of full-thickness GM tears and with contemporary tendon repair techniques, achieved significantly improved results in several PRO scores at minimum 2-year follow-up.

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