

Platelet-Rich Plasma Injections With Needle Tenotomy for Gluteus Medius Tendinopathy

A Registry Study With Prospective Follow-up

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Background: Gluteal tendinopathy is a prevalent condition that can be associated with significant pain and disability. To date, no studies have prospectively assessed the efficacy of intratendinous platelet-rich plasma (PRP) injections as a minimally invasive treatment for gluteus medius tendinopathy.

Purpose: To prospectively assess the efficacy of intratendinous PRP injections as treatment for chronic recalcitrant gluteus medius tendinopathy.

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

Methods: During the study period between July 2011 and November 2015, data were collected from the Hospital for Special Surgery Center for Hip Preservation Outcomes Registry on participants who underwent ultrasound-guided intratendinous PRP injections for recalcitrant gluteus medius tendinosis and/or partial tears of the tendon associated with moderate to severe lateral hip pain for longer than 3 months. All participants were assessed pre- and postinjection with 4 outcome measures: modified Harris Hip Score (mHHS), Hip Outcome Score–Activities of Daily Living subscale (HOS-ADL), Hip Outcome Score–Sport-Specific subscale (HOS-Sport), and the International Hip Outcome Tool–33 (iHOT-33). Demographic data, including age, sex, height, weight, body mass index, and smoking status, were also collected.

Results: A total of 21 patients were included in the study, with a mean follow-up of 19.7 months (range, 12.1–32.3 months). The mean improvements from preinjection to postinjection follow-up were 56.73 to 74.17 for mHHS, 68.93 to 84.14 for HOS-ADL, 45.54 to 66.72 for HOS-Sport, and 34.06 to 66.33 for iHOT-33. All mean outcome measure improvements were clinically and statistically significant ($P < .001$). Length of follow-up was positively correlated with improvements in HOS-ADL ($P = .021$) and HOS-Sport ($P = .004$) scores. No adverse events were observed during or after the procedure.

Conclusion: In this registry study with prospective follow-up, we found ultrasound-guided intratendinous PRP injections to be a safe and effective treatment option for chronic recalcitrant gluteus medius tendinopathy due to moderate to severe tendinosis and/or partial tendon tears. Well-powered randomized controlled studies are warranted to confirm our findings and further define the ideal candidates for this treatment.

Keywords: platelet-rich plasma; tenotomy; gluteus medius tendon; tendinopathy

Gluteal tendinopathy is a prevalent source of lateral hip pain and disability. Often insidious, the condition can be misdiagnosed as trochanteric bursitis in the absence of proper

imaging and anatomical considerations.^{4,7,10,30,45,53,63} A study conducted by Howell et al²⁸ reported that 20% of 176 patients undergoing total hip arthroscopy were found to have a gluteus medius or minimus tear that was missed on clinical examination prior to surgery. As the most prevalent lower limb tendinopathy,¹ gluteal tendinopathy has been reported to affect 23.5% of women and 8.5% of men between the ages of 50 and 79 years.⁵³ Sedentary individuals are susceptible to this condition, and frequent participation in running activities is a significant predisposing factor.¹⁷ As the mean population age and number of females participating in long-distance running continue to increase in the future, the prevalence of gluteal

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tendinopathy among athletes and nonathletes alike can be reasonably expected to rise as well.^{21,31,35,65} Baseline outcome measure scores from several prospective studies demonstrate that the condition is associated with moderate to severe pain and disability.^{6,9,29} Furthermore, a recent case-control study on the quality of life of patients with greater trochanteric pain syndrome concluded that the condition can confer disability comparable to that associated with end-stage hip osteoarthritis.¹⁸

Despite the high prevalence of gluteus medius tendinopathy and potential severity of its associated symptoms, there is a paucity of effective minimally invasive treatments for the condition.^{25,34,64} Commonly available treatment options include lifestyle modifications, oral analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, corticosteroid injections, and surgical interventions. Nonoperative treatments effectively relieve symptoms for most patients.²⁵ However, the optimal management of refractory cases remains incompletely understood.¹⁷

Platelet-rich plasma (PRP) is an autologous injectant prepared from a patient's own whole blood. Containing high concentrations of several soluble mediators of anabolic processes that can facilitate proper healing/remodeling of injured tendons, intratendinous PRP may be a viable intervention that expedites the resolution of patients' pain and disability from recalcitrant gluteus medius tendinopathy. A retrospective study on 16 subjects with chronic gluteus medius tendinopathy found that at a mean 15 months after receiving PRP injections, 81% reported improvements in their symptoms ranging from "moderate" to "complete" resolution. However, recall bias and a 55% survey completion rate, among other reasons, likely render these results weak evidence.³⁸ We believed that a more rigorous and prospective assessment for gluteus medius tendinopathy was warranted in light of strong evidence supporting the use of PRP injections for other recalcitrant insertional tendinopathies.^{27,41,59}

METHODS

Study Design and Treatment

The collection of data through medical records and the Center for Hip Preservation Outcomes Registry was approved by the Hospital for Special Surgery Institutional Review Board. During the study period between July 2011 and November 2015, registry data were collected on all participants who underwent intratendinous PRP injections for gluteus medius tendinopathy because of gluteus medius tendinosis and/or partial tears of the tendon.

Study subjects were required to meet the following inclusion criteria: moderate to severe lateral hip pain for longer than 3 months, symptoms refractory to nonoperative treatment (including at least 4 weeks of traditional physical therapy for this condition), gluteus medius tendinosis (moderate to severe) and/or partial tear as determined by magnetic resonance imaging (MRI), and a normal neurologic examination except for hip abductor weakness on the affected side. All patients were evaluated by ultrasound

TABLE 1
Study Inclusion and Exclusion Criteria^a

Inclusion criteria	
•	Moderate to severe lateral hip pain for >3 months
•	Symptoms refractory to conservative treatment (including at least 4 weeks of traditional physical therapy)
•	Gluteus medius tendinosis (moderate to severe) and/or partial tear as determined by MRI
•	Normal neurologic examination except for hip abductor weakness on the affected side
Exclusion criteria	
•	Severe hip osteoarthritis with active synovitis or bone edema
•	Active lumbar radiculopathy with pain, numbness, or weakness in a dermatomal distribution
•	Evidence of fatty atrophy, denervation, or complete tears of gluteus medius seen on MRI
•	Any condition requiring antiplatelet or anticoagulation therapy, including aspirin therapy for cardiac conditions

^aMRI, magnetic resonance imaging.

prior to the procedure.^{19,33} Included patients did not have bursitis. Additional exclusion criteria included severe hip osteoarthritis with active synovitis or bone edema; steroid injection within the past 3 months; active lumbar radiculopathy with pain, numbness, or weakness in a dermatomal distribution; evidence of fatty atrophy; denervation; complete tears of gluteus medius evident on MRI; and any condition requiring antiplatelet or anticoagulation therapy (eg, aspirin therapy for cardiac conditions) (Table 1).

PRP Preparation and Injection Technique

Using the Magellan Autologous Platelet Separator System (Magellan), 60 mL of patients' autologous whole blood was processed, yielding a 3.0- to 4.0-mL injectant of leukocyte-rich PRP. Prior to injection, approximately 2 mL of preservative-free 1% lidocaine was used for local anesthesia for the skin and soft tissue structures overlying the gluteus medius tendon. Under direct ultrasound guidance in the longitudinal plane, a 22-gauge, 3.5-inch spinal needle was used to inject the PRP sample into the hypoechoic and tender regions overlying the greater trochanter (Figures 1 and 2). A needle tenotomy technique followed, consisting of 6 to 9 needle passes through the hypoechoic regions of the gluteus medius tendon. All injections and needle tenotomies were performed by the principal investigator (P.J.M.), an attending interventional physiatrist specialized in disorders of the hip.

Postinjection Instructions

After the procedure, study participants were instructed to rest for a minimum of 2 weeks and refrain from taking NSAIDs for at least 6 weeks. All patients were evaluated by a therapist and given printed handouts for their exercises. No exercise logs were kept. Some patients continued formal physical therapy, and the number of visits were often determined by insurance. All patients entered a rehabilitation program consisting of core stabilization, hip

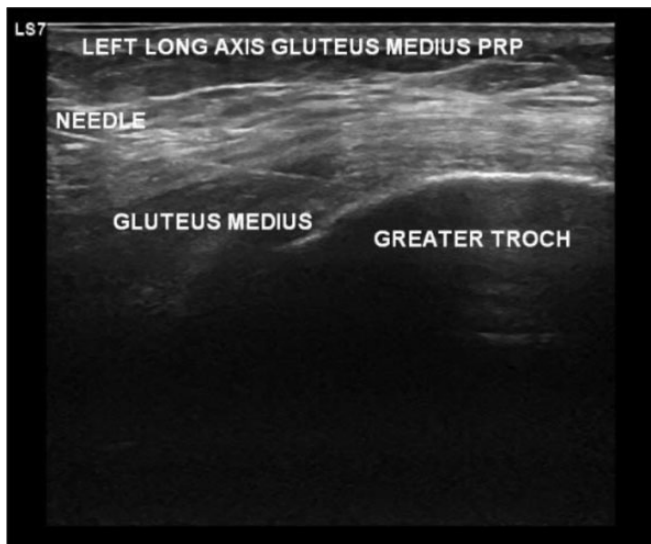


Figure 1. Sample image of ultrasound-guided platelet-rich plasma (PRP) injection into the gluteus medius tendon (long-axis view). Greater troch, greater trochanter.

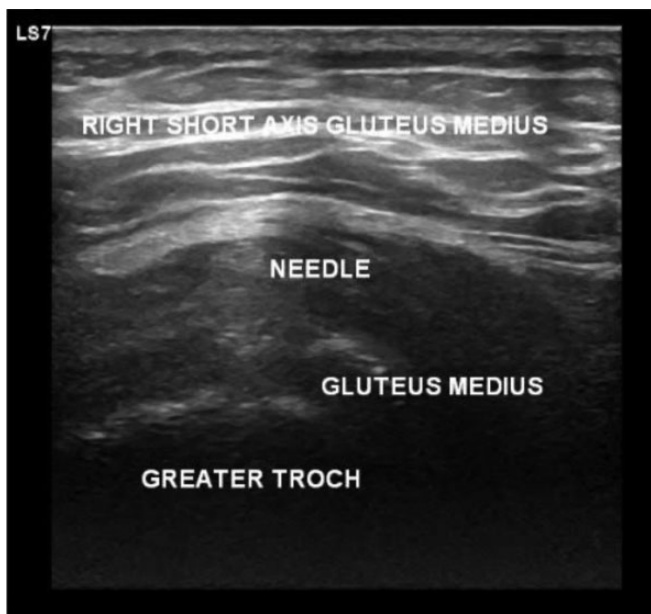


Figure 2. Ultrasound-guided platelet-rich plasma injection into the gluteus medius tendon (short-axis view). Greater troch, greater trochanter.

abductor strengthening with a focus on eccentric strengthening, and balance training. The pre- and postprocedure rehabilitation did not differ substantially, but since patients had previously been in therapy, only 6 to 8 therapy visits were suggested.

Data Elements

All participants were assessed before and after injection with the modified Harris Hip Score (mHHS), Hip Outcome

Score—Activities of Daily Living subscale (HOS-ADL), Hip Outcome Score—Sport-Specific subscale (HOS-Sport), and the International Hip Outcome Tool-33 (iHOT-33). The minimum clinically important difference (MCID) for the iHOT-33 has been reported in the literature as a 6-point change.⁴² The MCID for the HOS-ADL, HOS-Sport, and mHHS has been reported in the literature as a 9-, 6-, and 9-point change, respectively.³⁶ The HOS-ADL, HOS-Sport, and mHHS have been widely used to evaluate and assess hip pathology in arthroscopy patients as well as patients treated endoscopically for gluteus medius tendon tears.^{36,37,60} The iHOT-33, however, is a newer patient-reported outcome measure developed for hip-related problems in younger patients. It has been shown to be reliable and highly responsive to clinical change and has demonstrated face, content, and construct validity.⁴²

Multiple questionnaires were used because it was previously reported in patients undergoing hip arthroscopy that there was no conclusive evidence for the use of a single patient-reported outcome questionnaire.^{36,57} Data on study patient age, sex, height, weight, body mass index (BMI), and smoking status were also collected. No postinjection imaging was performed.

Statistical Analyses

Paired *t* tests were used to calculate significance between pre- and post-PRP groups for all patient-reported outcome scores. Regression analyses of patient age, sex, height, weight, BMI, length of follow-up, and smoking status were performed to assess for possible correlations with patient-reported outcomes. All statistical tests were performed using Stata version 11.2 (Stata Corp).

RESULTS

A total of 21 patients (17 females, 4 males) with a mean age of 48 years (range, 25-68 years) and a mean postinjection follow-up of 19.7 months (range, 12.1-32.3 months) were included in the study. At follow-up, the mean outcome scores from pre- to postinjection improved from 56.73 to 74.17 for mHHS, 68.93 to 84.14 for HOS-ADL, 45.54 to 66.72 for HOS-Sport, and 34.06 to 66.33 for iHOT-33 (Figure 3 and Table 2). All improvements in scores were statistically significant, with values that surpassed MCIDs ($P < .001$). The proportions of participants reporting improvements that met or surpassed MCIDs were 62% (13/21), 71% (15/21), 70% (14/20), and 90% (18/20) for mHHS, HOS-ADL, HOS-Sport, and iHOT-33, respectively (Table 2). Individual results for each study subject are depicted in Table 3. Regression analyses indicated that length of follow-up interval was positively correlated with improvement in HOS-ADL ($P = .021$) and HOS-Sport ($P = .004$).

No serious adverse events were associated with the intratendinous PRP injections. The most common complaint was self-limited pain and soreness at the site of injection.

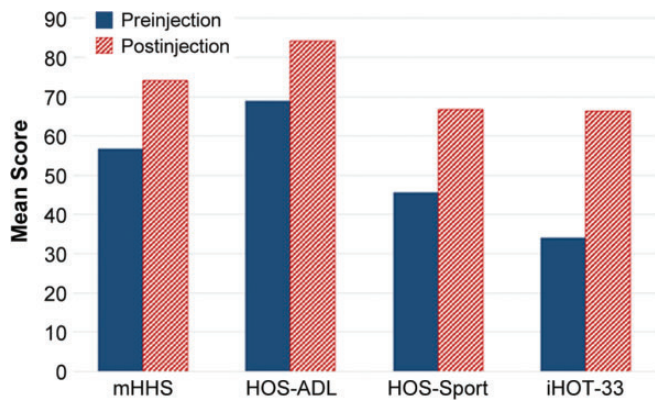


Figure 3. Mean pre- and postinjection modified Harris Hip Score (mHHS), Hip Outcome Score–Activities of Daily Living subscale (HOS-ADL), Hip Outcome Score–Sport-Specific subscale (HOS-Sport), and International Hip Outcome Tool–33 (iHOT-33) results.

TABLE 2
Summarized Results^a

	mHHS	HOS-ADL	HOS-Sport	iHOT-33
Preinjection				
Mean score	56.73	68.93	45.54	34.06
SD	11.19	16.48	23.40	15.33
Minimum score	35.20	20.59	5.56	6.45
Maximum score	73.70	100.00	94.40	74.06
Postinjection				
Mean score	74.17	84.14	66.72	66.33
SD	15.07	12.44	24.61	23.12
Minimum score	42.90	48.53	28.13	19.60
Maximum score	95.70	100.00	100.00	94.60
Change in mean score	17.44	15.21	21.18	32.27
% Meeting or surpassing MCID	62%	71%	70%	90%
<i>P</i> value for change in mean score	<.0001	<.0001	.0009	<.0001

^aHOS-ADL, Hip Outcome Score–Activities of Daily Living subscale; HOS-Sport, Hip Outcome Score–Sport-Specific subscale; iHOT-33, International Hip Outcome Tool–33; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score.

DISCUSSION

This is the first prospective evaluation of ultrasound-guided PRP injections as treatment for chronic and symptomatic gluteus medius tendinopathy. At a mean follow-up of 19.7 months, there were statistically ($P < .001$) and clinically (ie, surpassing MCIDs) significant improvements in mean mHHS, HOS-Sport, HOS-ADL, and iHOT-33 scores, with the cohort surpassing the MCIDs for each outcome measure. These findings are consistent with previous prospective studies that demonstrate long-term benefits conferred by intratendinous PRP as treatment for lateral epicondylitis and other insertional tendinopathies.^{12,26,41,47} Contrasting results reported by other studies^{13,16,22} can

possibly be explained by the in vitro observation that peri-/intra-tendinous anesthetic hinders the positive effects of PRP on human tendon cells.⁷ Furthermore, type of preparation, platelet concentration, use of activated or nonactivated PRP, and frequency of PRP applications have also been acknowledged as contributing to the observed variability in clinical results associated with this treatment.⁶²

Other currently available treatment options for recalcitrant gluteus medius tendinopathy include corticosteroid injections and surgery. With 72% to 75% positive responses reported at 4 weeks postinjection, corticosteroids have been shown to provide substantial short-term relief of pain associated with gluteus medius tendinopathy.^{29,51} While this medication has potent anti-inflammatory properties, high rates of recurrent pain suggest that it does not address the central pathological processes underlying the condition.^{5,11,50} The short-term benefit of corticosteroid injections as a treatment for gluteal tendinopathy can likely be attributed to its analgesic effects on local neuropeptides and neurotransmitters that relay pain generated by the condition.^{46,49} This theory is reinforced by histopathological studies that found no associations between gluteal tendinopathy and remarkable inflammatory processes.^{54,60} With consideration of the aforementioned observations and strong evidence suggesting that corticosteroids downregulate fibroblastic collagen production and contribute to tendon instability,⁵⁶ the long-term catabolic consequences associated with corticosteroid injections likely outweigh this minimally invasive treatment's short-term analgesic benefits for tendinopathy.

Surgery is also considered for recalcitrant lateral hip pain due to gluteus medius tears. Symptomatic gluteus medius tears without significant fatty atrophy of the muscle belly or tendon retraction evident on MRI can be repaired with open or endoscopic transfer debridement and/or transfer of the gluteus maximus tendon to improve hip abduction strength. While there are several studies supporting the efficacy of these interventions, they are limited to level 4 evidence, and some indicate prolonged recoveries.^{3,8,60} Furthermore, a case series reported that 19% of 72 patients who underwent surgical repair of gluteal tendon tears experienced significant complications, including deep vein thrombosis, pulmonary embolus, tendon re-tear, wound hematoma, pressure sores, wound infection, and even fracture of the greater trochanter.⁶¹

Tendon needling involves repeatedly fenestrating pain-generating tendons, which is hypothesized to disrupt chronic degeneration and encourage anabolic processes involving fibroblastic proliferation that may lead to organized collagen synthesis and proper tendon healing. There are limited clinical data on the benefits of percutaneous needle tenotomy as a stand-alone treatment for tendinopathy. However, multiple case series report encouraging results.^{29-31,40}

PRP is prepared from autologous whole blood that is centrifuged to yield an injectant concentrated with platelets and several biologically active molecules and proteins. Of particular interest in recent in vivo and in vitro investigations of the effects of PRP on tendons are the possible benefits mediated through its high concentrations of

TABLE 3
Individual Results^a

Participant ID	Length of Follow-up, mo	mHHS		HOS-ADL		HOS-Sport		iHOT-33	
		Preinjection	Postinjection	Preinjection	Postinjection	Preinjection	Postinjection	Preinjection	Postinjection
1	23.4	50.60	56.10	66.18	76.47	27.78	28.13	20.74	41.21
2	22.3	53.90	75.90	51.47	91.18	22.22	75.00	17.93	45.86
3	20.9	58.30	90.20	66.18	85.94	35.00	66.67	41.71	76.32
4	19.3	62.70	67.10	63.24	82.35	13.89	36.11	37.83	70.97
5	14.9	39.60	55.00	70.31	72.06	30.56	38.89	24.29	46.59
6	16.7	53.90	84.70	60.29	92.65	44.44	85.71	28.23	83.10
7	12.4	57.20	69.30	69.12	79.41	71.88	46.88	50.19	71.00
8	32.0	64.90	68.20	79.41	96.88	—	—	37.82	72.93
9	12.1	57.20	57.20	73.53	76.47	66.67	44.44	35.58	23.71
10	26.6	35.20	81.40	20.59	65.00	5.56	44.44	6.45	86.97
11	24.5	64.90	63.80	73.53	79.41	15.63	47.22	—	—
12	24.4	67.10	64.90	72.06	83.82	58.33	69.44	24.78	50.55
13	18.3	71.50	95.70	89.71	94.12	72.22	91.67	46.37	82.23
14	23.8	68.20	82.50	77.94	90.00	38.29	100.00	20.17	56.29
15	32.3	53.90	92.40	59.38	94.44	50.00	100.00	45.04	89.74
16	17.9	44.00	82.50	57.35	94.12	41.67	91.67	22.04	92.86
17	17.8	73.70	95.70	100.00	100.00	94.40	94.44	74.06	91.07
18	16.8	50.60	93.50	76.67	90.63	62.50	87.50	33.17	94.60
19	12.7	73.70	73.70	94.12	97.06	75.00	91.67	55.32	82.13
20	13.4	42.90	42.90	58.82	48.53	37.50	41.67	30.52	19.60
21	12.1	47.30	64.90	67.65	76.47	47.22	52.78	28.90	48.79

^aHOS-ADL, Hip Outcome Score—Activities of Daily Living subscale; HOS-Sport, Hip Outcome Score—Sport-Specific subscale; iHOT-33, International Hip Outcome Tool-33; mHHS, modified Harris Hip Score.

vascular endothelial growth factor (VEGF), insulin-like growth factor 1 (IGF-1), fibroblast growth factor (FGF), platelet-derived growth factor (PDGF), and transforming growth factor β 1 (TGF- β 1). VEGF has been demonstrated to stimulate angiogenesis in otherwise relatively avascular environments of chronically worn tendons.^{15,18,20,28,32,48} IGF-1 is a potent stimulator of tendon collagen synthesis.^{23,44} FGF plays roles in chemotaxis, cell proliferation, and collagen synthesis at local sites of tendon injury.⁴³ PDGF has been shown to improve tendon matrix remodeling, stimulate collagen synthesis, and increase cell proliferation/chemotaxis.^{23,24,39,55,56,58} Early in vitro studies found that flexor digitorum tendon specimens cultured in PRP led to pronounced increases in TGF- β 1 and PDGF expression along with indicators of fibrosis remission (ie, degradation of type III collagen and decreased expression of MMP3 and MMP13).^{39,52} A 2008 study found that the proliferation of human hamstring tendon tenocytes increased when cultured in PRP.¹⁴ Another study that cultured human hamstring tendon specimens in PRP reported increased fibroblast proliferation and VEGF expression by tenocytes.² Overall, there is strong in vivo and in vitro evidence involving human specimens and animal models that suggest PRP may promote growth factor-mediated anabolic processes associated with proper tendon healing.

Postinjection therapy was not consistent across study subjects. A standardized program would have been ideal, but this study was conducted at a regional center and there is variability in therapies between providers. A redeeming aspect of this limitation is that it may represent a realistic approach to treatment as the ability to participate in

supervised therapy has been greatly curtailed by the current insurance providers. All patients had received some therapy prior to the injection and did have home exercise routines. Another limitation of this study was that the composition of participants' PRP (eg, platelets, white blood cells, growth factor content) was not measured and included as data assessed in the regression analysis. The authors also recognize that the relative effects of needle tenotomy and PRP administration could not be discerned in the present study. Larger randomized and comparative controlled studies are still needed to evaluate the attributable therapeutic effect of PRP, specifically for the gluteus medius tendon. Well-designed studies evaluating the efficacy of PRP versus autologous whole blood versus tenotomy would provide evidence to support the ongoing use of PRP for tendinopathies.

CONCLUSION

This is the first prospective cohort study exploring the efficacy of ultrasound-guided PRP injections into the gluteus medius tendon as a treatment for chronic recalcitrant tendinopathy. Statistically and clinically significant improvements were observed across all outcome measures with over 1-year follow-up on all participants. Our results suggest that PRP is a safe and relatively effective nonsurgical treatment option for recalcitrant lateral hip pain secondary to gluteus medius tendinopathy from tendinosis and/or partial tears of the gluteus medius tendon. However, additional prospective studies are warranted to confirm these

findings and to further define the ideal candidates for this treatment.

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