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REVIEW

Platelet-rich plasma in the management of rotator cuff tendinopathy

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ABSTRACT

Platelet-rich plasma (PRP) is an autologous blood-derived product that has gained significant attention in the treatment of tendinopathies as one of many treatment modalities in the field of regenerative medicine. Rotator cuff pathologies are the leading cause of shoulder pain. Despite the high success rate with conservative treatment and arthroscopic surgical repair, the search for a nonsurgical treatment has made PRP a trending topic recently. The purpose of this article is to review the recent literature data on the possible role of PRP in different rotator cuff pathologies. The limited data in the literature about isolated tendinopathies without a tear (tendonitis and tendinosis) suggests potential benefit from conservative treatment with PRP. Many studies exist for the treatment of rotator cuff tears solely using PRP or as an augmentation to arthroscopic repair. Despite the large number of randomized clinical trials and meta-analyses about the topic, there is no consensus in favor of routine application of PRP in this patient population. The existing reliable evidence of benefit seems to be restricted to its use in only inflammatory tendinopathies with preserved tendon integrity.

Keywords: Platelet-rich plasma, rotator cuff, tear, tendinopathy, tendinosis, tendonitis.

Platelet-rich plasma (PRP) is an autologous blood-derived product that has gained significant attention in the treatment of various orthopedic problems recently. The first use of PRP in orthopedics dates back to 1998.[1] Since then, it has been frequently utilized to treat a variety of conditions such as osteoarthritis, epicondylitis, and tendinopathy as one of many treatment modalities in the field of regenerative medicine.

Shoulder pain is a common disabling symptom of shoulder pathologies, being the third most common musculoskeletal complaint.[2] Rotator cuff pathologies are the leading cause of shoulder pain, accompanying more than half of the shoulder pain cases applying to orthopedic clinics.[3] Despite the high success rate with arthroscopic surgical treatment, complications such as postoperative retears and patients' preference for nonsurgical treatment have recently made PRP applications a trending topic as an alternative to physical therapy solely or even to surgical management.

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This study aimed to review the recent literature on the possible role and outcomes of PRP in different rotator cuff pathologies. Before discussing the effectiveness of PRP, different types of rotator cuff pathologies should be classified. In rotator cuff tendonitis, inflammation is the predominant event, often accompanying the distortion of lubrication mechanisms such as bursae, whereas tendinosis is a condition in which mechanical structure of the tendon is disturbed and largely occurs due to overuse. Tears can be classified according to their extent in terms of thickness: partial and full-thickness tears.

TENDONITIS AND TENDINOSIS

Although tendonitis and tendinosis are distinct terms, they are commonly used interchangeably in the

literature, and in many studies, no clear distinction is made. Most of the time, tendonitis is an abrupt short-term condition in which inflammation is the result of a direct injury. As the condition persists or recurs by repetitive trauma or just simply due to the fact that the tendon is not healing, structural integrity of the tendon begins to deteriorate. The term tendinosis is used to refer to this stage.

In the early inflammatory stage (tendonitis), anti-inflammatory agents and rehabilitation programs, including exercise and electrotherapeutic modalities, are usually successful in controlling the disease.[4] Healing is prolonged or never occurs in chronic tendinopathies (tendinosis) because the tendon becomes less vascular, and inflammatory cells begin to appear less frequently as the pathology progresses.[5-7] Inflammatory cells and biologically active factors such as growth factors, cytokines, chemokines, and cell-adhesion molecules secreted by them are the fundamental prerequisites for tissue regeneration and repair. Their absence, when paired with repetitive use and injury, results in a vicious cycle. This creates an advantageous environment for PRP to break the cycle and demonstrate benefits.

There are many studies reporting improvement in shoulder function, Visual Analog Scale score, and range of motion as a result of PRP application. However, the literature is very limited in terms of studies on tendinopathy patients without a tear. Rha et al.[8] compared two sets of PRP injections with dry needling procedure in 39 patients and revealed that PRP injections resulted in greater relief of pain and arm functional improvement, but no difference was found in terms of shoulder range of motion. In another study comparing the effectiveness of PRP and corticosteroid injections in 58 patients, a significantly greater improvement in pain score was reported, but the difference in range of motion was not that obvious.[9] A recent meta-analysis of eight randomized controlled trials involving the data of more than 500 patients revealed that PRP was significantly better in controlling pain symptoms in 6- and 12-month follow-ups compared to control interventions.[1] However, according to the same study, the effect of PRP on functional outcomes was controversial, obtaining different results with different types of questionnaires.

One of the common features of studies about the outcomes of PRP on rotator cuff tendinopathies is having different concentration of platelets and formulas of PRP and working on heterogenous patient populations, including the ones with tears in some studies. Another point is that tendonitis-tendinosis discrimination was not made by almost any of these studies; therefore, it is hard to determine whether both pathologies benefit from the treatment or which one benefits more.

ROTATOR CUFF TEARS

In contrast to the cases without a tear, the literature on the use of PRP in cases with rotator cuff tears is quite rich. A study involving tenocyte cell cultures obtained from human rotator cuff tear lesions showed that PRP gel promotes cell proliferation and enhances the synthesis of tendon matrix by tenocytes.[10]

Many studies deal with patient groups having isolated tendinopathy and partial tears at the same time without any distinction and report favorable outcomes.[9,11,12] Rossi et al.[13] reported that PRP results in less functional improvement in patients with a partial rotator cuff tear compared to the ones with isolated tendinopathy without any tear. Another study conducted by Prodromos et al.[14] in 2021 included tendinopathy patients who failed conservatory treatment and evaluated them according to their tear status (no tear, partial tears of <50% or >50%, and full-thickness tear) after having two PRP injections. In contrast to the previous study, this study found that at the one-year follow-up, the Q-DASH (quick disabilities of the arm, shoulder, and hand) scores of partial tear groups with tear thicknesses of 50% and >50% improved significantly more than the score of the group with no tear. The results were similar at the six-month and two-year follow-ups. At this point, studies involving patients solely with a tear should be considered.

As far as we know, two prospective randomized studies exist that include only patients with partial rotator cuff tears and compare PRP injection with placebo or physical therapy (Table I).[15,16] In both studies, no significant difference could be demonstrated between the groups in terms of pain, range of motion, or functional score on behalf of PRP, except for the DASH score in one of them. Another randomized study comparing the effectiveness of PRP with sodium hyaluronate (SH), PRP + SH, and placebo on partial thickness tear cases revealed that PRP was more effective than placebo and SH alone.[17] Interestingly, the same study found that the PRP + SH combination was more effective than PRP alone in the treatment of partial thickness rotator cuff tears, and they suggested that SH might be providing a network that can increase the residence time of the growth factors and facilitate their release to the injured rotator cuff. Another randomized controlled study combining PRP with bone marrow concentrate

TABLE I

Characteristics and main results of randomized clinical trial samples conducted on patients with rotator cuff tendinopathy with the application of PRP

Year	Author	Sample size	Type of rotator cuff tendinopathy	Intervention group (n)		Control group (n)		Follow-up (months)	Main measures of outcome	Summary of the outcomes
2013	Kesikburun et al.[15]	40	Tendonitis and partial tear	PRP	20	Placebo	20	12	WORC, VAS, ROM	No more effective than placebo in improving function or pain.
2015	Ilhanli et al.[16]	62	Chronic partial tear	PRP	30	Physical therapy	32	12	DASH, VAS, ROM	Better improvement in pain and ROM with physical therapy. DASH score improved more in PRP group.
2018	Kim et al.[26]	24	Partial tear	PRP + BMAC	12	Physical therapy	12	3	ASES, VAS, tear size	Improved shoulder functions and pain, no significant difference in tear size.
2021	Kwong et al.[27]	99	Partial tear	PRP	47	Corticosteroid	52	12	ASES, VAS	Better improvement in short term, no sustained benefit at the end of 12 months.
2021	Dadgostar et al.[9]	58	Tendonitis and partial tear	PRP	29	Corticosteroid	29	3	WORC, VAS, ROM	Significantly better improvement.
2023	Vaquerizo et al.[19]	79	Chronic tear	3 PRP injections with one week intervals	39	3 corticosteroid injections with one week intervals	40	12	CMS, UCLA	Significantly superior and sustained pain relief and functional improvement.

PRP: Platelet-rich plasma; WORC: Western Ontairo Rotator Cuff Index; VAS: Visual Analog Scale; ROM: Range of motion; DASH: Disabilities of arm, shoulder and hand questionnaire; BMAC: Bone marrow aspirate concentrate; ASES: American shoulder and elbow surgeons score; CMS: Constant-Murley Shoulder outcome score; UCLA: The University of California-Los Angeles Shoulder Scale.

TABLE II

Characteristics and main results of randomized clinical trial samples conducted on patients with rotator cuff tear with the application of PRP-augmented arthroscopic repair

Year	Author	Sample size	Type of rotator cuff tendinopathy	Intervention group (n)		Control group (n)		Follow-up (months)	Main measures of outcome	Summary of the outcomes
2015	Jo et al.[10]	74	Partial and full thickness tear	PRP-augmented repair		Conventional repair		3	CMS, VAS, ROM, retear rate	Better functional scores, reduced retear rates.
2015	Wang et al.[28]	60	Partial and full thickness tear	PRP injections in postoperative 7th and 14th days	30	Conventional repair	30	4	OSS, VAS with serial assessments in early postoperative period, MRI in 16th week	PRP augmentation did not improve early healing or functional recovery.
2016	Pandey et al.[22]	102	Partial and full thickness, degenerative tear	PRP-augmented repair	52	Conventional repair	50	24	CMS, UCLA, VAS, retear rate	Better functional scores, reduced retear rate only in large tears.
2016	Flury et al.[29]	120	Full thickness tear	PRP-augmented repair	60	Ropivacaine injection + repair	60	24	CMS, pain, retear rate	No significant difference in functional scores or retear rates.
2022	Zhang et al.[30]	104	Partial and full thickness tear	3 PRP injections during double-row repair, at days 7 and 14 after surgery	52	Conventional double-row repair	52	24	CMS, UCLA, VAS, fatty infiltration, retear rate	Reduced fatty infiltration and retear rates in PRP group, but no significant difference in functional outcomes.
2022	Randelli et al.[25]	38	Full thickness tear	PRP-augmented repair	17	Conventional repair	21	120	CMS, UCLA, ASES, VAS, retear rate	Minor differences observed at two-year follow-up, but they disappeared at the end of 10 years.

PRP: Platelet-rich plasma; CMS: Constant-Murley Shoulder Outcome Score; VAS: Visual Analog Scale; ROM: Range of motion; OSS: Oxford shoulder score; MRI: Magnetic resonance imaging; UCLA: The University of California-Los Angeles Shoulder Scale; ASES: American Shoulder and Elbow Surgeons Score.

revealed that the combination is more effective than exercise therapy in the treatment of partial and full-thickness rotator cuff tears.[18] There are two randomized controlled studies demonstrating PRP's indisputable superiority over other treatment modalities, and they are not in the majority.[9,19]

Another popular method and compelling research area of PRP use in the treatment of cuff tears is combining it with surgical repair (Table II). One of the earliest randomized controlled studies conducted by Ruiz-Moneo et al.[20] in 2011 found no benefit of adding plasma rich in growth factors to the arthroscopic rotator cuff repair at the end of a one-year follow-up. Malavolta et al.[21] reported similar results in another study evaluating single-row repair with and without intraoperative use of PRP at the end of a two-year follow-up later in 2014. In 2016, Pandey et al.[22] reported that PRP-augmented repair reduced retear rate in large tears and resulted in better functional scores in all sizes of degenerative tears. Many others followed these short-term studies with different results. A 2021 meta-analysis by Xu and Xue[23] reported that intraoperative PRP application significantly reduced retear rate and improved shoulder function only in large and massive rotator cuff tears. Two other meta-analyses conducted on randomized controlled trials published recently found that the addition of intraoperative PRP to both single-row and double-row repair improved functional results and retear rates.[23,24] However, a recent study reporting the longest follow-up period with arthroscopic repair and PRP combination conducted by Randelli et al.[25] in 2021 found no significant superiority of PRP at the end of a 10-year follow-up.[31]

In conclusion, at least a subgroup of patients having isolated tendonitis has a strong potential to benefit from PRP treatment. Although there is some evidence suggesting the benefit of PRP with or without surgical repair in rotator cuff tears, there is no consensus in favor of routine application of PRP in this large patient population. The existing reliable evidence of benefit appears to be restricted to its use in tendonitis cases only. More large-scale and long-term research focusing on subgroups of rotator cuff tears with homogenous methodology on the application of PRP is needed.

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