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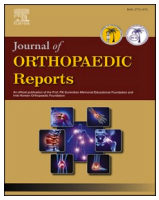

Intratendinous platelet-rich plasma injection and percutaneous needle tenotomy in the treatment of hip tendinopathies: A retrospective study

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ABSTRACT

Background: Both conservative and surgical treatment options for tendinopathies often have less than ideal outcomes. Platelet-rich plasma (PRP) has become an increasingly popular treatment option with only limited evidence for effectiveness.
Methods: A retrospective review was performed of all consecutive patients undergoing PRP for hip tendinopathies during a three-year period in a single outpatient spine and musculoskeletal clinic. Each procedure was performed under ultrasound guidance with a concurrent needle tenotomy. Categorical data analysis was performed to determine percent of patients achieving at least 30 %, 50 %, and 80 % relief of pain as measured by NRS.
Results: A total of 48 patients were included with an average follow period of 14 weeks. Seventy-seven percent of patient achieved at least 30 % improvement in pain by NRS (95 % CI: 63%–88 %), 65 % achieved at least 50 % improvement in pain (95 % CI: 49%–78 %), and 27 % achieved at least 80 % pain improvement (95 % CI: 15%–42 %).
Conclusion: This retrospective study demonstrates relatively good outcomes for this novel treatment. The results of this single practice audit are similar to previously published retrospective and prospective trials.

1. Background

Tendinopathies of the hip and pelvis are a common source of chronic lateral hip and buttocks pain 1. Conservative treatment often involves NSAIDS, rest, physical therapy and corticosteroid injections.[2] Lack of long-term improvement from these treatment modalities is often frustrating for patients and physicians. Surgical options are available but often have less than ideal outcomes.[3,4]

There has been significant interest over the past decade in regenerative type treatments for chronic tendinopathies.[5] Basic science research has shown benefit of tenocyte viability from growth factors found within autologous concentrations of platelets, platelet-rich plasma (PRP).[6] The tendon healing efficacy of PRP has been consistently demonstrated in animal studies.[7] Although there is a paucity of high-level clinical trials for hip tendinopathies, there is some evidence of significant benefit for refractory gluteal insertion and hamstring origin tendinopathies.[5,8,9] The purpose of this study is to evaluate the benefit of PRP on chronic hip tendinopathies in a community outpatient musculoskeletal practice.

2. Methods

A formal IRB exemption was obtained, and a retrospective review was performed of the corresponding author's practice to identify all PRP procedures for hip tendinopathies performed between January 6, 2018 through March 21, 2021 through a query of the investigators electronic billings system using PRP procedure code and corresponding diagnosis for gluteal, psoas or hamstring tendinopathy or hip 'bursitis.' All procedures were performed at a physiatry community-based spine and general musculoskeletal private practice.

Inclusion criteria: Undergone PRP to a hip tendon (Gluteus medius tendon, gluteus minimus tendon, hamstring tendon, or psoas tendon) for refractory tendinosis or partial tear between June 2018 and March 2021. Age 18–89 at the time of the procedure.

Exclusion criteria: unclear medical record, lack of baseline or follow-up numeric rating score (NRS) for pain.

Data analysis: categorical data analysis was performed to determine percent improvement at least 30 %, 50 % and 80 % improvement in NRS using Clopper-Pearson Exact method to determine confidence intervals.

PRP formulation and processing: Typically, 102 mL of whole blood was

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drawn from the antecubital fossa and this was combined with 18ml of ACDa citrate anticoagulant. If a bilateral procedure was performed, then 153 mL of whole blood was drawn and combined with 27mL ACDa. Of note, the whole blood was processed through the Arthrex Angel PRP system. Leukocyte-rich formulation was used (Angel setting of 7 % hematocrit). The blood was centrifuged per manufacture recommendations. Approximately 3 mL of PRP was obtained for each tendon injected.

PRP tendon injection and percutaneous tenotomy procedure: All procedures were performed by two of the authors, both with over ten years' experience in diagnostic and ultrasound guided procedures. All procedures were performed under ultrasound guidance using a linear transducer. Patients were placed in a lateral decubitus position for the gluteus medius and minimus tendons. For the hamstring tendons, patients were typically placed in a prone position with a bolster under the pelvis to elevate the pelvis about 12–18 inches in order to produce moderate hips flexion. Alternatively, a lateral decubital position was occasionally used with the hips flexed to about 70°. A 25-gauge needle was used to anesthetize the skin and superficial tissues with about 3 mL of ropivacaine 0.5 %. About 2 mL of ropivacaine was then placed just superficial to the tendon. A 21- or 22-gauge needle was then directed into the tendon in the region of the tendinosis or partial tear using primarily long axis needle technique with transverse view of the tendon with additional longitudinal view of the tendon and short axis needle technique. Depending upon patient tolerance, additional ropivacaine, 2–5 mL, was directed into the target tendon. A percutaneous tenotomy was performed with about 20–30 needle passes through the tendinosis or partial tear region. PRP was then injected within the tendinotic and/or partial tear region.

Aftercare: Patients were encouraged to apply ice intermittently to the area over the next 24 hours. They were instructed to avoid NSAIDS for at least 3 weeks. A minority were provided with 5–10 tablets of hydrocodone or tramadol for post procedure pain.

Patients were routinely seen in follow-up at about 2, 6, 12 weeks, as well as beyond depending on their respective improvement levels.

Typical rehabilitation course although variability did occur based upon patient and physician: Weeks 0–2, gentle stretching and ambulation only. Weeks 2–4, more aggressive stretching and ambulation as tolerated. Week 4 and beyond, gradually increasing eccentric contraction exercises. Week 6 and beyond, gradual return to activities of choice.

3. Results

Seventy patients underwent the PRP procedure. Twenty-two were excluded secondary to no follow up visit (6), no baseline NRS data (7), no follow up NRS (4), unclear medical record (2), development of a new injury confounding level of pain at index site (2), and one patient was deceased, cause of death was not related to the procedure. A total of 48 patients were included in the study. Average follow time was 14 weeks. Median age was 62 (Table 1). Gluteus medius and minimus were the most commonly injected tendons. There were no significant complications such as infection, bleeding, or severe discomfort (beyond 1 week).

Thirty-one patients underwent injections to the greater trochanteric tendons. Thirteen patients underwent the procedure to the hamstring tendons. Three patients underwent an injection to the gluteal and hamstring tendons (Table 2).

Categorical outcomes (Table 3): 77 % (95 % CI: 63 %–88 %) of patients achieved at least 30 % improvement in pain by NRS, 65 % (95 % CI: 49 %–78 %) obtained at least 50 % improvement in pain and 27 % (95 % CI: 15 %–42 %) reported 80 % improvement in pain.

Further analysis was performed for the most commonly injected regions, the gluteus medius±minimus (31/48) and the hamstring tendons (13/48). Please note the hamstring tendon subgroup included one patient in which the adductor magnus tendon (not a hamstring tendon) was injected along with the common hamstring and semimembranosus tendons. No patient underwent a PRP injection to the psoas tendon.

For the gluteus medius±gluteus minimus tendons 77 % (95 % CI: 59%–90 %) achieved at least 30 % improvement in pain, 61 % (95 % CI: 42%–78 %) obtained at least 50 % improvement and 13 % (95 % CI: 4%–30 %) achieved at least 80 %.

For the hamstring tendons 69 % (95 % CI: 39%–91 %) reported at least 30 % improvement, 62 % (95 % CI: 32 %–56 %) achieved at least 50 % pain relief and 46 % (95 % CI: 19 %–75 %) had at least 80 % improvement in NRS.

4. Discussion

Traditional treatment options for hip tendinopathies include physical therapy, activity modification, anti-inflammatory medications and corticosteroid injections. There may, however, be detrimental effects from this regimen. An increase in collagen-degrading enzymes activities has been demonstrated in a rat Achilles tendon model with the use of NSAIDS like ibuprofen and this may affect tendon healing.[10] Injection of corticosteroids is also widely used for the treatment of tendinopathy, although inflammation is generally absent in the above-mentioned tendinopathy, and there is the risk of tendon atrophy or secondary rupture.[11] PRP may have an actual regenerative capacity which is a much more attractive treatment option. There is evidence that it may accelerate cellular remodeling and reduce the healing time in injuries to soft tissues such as muscles, ligaments, and tendons.[12–14]

There are many PRP preparation systems. This specific report used the Arthrex Angel PRP system. No consensus exists that demonstrates one preparation is superior to another. The Arthrex Angel system uses specific wavelengths of light to separate cellular components of the centrifuged whole blood. This may produce higher concentrations of platelets compared to single spin. It should be noted that the clinical significance of the different platelet and other cellular component concentrations, is still indeterminate.[15]

The positive results of this study appear similar to other retrospective and prospective studies. Mautner et al.[16] evaluated the effectiveness of US-guided PRP injections in a retrospective cross-sectional study of 180 patients for chronic tendinopathies. Of the 16 patients with gluteal tendinopathy, 81 % had moderate improvement to complete resolution of symptoms at a mean follow-up of 15 months. Lee et al.[17] reported a prospective registry data case series of 21 patients evaluating US-guided

Table 1
Demographics: Age at time of injection with interquartile range (IQR). Period of time (in weeks) to last follow-up with IQR.

Age (years)				
Mean	Median	75 %	25 %	IQR
62.7	62	70.5	53.75	16.75
Time between Procedure and Follow-up (Weeks)				
Mean	Median	75 %	25 %	IQR
13.8	12	12	8	4

Table 2
Tendon regions and specific tendons injected. *Adductor magnus is not considered a hamstring tendon but was also injected in one patient along with the hamstring tendons.

Total: 48 (R: 22; L: 19; B: 7)	
Greater Trochanter Tendons	**31**
Gluteus Medius	11
Gluteus Medius/Gluteus Minimus	20
Gluteus Maximus (muscle)/Gluteus Medius/Gluteus Minimus	**1**
Hamstring Tendons	**13**
Common Hamstring	10
Common Hamstring and Semimembranosus	2
Common hamstring and semimembranosus, adductor magnus*	1
Gluteus Medius/Gluteus Minimus and Common Hamstring	**3**

Table 3
Tendon region injected and percentage of pain improvements by numeric rating scale. CI: confidence interval; R: right; L: left; B: bilateral.

Total: 48 (R: 22; L: 19; B: 7)			
All Tendons Injected	**Total: 48**		**95 % CI**
At least 30 % Improvement	37	77 %	63 %–88 %
At least 50 % Improvement	31	65 %	49 %–78 %
At least 80 % Improvement	13	27 %	15 %–42 %
Greater Trochanter Tendons	**Total: 31**		
At least 30 % Improvement	24	77 %	59 %–90 %
At least 50 % Improvement	19	61 %	42 %–78 %
At least 80 % Improvement	4	13 %	4 %–30 %
Hamstring Tendons	**Total: 13**		
At least 30 % Improvement	9	69 %	39 %–91 %
At least 50 % Improvement	8	62 %	32 %–86 %
At least 80 % Improvement	6	46 %	19 %–75 %

PRP injections with needle tenotomy of the gluteus medius tendons. This demonstrated clinical and statistically significant improvement in multiple hip outcome measures.[17]

In clinical practice, injection treatments for tendinopathies are commonly performed with corticosteroids. PRP has been compared to corticosteroid in a randomized controlled trial by Fitzpatrick and colleagues for gluteal tendinopathy. Eighty patients with gluteus medius or minimus tendinopathy, bursitis or partial tears underwent either an ultrasound guided PRP or corticosteroid intratendinous injection without guidance. PRP was superior at 12 weeks using the mHHS outcome measure.[18] A follow up study did demonstrate the PRP group did remain superior over corticosteroid out to 2 years.[8]

There are several limitations innate to any retrospective report such as background data gaps with no specific baseline data in regards to duration of symptoms and co-morbidities. A further limitation is that the authors did not grade the degeneration, tendinopathy or tears of the tendons and the diagnosis of tendinopathy was not standardized. Tendinopathy was typically diagnosed by MRI and ultrasound, but in some patients, it was diagnosed by ultrasound alone. It is possible that some grades of tears and degrees of tendinopathy may respond differently to PRP. Another limitation is that the effects of the PRP could not be discerned from the needle tenotomy as they were always performed together. A third limitation is that follow up was at an average of 14 weeks for this specific cohort. Longer follow up would be beneficial to evaluate the long-term success of this treatment. Post procedure rehabilitation was recommended to most patients but was not highly standardized nor was compliance documented which certainly may confound the results. Other limitations include non-standardized medication regimen, other than NSAID use, as well as additional treatments employed during the study period.

5. Conclusion

This retrospective study of a single practice was performed to evaluate the effectiveness of ultrasound-guided PRP injections in conjunction with a percutaneous tenotomy for chronic hip tendinopathy. Significant improvement in categorical data was noted at an average of 14-week follow-up. The results suggest that PRP is a safe and relatively effective nonsurgical treatment option for hip tendinopathy and/or partial tears. Additional, higher quality studies are warranted to confirm these findings.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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6. Patients consent

A formal IRB exemption was obtained.

Ethical Statement

1) This material is the authors' own original work, which has not been previously published elsewhere.
2) The paper is not currently being considered for publication elsewhere.
3) The paper reflects the authors' own research and analysis in a truthful and complete manner.
4) The paper properly credits the meaningful contributions of co-authors and co-researchers.
5) The results are appropriately placed in the context of prior and existing research.
6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference.
7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.

The violation of the Ethical Statement rules may result in severe consequences.

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CRediT authorship contribution statement

David Levi: Conceptualization, and, design of the work, Data analysis and interpretation, Drafting the article, Critical revision of the article, Final approval before submission. **Yuchia Wang:** Conceptualization, and, design of the work, Data analysis and interpretation, Data collection, Drafting the article, Critical revision of the article, Final approval before submission. **Scott Horn:** Conceptualization, and, design of the work, Data analysis and interpretation, Drafting the article, Critical revision of the article, Final approval before submission. **Sydney Campbell:** Data collection, Data analysis and interpretation, Drafting the article, Critical revision of the article, Final approval before submission. **Christa Ventura:** Data collection, Data analysis and interpretation, Drafting the article, Critical revision of the article, Final approval before submission.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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