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Review Article

Indications and Considerations for PRP Utilization in Sports Medicine

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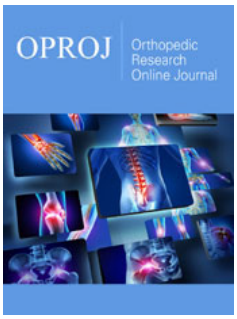

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Abstract

Platelet-Rich Plasma (PRP) therapy has gained traction as a treatment for various musculoskeletal injuries, though its precise indications and timing of administration remain unclear. This article reviews the biological mechanisms underlying PRP's action as well as common indications for its use. For lateral epicondylitis, systematic reviews indicate significant improvement in patient-reported outcomes compared to placebo and corticosteroids. Evidence is less clear regarding the efficacy of PRP in plantar fasciitis, patellar, and achilles tendonopathies. PRP demonstrates favorable outcomes in rotator cuff tendinopathy, outperforming traditional rehabilitation methods, though comparisons to corticosteroids show limited superiority. PRP also shows promise in surgical settings, particularly in meniscal repair and rotator cuff repair, where it has been associated with lower retear rates and improved functional scores. In conclusion, PRP represents a valuable conservative option for certain chronic musculoskeletal conditions, particularly where traditional treatments are ineffective, while further high-quality research is needed to solidify its role across diverse applications.

Overview

Platelet Rich Plasma (PRP) has become an increasingly popular and studied modality in addressing a variety of musculoskeletal injuries. This treatment is frequently considered as a last resort by most in conservative treatment plans, however exact indications and timing of PRP administration remains elusive. The purpose of this article is to guide the reader in developing a better understanding of when PRP should be considered and the expected benefit of its utilization.

Biology and mechanism of action

The goal of PRP is to cause an acute, localized inflammatory response to promote healing of damaged tissue. While there are many immune factors that contribute to this response, several have been identified that play a significant role (Table 1); [1]. Through recruitment and activation of nearby mesenchymal stem cells the body is able to maximize an acute healing response, thus reversing the deleterious effects secondary to chronic inflammation.

Table 1:

Factor	Function
PDGF	Chemotaxis, proliferation, and mitogenic changes to surrounding macrophages and fibroblasts
TGF-β	Angiogenesis, fibroblast activation and proliferation, collagen synthesis, and extracellular matrix modification
VEGF	Angiogenesis, epithelialization, collagen synthesis
TNF-α	Chemotaxis, promotion of extracellular matrix synthesis, regulation of activity of fibroblast, keratinocytes, and endothelial cells
IGF-1	Angiogenesis, collagen synthesis, chemotaxis of fibroblast
EGF	Regulation of fibroblasts and keratinocytes, chemotaxis, epithelialization, and granulation tissue formation

Platelet Derived Growth Factor (PDGF), Tumor Growth Factor Beta (TGF-β), Vascular Endothelial Growth Factor (VEGF), Tumor Necrosis Factor Alpha (TNF-α), Insulin Growth Factor-1 (IGF-1), Epidermal Growth Factor (EGF)

Indications

Due to PRP not being approved by the United States Food and Drug Administration (FDA) for use outside of bone graft preparation, there are no formal guidelines outlining its use in musculoskeletal injuries. However, extensive research has been performed to investigate its use and clinical outcomes for a variety of conditions. While this review article will not discuss all conditions that could be reasonably addressed with PRP, it will aim to include routine conditions that PRP has been used to treat.

Lateral epicondylitis

Perhaps one of the most well-known and treated conditions with PRP, lateral epicondylitis is a painful and debilitating condition caused by chronic inflammation involving the origin of the common extensor tendon from the lateral epicondyle. A multitude of studies have investigated the use of PRP for this condition. A recent systematic review performed by Niemiec et. al included 26 studies and demonstrated significant improvement greater than Minimally Clinical Important Difference (MCID) in Patient Reported Outcomes (PROMs) including Visual Analog (VAS) pain, disabilities of the arm shoulder and hand (DASH), and Mayo Clinical Performance Index (MAYO) up to 104 weeks post injection for some of the included studies [2]. Studies comparing PRP to placebo injection with tendon needling or corticosteroid injections have confirmed PRP to be superior in regard to longer duration of pain relief [3-5].

The above mentioned literature in addition to other articles supports the use of PRP in the treatment of lateral epicondylitis, particularly in cases when other conservative treatment modalities such as bracing and physical therapy have failed. Furthermore, multiple studies have demonstrated superior effects of PRP and longer duration when compared to corticosteroid injections.

Plantar fasciitis

While there is less data studying the benefit of PRP injections for plantar fasciitis compared to lateral epicondylitis, several studies have demonstrated promise in this modality. A meta-analysis by Singh et al. [6] investigated use of PRP versus corticosteroid in individuals who had failed conservative treatment modalities [6]. This analysis demonstrated that PRP was associated with a significant difference in improved VAS pain scores and American Orthopaedic Foot and Ankle Scores (AOFAS) when compared to individuals undergoing corticosteroid injection at 3 month follow up. Another meta-analysis that included 9 randomized control trials (RCTs) found that there were no differences between PRP injection and corticosteroid injection after 4 or 12 weeks, however PRP demonstrated significantly higher improvements in VAS pain than corticosteroid injections at 24 weeks [7]. Further supporting these meta-analyses, a double-blinded multicenter RCT including 82 patients was performed which demonstrated superior pain relief and functional improvement for individuals undergoing PRP for plantar fasciitis at 1 year follow up when compared to corticosteroid injection [8]. A more recent case series including 30 patients investigated PRP use in chronic plantar fasciitis found significant improvements in VAS at 6 and 12 weeks and a significant decrease in plantar fascia thickness when assessed with ultrasound at 12 weeks [9].

While the evidence for routine use of PRP for plantar fasciitis is not as strong when compared to its use for lateral epicondylitis, largely due to available supporting studies and their sample size, there is sufficient literature to suggest that PRP is a reasonable treatment option. Furthermore, PRP provides a longer duration of symptom relief when compared to corticosteroid injections. Another benefit to consider with use of PRP utilization is avoiding the known risk of plantar fascia rupture and fat pad atrophy with repetitive injection of corticosteroids [10].

Patellar tendinopathy

Patellar tendinopathy is a painful condition that commonly affects jumping athletes and can lead to chronic anterior knee pain that is unresponsive to traditional conservative measures such as physical therapy and rest. PRP has been utilized and studied for addressing this condition in these cases, particularly considering concerns regarding tendon atrophy and rupture with corticosteroid injections [11]. Several recent studies have demonstrated superior improvement with PRP when compared to other modalities. Vetrano et al. [12] examined the utilization of PRP injection compared to extracorporeal shockwave therapy in a small RCT and found that PRP was superior in providing pain relief at 6-month and 12 month follow up [12]. Another study found that PRP was superior to high volume saline injection alone at 6 month follow up in regards to pain and function and that combining PRP with high volume saline injection provided superior benefit compared to PRP alone [13]. A study by Kaux et al. [14] found that PRP was superior to hyaluronic acid injections in preserving quadriceps strength and pain [14]. However, numerous other studies have reported equivocal or inferior results of PRP use for treatment of patellar tendinopathy compared to other modalities [15,16]. A recent meta-analysis that included 8 comparative studies for PRP treatment of patellar tendinopathy, including studies that compared PRP to no active treatment, found that there was no significant improvement for use of PRP compared to other injections or conservative modalities [17].

Currently available evidence does not support or recommend against the routine use of PRP injection for treatment of patellar tendinopathy. Ultimately more high-quality research and large RCTs need to be performed to more definitively parse out the significance of PRP utilization for this condition.

Achilles tendinopathy

Achilles Tendinopathy (AT) presents a challenging condition to treat due to its persistence and significant impact on activities such as running and jumping. The mainstay of treatment, similar to patellar tendinopathy, is focused on a regimen of rest, oral anti-inflammatories, and targeted strengthening with physical therapy. PRP has been used to treat achilles tendinopathy and studies remain mixed on the true benefit of this modality.

A RCT performed by Boesen et. al compared one high volume injection with saline, steroid, local anesthetic to four injections of

PRP separated by 14 days to a placebo group who received saline injection alone for AT [18]. The results of this study demonstrated significantly improved pain, function, and decreased achilles tendon thickness in the PRP and high-volume injection groups compared to the placebo group. A systematic review evaluating 11 studies of various designs found equivocal results for PRP treatment of AT with included retrospective studies demonstrating purported benefit while higher evidence RCT studies did not when compared to control groups [19]. A more recent meta-analysis published in 2023 evaluated PRP use for treatment of AT and only included randomized control trials [20]. A total of 8 studies were evaluated and concluded that PRP did not provide significant improvement in regard to pain, patient satisfaction, or return to sport at 6 and 24 week follow up; although PRP did seem to provide significant improvement in regards to VAS pain scores at 12 week follow up. Ultimately the authors did not recommend routine use of PRP for AT based on their findings and recommended that large, well designed randomized control trials be performed to definitively elucidate potential benefit of PRP use.

Literature investigating the use of PRP for AT remains inconclusive about its benefit. The majority of available RCTs do not show that PRP provides significant improvement for treatment of AT; although most of these studies are limited by sample size and design. There are retrospective studies and an RCT that included multiple successive PRP injections that do show potential benefit of this modality in treating AT [18,21,22]. Ultimately an honest discussion about the lack of certainty of PRP in treating AT should be had by the clinician and patient and shared decision making should occur before proceeding.

Rotator cuff tendinopathy

Rotator cuff tendinopathy is the result of untreated chronic tendonitis that becomes difficult to treat due to the prolonged nature of inflammation and limited healing of the damaged rotator cuff tendons. PRP has been explored as an alternative treatment option due to its potential of promoting tendon healing and restoration rotator cuff integrity.

Studies thus far have overall demonstrated equivalent results with PRP injection when compared to corticosteroid injections in treating this condition with some studies suggesting PRP provides superior relief of symptoms in long term follow up and cases that are refractory to physical therapy and steroid injection [23-25]. A meta-analysis investigating this topic included 8 RCT found that PRP injection was superior to other modalities such as saline injection, dry needling, exercise rehabilitation program alone for pain relief and shoulder function at long term follow up [26]. These findings are consistent with another published meta-analysis which found PRP was superior for pain relief, but not shoulder function, at 6 month follow up compared to other modalities, excluding steroid injections [27].

PRP injection for rotator cuff tendinopathy is a reasonable treatment option and current literature has demonstrated it is superior to physical rehabilitation programs alone or other modalities such as dry needling or saline injection. However, studies comparing PRP to corticosteroid injection demonstrate that these modalities are largely comparable in regards to outcomes and pain relief. Possible reasons to consider PRP over corticosteroid injection include individuals in whom corticosteroid injections are contraindicated, to avoid use of steroid in patients who might progress to needing surgical intervention within 3 months, and the theorized healing properties of PRP compared to the known catabolic effects of steroid injections.

Greater trochanteric pain syndrome/gluteus medius tendinopathy

Hip abductor tendinopathy is the most common tendinopathy affecting the lower extremity and typically is a bothersome and debilitating condition in the aging population [28,29]. Traditional treatment regimens include physical therapy, corticosteroid injections, oral NSAIDs, and rest from aggravating activities. However, in the case of chronic inflammation or partial tendon tears these modalities are not always successful due to tendon degeneration and fatty atrophy. Thus, it is thought that PRP injection can restore tendon integrity and function through enhancing the acute healing environment.

A case series including 21 patients with moderate to severe gluteus medius tendinosis or partial tear found that ultrasound guided PRP injection with concomitant needle tenotomy provided significant improvement in average hip pain and function at long term follow up of 19 months [30]. Fitzpatrick et. al conducted a RCT evaluating corticosteroid injection versus PRP in 80 individuals with recalcitrant gluteus tendinopathy and found that PRP provided significantly greater improvement in modified Harris Hip Score at 12 weeks follow up compared to corticosteroid injection [31]. An extension of this study with follow-up at 2 years found that the benefit of PRP administration persisted in regards to pain and function and remained superior to corticosteroid injection [32]. Another study evaluating ultrasound guided PRP injection vs gluteus tendon fenestration found that both modalities provided significant at mean follow up of 92 days with no significant difference noted between the two groups, however this study was significantly limited by sample size [33]. A systematic review that evaluated 5 studies (3 RCTs and 2 case series) concluded that PRP is a viable option for treatment of persistent greater trochanteric bursitis refractory to traditional conservative treatment options and provides relief at long term follow up [34].

Evidence surrounding PRP use for chronic greater trochanteric pain syndrome/gluteus medius tendinopathy is promising and suggests that this modality can yield prolonged relief and benefit. Furthermore, studies demonstrate this benefit is superior to relief provided by a single corticosteroid injection.

Surgical applications

PRP has also been explored as a means of augmentation of multiple sports medicine procedures. This section will not expound at length about the details and extent of current research surrounding this topic but will seek to briefly highlight the utility of PRP augmentation at the time of surgery or in the perioperative window.

Anterior Cruciate Ligament Reconstruction (ACL-R)

PRP augmentation has been extensively explored in the setting of ACL-R. A large and recent meta-analysis that included 23 RCTs and 943 knees concluded that there was no consensus on the utility of PRP augmentation in the setting of ACL-R with some studies reporting improved outcomes, graft healing, and donor site healing while others did not [35]. Furthermore, the studies included in this article had a wide variety of outcome measurements, PRP administration, and techniques of ACL-R that made it difficult to compare studies. Another meta-analysis reported significantly improved pain in the short term and less than half of the included studies reported improved graft healing and decreased tunnel widening; however, there were no long-term benefits of PRP augmentation of ACL-R [36]. Currently there is lacking high quality research suggesting routine augmentation of ACL-R with PRP.

Meniscus repair

Biologic augmentation of meniscal repair with PRP has been sought due to the reported high retear rate of this surgery approaching greater than 20% [37,38]. Current evidence addressing this topic overall has shown promise in increasing healing rates following surgery. A recent meta-analysis that included a total of 9 studies and 1164 participants found that PRP augmentation of meniscus repair leads to lower retear rate and improved pain when compared to non-augmented repair or augmentation with platelet rich fibrin matrix [39]. Of note, this study was unable to provide sufficient evidence that PRP augmentation significantly improved knee functional scores after repair. Another systematic review reported similar findings of PRP augmentation leading to decreased retear rates of 10.8% vs 27.0% for non-augmented repairs, although there were no significant differences in patient reported outcomes following surgery between groups [38]. Based on current available evidence, PRP augmentation of meniscus repair yields significantly lower retear rates following surgery although the clinical significance in regards to knee function remains to be elucidated.

Rotator Cuff Repair (RCR)

Current evidence surrounding PRP augmentation of RCR is vast and is overall positive. A recent systematic review including 13 meta-analyses, and 1800 patients found that PRP augmentation improved functional outcomes, primarily in Constant score, and led to significantly lower retear rates following RCR when compared to control groups [40]. Similarly, a meta-analysis performed in 2023 that included 25 studies demonstrated that PRP augmentation of RCR lead to lower retear rate and significantly improved postoperative functional scoring for Constant, Simple Shoulder Test, and UCLA Shoulder Rating [41]. It is important to note that the difference in all three of these patients reported outcome measures was below the level of MCID. Overall PRP augmentation of RCR does appear to lead to lower retear rates and improved patient reported outcome measures following surgery, although further large scale RCTs and studies focused on cost analysis need to be performed before routine use of this modality is implemented.

Cost and complications

A. Cost

A major concern regarding PRP administration is financial burden to the patient. Due to PRP not being FDA approved for treatment of musculoskeletal disorders, a majority of insurance companies will not cover the cost of PRP injections. The cost of PRP injection varies greatly depending on the geographical area where injection is performed in addition to anatomic site of injection. The average cost of PRP injection is approximately $800 to $1000, although can exceed $2800 and be as low as $350 [42,43]. It is important that the cost of PRP injection is thoroughly discussed with the patient, ideally at multiple visits, prior to administration. Furthermore, it is important to discuss the realistic expectation of therapeutic benefits one can expect from PRP injection based on available research and the possible need of a repeat injection in the future.

B. Complications: PRP overall is a safe treatment option for musculoskeletal disorders and serious complications with this modality are rare. Due to PRP being an autologous blood product there is limited risk for allergic reaction outside of reaction of topical analgesia or adhesive products at time of injection. There is an inevitable risk of injection site infection, as is the case with any injection, due to contamination of the blood product at time of harvest or introduction of skin flora due to inadequate sterile prepping prior to injection. Other complications include pain at the time of blood product harvest and injection, clotting of blood product during preparation, neurovascular structure damage, and local tissue swelling and pain secondary to initiated inflammatory cascade.

Conclusion

PRP is an increasingly common conservative modality used in addressing chronic musculoskeletal disorders in the sports medicine setting. Current evidence suggests benefit of this modality in addressing conditions such as lateral epicondylitis and plantar fasciitis that are recalcitrant to traditional conservative approaches. PRP has also demonstrated benefit in surgical augmentation of RCR and meniscal repair by lowering retear rates and improving functional outcomes, although the clinical significance of these findings remains unknown.

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