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# Which patients might benefit from platelet-rich plasma?

PRP has become a popular form of regenerative medicine. This review looks at the evidence for its use in various musculoskeletal conditions.

## PRACTICE RECOMMENDATIONS

› Consider platelet-rich plasma (PRP) for conservative management of knee osteoarthritis and lateral epicondylitis. **B**

› Consider giving multiple injections of PRP for long-term pain relief and expedited return to sport in patellar tendinopathy. **B**

› Do not use PRP for Achilles tendinopathy due to a lack of clinical evidence. **B**

### Strength of recommendation (SOR)

- A** Good-quality patient-oriented evidence
- B** Inconsistent or limited-quality patient-oriented evidence
- C** Consensus, usual practice, opinion, disease-oriented evidence, case series

Platelet-rich plasma (PRP) injections have become a popular treatment option in a variety of specialties including sports medicine, maxillofacial surgery, dermatology, cosmetology, and reproductive medicine.<sup>1</sup> PRP is an autologous blood product derived from whole blood, using a centrifuge to isolate a concentrated layer of platelets. The  $\alpha$ -granules in platelets release transforming growth factor  $\beta$  1, vascular endothelial growth factor, platelet-derived growth factor, basic fibroblast growth factor, epidermal growth factor, insulin-like growth factor 1, and other mediators that enhance the natural healing process.<sup>2</sup>

**When patients ask.** Familiarity with the use of PRP to treat specific musculoskeletal (MSK) conditions is essential for family physicians who frequently are asked by patients about whether PRP is right for them. These patients may have experienced failure of medication therapy or declined surgical intervention, or may not be surgical candidates. This review details the evidence surrounding common intra-articular and extra-articular applications of PRP. But first, a word about how PRP is prepared, its contraindications, and costs.

## Preparation and types of PRP

Although there are many commercial systems for preparing PRP, there is no consensus on the optimal formulation.<sup>2</sup> Other terms for PRP, such as *autologous concentrated platelets* and *super-concentrated platelets*, are based on concentration of red blood cells, leukocytes, and fibrin.<sup>3</sup> PRP therapies usually are categorized as *leukocyte-rich PRP* (LR-PRP) or *leukocyte-poor PRP* (LP-PRP), based on neutrophil concentrations that are above and below baseline.<sup>2</sup> Leukocyte concentration is one of the most debated topics in PRP therapy.<sup>4</sup>

Common commercially available preparation systems produce platelet concentrations between 3 to 6 times the baseline platelet count.<sup>5</sup> Although there is no universally agreed



Familiarity with the use of platelet-rich plasma to treat specific musculoskeletal conditions is essential for FPs who frequently are asked by patients about whether it is right for them.

upon PRP formulation, studies have shown 2 centrifugation cycles (“double-spun” or “dual centrifugation”) that yield platelet concentrations between 1.8 to 1.9 times the baseline values significantly improve MSK conditions.<sup>6-8</sup>

For MSK purposes, PRP may be injected into intratendinous, peritendinous, and intra-articular spaces. Currently, there is no consensus regarding injection frequency. Many studies have incorporated single-injection protocols, while some have used 2 to 3 injections repeated over several weeks to months. PRP commonly is injected at point-of-care without requiring storage.

■ **Contraindications.** PRP has been shown to be safe, with most adverse effects attributed to local injection site pain, bleeding, swelling, and bruising.<sup>9</sup>

Contraindications to PRP include active malignancy or recent remission from malignancy with the exception of non-metastatic skin tumors.<sup>10</sup> PRP is not recommended for patients with an allergy to manufacturing components (eg, dimethyl sulfoxide), thrombocytopenia, nonsteroidal anti-inflammatory drug use within 2 weeks, active infection causing fever, and local infection at the injection site.<sup>10</sup> Since local anesthetics may impair platelet function, they should not be given at the same injection site as PRP.<sup>10</sup>

■ **Cost.** PRP is not covered by most insur-

ance plans.<sup>11,12</sup> The cost for PRP may range from \$500 to \$2500 for a single injection.<sup>12</sup>

## Evidence-based summary by condition

### Knee osteoarthritis

#### »» Consider using PRP

Knee osteoarthritis (OA) is a common cause of pain and disability. Treatment options include physical therapy, pharmacotherapy, and surgery. PRP has gained popularity as a nonsurgical option. A recent meta-analysis by Costa et al<sup>13</sup> of 40 studies with 3035 participants comparing intra-articular PRP with hyaluronic acid (HA), corticosteroid, and saline injections, found that PRP appears to be more effective or as effective as other nonsurgical modalities. However, due to study heterogeneity and high risk for bias, the authors could not recommend PRP for knee OA in clinical practice.<sup>13</sup>

Despite Costa et al's findings, reproducible data have demonstrated the superiority of PRP over other nonsurgical treatment options for knee OA. A 2021 systematic review and meta-analysis of 18 randomized controlled trials (RCTs; N = 811) by Belk et al<sup>6</sup> comparing PRP to HA injections showed a higher mean improvement in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores in the PRP group compared to the HA group (44.7% vs 12.6%,

IMAGE: KIMBERLY MARTENS

➤ PRP has been shown to be safe, with most adverse effects attributed to local injection-site pain, bleeding, swelling, and bruising.

respectively;  $P < .01$ ).<sup>6</sup> Six of 11 studies using the visual analog scale (VAS) for pain reported significantly less pain in the PRP group compared to the HA group ( $P < .05$ ).<sup>6</sup> The mean follow-up time was 11.1 months.<sup>6</sup> Three of 6 studies reported improved subjective International Knee Documentation Committee (IKDC) scores (range from 0-100, with higher scores representing higher levels of function and lower levels of symptoms) in the PRP group compared to the HA group:  $75.7 \pm 15.1$  vs  $65.6 \pm 16.9$  ( $P = .004$ );  $65.5 \pm 3.6$  vs  $55.8 \pm 3.8$  ( $P = .01$ ); and  $60.8 \pm 9.8$  vs  $48.4 \pm 6.2$  ( $P < .05$ ).<sup>6</sup> There was concern for moderate-to-high heterogeneity.<sup>6</sup>

Other systematic reviews and meta-analyses found similar efficacy of PRP for knee OA, including improved WOMAC scores and patient-reported outcomes (eg, pain, physical function, stiffness) compared to other injectable options.<sup>14,15</sup> A systematic review of 14 RCTs ( $N = 1423$ ) by Shen et al<sup>15</sup> showed improved WOMAC scores at 3 months (mean differences [MD] =  $-14.53$ ; 95% CI,  $-29.97$  to  $-7.09$ ;  $P < .001$ ), 6 months (MD =  $-18.21$ ; 95% CI,  $-27.84$  to  $-8.95$ ;  $P < .001$ ), and 12 months (MD =  $-19.45$ ; 95% CI,  $-26.90$  to  $-12.82$ ;  $P < .001$ ) in favor of PRP vs controls (saline placebo, ozone, corticosteroids, HA).<sup>15</sup>

Despite a lack of consensus regarding the optimal preparation of PRP for knee OA, another recent RCT ( $N = 192$ ) found significant improvement in mean subjective IKDC scores in the LR-PRP group ( $45.5 \pm 15.5$  to  $60.7 \pm 21.1$ ;  $P < .0005$ ) and the LP-PRP group ( $46.8 \pm 15.8$  to  $62.9 \pm 19.9$ ;  $P < .0005$ ), indicating efficacy regardless of PRP type.<sup>4</sup>

### Ankle osteoarthritis

#### ➤➤➤ Additional research is needed

Ankle OA affects 3.4% of all adults and is more common in the younger population than knee or hip OA.<sup>16</sup> An RCT ( $N = 100$ ) investigating PRP vs placebo (saline) injections showed no statistically significant difference in American Orthopedic Foot and Ankle Society scores evaluating pain and function over 26 weeks ( $-2$  points; 95% CI,  $-5$  to  $1$ ;  $P = .16$ ).<sup>16</sup> Limitations to this study include its small sample size and the PRP formulation used. (The intervention group received

2 injections of 2 mL of PRP, and the platelet concentration was not reported.)<sup>16</sup>

A 2020 systematic review and meta-analysis of 4 RCTs and 5 case series by Evans et al<sup>17</sup> concluded that PRP improves pain and function in small-joint OA compared to controls of saline, corticosteroids, and HA.<sup>17</sup> One of the case series ( $N = 20$ ) included in the study demonstrated improvement in ankle OA pain and function scores at 24 weeks post-treatment ( $P = .04$ ), although improvement in pain and function peaked at 12 weeks.<sup>17</sup> In addition, a 2017 retrospective study ( $N = 20$ ) from the review reported improved VAS scores and function at 17 months following 4 injections of PRP over 4 weeks ( $P < .001$ ).<sup>17</sup> Given that RCT data found no benefit with PRP in treating small-joint OA, additional research is indicated.

### Hip osteoarthritis

#### ➤➤➤ Additional research is needed

Symptomatic hip OA occurs in 40% of adults older than 65 years, with a higher prevalence in women.<sup>18</sup> Currently, corticosteroid injections are the only intra-articular therapy recommended by international guidelines for hip OA.<sup>19</sup> A systematic review and meta-analysis comparing PRP to HA injections that included 4 RCTs ( $N = 303$ ) showed a statistically significant reduction in VAS scores at 2 months in the PRP group compared to the HA group (weighted mean difference [WMD] =  $-0.376$ ; 95% CI,  $-0.614$  to  $-0.138$ ;  $P = .002$ ).<sup>18</sup> However, there were no significant differences in VAS scores between the PRP and HA groups at 6 months (WMD =  $-0.141$ ; 95% CI,  $-0.401$  to  $0.119$ ;  $P = .289$ ) and 12 months (WMD =  $-0.083$ ; 95% CI,  $-0.343$  to  $0.117$ ;  $P = .534$ ). Likewise, no significant differences were found in WOMAC scores at 6 months (WMD =  $-2.841$ ; 95% CI,  $-6.248$  to  $0.565$ ;  $P = .102$ ) and 12 months (WMD =  $-3.134$ ; 95% CI,  $-6.624$  to  $0.356$ ;  $P = .078$ ) and Harris Hip Scores (HHS) at 6 months (WMD =  $2.782$ ; 95% CI,  $-6.639$  to  $12.203$ ;  $P = .563$ ) and 12 months (WMD =  $0.706$ ; 95% CI,  $-6.333$  to  $7.745$ ;  $P = .844$ ).<sup>18</sup>

A systematic review of 6 RCTs ( $N = 408$ ) by Belk et al<sup>20</sup> comparing PRP to HA for hip OA found similar short-term improvements in WOMAC scores (standardized mean dif-

ferences [SMD] = 0.27; 95% CI, -0.05 to 0.59;  $P = .09$ ), VAS scores (MD = 0.59; 95% CI, -0.741 to 1.92;  $P = .39$ ), and HHS (MD = -0.81; 95% CI, -10.06 to 8.43;  $P = .93$ ). The average follow-up time was 12.2 and 11.9 months for the PRP and HA groups, respectively.<sup>20</sup>

LR-PRP, which was used in 1 of the 6 RCTs, showed improvement in VAS scores and HHS from baseline, but no significant difference compared to HA at the latest follow-up.<sup>20</sup> A pooled subanalysis of the 3 studies that used LP-PRP found no difference in WOMAC scores between the PRP and HA groups (SMD = 0.42; 95% CI, -0.01 to 0.86;  $P = .06$ ).<sup>20</sup> Future studies comparing the efficacy of intra-articular steroid vs PRP for hip OA would be beneficial.<sup>18</sup>

### Rotator cuff tendinopathy

#### »» Consider PRP for short-term pain relief

Painful conditions of the rotator cuff include impingement syndrome, tendonitis, and partial and complete tears. A 2021 RCT (N = 58) by Dadgostar et al<sup>21</sup> comparing PRP injection to corticosteroid therapy (methylprednisolone and lidocaine) for the treatment of rotator cuff tendinopathy showed significant improvement in VAS scores at 3 months in the PRP group compared to the corticosteroid group ( $6.66 \pm 2.26$  to  $3.08 \pm 2.14$  vs  $5.53 \pm 1.80$  to  $3.88 \pm 1.99$ , respectively;  $P = .023$ ). There also were more significant improvements in adduction in the PRP group compared to the corticosteroid group ( $20.50^\circ \pm 8.23^\circ$  to  $28^\circ \pm 3.61^\circ$  vs  $23.21^\circ \pm 7.09^\circ$  to  $28.46^\circ \pm 4.18^\circ$ , respectively;  $P = .011$ ), and external rotation ( $59.66^\circ \pm 23.81^\circ$  to  $76.66^\circ \pm 18.30^\circ$  vs  $57.14^\circ \pm 24.69^\circ$  to  $65.57^\circ \pm 26.39^\circ$  for the PRP and corticosteroid groups, respectively;  $P = .036$ ).<sup>21</sup>

Another RCT (N = 99) by Kwong et al<sup>22</sup> comparing PRP to corticosteroids found similar short-term advantages of LP-PRP with an improved VAS score (-13.6 vs 0.4;  $P = .03$ ), American Shoulder and Elbow Surgeons score (13.0 vs 2.9;  $P = .02$ ), and Western Ontario Rotator Cuff Index score (16.8 vs 5.8;  $P = .03$ ). However, there was no long-term benefit of PRP over corticosteroids found at 12 months.<sup>22</sup>

A 2021 systematic review and meta-analysis by Hamid et al<sup>23</sup> that included 8 RCTs (N = 976) favored PRP over control (no

injection, saline injections, and/or shoulder rehabilitation) with improved VAS scores at 12 months (SMD = -0.5; 95% CI, -0.7 to -0.2;  $P < .001$ ). The evidence on functional outcome was mixed. Data pooled from 2 studies (n = 228) found better Shoulder Pain and Disability Index (SPADI) scores compared to controls at 3- and 6-month follow-ups. However, there were no significant differences in Disabilities of the Arm, Shoulder and Hand (DASH) scores between the 2 groups.<sup>23</sup>

### Patellar tendinopathy

#### »» Consider using PRP for return to sport

Patellar tendinopathy, a common MSK condition encountered in the primary care setting, has an overall prevalence of 22% in elite athletes at some point in their career.<sup>24</sup> Nonsurgical management options include rest, ice, eccentric and isometric exercises, anti-inflammatory drugs, extracorporeal shock wave therapy (ESWT), and dry needling (DN).

A 2014 RCT (N = 23) evaluating DN vs PRP for patellar tendinopathy favored PRP with improved VAS scores (mean  $\pm$  SD =  $25.4 \pm 23.2$  points;  $P = .01$  vs  $5.2 \pm 12.5$  points;  $P = .20$ ) at 12 weeks ( $P = .02$ ). However, at  $\geq 26$  weeks, the improvement in pain and function scores was similar between the DN and PRP groups ( $33.2 \pm 14.0$  points;  $P = .001$  vs  $28.9 \pm 25.2$  points;  $P = .01$ ). Notably, there was significantly more improvement in the PRP group at 12 weeks ( $P = .02$ ) but not at 26 weeks ( $P = .66$ ).<sup>25</sup>

Another prospective study (N = 31) comparing PRP to physiotherapy showed a greater improvement in sport activity level reflected by the Tegner score in the PRP group (percentage improvement,  $39 \pm 22\%$ ) compared to control ( $20 \pm 27\%$ ;  $P = .048$ ) at 6 months.<sup>7</sup>

A recent RCT (N = 20) revealed improved VAS scores at 6 months with rehabilitation paired with either bone marrow mesenchymal stem cells (BM-MS) or LP-PRP when compared with baseline (BM-MS group:  $4.23 \pm 2.13$  to  $2.52 \pm 2.37$ ;  $P = .0621$ ; LP-PRP group:  $3.10 \pm 1.20$  to  $1.13 \pm 1.25$ ;  $P = .0083$ ). Pain was significantly reduced during sport play in both groups at 6 months when compared with baseline (BM-MS group: 6.91



Currently, corticosteroid injections are the only intra-articular therapy recommended by international guidelines for hip OA.



**The evidence on functional outcome of platelet-rich plasma for rotator cuff tendinopathy is mixed.**

$\pm 1.11$  to  $3.06 \pm 2.89$ ,  $P = .0049$ ; PRP group:  $7.03 \pm 1.42$  to  $1.94 \pm 1.24$ ,  $P = .0001$ ).<sup>26</sup>

A 2019 systematic review and meta-analysis ( $N = 2530$ ) demonstrated greater improvements in Victorian Institute of Sport Assessment scale for patellar tendinopathy (VISA-P) with multiple injections of PRP (38.7 points; 95% CI, 26.3-51.2 points) compared to single injections of PRP (24.3 points; 95% CI, 18.2-30.5 points), eccentric exercise (28.3 points; 95% CI, 18.9-37.8 points) and ESWT (27.4 points; 95% CI, 10.0-39.8 points) after 6 months.<sup>27</sup> In contrast, an RCT ( $n = 57$ ) comparing a single injection of LR-PRP or LP-PRP was no more effective than a single injection of saline for improvement in mean VISA-P scores ( $P > .05$ ) at 1 year.<sup>28</sup>

**Lateral epicondylitis**

**»» Consider using PRP**

Lateral epicondylitis (“tennis elbow”) is caused by overuse of the elbow extensors at the site of the lateral epicondyle. Chronic lateral epicondylitis involves tissue degeneration and microtrauma. Most cases of epicondylar tendinopathies are treated non-operatively, with corticosteroid injections being a mainstay of treatment despite their short-term benefit<sup>29</sup> and potential to deteriorate connective tissue over time. Recent studies suggest PRP therapy for epicondylitis and epicondylitis may increase long-term pain relief and improve function.

A 2017 systematic review and meta-analysis of 16 RCTs ( $N = 1018$ ) concluded PRP was more efficacious than control injections (bupivacaine) for pain reduction in tendinopathies (effect size = 0.47; 95% CI, 0.22-0.72).<sup>30</sup> In the review, lateral epicondylitis was evaluated in 12 studies and was most responsive to PRP (effect size = 0.57) when compared to control injection.<sup>30</sup> In another systematic review (5 RCTs; 250 patients), corticosteroid injections improved pain within the first 6 weeks of treatment. However, PRP outperformed corticosteroid in VAS scores ( $21.3 \pm 28.1$  vs  $42.4 \pm 26.8$ ) and DASH scores ( $17.6 \pm 24.0$  vs  $36.5 \pm 23.8$ ) ( $P < .001$ ) at 2 years.<sup>31</sup>

A 2022 systematic review and meta-analysis (26 studies;  $N = 1040$ ) comparing scores at baseline vs 2 years post-PRP showed improvement in VAS scores ( $7.4 \pm 1.30$  vs

$3.71 \pm 2.35$ ;  $P < .001$ ), DASH scores ( $60.8 \pm 12.5$  vs  $13.0 \pm 18.5$ ;  $P < .001$ ), Patient-Rated Tennis Elbow Evaluation ( $55.6 \pm 14.7$  vs  $48.8 \pm 4.1$ ;  $P < .001$ ), and Mayo Clinic Performance Index ( $55.5 \pm 6.1$  vs  $93.0 \pm 6.7$ ;  $P < .001$ ).<sup>32</sup>

Regarding the therapeutic effects of different PRP types in lateral epicondylitis, a 2022 systematic review of 33 studies ( $N = 2420$ ) found improved function and pain relief with LR-PRP and LP-PRP with no significant differences.<sup>33</sup> Pretreatment VAS scores in the LR-PRP group, which ranged from 6.1 to 8.0, improved to 1.5 to 4.0 at 3 months and 0.6 to 3.3 after 1 year.<sup>33</sup> Similarly, pretreatment VAS scores in the LP-PRP group, which ranged from 4.2 to 8.4, improved to 1.6 to 5.9 at 3 months and 0.7 to 2.7 after 1 year.<sup>34</sup> DASH scores also improved in the LR-PRP and LP-PRP groups, with pretreatment scores (LR-PRP, 47.0 to 54.3; LP-PRP, 30.0 to 67.7) improving to 20.0 to 22.0 and 5.5 to 19.0, respectively, at 1 year.<sup>33</sup>

**Achilles tendinopathy**

**»» Do not use PRP; evidence is lacking**

Achilles tendinopathy, caused by chronic overuse and overload resulting in microtrauma and poor tissue healing, typically occurs in the most poorly vascularized portion of the tendon and is common in runners. First-line treatments for Achilles tendinopathy include eccentric strength training and anti-inflammatory drugs.<sup>34,35</sup> Corticosteroid injections are not recommended, given concern for degraded tendon tissue over time and worse function.<sup>34</sup>

A 2020 systematic review of 11 randomized and nonrandomized clinical trials ( $N = 406$ ) found PRP improved Victorian Institute of Sports Assessment—Achilles (VISA-A) scores at 24 weeks compared to other non-surgical treatment options (41.2 vs 70.12;  $P < .018$ ).<sup>34</sup> However, a higher-quality 2021 systematic review and meta-analysis of 4 RCTs ( $N = 170$ ) comparing PRP injections with placebo showed no significant difference in VISA-A scores at 3 months (0.23; 95% CI, -0.45 to 0.91), 6 months (0.83; 95% CI, -0.26 to 1.92), and 12 months (0.83; 95% CI, -0.77 to 2.44).<sup>36</sup> Therefore, further studies are warranted to evaluate the benefit of PRP injections for Achilles tendinopathy.

TABLE

## Utility of platelet-rich plasma therapy for musculoskeletal conditions<sup>4,6,7,14-18,20-23,25-28,30-34,36</sup>

Condition	Studies	Results <sup>a</sup>
Knee osteoarthritis <sup>4,6,14,15</sup>	3 systematic reviews and meta-analyses	PRP improved WOMAC, VAS, and IKDC scores compared to HA Improved WOMAC scores with PRP compared to saline, corticosteroid, ozone, and HA Improved IKDC scores regardless of whether LR-PRP or LP-PRP was used <b>SOR, B</b>
Ankle osteoarthritis <sup>16,17</sup>	Small RCT, case series, retrospective study	RCT found no difference in pain or function between PRP and placebo Case series showed improved pain and function at 24 weeks Retrospective study showed improved VAS scores and function at 17 months <b>SOR, B</b>
Hip osteoarthritis <sup>18,20</sup>	2 systematic reviews and meta-analyses	Short-term improvement in WOMAC, VAS, and HHS scores with PRP compared to HA <b>SOR, B</b>
Rotator cuff tendinopathy <sup>21-23</sup>	Systematic review and meta-analysis, 2 RCTs	Systematic review found PRP favored over control (no injection, saline, physical therapy) for improved VAS scores at 12 months RCT found short-term benefit in pain and range of motion with PRP compared to corticosteroids <b>SOR, B</b>
Patellar tendinopathy <sup>7,25-28</sup>	Systematic review and meta-analysis, 3 small RCTs, prospective study	Systematic review and meta-analysis showed improved VISA-P at 6 months with multiple PRP injections RCT/prospective study found improved sport activity with PRP compared to physical therapy <b>SOR, B</b>
Lateral epicondylitis <sup>30-33</sup>	4 systematic reviews and meta-analyses	Improved long-term pain and patient-reported outcomes, including VAS, DASH, PRTEE, MAYO scores with PRP <b>SOR, B</b>
Achilles tendinopathy <sup>34,36</sup>	Systematic review and meta-analysis, RCT	No difference in VISA-A compared to placebo Current evidence does not support use of PRP for Achilles tendinopathy <b>SOR, B</b>

DASH, Disabilities of the Arm, Shoulder and Hand; HA, hyaluronic acid; HHS, Harris Hip Scores; IKDC, International Knee Documentation Committee; LP, leukocyte-poor; LR, leukocyte-rich; MAYO, Mayo Clinic Performance Index; PRP, platelet-rich plasma; PRTEE, Patient-Rated Tennis Elbow Evaluation; RCT, randomized controlled trials; SOR, strength of recommendation; VAS, visual analog scale; VISA-A, Victorian Institute of Sports Assessment—Achilles; VISA-P, Victorian Institute of Sport Assessment scale for patellar tendinopathy; WOMAC, Western Ontario and McMaster Universities Arthritis Index.

<sup>a</sup> Strength of recommendation (SOR): **A**, good-quality patient-oriented evidence; **B**, inconsistent or limited-quality patient-oriented evidence; **C**, consensus, usual practice, opinion, disease-oriented evidence, case series.

### Conclusions

While high-quality studies support the use of PRP for knee OA and lateral epicondylitis, they have a moderate-to-high risk for bias. Several RCTs show that PRP provides superi-

or short-term pain relief and range of motion compared to corticosteroids for rotator cuff tendinopathy. Multiple injections of PRP for patellar tendinopathy may accelerate return to sport and improve symptoms over the long

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RCT data showed no benefit with platelet-rich plasma in treating small-joint osteoarthritis.

term. However, current evidence does not support PRP therapy for Achilles tendinopathy. Given variability in PRP preparation, an accurate interpretation of the literature regarding its use in MSK conditions is recommended (TABLE 4,6,7,14-18,20-23,25-28,30-34,36).

Concerning the effectiveness of PRP, it is important to consider early publication bias. Although recent studies have shown its benefits,<sup>6,14,15,37</sup> additional studies comparing PRP to placebo will help demonstrate its efficacy. Interestingly, a literature search by Bar-Or et al<sup>38</sup> found intra-articular saline may have a therapeutic effect on knee OA and confound findings when used as a placebo.

Recognizing the presence or lack of clinically significant improvement in the literature is important. For example, while some recent studies have shown PRP exceeds the minimal clinically significant difference for knee OA and lateral epicondylitis, others have not.<sup>32,37</sup> A 2021 systematic review of 11 clinical practice guidelines for the use of PRP in knee OA found that 9 were “uncertain or unable to make a recommendation” and 2 recommended against it.<sup>39</sup>

In its 2021 position statement for the responsible use of regenerative medicine, the American Medical Society for Sports Medicine includes guidance on integrating orthobiologics into clinical practice. The guideline emphasizes informed consent and provides an evidence-based rationale for using PRP in certain patient populations (lateral epicondylitis and younger patients with mild-to-moderate knee OA), recommending its use only after exhausting other conservative options.<sup>40</sup> Patients should be referred to physicians with experience using PRP and image-guided procedures. **JFP**

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