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Degenerative gluteal tears associated with hip arthroplasty

Dani Gaillard-Campbell[1*] and Thomas Gross[1]

Abstract

Background Unrepaired chronic abductor tears may be a cause of residual pain and weakness after hip arthroplasty, but the current incidence is unclear.

Methods From 1994 to 2009, the senior surgeon performed 1628 hip resurfacing and 864 total hip arthroplasties without identifying any gluteal tears. We recognized our first case of concomitant abductor tear during a hip resurfacing procedure in April 2009. After this, we began following a protocol to identify and repair abductor tears in the next 5601 consecutive primary hip arthroplasties (5429 hip resurfacings and 172 total hips).

Results Women over 60 were the highest-risk group for abductor tear, with a 3.6% rate of tears identified. All tears were repaired. We found no differences in mean HHS and VAS pain score in patients with repair gluteal tears versus a control group of cases without a tear. Patients without a tear had higher postoperative UCLA activity scores at 2 years postoperative. The majority (98.1%) of hip arthroplasty patients with a gluteal tear repair at time of surgery presented with 4 or 5 abductor strength at their 2-year postoperative physical exam. Of our abductor tear cohort, 70.3% had no limp and 21.9% had a slight limp at 2 years postoperative.

Conclusions In a large group of hip arthroplasty cases ($n=4507$), we identified gluteal tears in 3.6% of women and 1.0% of men. All reported clinical outcomes (excluding mean HHS) in our cohort of hip arthroplasty patients did not differ significantly between cases without abductor tears and those that had gluteal repair at time of surgery. These results suggest abductor tears may be repaired at time of hip arthroplasty surgery without forgoing desirable functional outcomes.

Level of evidence Level 3 Retrospective Cohort Study.

Keywords Hip arthroplasty, Gluteus medius, Gluteus minimus, Abductor repair, Clinical outcomes, Hip function, Tendon tear

*Correspondence:
Dani Gaillard-Campbell
dani.gaillard@midorthoneuro.com
[1]Midlands Orthopaedics & Neurosurgery, 1910 Blanding Street, Columbia, SC 29201, USA

Introduction

The gluteal muscle-tendon structure is critical in maintaining stability of both the natural and artificial hip. The incidence of chronic abductor degenerative tears (CADT) associated with an arthritic hip is unknown, with published rates ranging widely from 1.6 to 22% [1–8] occurrence of CADT in patients with hip arthritis and pain. Based on these available reports, chronic abductor tendon degeneration seems to be more common in conjunction with a severely arthritic hip than as an isolated condition. CADT should then be of particular interest for patients with osteoarthritis undergoing either total hip arthroplasty (THA) or hip resurfacing arthroplasty (HRA).

In a typical orthopedic practice, it is standard protocol to perform a physical exam and obtain x-rays of the hip when a patient presents with hip pain and limp. MRIs are not routinely performed on arthritic cases. Thus, chronic degenerative abductor tears present in conjunction with significant arthritis may not be recognized until the time of surgery. Even as a patient's hip function improves after treating their joint pain with a hip arthroplasty, they may still have residual pain and limp. We therefore investigate the role unresolved CADTs, if any, play as one of the potential causes of residual pain and dissatisfaction after hip arthroplasty.

We hypothesize that abductor tears will be recognized more frequently with routine excision of any thick bursa so that the abductors can be adequately examined. We investigate the incidence of CADTs using this method, determine risk factors, and evaluate clinical outcomes after repair.

Patients and methods

In the last 10 years, metal artifact suppression (MARS) MRI has allowed us to begin diagnosing abductor tears, but the level of accuracy of this test for this purpose is not known. After becoming aware of degenerative abductor tears as a possible coexisting condition with degenerative osteoarthritis, our index of suspicion was raised enough to begin intraoperative examination of the abductors routinely during every hip arthroplasty procedure. In April 2009, we recognized our first concomitant abductor tear during an HRA procedure done through a posterior approach and repaired it. With time, we began noticing them more frequently. These tears were often hidden under a thick trochanteric bursa, and the trochanter often had a rough, gravely texture when palpated.

We maintained a database of all hip and knee cases performed by a single surgeon, to collect routine perioperative information, including details on complications and failures. We queried the database for all cases with a CADT repair. We divided these into three groups for analysis. Type 1 comprises isolated abductor tears without significant arthritis. Type 2 includes hip arthroplasty (THA and HRA) cases in which we recognized and repaired a concomitant chronic degenerative abductor tear. Lastly, Type 3 CADTs are degenerative tears recognized after hip arthroplasty in patients with some residual or recurrent symptoms.

Table 1 Summary of cases

Variable	All Tears	Study Cohort*
# of Cases (n)	87	74
Date Range (month/year)	4/2009-3/2023	
Rate of Tears	1.4%	
#, % Gluteus Minimus tears	9 (10.3%)	9 (12.2%)
#, % Gluteus Medius tears	35 (40.2%)	24 (32.4%)
#, % Minimus + Medius tears	43 (49.4%)	41 (55.4%)

*Study cohort includes gluteal tear cases where patient had a minimum of 1-year follow-up

Table 2 Demographics for study cohort

	Type 1	Type 2	Type 3	Total
# of Cases (n)	3 (4.1%)	66 (89.2%)	5 (6.8%)	74
Mean Age (Years)	57.5 ± 5.9	64.3 ± 6.4	58.1 ± 11.5	63.6 ± 7.0 (range: 42–78)
BMI	25.0 ± 1.7	27.6 ± 6.1	28.6 ± 6.3	27.5 ± 6.0 (range: 19–48)
#, % Female	3 (100%)	47 (70.1%)	3 (60.0%)	53 (71.6%)

Table 2. Summarizes cohorts for each category of gluteal tear. Type 1: tear without arthroplasty. Type 2: tear concomitant with arthroplasty. Type 3: tear discovered late after arthroplasty. *Study cohort includes only gluteal tears with minimum of 1-year postoperative follow-up captured

Between 10/1994 and 4/2009, we performed 2489 primary hip arthroplasties (1628 HRA and 861 THA) without noticing any abductor tears. Between 4/2009 and 1/2023, we performed 4507 primary hip arthroplasties (4304 HRA and 203 THA) and repaired 78 Type 2 abductor tears (1.4% incidence). During this period, 3 isolated abductor tears were repaired and 6 CADTs were repaired in a separate procedure years after the primary arthroplasty. Table 1 presents a summary of CAD types. The primary surgeon does not select against patients on the basis of age, sex, or diagnosis; patient demographics are listed in Table 2.

Of the 87 cases with identified gluteal tear, 74 cases (85.1%) had a minimum of 1-year postoperative follow-up. These 74 cases comprise our cohort of interest. These include 3 Type 1 tear, 66 Type 2, and 5 Type 3 abductor tears. To minimize the influence of confounding variables, we identified a subset of HRA cases that includes only our Type 2 tear group, and we compare their postoperative outcomes with a randomized subgroup of HRA cases without tears matched by age, BMI, and ratio of female cases. Type 1 and Type 3 tear groups were too small for comparative analysis.

Surgical technique

In this section, we detail the surgical technique for the repair of Type 2 tears. If the preoperative radiograph showed an irregular surface on the lateral aspect of the greater trochanter, or in the unusual situation where an MRI was done preoperatively and indicated a tear, the index of suspicion for a degenerative tear is raised. Typically, the senior surgeon utilized a minimally invasive 3–5 inch posterior approach for hip arthroplasty. After splitting the fascia and placing the Charnley retractor, the trochanteric attachment of the abductors was briefly inspected in all cases. If there was a thick bursa, this too raised the index of suspicion for a degenerative tear. The bursa was then completely excised to allow careful inspection of the abductors. If no tear was seen in the medius, the trochanteric surface was palpated with the index finger. If this surface was rough and gravely, the index of suspicion is again raised. The anterior third of the gluteus medius was then divided leaving a small cuff for repair and the minimus was examined. We diagnosed as an abductor tear if there was a disruption of tendinous attachment from the greater trochanter of more than 1 cm.

If a tear was recognized, the next step was to extend the distal skin incision by 1–2 inches to allow further anterior access by skin and fascia retraction than is required for hip arthroplasty alone. The hip arthroplasty was still performed with the standard technique, then the abductor tear(s) were addressed. In our experience, minimus tears were the most technically demanding and time-consuming repair. It was especially difficult to identify the tendon within and dissect it from the bed of chronic scar tissue. Part of the minimus tendon was fused with the hip capsule, while another part was often fused with the medius in a bed of scar tissue. The minimus needed to be separated from both to adequately identify and repair it. We therefore separately approached the minimus from posterior after detaching the piriformis where we could then find the plane between the minimus and the capsule below and the medius above. The connection between the minimus and the capsule was divided from posterior to allow complete mobilization of the minimus muscle. After complete isolation and mobilization, minimal debridement was performed. Then, two separate Krackow tendon stitches were placed with #2 Dynacord™ nonabsorbable suture from the tendon end fanning out into the broad expanse of the muscle. The lateral surface of the trochanter was cleared of soft tissue and gently burrowed to bleeding bone. A 4-mm x 8-mm longitudinal trough was then made into the trochanter about 5-mm deep with a high-speed burr. Three drill holes were made into the depths of the trough from widely diverging positions on the posterior trochanter. A simple suture passer was used to pull the four ends of the Dynacord™ sutures through, thereby dragging the tendon end into the trough. The leg was abducted and internally rotated on a pillow while the sutures were tied down over bone and then tied to each other. A #2 barbed absorbable PDS Quill™ suture was used to augment this repair to any adjacent portions of remaining intact minimus if indicated. Occasionally, we augmented extremely poor tissue with an absorbable mesh used for hernia repair as well. We sprayed platelet concentrate and vancomycin powder onto the site before the medius was repaired over it. We encountered most medius tears in the anterior third, repaired with two suture anchors, and augmented with #2 PDS Quill absorbable barbed suture. The rare posterior medius tear involving the tendinous portion was repaired with a Krackow stitch using a #2 Dynacord™ nonabsorbable suture into a bone trough.

Postoperative management

Since abductor engagement is necessary throughout each gait cycle for both movement and stability, severe stresses at the site of the repair may occur without precautions. Therefore, as soon as a tear is recognized, we warned patients that outcome is not as good as with isolated hip arthroplasty, that recovery would be longer, and restrictions would be severe. For maximum chances of success, we advised a prolonged period of protected weight bearing. Our protocol was 6 weeks of 10% weight bearing, followed by 1 month of advancing to 50%, and then another month of advancing to 100%. Thereafter, patients were advised to use a cane for at least another month to maintain hip forces at 2–3 times body weight before returning to unrestricted walking. We allowed unweighted, side-lying isometric abductor exercises at 3 months and more vigorous abductor strengthening starting at 6 months postoperative.

Postoperative follow-up

We requested patients return for follow-up at 6 weeks, 1-year, and 2-years postoperative, followed by a visit every other year thereafter. We collected radiographs and clinical questionnaires at each visit. A physical examination testing strength and range-of-motion was performed at 6-week and 1-year follow-ups. Questionnaires facilitated the collection information from patients necessary for calculating the following clinical scores: Harris hip score (HHS) [9], University of California, Los Angeles (UCLA) activity score [10], and visual analog scale (VAS) pain score for normal and worst days [11]. HHS grades clinical outcome; UCLA activity scores measure activity level after surgery on a scale from 1 to 10, for which 10 represented the highest level of activity; VAS pain scores rate the level of pain from 0 to 10, with zero representing no pain and 10 representing maximum debilitating pain. Limp scores were taken from patients self-reported

limp component of the HHS. Abductor strength was rated by a physician or physical therapist during physical examination.

Statistical analysis

All statistical analyses were performed using XLSTAT (Addinsoft, New York, NY) at a 95% confidence interval. We identified significant differences between group means using paired, 2-tailed Student's t-test and between rates using two-sample proportion Z-tests. For comparison of clinical outcomes, we used XLSTAT to randomize a subset of HRA cases without abductor tears ($n = 851$) matched by age, BMI, and ratio of female patients with the group of HRA cases with Type 2 tears.

Results

We list demographics for this study group in Table 2. The overall chance of finding a degenerative abductor tear (Type 2) at the time of primary hip arthroplasty in a young cohort (mean age 53.5 ± 8.5 years) was 1.3% among primary HRA cases and 5.2% in primary THA cases. The demographic with the highest incidence of concomitant abductor tear was women over age 60, with a Type 2 tear identified in 3.6% of cases.

We obtained completed 1-year follow-up on 85.1% of patients and >2-year follow-up on 70.1%. We summarize these clinical outcomes in Table 3. We compared 1- and 2-year postoperative outcomes of our study group ($n = 66$) with mean outcomes of a control group sub-cohort matched by demographics ($n = 851$) comprising cases of primary hip arthroplasty uncomplicated by a tear. In our demographics-matched patient cohort of HRA, cases performed from 2009 to 2021, average HHS was 98.7 for those without tears and 93.8 for those with a repaired gluteal tear at 2 years postoperative ($p < 0.0001$). Mean HHS for Type 1 and 3 tears were 89.9 and 85.5, respectively. Cases with tears had an average UCLA score of 6.1 vs. a mean of 6.6 for those without a tear ($p = 0.055$). Mean UCLA for Type 1 and 3 tears were 6.0 and 7.0, respectively. VAS pain scores were not significantly different between the two groups. The rate of clinically "normal" abductor strength scores (defined by abductor score = 5) was 85.7% for the study group, compared to 85.6% in the control group ($p = 0.575$). Of the gluteal tear cohort, 75.0% had no limp, and 21.4% had a slight limp. This compares to 95.4% and 3.6% in the control group, respectively ($p < 0.0001$). We present incidence of Type 2 abductor in any hip arthroplasty by year in Table 4. The numbers of Type 1 and Type 3 tears are too small for comparison, but results are provided.

Within the study cohort, there was one failure (1.4%) due to recurrent dislocation, which was revised 5 months postoperative. We observed two complications (2.7%). The first was a trochanteric tip avulsion occurring

Table 3 Clinical outcomes

Variable	Type 2 Tears	Control (HRA with no tear - matched demo)	*p*-value
Postoperative (2-year follow-up)			
Harris Hip Score	95.5 ± 6.0 (range: 72–100)	98.7 ± 4.3 (range: 43–100)	**< 0.0001***
UCLA Score	6.2 ± 1.9 (range: 3–10)	6.6 ± 1.9 (range: 1–10)	0.131
VAS Pain: Regular	0.2 ± 0.5 (range: 0–2)	0.2 ± 0.7 (range: 0–7)	1.000
VAS Pain: Worst	1.0 ± 1.5 (range: 0–7)	1.0 ± 1.7 (range: 0–10)	1.000
Mean Co at 2 years (µg/L)	1.9 ± 1.2 (range: 0.7–5.2)	1.6 ± 1.5 (range: 0.0-13.2)	0.306
Mean Cr at 2 years (µg/L)	1.7 ± 2.0 (range: 0.1–8.8)	1.6 ± 1.5 (range: 0.0-14.9)	0.739
Abduction Scores			
0	0 (0.0%)	0 (0.0%)	1.00
1	0 (0.0%)	0 (0.0%)	1.00
2	0 (0.0%)	7 (0.9%)	0.516
3	1 (2.0%)	23 (2.8%)	0.749
4	6 (12.3%)	86 (10.5%)	0.704
5	42 (85.7%)	700 (85.6%)	0.992
Limp Scores			
-1	0 (0.0%)	0 (0.0%)	1.00
0	2 (3.6%)	1 (0.1%)	**< 0.0001***
5	0 (0.0%)	7 (0.8%)	0.497
8	12 (21.4%)	31 (3.6%)	**< 0.0001***
11	42 (75.0%)	812 (95.4%)	**< 0.0001***

Table 4 Incidence of CAD by year

Year	Hip Arthroplasty Cases	Gluteal Tears
2009	402	1 (0.3%)
2010	398	1 (0.3%)
2011	411	2 (0.5%)
2012	402	4 (1.0%)
2013	360	3 (0.8%)
2014	394	3 (0.8%)
2015	439	5 (1.1%)
2016	323	10 (3.1%)
2017	407	7 (1.7%)
2018	427	5 (1.2%)
2019	409	6 (1.5%)
2020	342	8 (2.3%)
2021	241	13 (5.4%)
2022	262	8 (3.1%)
2023	384	2 (0.5%)
TOTAL	**5601**	**78 (1.4%)**

1-month postoperative; this fracture was treated conservatively. Next, there was one late trochanteric fracture at 2 years postoperative which was repaired.

Discussion

Chronic abductor degenerative tears associated with severe hip arthritis are more common than is generally appreciated [1–7]. Although it can occur at any age, it is most common in women above 60 [7, 12], where we found the incidence to be 3.6%. In our study cohort, men beyond 60 presented a CADT incidence of 1.2%. Published reports suggest residual pain after THA occurs in approximately 20% of cases [13–15]; unexplained moderate residual pain occurs in 2% of our HRA population [16]. It is unknown if any of these are due to unrecognized CADT.

Before our first case recognized in 2009, we had performed thousands of THA and HRA without ever diagnosing an abductor tear. Now, we discover them in approximately 1.4% of hip arthroplasty cases. We have a unique practice focused primarily on HRAs in young patients; this could explain the lower incidence of abductor tears compared to the literature, as CADTs are expected to be more common in older patients [16, 17]. According to our data, it seems that the general arthroplasty surgeon with a mean patient age is 70 should be experiencing abductor tears in no less than 3.5% of their female and 1% of their male patients.

Our results demonstrate that the clinical outcome of cases where CADT is recognized and repaired is quite good but not quite as good as other primary hip arthroplasty patients in our database. We do not know what the outcome would be if the abductor tear was left unrepaired. As soon as we began recognizing them, we began repairing them. We are unable to justify creating a treatment arm of documented tears without repair. Residual lateral hip pain is not uncommon after THA [18], therefore it seems that looking for and repairing CADT should be a part of every hip arthroplasty operation. This is in fact what we have been doing since 2009.

There are several notable limitations to this study worth mentioning. The first weakness is inherent to the nature of retrospective studies, with naturally falling out of follow-up and the consecutive implementation of interventions introducing conflicting variables. Another flaw is, by nature of study design, we are unable to compare our study group of hip arthroplasties with repaired concomitant gluteal tears to a control group of unrepaired tears in arthroplasty cases. While there may have been unrecognized tears in the control group, no tears that were identified would be left unrepaired during surgery. Next, this study is done by a high-volume hip surgeon and may not be generalizable. Further, these results mainly comprise resurfacing cases (95% of study group); thus, outcomes may differ from cohorts of exclusively THA cases. While these findings are more applicable to HRA, these results still elucidate relevant information on outcomes of concomitant gluteal tears in hip arthroplasty, especially considering the current lack of published information. Lastly, it is possible we have missed cases of abductor tears in the control group. Most reports on primary THA or HRA lack sufficient data on the rate of concomitant abductor tears, so it is difficult to compare our results to the established literature. There are two possible solutions to increasing the rate of identification of gluteal tears: routinely detaching the gluteus medius in every operation to explore the minimus or obtaining a routine MRI before every hip arthroplasty. As our date suggests gluteal tears occur at a rate of 3.6% within our cohort of women over the age of 60, obtaining routine preoperative MRI preop may be worthwhile in these cases.

Table 5 Literature comparison

	Primary Cases	Total Tears	Mean Postoperative HHS	Revision
Current	4161	56 (1.3%)	93.8 ± 11.5 (range: 72–100)	0 (0%)
Domb et al. [16]	989	50 (5.1%)	86.2	4 (8%)
Howell et al. [8]	176	34 (20%)	N/A	N/A
Betz et al. [7]	40 high-risk	20 (50%)	91 ± 13	N/A
Cates et al. [1]	513	8 (1.6%)	N/A	N/A

Publications on the incidence of concomitant gluteal tear with hip arthroplasty remain lacking. We summarize relevant available literature in Table 5. From a cohort of 989 total hip arthroplasty patients, Domb et al. [19] identified 50 with gluteal tear or tendinopathy. However, only 163 met their inclusion/exclusion criteria, including having preoperative MRI. These 50 cases thus represent a rate of 5% gluteal tear within the large THA cohort or 30% of those with available MRI. Within a cohort of patients with obvious abductor weakening or other complex deformity, Betz.et al. [7] identified a rate of 50% gluteal tears with preoperative MRI. However, this high-risk cohort of 40 was taken from a larger sample of 1342 hip arthroplasty patients. Thus, neither of these rates are generalizable to average arthroplasty cohorts. A survey of 459 French orthopedic surgeons suggested that tears of the gluteal tendon are likely underrecognized [6]. Our current data suggests that at a typical orthopedic practice, approximately 4% of women and 1% of men will have a concomitant abductor tear. These values are consistent with several sources among available peer-review literature.

In conclusion, CADT seems to be a poorly understood and underreported problem in hip arthroplasty that needs further study. Our small series indicates that good outcomes can be achieved if the problem is recognized and repaired at the time of primary hip arthroplasty.

On the other hand, we cannot know how these patients would fare if the CADT was left unrepaired. We are publishing these data to raise awareness of CADT and encourage other surgeons to publish their outcomes, particularly those with older THA populations. It is our hope that if this problem becomes widely recognized and addressed at the time of primary hip arthroplasty that the rate of residual pain and limp after THA will drop.

Abbreviations

CADT	Chronic abductor degenerative tear
THA	Total hip arthroplasty
HRA	Hip resurfacing arthroplasty
MARS	Metal artifact suppression
HHS	Harris Hip Score
UCLA	University of California, Los Angeles
VAS	Visual analog scale

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Author contributions
All authors contributed to this work. The senior author (TPG) was responsible for study design, initial draft, and proofreading. The corresponding author (DGC) was responsible for data collection and analysis, initial draft, and proofreading.

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Data availability
Summary data are available in the attached data tables. Raw data free of patient-identifying information is available upon request, or within the Synapse data repository (SynID: syn61979705).

Declarations

Ethics approval and consent to participate
We present a retrospective analysis of data collected per standard of care, with patient information withheld. In accordance with U.S. Department of Health and Human Services regulations for the protection of human subjects in research, this type of study is exempt from IRB review based on 45 CFR 46, "Collection or Study of Existing Data", considering the HIPPA Privacy Rule (45 CFR 160 and 164a). Patients are informed preoperatively that their blinded clinical data may be analyzed for trends and published on, and they sign a consent form of acknowledgement prior to surgery.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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