The Effect of Platelet-rich Fibrin Matrix at the Time of Gluteus Medius Repair: A Retrospective Comparative Study

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Purpose: To evaluate the effect of platelet-rich fibrin matrix (PRFM) on outcomes after surgical repair of gluteus medius tendons. **Methods:** This is a retrospective review of prospectively collected data comparing patients who underwent gluteus medius repair with PRFM and patients without PRFM. Preoperative characteristics, intraoperative characteristics, and postoperative outcomes at a minimum of 1 year were recorded. Statistical analysis was performed using a multivariate analysis of variance to test for differences in continuous demographic variables and postoperative-only scores between patient groups, χ^2 tests were performed for categorical variables, and a repeated-measures analysis of variance was performed to test for the effects of PRFM. We also assessed for interobserver variation in grading adductor tendon tears. **Results:** In total, the series of gluteus medius repairs without PRFM included 29 patients (25 women and 4 men, 15 right and 4 left) with a mean age of 63.09 ± 12.0 years. The series of gluteus medius repairs with PRFM included 18 patients (16 women and 2 men, 6 right and 12 left) with a mean age of 60.26 ± 8.8 years. There were no differences in patient preoperative variables or intraoperative characteristics. Although there was a significant effect of surgical intervention on the visual analog scale for pain, Hip Outcome Score—Activities of Daily Living, Hip Outcome Score—Sports Specific, and modified Harris Hip Score, the use of PRFM had no significant effect on outcome. Linear models showed a significant positive effect of PRFM on only postoperative Short Form 12 Physical and International Hip Outcome Tool 12 scores. **Conclusions:** PRFM augmentation does not appear to have an effect on gluteus medius tendon repair in terms of pain or clinical evidence of retears but may have a role in improving subjective outcomes of overall and hip-specific physical functioning. **Level of Evidence:** Level III, retrospective comparative study.

The gluteus medius and minimus muscle—tendon complexes provide a critical role in gait function and hip stability.[1] Hip abductor tendon tears are typically seen in older individuals and can be a debilitating cause of lateral hip pain, weakness, and dysfunction.[2-5] Although initially an elusive diagnosis, our ability to diagnose abductor tendon tears has improved with refined physical examination techniques and imaging studies.[6-9] When conservative management including physical therapy, activity modifications, and injections fails, surgical intervention is appropriate; however, success rates remain in the 75% to 90% range, with some patients exhibiting persistent weakness and pain despite repair.[2,8,10,11] In some studies rerupture rates of 11% at 6 months and 31% at 12 months postoperatively have been reported.[12,13] As well, certain negative predictive factors, including muscle atrophy, continue to be difficult to overcome with surgical means and thus are examples of where improvements can be generated.[11]

Platelet-rich plasma (PRP) has, in the past decade, emerged as a highly studied augmentation strategy for the healing environment of tendinopathy and ligamentous injury.[14,15] Its efficacy is believed to be a

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result of a cytokine reservoir that releases numerous growth factors through alpha-granule degranulation,[16] to enhance gene expression of matrix proteins, fibroblast proliferation, and collagen production.[17,18] Platelet-rich fibrin matrix (PRFM) is a delivery means of PRP that uses a fibrin matrix pellet that acts as a scaffold to enable cell migration into the site of repair and provide an extended release of growth factors.[19-21] Although its efficacy in use for animal-model and human rotator cuff tendon repair or anterior cruciate ligament reconstruction has been ineffective or equivocal at best,[19,22] its effectiveness as an adjunct to gluteus medius tendon repair has not previously been studied.

The purpose of this study was to evaluate the effect of PRFM on outcomes after surgical repair of gluteus medius tendons. We hypothesized that PRFM would accelerate abductor tendon healing and lead to superior clinical outcomes and lower clinically evident retear rates.

Methods

Patients

This study proceeded after review and approval from the institutional review board. The prospective database of the senior author (S.J.N.) was accessed from its inception (January 2010) to September 2014 to identify all patients who had undergone gluteus medius and/or minimus tendon repair—with or without the application of PRFM—with at least 1 year of follow-up (most were near the 2-year postoperative time point). Patients were excluded only if the tear was irreparable by primary repair means; all other patients were included. Ultimately, patients in the "no treatment" group were those who underwent gluteus medius repair without PRFM, whereas the "treatment" series of patients were those who underwent repair with application of PRFM. Table 1 highlights a summary of the included comparative variables.

Table 1. Summary of Preoperative, Intraoperative, and Postoperative Data Compared Between Group With PRFM (Treatment) and Group Without PRFM (No Treatment)

Preoperative
Sex (M or F)
Date of surgery
Age at surgery (in years)
Laterality (R or L)
Presence or absence of femoroacetabular impingement
Presence or absence of abductor atrophy noted by MRI or examination
Tear size*
Tear grade (out of 4)
G-F classification (out of 4)
Presence or absence of fatty infiltration
Presence or absence of limp on physical examination
History of orthopaedic surgery (yes or no)
History of surgery on ipsilateral hip (yes or no)
History of surgery on contralateral hip (yes or no)
History of spinal surgery (yes or no)
Time between symptom onset and surgical intervention (in months)
Mechanism of injury†
Clinical scores (VAS for pain, HOS-ADL, HOS-SS, mHHS)
Intraoperative
Procedural approach (open vs endoscopic)
Concomitant gluteus maximus transfer at time of surgery (yes or no)
Repair characteristics (single row vs double row)
Postoperative
Final follow-up time (in years)
Presence or absence of repeat tear
Clinical scores (HOS-ADL, HOS-SS, HHS, mHHS, VAS for pain, patient satisfaction, SF-12 Physical, iHOT-12)

F, female; G-F, Goutallier-Fuchs; HHS, Harris Hip Score; HOS-ADL, Hip Outcome Score—Activities of Daily Living; HOS-SS, Hip Outcome Score—Sport Specific; iHOT-12, International Hip Outcome Tool 12; L, left; M, male; mHHS, modified Harris Hip Score; MRI, magnetic resonance imaging; PRFM, platelet-rich fibrin matrix; R, right; SF-12, Short Form 12; VAS, visual analog scale.

*Tear size was categorized as either a small or low-grade partial tear measuring less than 2 cm, a large or high-grade partial tear measuring greater than 2 cm, or a large or high-grade full-thickness tear measuring greater than 2 cm.

†Mechanism of injury was defined as either acute injury (referring to a recollection of a single distinct occurrence when symptoms began) or insidious onset (referring to no recollection of a discrete injury).

Preoperative Evaluation

As is customary of the senior author's clinic, all patients had undergone a standard preoperative assessment. Specific to this study's evaluation, we highlight the patient's gait analysis (presence or absence of a limp), strength testing, notable abductor atrophy on examination, and whether the patient was diagnosed with femoroacetabular impingement (FAI). The following demographic variables were recorded as well: patient sex, date of surgery, age at surgery, and laterality. The patient's history was scrutinized for any orthopaedic surgery, surgical intervention on the ipsilateral hip or contralateral hip, or spinal surgery. Patients were also questioned on the mechanism of injury that resulted in the inception of symptoms (specifically whether a single acute injury was responsible or whether the symptoms were more insidious and not attributable to a single discrete episode).

For those patients with a preoperative magnetic resonance imaging (MRI) scan on file, we scrutinized the imaging for tear grade, presence of abductor atrophy and/or fatty infiltration, tear size, and Goutallier-Fuchs classification grade.[23] Tear size was categorized as one of the following by the senior author: small or low-grade partial tear measuring less than 2 cm, large or high-grade partial tear measuring greater than 2 cm, or large or high-grade full-thickness tear measuring greater than

2 cm. The Goutallier-Fuchs classification grade was applied as per Bogunovic et al.,[1] given their recent suggestion of its reliability and reproducibility in evaluating abductor tendon tears of the hip, in addition to its correlation with patient-rated outcomes after repair.

Preoperative patient-reported outcome scores were also obtained and included a visual analog scale (VAS) for pain and the Hip Outcome Score—Activities of Daily Living (HOS-ADL), Hip Outcome Score—Sports Specific (HOS-SS), and modified Harris Hip Score (mHHS). All patients diagnosed with abductor tendon tears had symptoms of lateral hip pain, tenderness on palpation of the greater trochanter, weakness with resisted hip abduction, and findings on MRI of gluteus medius and/or minimus tears.[1]

Operative Technique, Intraoperative Variables, and Postoperative Rehabilitation

In all patients indicated for operative repair, a trial of conservative management had failed, with a combination of activity modification, oral anti-inflammatory medications, a focused physical therapy regimen, and corticosteroid injections. The time between symptom onset and surgical intervention was recorded. Before surgical intervention, for each patient, the decision as to whether to supplement the repair site with PRFM was made by the patient after a discussion of the associated risks, benefits, and costs.

Specific surgical variables that were recorded during data extraction for analysis included the approach (open vs endoscopic) and repair technique (single row vs double row). Again, tear size (categorized as described earlier), abductor atrophy, and fatty infiltration were noted by the senior author intraoperatively and used to addend the findings from the preoperative MRI appearance. The performance of a concurrent gluteus maximus transfer to augment surgical repair was identified in few patients.

The surgical approach differed based on the use of an open or endoscopic technique,[24] but common to all procedures was a thorough bursectomy, debridement of the torn abductor tendons, decortication of the insertion site on the greater trochanter, use of 5.5-mm BioComposite anchors double loaded with No. 2 high-strength sutures (Bio-Corkscrew; Arthrex, Naples, FL), and suture placement in a horizontal mattress configuration. Typically, small or medium tears (<2 cm) were repaired in a single-row fashion with 1 or 2 suture anchors, whereas large or massive tears (>2 cm) were repaired in a double-row suture bridge fashion with the medial-row suture limbs incorporated into 1 laterally placed knotless anchor (SwiveLock; Arthrex).[1]

Postoperative rehabilitation was standardized and followed a 3-phase protocol. Phase I (0-6 weeks postoperatively) included full-time bracing to limit abduction, allowing only gentle passive range of motion, as well as partial weight bearing with a walker or crutches. In phase II (6-12 weeks postoperatively) the patient progressed to full weight bearing and initiated hip-strengthening exercises as the brace was discontinued. Phase III (>12 weeks postoperatively) allowed for ambulation without assistance and return as tolerated to general activity.

Postoperative Outcome Measures

All patients were evaluated at least 1 year postoperatively (most were near the 2-year postoperative time point) from initial surgical intervention. The presence or absence of a repeat clinically evident gluteus medius tear by physical examination findings (persistent or recently developed weakness of abductor strength against resistance and/or Trendelenburg sign) and/or corroborating MRI (gold standard for assessing retears) was recorded—when the senior author had clinical concerns, on the basis of examination findings or patient history, for a retear, an MRI scan was obtained for confirmation (MRI was not performed routinely postoperatively to evaluate the repair site). Patient-reported outcomes were again obtained at this final clinical visit and included the HOS-ADL, HOS-SS, Harris Hip Score (HHS), mHHS, VAS for pain, Short Form (SF) 12 Physical, and International Hip Outcome Tool (iHOT) 12 scoring scales. A supplemental questionnaire was used to assess overall postoperative patient satisfaction, rated on a scale from 0 to 10.

Statistical Analysis

We used independent-samples t tests to assess for differences in continuous demographic variables between our 2 patient experimental groups. We conducted χ^2 tests on categorical (or ordinal) demographic variables. We performed a repeated-measures analysis of variance (rm-ANOVA) for VAS, HOS-ADL, HOS-SS, and mHHS, which were each measured preoperatively and postoperatively, to test for the effects of surgical intervention (time parameter in rm-ANOVA) and PRFM (treatment parameter), as well as their interaction (treatment-by-time interaction). With rm-ANOVA, a significant time effect would indicate the positive effect of surgical intervention, whereas a positive treatment-by-time interaction would indicate that PRFM modified the magnitude of the surgical treatment (i.e., had a positive effect).[25] Independent-samples t tests were again run for HHS, patient satisfaction, SF-12 Physical, and iHOT-12, which were each measured postoperatively only. In addition, we conducted a post hoc power analysis on these parameters using the sample size, α of .05, and effect size. The effect size was calculated following the protocol of Rosenthal and Rosnow[26] using the t value and degrees of freedom from the prior conducted t test. We also calculated the sample size needed to achieve significance with 2

nonsignificant values: HHS and patient satisfaction. We conducted *t* tests and rm-ANOVA using SPSS software (IBM). To assess interobserver reliability for grading the tear, we had 3 independent observers (a medical doctor—researcher whose work focuses on orthopaedic hip arthroscopic surgery [G.U.], a fourth-year orthopaedic surgery resident [B.M.S.], and an orthopaedic sports medicine fellow [E.C.M.]; all with clinical experience in grading MRI scans by this classification scheme) assign a grade to the corresponding MRI scan; we then analyzed their reported values using the Fleiss κ. We conducted χ^2 tests and assessed inter-rater reliability in the R program (R Foundation for Statistical Computing). We used the *irr* package to calculate the Fleiss κ for inter-rater reliability and used the *pwr* package to calculate power. Results were considered significant with $P < .05$, and values are reported as mean accompanied by a 95% confidence interval (CI).

Results

Table 2 details the preoperative characteristic comparisons between the 2 patient groups. In total, the series of gluteus medius repairs without PRFM included 29 patients (25 women and 4 men, 15 right and 14 left) with a mean age of 63.09 ± 12.0 years (95% CI, 58.53-67.64 years). Most of these patients had preoperative

Table 2. Comparison of Preoperative Characteristics Between Groups

Preoperative Variable	Gluteus Medius Repair Without PRFM (No Treatment)	Gluteus Medius Repair With PRFM (Treatment)	*P* Value
No. of patients	29	18	—
Sex (female), n	25 (86.2%)	16 (88.9%)	.745*
Age, yr			
Mean (range)	63.09 ± 12.0 (37.8-88.5)	60.26 ± 8.8 (46.2-74.2)	.391†
95% CI	58.53-67.64	55.88-64.64	
Laterality (right hip), n	15 (51.7%)	6 (33.3%)	.218*
FAI, n	21 (72.4%)	10 (55.6%)	.236*
Abductor atrophy, n	20 (69.0%)	11 (61.1%)	.581*
Tear size, n			.773*
Small or low-grade partial tear	9 (31.0%)	6 (33.3%)	
Large or high-grade partial tear	17 (58.6%)	9 (50.0%)	
Large or high-grade full tear	3 (10.4%)	3 (16.7%)	
Tear grade			Without PRFM: .065* With PRFM: .409*
1	13 (44.9%)	4 (22.2%)	
2	6 (20.7%)	5 (27.8%)	
3	3 (10.3%)	2 (11.1%)	
4	7 (24.2%)	7 (38.9%)	
Goutallier-Fuchs classification	n = 25	n = 14	Without PRFM: .178* With PRFM: .963*
1	9 (36%)	4 (28.6%)	
2	9 (36%)	3 (21.4%)	
3	3 (12%)	4 (28.6%)	
4	4 (16%)	3 (21.4%)	
Fatty infiltration, n	18 (62.1%)	10 (55.6%)	.658*
Limp, n	19 (65.5%)	11 (61.1%)	.760*
Surgical history, n			
Any orthopaedic surgery	19 (65.5%)	10 (55.6%)	.495*
Ipsilateral hip	4 (13.8%)‡	3 (16.7%)§	.788*
Contralateral hip	2 (6.9%)‖	2 (11.1%)¶	.615*
Spine	5 (17.2%)	0 (0%)	.062*
Duration of symptoms before surgery, mo			
Mean (range)	29.98 ± 28.5 (3.5-128)	33.35 ± 60.3 (2-240)	.798†
95% CI	19.14-40.82	2.37-64.33	
Mechanism of injury, n			.869*
Acute injury	9 (31.0%)	6 (33.3%)	
Insidious onset	20 (69.0%)	12 (66.7%)	

CI, confidence interval; FAI, femoroacetabular impingement; PRFM, platelet-rich fibrin matrix.
**P* values obtained from χ^2 analysis.
†Multivariate analysis of variance conducted on preoperative characteristics.
‡Included bursectomy and iliotibial band lengthening (n = 1), FAI repair (n = 2), and arthroscopic and open gluteus medius repair (n = 1).
§Included total hip arthroplasty (n = 1), hamstring repair (n = 1), and open gluteus medius repair with gluteus maximus transfer (n = 1).
‖Included trochanteric bursectomy (n = 1) and proximal femur fracture intramedullary nailing with subsequent removal of hardware and trochanteric bursectomy (n = 1).
¶Included open gluteus medius repair (n = 1) and endoscopic gluteus medius repair (n = 1).

Table 3. Comparison of Intraoperative Characteristics Between Groups Using χ^2 Analysis

Intraoperative Variable	Gluteus Medius Repair Without PRFM (No Treatment)	Gluteus Medius Repair With PRFM (Treatment)	*P* Value
Procedural approach, n			.114
Open	1 (3.4%)	3 (16.7%)	
Endoscopic	28 (96.4%)	15 (83.3%)	
Concomitant gluteus maximus transfer, n	3 (10.3%)	1 (5.6%)	.567
Repair characteristics, n			.869
Single row	9 (31.0%)	6 (33.3%)	
Double row	20 (69.0%)	12 (66.7%)	

PRFM, platelet-rich fibrin matrix.

FAI (72.4%), abductor atrophy (69.0%) with fatty infiltration (62.1%), and a limp (65.5%). This group had endured symptoms for a mean of 29.98 ± 28.5 months (95% CI, 19.14-40.82 months) before surgery. Most tears were large or high-grade partial tears (58.6%) with an insidious onset of symptoms (69.0%). Inter-rater reliability showed "fair" agreement, with a Fleiss κ value of 0.283 ($P = .0001$). The final mean follow-up period was 2.61 ± 1.0 years (range, 1.3-6.3 years; 95% CI, 2.25-2.96 years) for the patients without PRFM and 2.13 ± 0.6 years (range, 1.2-3.5 years; 95% CI, 1.86-2.39 years) for those with PRFM.

The series of gluteus medius repairs with PRFM included 18 patients (16 women and 2 men, 6 right and 12 left) with a mean age of 60.26 ± 8.8 years (95% CI, 55.88-64.64 years). Similar to the series without PRFM, most of these patients had preoperative FAI (55.6%), abductor atrophy (61.1%) with fatty infiltration (55.6%), and a limp (61.1%). This group had endured symptoms for a mean of 33.35 ± 60.3 months (95% CI, 2.37-64.33 months) before surgery. Again, most tears were large or high-grade partial tears (50.0%) with an insidious onset of symptoms (66.7%). There were no statistically significant differences observed between patient groups in terms of continuous and categorical preoperative variables (results of *t* tests and χ^2 analysis are shown in Table 2).

Table 3 details the intraoperative characteristic comparisons between the 2 groups. Most patients underwent endoscopic surgery (96.4% in series without PRFM vs 83.3% in series with PRFM) with double-row repair (69.0% in series without PRFM vs 66.7% in series with PRFM). There were few concomitant gluteus maximus transfers in either group (10.3% in series without PRFM vs 5.6% in series with PRFM). Again, there were no statistically significant differences observed between groups in terms of intraoperative variables.

At final follow-up of 2.61 ± 1.0 years (range, 1.3-6.3 years) for the series without PRFM and 2.13 ± 0.6 years (range, 1.2-3.5 years) for the series with PRFM, only 1 clinical retear (5.6%) had occurred in the series with PRFM and 3 clinical retears (10.3%) had occurred in the series without PRFM (no significant difference, $P > .05$), with all retears confirmed by MRI. An additional 5 patients in the series with PRFM and 8 patients in the series without PRFM underwent MRI evaluation postoperatively given patient symptoms and/or examination findings, and in these patients the MRI scan did not show a significant failure of the abductor repair site. In terms of patient-reported outcomes with reported values both preoperatively and postoperatively, there was a significant effect (as per rm-ANOVA) of surgical intervention on VAS pain score, HOS-ADL, HOS-SS, and mHHS (Table 4). However, there was no treatment-by-time interaction, indicating that the use of PRFM had no significant effect on the nature of the outcome after surgery (Fig 1, Table 5).

Four outcome scores—SF-12 Physical, iHOT-12, HHS, and patient satisfaction—were measured only postoperatively in each series. There was a significant effect (as per *t* test) of PRFM on SF-12 Physical score (effect size, 0.651) and iHOT-12 score (effect size, 0.467) when the series were compared ($P = .016$ and $P = .029$, respectively; Fig 2). No significant effect was detected for HHS (effect size, 0.116; $P = .444$) or patient satisfaction (effect size, 0.096; $P = .534$). To detect significant effects of PRFM on HHS and patient satisfaction, 86 patients and 80 patients, respectively, would be needed in each group.

Discussion

Our study shows that no differences were seen in clinically evident retear rate (which was remarkably low in each group in our study) or pain with PRFM use; moreover, preoperative to postoperative improvements in most patient-reported outcome scales (VAS for pain, HOS-ADL, HOS-SS, and mHHS), as well as postoperative HHS and patient satisfaction, at about 2 years postoperatively showed no significant differences. However, the use of PRFM had a significant positive effect on postoperative SF-12 Physical and iHOT-12 scores.

The outcomes of gluteus medius and minimus tendon repair have been improving recently but remain imperfect with room for improvement. Makridis et al.[11] evaluated 67 patients (62 women and 5 men) at a mean follow-up of 4.6 years, after each underwent an open double-row repair. They reported significant improvements in VAS score, Lequesne index, and HHS but had a 16% failure rate including 2 repeat tears. Muscle atrophy—but not fatty degeneration—had a significant negative impact on functional outcome as per their analysis as well, and they thus found these results encouraging but suggested that the technique needed to be performed

Table 4. Comparison of PRO Scores Between Groups

Variable (PRO)	Preoperative	Postoperative	*P* Value
Gluteus medius repair without PRFM (no treatment)			
VAS pain score			
Mean (range)	6.4 ± 1.7 (2-9)	1.92 ± 2.1 (0-7.54)	<.001
95% CI	5.69-7.08	1.09-2.74	
HOS-ADL			
Mean (range)	57.8 ± 11.2 (33-76.43)	82.79 ± 11.8 (53-100)	<.001
95% CI	54.67-62.94	78.20-87.38	
HOS-SS			
Mean (range)	37.21 ± 12.7 (9-55.12)	72.31 ± 18.0 (11.1-98.5)	<.001
95% CI	32.07-42.35	65.33-79.30	
mHHS			
Mean (range)	55.96 ± 6.1 (41-65)	78.72 ± 13.5 (41.8-100)	<.001
95% CI	53.37-58.54	73.48-83.96	
HHS			
Mean (range)	—	77.24 ± 13.3 (40-91)	
95% CI		72.09-82.38	
SF-12 Physical score			
Mean (range)	—	28.09 ± 8.3 (16.4-42.1)	
95% CI		21.71-34.47	
Patient satisfaction rating			
Mean (range)	—	89.29 ± 13.5 (60-100)	
95% CI		84.05-94.52	
iHOT-12 score			
Mean (range)	—	44.03 ± 24.0 (19.4-94.3)	
95% CI		26.84-61.21	
Gluteus medius repair with PRFM (treatment)			
VAS pain score			
Mean (range)	7.17 ± 2.0 (4-10)	2.51 ± 2.6 (0-8.1)	<.001
95% CI	5.98-8.32	0.93-3.90	
HOS-ADL			
Mean (range)	53.74 ± 13.9 (37-90.4)	82.73 ± 15.4 (33.8-100)	<.001
95% CI	45.27-60.96	71.79-92.69	
HOS-SS			
Mean (range)	30.44 ± 21.9 (2.8-81.2)	68.04 ± 26.4 (0-100)	<.001
95% CI	17.80-43.08	62.14-84.41	
mHHS			
Mean (range)	50.87 ± 11.1 (38-72)	77.01 ± 19.9 (26.4-100)	<.001
95% CI	44.94-56.80	67.13-86.89	
HHS			
Mean (range)	—	73.58 ± 18.9 (24-91)	
95% CI		64.19-82.98	
SF-12 Physical score			
Mean (range)	—	45.50 ± 10.1 (35.8-56.8)	
95% CI		27.49-58.50	
Patient satisfaction rating			
Mean (range)	—	82.1 ± 31.6 (0-100)	
95% CI		84.43-99.53	
iHOT-12 score			
Mean (range)	—	64.61 ± 31.9 (1.4-98.8)	
95% CI		52.86-86.89	

CI, confidence interval; HHS, Harris Hip Score; HOS-ADL, Hip Outcome Score—Activities of Daily Living; HOS-SS, Hip Outcome Score—Sport Specific; iHOT-12, International Hip Outcome Tool 12; mHHS, modified Harris Hip Score; PRFM, platelet-rich fibrin matrix; PRO, patient-reported outcomes; SF-12, Short Form 12; VAS, visual analog scale.

before muscle atrophy set in on preoperative MRI. Domb et al.[27] found effective results with endoscopic surgical repair through a transtendinous or full-thickness technique at a minimum follow-up of 2 years, with good to excellent patient satisfaction and postoperative improvements in all evaluated hip-specific outcome scores for 14 of 15 patients evaluated.

Alpaugh et al.[6] systematically reviewed the literature on abductor tendon repair. They identified that most patients (90%) undergoing surgical repair for partial- and full-thickness tears are predominantly women, which our groups reflect as well. Although both open and endoscopic techniques are viable surgical approaches with good or excellent functional results, they

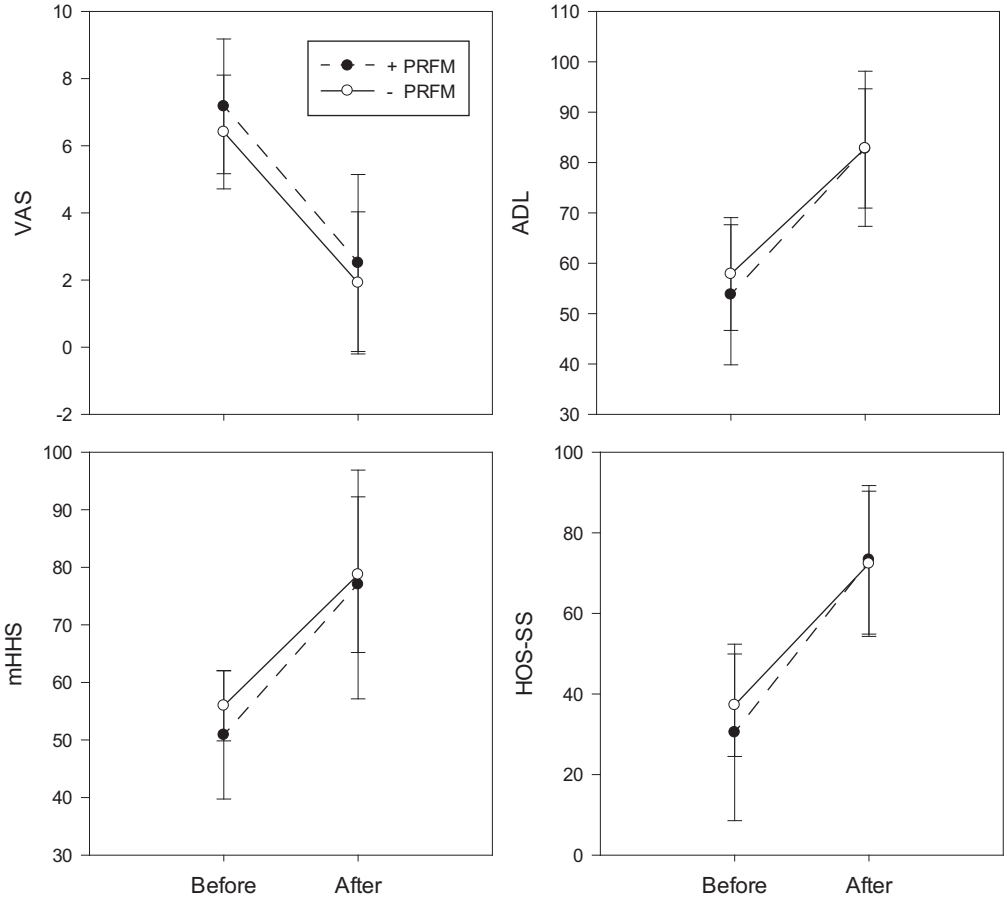

Fig 1. Comparison of patient-reported outcome scores measured preoperatively and postoperatively. This analysis used repeated-measures analysis of variance and showed that there was no effect of platelet-rich fibrin matrix (PRFM) on these outcomes, as indicated by the similar slopes in all graphs (Table 5). Each point represents the mean ± standard deviation of the group. (ADL, Hip Outcome Score—Activities of Daily Living; HOS-SS, Hip Outcome Score—Sports Specific; mHHS, modified Harris Hip Score; VAS, visual analog scale.)

showed that the latter has fewer postoperative complications including retears. They also found that the average preoperative symptom duration was greater than 2 years, similar to the averages in both groups in our study, in which patients endured symptoms even longer before intervention. This reflects the insidious nature of this condition and the importance of early recognition to possibly decrease tendon fatty atrophy and retraction, which could affect reparability.

Augmented surgical repair for gluteus minimus and medius tears has been described with improved results, suggesting that avenues exist with which to improve on the standard techniques. Bucher et al.[28] reported on a consecutive series of 22 patients who underwent gluteal tendon repair using synthetic augmentation with the Ligament Augmentation and Reconstruction System (LARS). They reported a significant improvement in the Oxford Hip Score, Short Form 36 score, and VAS pain score at 12 months postoperatively. All patients were at least "satisfied" with the procedure. Only 1 patient required repeat intervention, for removal of the LARS interference screw, which led to immediate relief. Rao et al.[29] described a prospective evaluation of patients treated with transosseous repair of gluteus medius and minimus insertions augmented by a GraftJacket allograft acellular human dermal matrix (Wright Medical Group) over the anterior and anterolateral aspects of the greater trochanter. They reported that in the 12 patients evaluated, significant improvements were seen in the VAS pain score, limp, and gait, along with abductor strength. A negative Trendelenburg test was reported in 11 of 12 patients, and the HHS improved significantly at 22 months postoperatively.

Although PRFM has not been evaluated in the context of abductor tendon repair, its use in rotator cuff tendon repair has been studied in several recent studies without much success. Weber et al.[21] performed a prospective randomized study to evaluate PRFM application at the time of arthroscopic rotator cuff repair and reported no improvements in perioperative morbidity, clinical outcomes, or structural integrity when compared with the control group at short-term follow-up. Rodeo et al.[30] echoed these findings in their prospective randomized study, in which PRFM applied to the tendon-bone interface at the time of rotator cuff repair had no demonstrable effect on tendon healing, tendon vascularity, manual muscle strength, or clinical rating scales. Fu et al.,[31] in a meta-analysis of the literature, reported that no significant differences existed in outcomes when comparing

Table 5. Results of Repeated-Measures Analysis of Variance for Patient-Reported Outcome Scores Evaluated Both Preoperatively and Postoperatively

Outcome	Time				Treatment				Treatment × Time			
		95% CI				95% CI				95% CI		
	Change	Lower	Upper	*P* Value	Change	Lower	Upper	*P* Value	Coefficient	Lower	Upper	*P* Value
VAS pain score	4.675	3.851	5.5	<.001	−0.773	−1.71	0.161	.1	0.174	−1.587	1.935	.98
HOS-ADL	−27.3	−32.94	−21.66	<.001	2.855	−2.75	8.462	.31	−4.044	−15.086	6.998	.66
HOS-SS	−38.14	−45.22	−31.06	<.001	4.607	−4.82	14.03	.33	−7.731	−23.751	8.289	.35
mHHS	−26.45	−31.96	−20.94	<.001	3.611	−1.77	8.988	.18	−1.434	−12.567	9.699	.59

NOTE. "Time" corresponds to the effect of surgical intervention on the 4 parameters, with "Change" corresponding to the difference in score from preoperatively to postoperatively. "Treatment" corresponds to the effect of platelet-rich fibrin matrix (PRFM) on the 4 parameters, with "Change" corresponding to the difference between PRFM and no PRFM. The treatment-by-time interaction corresponds to the interaction between PRFM and time for the 4 parameters.

CI, confidence interval; HOS-ADL, Hip Outcome Score—Activities of Daily Living; HOS-SS, Hip Outcome Score—Sport Specific; mHHS, modified Harris Hip Score; VAS, visual analog scale.

control patients with patients who received PRP or PRFM at the time of rotator cuff repair. PRFM has similarly been found non-efficacious in terms of MRI (radiologic graft integration) and objective clinical evaluation (knee stability) after anterior cruciate ligament reconstruction, but short-term improvements in patient-reported knee function are superior to control patients.[22]

Our study provides preliminary data to suggest that PRFM use in abductor tendon repair may follow suit with findings of its evaluation in rotator cuff repair. However, the large clinically significant effect seen with PRFM on SF-12 Physical and iHOT-12 scores—arguably the most well-validated measures used in our study—may suggest that its influence may be more focused on subjective physical health outcomes. Moreover, it should be noted that unlike the mHHS score (which has very poor psychometric properties), the SF-12 and iHOT-12 scores have quite strong psychometric properties, which may confound (through incorporation of patient knowledge, abilities, attitudes, and/or personality traits) an otherwise more hip-specific outcome measurement tool. It may also be that these psychometric properties are somehow influenced by the use of PRFM, be it through biological, psychological, social, or other means. Furthermore, the SF-12 Physical score incorporates more general health measures and is thus less specific to hip problems, yet a large, significant difference was seen between cohorts at final follow-up. It is possible that the patients without PRFM have more and other complaints (back, knee, shoulder, and so on) that are also affecting their SF-12 scores and are not hip related. The preoperative patient demographic variables that we identified and compared were not significantly different, and although we did compare between patient series the history of other orthopaedic surgical procedures, as well as surgical intervention on the spine or contralateral hip, this is not an exhaustive and/or all-inclusive list that could identify other areas that would lower the SF-12 score. Regardless, such discussion is not pertinent to the significant comparative findings with the iHOT-12 scores (which are more hip specific). Future longer-term evaluations with prospective randomized protocols are necessary to further delineate any significant efficacy with PRFM use in this setting.

Limitations

There are several limitations inherent to this study. First, the overall series size is relatively small, which limits the statistical power. However, we were able to statistically compare 2 groups that were found to have similarities in preoperative findings and demographic characteristics, and thus the postoperative findings and comparisons do have a place in the literature. Operative repair techniques were not uniform across all

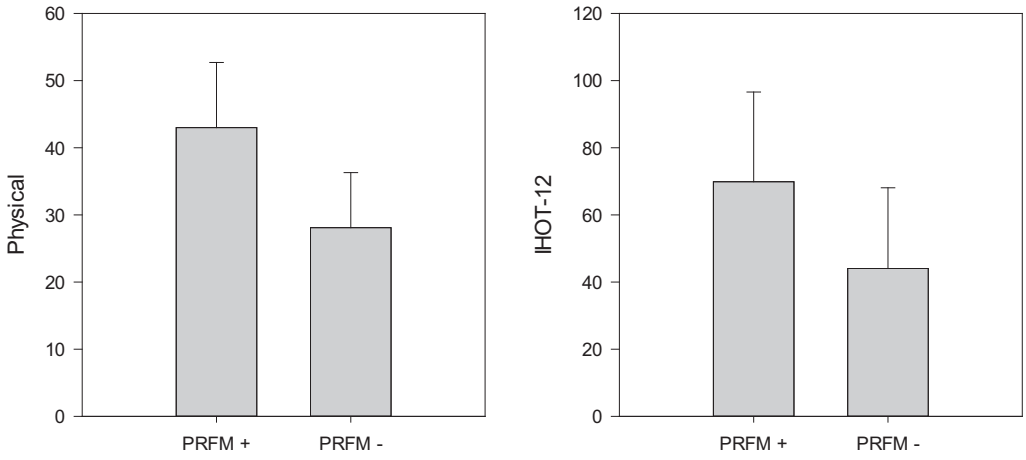

Fig 2. Comparison of patient-reported outcome scores measured post-operatively using *t* tests. Each bar represents the mean ± standard deviation of the group. (iHOT, International Hip Outcome Tool; Physical, Short Form 12 Physical; PRFM, platelet-rich fibrin matrix.)

study patients and were dictated by the pathology, but again, the findings of tear grade and/or size and repair characteristics were not statistically different between the series with PRFM treatment and the series without PRFM treatment, which ideally would reduce the degree of selection bias that otherwise could have occurred. Concomitantly performed procedures and a history of ipsilateral hip intervention may have additionally confounded the results, given that subgroup analysis was not possible as a result of the relatively small series sizes. Patients made the decision on whether PRFM was used in their surgical intervention; thus, a potential selection bias could have been introduced because its use may have been influenced by patient socioeconomic status. A possible placebo effect in the patient series with PRFM cannot be ignored either, because these patients were not blinded to their treatment. The inter-rater reliability of grading abductor tears showed only fair agreement, which may affect the comparison of grades between patient groups and may also challenge the higher interobserver reliability found for the Goutallier-Fuchs rotator cuff classification in the evaluation of hip abductor tendon tears from prior literature[1] and thus its overall utility for this pathology. Finally, unfortunately, we did not have postoperative MRI examinations for all patients to assess for radiographic evidence of healing or musculotendinous bulk and thus relied on physical examination proxies for retears (abductor strength against resistance, Trendelenburg sign) as clinical evidence of abductor retears in some patients rather than the gold-standard MRI examination. Prior studies on abductor repair have similarly used physical examination findings rather than uniform MRI in all patients as a measure of clinically evident abductor tendon retears,[15,32-35] although physical examination has not been shown to be a validated way to evaluate for retears.

Conclusions

PRFM augmentation does not appear to have an effect on gluteus medius tendon repair in terms of pain or clinically evident retears but may have a role in improving subjective outcomes of overall and hip-specific physical functioning.

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