

Augsburg University

Idun

Theses and Graduate Projects

2023

The Efficacy of PRP Injection vs Corticosteroid Injection in the Management of Common Tendinopathies: A Systematic Review

Eric Caloud

Follow this and additional works at: <https://idun.augsburg.edu/etd>



Part of the [Osteopathic Medicine and Osteopathy Commons](#)

The Efficacy of PRP Injection vs Corticosteroid Injection in the Management of Common
Tendinopathies: A Systematic Review

Eric Caloud

Augsburg University

Abstract

Background: Tendinopathy is one of the most prevalent musculoskeletal disorders in active patients, accounting for at least 7% of physician visits in the United States. In recent years, there has been an increasing body of evidence for the use of platelet-rich plasma (PRP) in the management of tendinopathies compared to corticosteroid injections (CSI) for patients refractory to conservative treatment.

Methods: This review was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The SPORTDiscus, PubMed, and Google Scholar databases were searched for randomized controlled studies published between 2010 and 2023. The keywords utilized in the search included a combination of the following: “platelet-rich plasma”, “corticosteroids”, “rotator cuff”, “gluteal tendinopathy”, “greater trochanteric”, and “lateral epicondylitis”. The Boolean connector “AND” was utilized to connect “platelet-rich plasma”, “corticosteroids”, and the various tendinopathy sites. Studies were excluded if PRP was combined with CSI or another alternate therapy, if it was performed in conjunction with surgical repair, or if the study population included a condition closely associated with the primary conditions screened for. The primary outcome measures analyzed across all injury types were pain, functional outcome scores, imaging findings, and clinical measures.

Results: Of the 385 studies initially screened, 21 were included in this review. 2 investigated the effects of PRP vs. CSI on the management of gluteal tendinopathy, 10 studies investigated the effects of PRP vs. CSI on the management of rotator cuff tendinopathy, and 9 studies investigated the effects of PRP vs. CSI on the management of lateral epicondylitis. Across all three sites, most studies found CSI outperforming PRP in the short-term follow-up period up to 12 weeks. PRP patients tended to improve over time gradually and consistently while patients who received corticosteroids regressed back towards baseline regarding pain and function. There were no consistent significant differences found regarding imaging findings and clinical measures.

Discussion: This review has demonstrated the potential for successful treatment outcomes when utilizing PRP for chronic tendinopathies. The results generally show that while corticosteroids outperform PRP injections in the short term, PRP patients tend to slowly improve over time and surpass the results of the CSI group. Positive effects were demonstrated amongst all three tendinopathy sites, primarily with improvement in pain and function. With respect to imaging findings and clinical improvement, results varied between studies and no consistent conclusion can be drawn.

INTRODUCTION

Tendinopathy is one of the most prevalent musculoskeletal disorders in active patients. In fact, tendon disorders account for at least 7% of physician visits in the United States and over 30% of sports-related injuries pertain to tendons.¹ While active individuals are certainly affected, tendinopathies can be developed through occupational exposure as well, therefore affecting a broad spectrum of individuals. A few of the most common tendinopathies involve the rotator cuff tendons, lateral epicondyle, and gluteal tendons.^{2,3,4} Despite its prevalence, tendinopathy continues to be a challenge to successfully treat with complete resolution of symptoms.⁵

Tendinopathy is a complex disorder typically caused by repetitive overuse above the capacity of the tendon in which it can actively recover from.⁶ This progresses over time to a failed healing response and a chronically degenerated tendon. Tendons typically have poor blood supply, and this is a significant contributor to the development of the disorder.¹ The pathophysiology of this process is why the term tendinopathy is preferred to tendinitis, because although inflammation may be present, it is primarily a degenerative condition characterized by irregularities in the microstructure, composition, and cellularity of the tendon. An altered tendon is composed of disintegrated type III collagen fibers, disorganized collagen bundles, and increased neovascularization and neoinnervation, which are the growth of new blood vessels and nerves. All of these characteristics alter the material properties of the tendon. This contrasts with normal tendon structure that is composed of well-organized, parallelly aligned type I collagen.⁵ The change in composition leads to a decreased ability to carry load and maintain tensile strength for longer periods of time. Furthermore, it is believed the etiology of associated tendon pain is attributed to neovascularization, neurochemicals, and mechanical breakdown.¹ Understanding the

physiological changes associated with the condition is paramount to maximize the likelihood of a successful treatment outcome.

The primary methods of treatment for tendinopathy are activity modification, patient education, relative rest, exercise-based strategies, and pharmacologic pain control with non-steroidal anti-inflammatory drugs (NSAIDs).^{1,5,6} The rehabilitation is especially challenging because it may take months despite strict adherence.⁶ While these interventions provide improvement in some patients, there are plenty who fail the initial treatment plan. This can lead to further intervention with corticosteroid injection (CSI) and surgery.¹ However, the pathophysiology of the condition is characterized by a failed healing response of the tendon with a lack of inflammation. This questions the reasoning behind NSAIDs and CSI because both interventions lead to a substantial reduction in the inflammatory process, theoretically impairing the healing response of the tissue.⁵ Additionally, CSIs do carry a risk of tendon rupture and the risk increases with each subsequent injection.^{1,6}

In addition to the previously mentioned therapies, platelet-rich plasma (PRP) injections have recently garnered attention in the management of tendinopathies. PRP is a preparation of autologous blood centrifuged to contain a supraphysiological concentration of platelets, with or without the addition of leukocytes.^{7,8} The idea behind PRP is injecting concentrated platelets may initiate and promote the healing process through the release of growth factors, including fibroblast growth factor, epidermal growth factor, insulin-like growth factor-1, platelet derived growth factor, transforming growth factor- β , and vascular endothelial growth factor.^{7,8} These factors trigger fibroblasts, osteoblasts, chondrocytes, and other cells, which then contribute to further tissue healing.⁸ There are many formulations of PRP, including different concentrations

of platelets, WBCs, RBCs, neutrophils, and activation components, but that is beyond the scope of this review.

The purpose of this review is to determine the efficacy of platelet-rich plasma injection vs corticosteroid injection in the management of common tendinopathies, including rotator cuff, lateral epicondyle, and gluteal tendinopathies. The efficacy will be evaluated by comparing each intervention's effects on pain, functional outcome measures, and imaging findings. The hypothesis was that there would be a significant improvement in pain, function, and imaging in favor of PRP injections.

METHODS

This review was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The SPORTDiscus, PubMed, and Google Scholar databases were searched for studies published between 2010 and 2023. The keywords utilized in the search included a combination of the following: “platelet-rich plasma”, “corticosteroids”, “rotator cuff”, “gluteal tendinopathy”, “greater trochanteric”, and “lateral epicondylitis”. The Boolean connector “AND” was utilized to connect “platelet-rich plasma”, “corticosteroids”, and the various tendinopathy sites.

Inclusion and Exclusion Criteria

The scope of this review included randomized controlled trials (RCTs) comparing platelet-rich plasma injection(s) with corticosteroid injection(s) in participants over eighteen years of age that occurred in the year 2010 or after published in the English language. Included were studies that analyzed the effects of these interventions on one of the following outcomes:

pain, functional outcome measure, or imaging findings. Included conditions were rotator cuff tendinopathy, gluteal tendinopathy, and lateral epicondylitis. Studies were excluded if PRP was combined with CSI or another alternate therapy, if it was performed in conjunction with surgical repair, or if the study population included a condition closely associated with the primary conditions screened for, such as subacromial impingement, adhesive capsulitis, osteoarthritis, or greater trochanteric bursitis. This research was conducted by a single reviewer. Studies that met inclusion criteria were assessed and stratified based on injury type.

RESULTS

The three databases yielded 385 studies after duplicates were removed. During the screening of titles and abstracts, a total of 354 studies were excluded. 31 full-text articles were screened for eligibility. 5 full-text articles were unable to be retrieved, 3 were not randomized-controlled trials, and 2 were studies that got replaced with follow-up studies that reported outcome measures at extended points in time. This led to a total of 21 studies that were included in this review (Figure 1).

Out of the 21 RCTs reviewed in this study, 2 investigated the effects of PRP vs. corticosteroids on the management of gluteal tendinopathy, 10 studies investigated the effects of PRP vs corticosteroids on the management of rotator cuff tendinopathy, and 9 studies investigated the effects of PRP vs. corticosteroids on the management of lateral epicondylitis. 8 of the studies were double blinded, 1 study was triple blinded, 1 study blinded participants, 1 was assessor blinded, and 10 studies were not blinded. Follow-up time ranged from 1 week to 2 years. 13 studies utilized ultrasound-guidance for the injections, while 8 studies did not.

Analysis by Type of Tendinopathy

Gluteal Tendinopathy

Two studies directly investigated the effects of PRP vs corticosteroids in the management of gluteal tendinopathy. Bekgas et al included participants with lateral hip pain that had failed the typical conservative treatment of ice, rest, NSAIDs, shockwave, and US therapy.⁹ Both groups received a single injection of either PRP or corticosteroids under ultrasound (US) guidance. There was no formal physical therapy prescribed after injection, however oral antibiotics and NSAIDs were given for four days after the injection. The primary outcome measures were the Visual Analog Scale (VAS) for pain and the Harris Hip Score (HHS) for function, both of which were assessed at baseline and at 4-, 12-, and 24-weeks post-injection.⁹ The corticosteroid group showed more improvement at the 4 week mark in pain reduction, however the PRP group showed better pain scores at 12 and 24 weeks as well as significantly improved HHS scores at 24 weeks when compared to baseline.⁹ This study demonstrates the potential long-term benefits of PRP compared to CSI, however, the sample size was small with only 12 participants per group. Additionally, prescribing NSAIDs for four days after the injection may have dampened the initial proinflammatory effects of PRP.

Fitzpatrick et al demonstrated equivalent long-term benefits of PRP on a larger scale with a longer follow-up period.¹⁰ They included 80 total individuals with gluteal tendinopathy with symptoms for over four months with radiologic confirmation of grade II or III severity via US and MRI in order to exclude full thickness tears from the study.¹⁰ Leukocyte-rich PRP or a CSI was administered under US guidance and both groups were provided the same 12-week unsupervised rehab program. The primary outcome measure was the modified Harris Hip Score (mHHS), which included questions regarding squatting and sitting cross legged that the HHS does not. It was measured at 2, 6, 12 weeks and 6, 12, 24 months. There were no significant

differences at 2 and 6 weeks between the two groups but at 12 weeks there was a significant difference in favor of the PRP group. The PRP group continued to improve at 6, 12, and 24 months while the CS group did not.¹⁰ Furthermore, the PRP group actually had twice the amount of individuals with grade III tendinopathy at baseline but still performed better compared to the CSI group. While there are only two included studies for gluteal tendinopathy, both demonstrated favorable long-term results regarding pain and functional outcome measures. Results demonstrated similar findings among rotator cuff tendinopathy, though there was a much larger number of included studies.

Rotator Cuff Tendinopathy

Ten studies evaluated the effectiveness of PRP vs corticosteroids in the management of rotator cuff tendinopathy. Between the ten studies, there was variation regarding follow-up time, injection and post-injection protocol, and outcome measures.

The first two studies included additional comparison groups to the PRP and CSI interventions. Sari et al randomized 129 participants to groups of prolotherapy (a mixture of 20% dextrose and lidocaine), PRP, CSI, and lidocaine groups under US guidance. The VAS, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), and Western Ontario Rotator Cuff (WORC) Index were measured at 3-, 12-, and 24-weeks post-injection. At 3 weeks the CSI group showed a more significant improvement compared to the other injections across all three measures. There were no significant differences at 12 weeks, however PRP showed a more significant improvement at 24 weeks.¹¹ This study provides strong evidence due to double-blinding, and again shows PRP outperforming CSI at longer follow-ups. Sabaah et al similarly analyzed the differences between PRP, prolotherapy, and CSI regarding

their effects on the VAS, WORC, and ultrasonographic findings at 3 months post-injection.¹² 20 participants were randomized to the three groups. They received two US guided injections 2 weeks apart. Prolotherapy and CSI had significant improvements in VAS while the PRP group did not. All three groups demonstrated a significant improvement in the WORC index. US findings demonstrated significant improvement in the prolotherapy and PRP groups in the grade of the tendon lesion, but the CSI group showed no improvement.¹² This study has a significant limitation of a short follow-up period of only three months. We see some benefit for the PRP group, however PRP tends to have favorable outcomes past the three month mark. These studies show that other injections have efficacy in the management of rotator cuff tendinopathy, but PRP is more effective as time goes on. A few studies had similarities with how their PRP injection was prepared.

Four studies specifically utilized leukocyte-poor PRP (LP-PRP) in comparison to CSI and yielded similar results.^{13,14,15,16} Kwong et al measures changes in the VAS, ASES, and WORC scores at 6 weeks, 3 months, and 12 months between a total of 104 participants. They found a significant difference in pain reduction (VAS) favoring LP-PRP over CSI and a significant improvement in ASES and WORC scores at the 3-month mark. However, there were no significant differences at the 12-month follow-up.¹³ This study provides a unique finding of LP-PRP outperforming CSI at the 3-month mark but not maintaining these benefits at 1 year, which is contradictory to what has been typically found. These results contrast with Thepsoparn et al, who assessed the VAS and Oxford Shoulder Score (OSS) at 1- and 6-months post-injection. There were no differences found at the 1-month follow-up, however at 6 months, both the VAS and OSS were significantly improved in favor of the LP-PRP group. Both groups demonstrated significant improvements in VAS and OSS scores at all time points compared to baseline, but the

CS group had no significant change between the 1- and 6-month mark, demonstrating the fading effects of a CSI.¹⁴ These results suggest positive effects of LP-PRP, but the LP-PRP group was quite younger than the CSI group (11.1 years mean age difference), which likely contributed to the outcomes of the participants involved. The following two studies had much better homogeneity at baseline between groups.

Tanpowpong et al assessed the changes in the ASES, Constant-Murley Score (CMS), and MRI findings at 6 months post-injection in 30 total participants (15 per group). They found significant tear size reduction in the LP-PRP group while there was a non-significant tear reduction in the CS group. Significant improvement was observed in the ASES and CMS in both groups at 6 months, with a significant difference between groups in favor of the LP-PRP group.¹⁵ While the sample size was small and both groups improved, LP-PRP still demonstrated significant improvement overall compared to the CSI group. Vaquerizo et al varied from the last three studies by administering each injection three times (1 every other week).¹⁶ This study was double blinded, had a longer follow-up, and a larger sample size of 42 people per group. The UCLA shoulder score, Quick Disabilities of Arm, Shoulder & Hand (QuickDASH), and CMS were evaluated at 3-, 6-, and 12-months post-injection. Both groups showed significant clinical and functional improvement at all time points in all three outcome measures.¹⁶ The LP-PRP group demonstrated significantly higher improvement in all outcome measures at all time points except for the UCLA score at 3 months.¹⁶ These studies demonstrated positive effects of both interventions, however LP-PRP improved to a higher extent across a variety of outcome measures. To further examine potential PRP benefits, a few studies analyzed additional variables between groups including clinical measures and imaging findings.

The remaining four studies included some form of imaging and/or clinical measure such as strength or range of motion (ROM).^{17,18,19,20} Jo et al randomized 60 subjects to receive either allogeneic PRP or CSI and assessed changes in CMS, pain, ROM, strength, Shoulder Pain and Disability Index (SPADI), ASES, UCLA, SST, and DASH scores at 1 week and 1, 3, and 6 months after injection.¹⁷ There was no significant difference between groups at any point in the constant score, but the PRP group gradually improved over time and became significantly higher than baseline at 6 months while the CS group peaked at 1 month and regressed toward baseline at 6 months. Pain measurements followed a similar trend for both groups. The only ROM changes noted were external rotation with the arm at the side demonstrated significantly greater improvement in the PRP group compared to the CS group. For strength, no between group differences were found. The supraspinatus and infraspinatus strength measures were significantly greater at 3 months compared to pre-injection in the PRP group while the CS group were significant at 1 month and decreased at 3 months. In the PRP group, the SPADI, ASES, UCLA, SST, and DASH scores gradually improved over time while the CS group scores improved rapidly at 1 month and then worsened thereafter.¹⁷ While we see some potential clinical benefits of PRP in strength and ROM, no significant conclusions can be drawn from this study regarding these outcomes. Again, we saw positive long-term results regarding pain and functional outcome measures.

Shams et al decided to look at imaging findings rather than clinical outcomes. They compared changes in the ASES, CMS, SST, and VAS of a single PRP or CSI at 6 weeks, 3 months, and 6 months, with a total of 40 participants.¹⁸ An MRI was also performed at 6 months. All subjects in both groups had statistically significantly better ASES, CMS, SST and VAS after injection compared to baseline. The PRP group was significantly better at 3 months in the SST,

ASES, CMS, and VAS compared to the CSI group, however there was no statistically significant difference at 6 months. MRI showed a slight, nonsignificant improvement in tendinopathy grades in both groups, with no differences between groups.¹⁸ This study contrasts with the others in the sense that PRP did not outperform CSI at the later follow-up period, and it was not significantly better based on imaging improvement. It should be noted that this injection was not US-guided, which could have decreased the accuracy and the healing potential of the PRP injection.

Dadgostar et al analyzed the changes in 58 total participants in the WORC, DASH, VAS, and shoulder ROM after a single PRP or CSI at 1 week, 1 month, and 3 months.¹⁹ All scores showed significant improvement during follow-up in both groups. PRP had significantly higher improvement in pain at the 3 month follow-up and a more significant improvement in adduction and external rotation, but otherwise there were no differences in improvement of ROM, WORC, DASH, or supraspinatus thickness during the follow-up period.¹⁹ While PRP had some significant benefit in pain and a few ROM measures, this study did not contain a long-term follow-up that could have potentially demonstrated PRP's efficacy. Lastly, Ibrahim et al performed a PRP or CSI in 30 total subjects and assessed changes in the VAS, shoulder ROM, Shoulder Disability Questionnaire (SDQ), clinical and US exams at 2 months post-injection.²⁰ There were significant improvement of all measures besides US examinations in both groups with insignificant differences between groups.²⁰ Again, the short follow-up minimizes the opportunity for PRP to demonstrate positive effects. While these two studies did include unique measures such as imaging and clinical findings, the follow-up period was too short to display the regenerative capabilities of PRP.

Overall, we see positive long-term outcomes for PRP in individuals with rotator cuff tendinopathy regarding pain and functional outcome measures but not with clinical and imaging

findings. The body of evidence for lateral epicondylitis was similar in size and displayed similar results.

Lateral Epicondylitis

Nine studies evaluated the effectiveness of PRP vs CSI in the management of lateral epicondylitis. Comparable to rotator cuff tendinopathy, studies varied in outcome measures, PRP preparation, and comparison groups.

Three studies examined the effectiveness of leukocyte-rich PRP (LR-PRP) vs. CSI in the management of lateral epicondylitis.^{21,22,23} Gosens et al randomized 100 subjects to receive either LR-PRP or CSI and both participants and assessors were blinded. The DASH and VAS were the two primary outcome measures for this study.²¹ The CSI group had a greater improvement in the VAS and DASH at 4 weeks and 8 weeks. The LR-PRP group demonstrated better improvement at the 12 week, 6 months, 1 year, and 2 year mark in both the VAS and DASH.²¹ This study provides strong long-term evidence for LR-PRP with thorough follow-up and double blinding. The next two studies produced similar findings, but with a few limitations and smaller sample sizes that decrease their strength of evidence.

Arora et al and Nasser et al both utilized LR-PRP in comparison to CSI and saline injections.^{22,23} Arora et al had 60 total participants and found the CSI and LR-PRP groups to be almost equally effective at the 4 and 8 week marks with the CSI group showing slightly more improvement in the VAS, DASH, Mayo Elbow Performance Score (MEPS), and patient-rated tennis elbow evaluation (PRTEE). However, LR-PRP had a significant improvement compared to the CSI group at the 12-week point.²² This study did not have any blinding and utilized a smaller sample size compared to Gosens et al. Nasser et al found similar results with 45 total

subjects. They had a more significant improvement in VAS and PRTEE in the LR-PRP group compared to the CSI group at the 3-month mark.²³ This study has a significant limitation of only one follow-up period, which decreased the ability to analyze results over multiple time points. Both studies demonstrated significant improvement in both interventions when compared to the saline groups, therefore showing results were not placebo based.^{22,23}

Like the previous two studies, the following two studies included a third group for comparison but did not utilize LR-PRP.^{24,25} Krogh et al compared PRP, CSI, and saline groups with regards to changes in PRTEE, US changes, and color doppler activity at 4 weeks, 3, 6, and 12 months. They found the CSI group had a more significant decrease in PRTEE pain score at 1 month but there were no between group differences found at 3 months. CSI were also superior to both groups in reducing tendon thickness and color doppler activity at 3 months. There was a significant attrition rate in this study leading to a cessation of the ability to analyze data past 3 months.²⁴ This is a significant limitation because previous studies show PRP benefits are typically seen past three months, and this is not enough time to likely induce significant changes in tendon properties and outcome measures.

Kivrak et al were able to analyze findings throughout a longer time frame. They compared PRP, CSI, or autologous blood injections and their effects on VAS, DASH, and Nirschl scores at 2 weeks, 4 weeks, 3 months, and 6 months. CSI showed significant improvement in all three outcomes compared to both groups at 2 weeks and 4 weeks. However, outcome measures started to plateau or regress in the CSI group at 3 months and 6 months while the other two groups continued to improve.²⁵ While the attrition rate in Krogh's study makes it difficult to draw any conclusions, the findings of Kivrak et al show beneficial long-term effects

of PRP, aligning with what has been reported so far. In addition to including measures of pain and functional outcomes, a small sample of studies included measures on strength.

Three studies included a measure of grip strength in addition to their other outcomes and yielded similar results to the aforementioned studies.^{26,27,28} Yadav et al utilized 65 participants and found significant improvement for the CSI group in the VAS and grip strength at the 2 week and 1 month marks, however the PRP group had a significant between group difference at 3 months for the VAS, handgrip strength, and QuickDASH.²⁶ While they found positive improvements in handgrip strength favoring PRP, the next two studies did not. Gautam et al utilized 30 total subjects and found significant differences in favor of CSI at 2 weeks and 6 weeks in the VAS, modified Mayo performance index, DASH, and Oxford Elbow score when compared to the PRP group, but the PRP group exhibited significant improvement at 6 months in all the same measures when compared to the CS group.²⁷ There were no between group differences in handgrip strength but both groups improved compared to baseline.²⁷ Kamble et al found results consistent with Gautam et al, with PRP showing significant improvement at later follow-up but no between group differences in strength measures. The VAS, DASH, and PRTEE scores favored the CS group at 3 months, while they favored the PRP group at 2 years. Handgrip strength improved in both groups but there were not any significant between group differences found at 2 years.²⁸ While it is an interesting outcome to analyze, there has yet to be any conclusive evidence to demonstrate PRP is significantly superior to CSI with regard to strength improvement. One final study did not possess similarities to be grouped with any of the aforementioned studies but did include outcome measures of pain and function.

Varshney et al randomized 83 total participants to two groups of PRP vs CSI. They investigated their effects on the VAS and Mayo performance index. Both interventions were

equally effective at the 1- and 2-month follow-ups, however the PRP group showed significant improvement in both the VAS and Mayo scores at the 6-month follow-up.²⁹ This result is consistent with the majority of studies regarding lateral epicondylitis, as well as the other two tendinopathy sites. There is a significant trend showing CSI outperforming PRP regarding pain and functional outcome measures at short-term follow-up (up to three months), but PRP continuously improving over time to exceed CSI results long-term.

DISCUSSION

This review has demonstrated the potential for successful treatment outcomes when utilizing PRP for chronic tendinopathies. The results generally show that while corticosteroids outperform PRP injections in the short term, PRP groups tend to improve over time gradually and consistently while subjects who received corticosteroids regress back towards baseline regarding pain and function. Positive effects were demonstrated amongst all three tendinopathy sites, primarily with improvement in pain and function. With respect to imaging findings and clinical improvement, results varied between studies and no consistent conclusion can be drawn.

A common finding across most of the studies was corticosteroid injections demonstrating a more significant decrease in pain up to the 8-to-12-week mark. There were studies that showed no significant changes in pain at the conclusion of the study, however these studies did not have follow-ups past the three month mark, which is when we typically begin to see the benefits of CSI fade and those of PRP begin to further improve.^{12,20} Each tendinopathy site had a study with a prolonged follow-up of 2-years, and they all showed a benefit in pain reduction favoring the PRP groups at the 2-year mark.^{10,21,28} However, Kwong et al and Shams et al found no significant improvement in pain at the final follow-up of their study at 12 months and 6 months,

respectively.^{13,18} Similar patterns of improvement were found for the functional outcome measures assessed throughout all of the studies.

Comparable with pain changes, the CSI groups tended to have rapid improvements at early follow-ups and then benefits would taper off as the study progressed. Gosens et al found that 51% of individuals in the CSI group and 73% of individuals the PRP group had a successful treatment at the 1 year follow-up regarding their improvement in DASH scores, defined as at least a 25% reduction.²¹ At 2 years, 56 subjects were still considered successfully treated based on DASH scores, with 66% from the PRP group.²¹ Varshney et al showed a mean 54.4% improvement in the Mayo Elbow Performance Index at 6 months compared to a mean 1.25% improvement in the CS group.²⁹ Many of the other studies similarly found a progressive improvement in functional outcome measures over time in the PRP groups, indicating people not only feel better symptomatically, but they also perceive higher levels of function as time goes on. While functional outcome and pain measures followed comparable trends, the same cannot be stated for imaging outcomes.

Imaging findings were markedly inconsistent amongst the studies included. Two studies found imaging improvement in both groups without differences between groups.^{18,23} One study found a significant tear size reduction in favor of the PRP group compared to the CS group for supraspinatus tears.¹⁵ The last study found a decrease in doppler activity and tendon thickness favoring the CS group in subjects with lateral epicondylitis, however the study did not analyze data past three months due to significant attrition.²⁴ It is known tendon healing and regeneration likely takes much longer than three months, so not much can be drawn from the results presented in that study. In addition to imaging findings, a small sample of studies analyzed clinical

outcomes such as strength and range of motion, however, these results were similarly inconsistent.

Joint range of motion was included as an accessory outcome measure in a few studies. Two of the studies found that both groups improved in range of motion measures, but it was not significant between groups for those with rotator cuff tendinopathy.^{19,20} Sabaah et al found no improvement in ROM in both the CS and PRP groups, while Jo et al found only a slight benefit in shoulder external rotation in the PRP group.^{12,17} Many studies also found similar improvements in strength measures without a significant difference between groups.^{17,27,28} This is an interesting finding because with the widespread improvement in functional outcome measures in the PRP groups, it would be hypothesized that clinical findings would additionally correlate. The positive benefit in functional outcome measures could potentially be attributed to a decrease in symptoms, therefore leading the patient to increase their activity without being hindered by pain. While there seems to be substantial evidence for long-term improvement in pain and functional outcome measures, the same cannot be stated for imaging findings and clinical measures.

Limitations

There are a few limitations in this review that influence the generalizability of the findings. First off, the outcome measures included for review were not standardized. This led to a wide range of functional outcome measures reported, which all have variable reliability and validity. Second, there was a lot of variety regarding PRP preparation, injection, and post-injection protocols. This led to leukocyte-rich, leukocyte-poor, and different centrifugation methods for PRP preparation. The injection protocol itself was different between studies. The majority utilized a single injection, but a few included repeat injections (up to three). A little over

half of the studies used ultrasound to guide the injection while the others did not. Different post-injection variables included structured physical therapy, immobilization, and NSAID use. There seems to be a significant lack of standardization regarding PRP preparation, injection, and post-injection techniques, which significantly limits the ability to generalize these findings. Lastly, the majority of studies utilized relatively small sample sizes, with a total participant sample usually between 30 to 60 split between two or three groups. Only four studies had over 100 total participants, with the highest being 129. These results need to be replicated on a larger scale to draw firm conclusions.

CONCLUSION

Tendinopathy is one of the most prevalent musculoskeletal conditions that affects a variety of individuals. There are a significant number of individuals who end up developing chronic tendinopathies which are refractory to treatment interventions, demonstrating the need for new therapies such as PRP. Much of the evidence in this review demonstrates a positive, long-term effect of PRP on pain and functional outcome measures in treatment-resistant tendinopathy patients when compared to CSI. There seems to be a lack of strong evidence that PRP has a more significant effect on improvements in imaging and clinical findings versus CSI. As the body of research regarding PRP continues to grow, there needs to be more standardization regarding preparation, injection, and post-injection protocols. Additionally, studies need to be replicated on a larger scale to produce a more generalizable conclusion. While early research findings are promising, further investigation needs to be completed to truly determine the efficacy of PRP injections in the management of chronic tendinopathies.

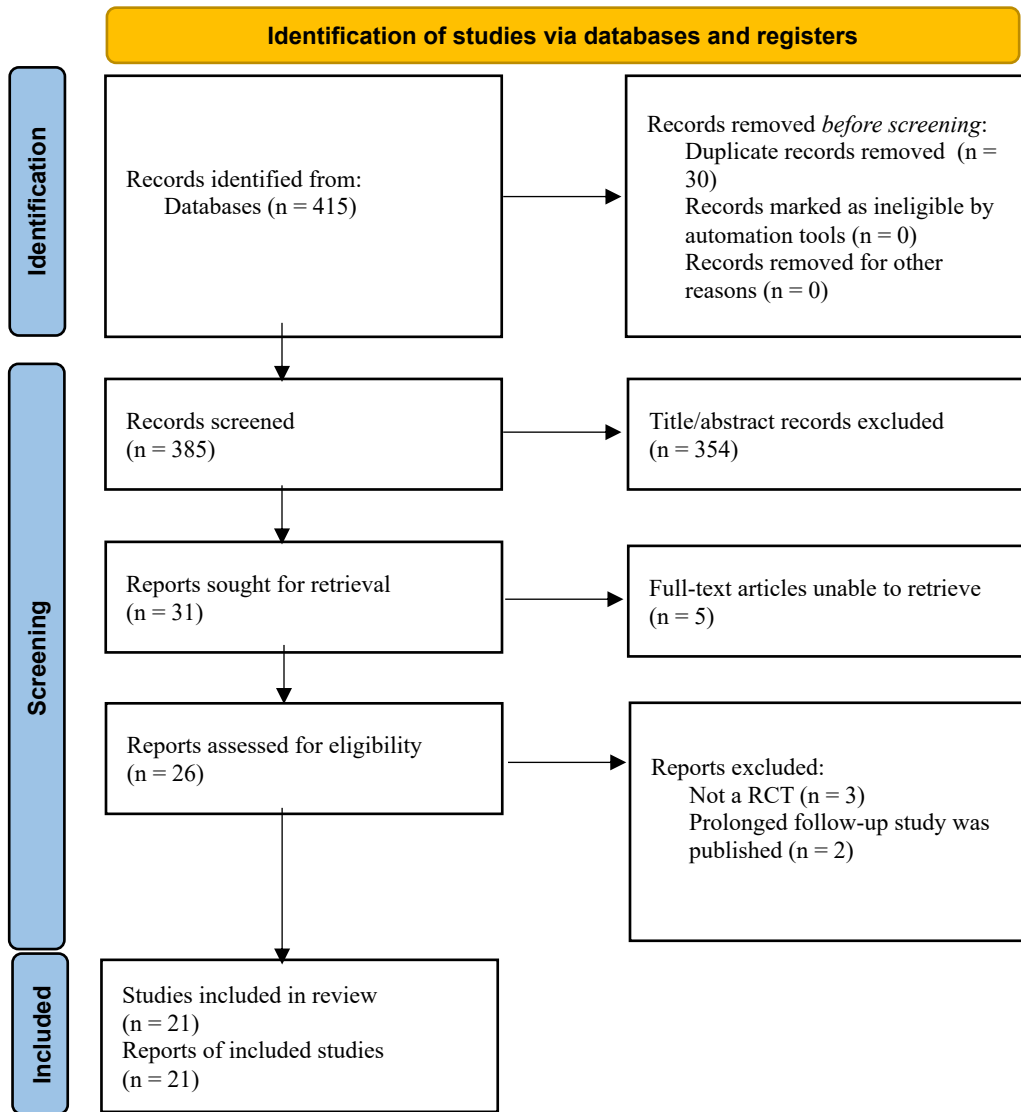


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram of studies included in this review.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

References

1. Kane SF, Olewinski LH, Tamminga KS. Management of Chronic Tendon Injuries. *Am Fam Physician*. 2019;100(3):147-157.
2. Ladurner A, Fitzpatrick J, O'Donnell JM. Treatment of Gluteal Tendinopathy: A Systematic Review and Stage-Adjusted Treatment Recommendation. *Orthop J Sports Med*. 2021;9(7):23259671211016850. Published 2021 Jul 29. doi:10.1177/23259671211016850
3. Leong HT, Fu SC, He X, Oh JH, Yamamoto N, Hang S. Risk factors for rotator cuff tendinopathy: A systematic review and meta-analysis. *J Rehabil Med*. 2019;51(9):627-637. doi:10.2340/16501977-2598
4. Lenoir H, Mares O, Carlier Y. Management of lateral epicondylitis. *Orthop Traumatol Surg Res*. 2019;105(8S):S241-S246. doi:10.1016/j.otsr.2019.09.004
5. Millar NL, Silbernagel KG, Thorborg K, et al. Tendinopathy [published correction appears in Nat Rev Dis Primers. 2021 Feb 3;7(1):10]. *Nat Rev Dis Primers*. 2021;7(1):1. Published 2021 Jan 7. doi:10.1038/s41572-020-00234-1
6. Cardoso TB, Pizzari T, Kinsella R, Hope D, Cook JL. Current trends in tendinopathy management. *Best Pract Res Clin Rheumatol*. 2019;33(1):122-140. doi:10.1016/j.berh.2019.02.001
7. Everts P, Onishi K, Jayaram P, Lana JF, Mautner K. Platelet-Rich Plasma: New Performance Understandings and Therapeutic Considerations in 2020. *Int J Mol Sci*. 2020;21(20):7794. Published 2020 Oct 21. doi:10.3390/ijms21207794
8. Van Schaik KD, Lee KS. Orthobiologics: Diagnosis and Treatment of Common Tendinopathies. *Semin Musculoskelet Radiol*. 2021;25(6):735-744. doi:10.1055/s-0041-1735475
9. Begkas D, Chatzopoulos ST, Touzopoulos P, Balanika A, Pastroudis A. Ultrasound-guided Platelet-rich Plasma Application Versus Corticosteroid Injections for the Treatment of Greater Trochanteric Pain Syndrome: A Prospective Controlled Randomized Comparative Clinical Study. *Cureus*. 2020;12(1):e6583. Published 2020 Jan 7. doi:10.7759/cureus.6583
10. Fitzpatrick J, Bulsara MK, O'Donnell J, Zheng MH. Leucocyte-Rich Platelet-Rich Plasma Treatment of Gluteus Medius and Minimus Tendinopathy: A Double-Blind Randomized Controlled Trial With 2-Year Follow-up. *Am J Sports Med*. 2019;47(5):1130-1137. doi:10.1177/0363546519826969
11. Sari A, Eroglu A. Comparison of ultrasound-guided platelet-rich plasma, prolotherapy, and corticosteroid injections in rotator cuff lesions. *J Back Musculoskelet Rehabil*. 2020;33(3):387-396. doi:10.3233/BMR-191519
12. Sabaah HMAE, Nassif MA. What is better for rotator cuff tendinopathy: dextrose prolotherapy, platelet-rich plasma, or corticosteroid injections? A randomized controlled study. *Egyptian Rheumatology and Rehabilitation*. 2020;47(1). doi:https://doi.org/10.1186/s43166-020-00040-3
13. Kwong CA, Woodmass JM, Gusnowski EM, et al. Platelet-Rich Plasma in Patients With Partial-Thickness Rotator Cuff Tears or Tendinopathy Leads to Significantly Improved Short-Term Pain Relief and Function Compared With Corticosteroid Injection: A Double-Blind Randomized Controlled Trial. *Arthroscopy*. 2021;37(2):510-517. doi:10.1016/j.arthro.2020.10.037

14. Thepsoparn M, Thanphraisian P, Tanpowpong T, Itthipanichpong T. Comparison of a Platelet-Rich Plasma Injection and a Conventional Steroid Injection for Pain Relief and Functional Improvement of Partial Supraspinatus Tears. *Orthop J Sports Med.* 2021;9(9):23259671211024937. Published 2021 Sep 1. doi:10.1177/23259671211024937
15. Tanpowpong T, Thepsoparn M, Numkarunarunrote N, Itthipanichpong T, Limskul D, Thanphraisian P. Effects of Platelet-Rich Plasma in Tear Size Reduction in Partial-Thickness Tear of the Supraspinatus Tendon Compared to Corticosteroids Injection. *Sports Med Open.* 2023;9(1):11. Published 2023 Feb 8. doi:10.1186/s40798-023-00556-w
16. Vaquerizo V, García-López M, Mena-Rosón A, Prado R, Padilla S, Anitua E. Plasma rich in growth factors versus corticosteroid injections for management of chronic rotator cuff tendinopathy: a prospective double-blind randomized controlled trial with 1 year of follow-up. *J Shoulder Elbow Surg.* 2023;32(3):555-564. doi:10.1016/j.jse.2022.08.017
17. Jo CH, Lee SY, Yoon KS, Oh S, Shin S. Allogeneic Platelet-Rich Plasma Versus Corticosteroid Injection for the Treatment of Rotator Cuff Disease: A Randomized Controlled Trial. *J Bone Joint Surg Am.* 2020;102(24):2129-2137. doi:10.2106/JBJS.19.01411
18. Shams A, El-Sayed M, Gamal O, Ewes W. Subacromial injection of autologous platelet-rich plasma versus corticosteroid for the treatment of symptomatic partial rotator cuff tears. *Eur J Orthop Surg Traumatol.* 2016;26(8):837-842. doi:10.1007/s00590-016-1826-3
19. Dadgostar H, Fahimipour F, Pahlevan Sabagh A, Arasteh P, Razi M. Corticosteroids or platelet-rich plasma injections for rotator cuff tendinopathy: a randomized clinical trial study. *J Orthop Surg Res.* 2021;16(1):333. Published 2021 May 21. doi:10.1186/s13018-021-02470-x
20. Ibrahim DH, El-Gazzar NM, El-Saadany HM, El-Khouly RM. Ultrasound-guided injection of platelet rich plasma versus corticosteroid for treatment of rotator cuff tendinopathy: Effect on shoulder pain, disability, range of motion and ultrasonographic findings. *The Egyptian Rheumatologist.* 2019;41(2):157-161. doi:10.1016/j.ejr.2018.06.004
21. Gosens T, Peerbooms JC, van Laar W, den Oudensten BL. Ongoing positive effect of platelet-rich plasma versus corticosteroid injection in lateral epicondylitis: a double-blind randomized controlled trial with 2-year follow-up. *Am J Sports Med.* 2011;39(6):1200-1208. doi:10.1177/0363546510397173
22. Arora KK, Kapila R, Kapila S, Patra A, Chaudhary P, Singal A. Management of Lateral Epicondylitis: A Prospective Comparative Study Comparing the Local Infiltrations of Leucocyte Enriched Platelet-Rich Plasma (L-aPRP), Glucocorticoid and Normal Saline. *Malays Orthop J.* 2022;16(1):58-69. doi:10.5704/MOJ.2203.009
23. Nasser MET, El Yasaki AZ, Ezz El Mallah RM, Abdelazeem ASM. Treatment of lateral epicondylitis with platelet-rich plasma, glucocorticoid, or saline. A comparative study. *Egyptian Rheumatology and Rehabilitation.* 2017;44(1):1-10. doi:10.4103/1110-161x.200838
24. Krogh TP, Fredberg U, Stengaard-Pedersen K, Christensen R, Jensen P, Ellingsen T. Treatment of lateral epicondylitis with platelet-rich plasma, glucocorticoid, or saline: a randomized, double-blind, placebo-controlled trial. *Am J Sports Med.* 2013;41(3):625-635. doi:10.1177/0363546512472975

25. Kivrak A, Ulusoy I. Comparison of the Clinical Results of Platelet-Rich Plasma, Steroid and Autologous Blood Injections in the Treatment of Chronic Lateral Epicondylitis. *Healthcare (Basel)*. 2023;11(5):767. Published 2023 Mar 6. doi:10.3390/healthcare11050767
26. Yadav R, Kothari SY, Borah D. Comparison of Local Injection of Platelet Rich Plasma and Corticosteroids in the Treatment of Lateral Epicondylitis of Humerus. *J Clin Diagn Res*. 2015;9(7):RC05-RC7. doi:10.7860/JCDR/2015/14087.6213
27. Gautam VK, Verma S, Batra S, Bhatnagar N, Arora S. Platelet-rich plasma versus corticosteroid injection for recalcitrant lateral epicondylitis: clinical and ultrasonographic evaluation. *J Orthop Surg (Hong Kong)*. 2015;23(1):1-5. doi:10.1177/230949901502300101
28. Kamble P, Prabhu RM, Jogani A, Mohanty SS, Panchal S, Dakhode S. Is Ultrasound (US)-Guided Platelet-Rich Plasma Injection More Efficacious as a Treatment Modality for Lateral Elbow Tendinopathy Than US-Guided Steroid Injection?: A Prospective Triple-Blinded Study with Midterm Follow-up. *Clin Orthop Surg*. 2023;15(3):454-462. doi:10.4055/cios22128
29. Varshney A, Maheshwari R, Juyal A, Agrawal A, Hayer P. Autologous Platelet-rich Plasma versus Corticosteroid in the Management of Elbow Epicondylitis: A Randomized Study. *Int J Appl Basic Med Res*. 2017;7(2):125-128. doi:10.4103/2229-516X.205808

AUGSBURG UNIVERSITY

Augsburg University Institutional Repository Deposit Agreement

By depositing this Content ("Content") in the Augsburg University Institutional Repository known as Idun, I agree that I am solely responsible for any consequences of uploading this Content to Idun and making it publicly available, and I represent and warrant that:

- I am *either* the sole creator or the owner of the copyrights in the Content; or, without obtaining another's permission, I have the right to deposit the Content in an archive such as Idun.
- To the extent that any portions of the Content are not my own creation, they are used with the copyright holder's expressed permission or as permitted by law. Additionally, the Content does not infringe the copyrights or other intellectual property rights of another, nor does the Content violate any laws or another's right of privacy or publicity.
- The Content contains no restricted, private, confidential, or otherwise protected data or information that should not be publicly shared.

I understand that Augsburg University will do its best to provide perpetual access to my Content. To support these efforts, I grant the Board of Regents of Augsburg University, through its library, the following non-exclusive, perpetual, royalty free, worldwide rights and licenses:

- To access, reproduce, distribute and publicly display the Content, in whole or in part, to secure, preserve and make it publicly available
- To make derivative works based upon the Content in order to migrate to other media or formats, or to preserve its public access.

These terms do not transfer ownership of the copyright(s) in the Content. These terms only grant to Augsburg University the limited license outlined above.

Initial one:

EC I agree and I wish this Content to be Open Access.

I agree, but I wish to restrict access of this Content to the Augsburg University network.

Work (s) to be deposited

Title: The Efficacy of PRP Injection vs Corticosteroid Injection in the Management of Common Tendinopathies: A Systematic Review

Author(s) of Work(s): Eric Caloud

Depositor's Name (Please Print): Eric Caloud

Author's Signature: Eric Caloud Date: 8/1/2023

If the Deposit Agreement is executed by the Author's Representative, the Representative shall separately execute the following representation.

I represent that I am authorized by the Author to execute this Deposit Agreement on the behalf of the Author.

Author's Representative Signature: _____ Date: _____