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Biologics for Breakdown: A Scoping Review of Platelet-Rich Plasma for Musculoskeletal Degeneration

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ABSTRACT

Background: Musculoskeletal (MSK) degeneration significantly compromises patient mobility and imposes substantial costs on healthcare systems. Conventional treatments, including conservative management and intra-articular injections of corticosteroids or Hyaluronic Acid (HA), are limited by transient efficacy or potential long-term structural tissue detriment. Platelet-Rich Plasma (PRP) offers a biological alternative designed to modulate the local microenvironment and promote tissue repair.

Objective: To evaluate the clinical utility of PRP and consolidate evidence-based recommendations for specific MSK degenerative conditions.

Methods: A scoping review was conducted following PRISMA-ScR guidelines. A systematic search of PubMed/MEDLINE, Embase and the Cochrane Library identified high-level evidence (Level I and II studies) published between November 1st, 2015 and November 1st, 2025. A total of 13 studies-comprising 3 randomized controlled trials and 10 meta-analyses-were selected for qualitative synthesis.

Results: In cases of knee osteoarthritis, plantar fasciitis and lateral epicondylitis, PRP demonstrated a distinct temporal crossover effect when compared to corticosteroids; corticosteroids provided superior relief in the short term (0 to 4 weeks), whereas PRP yielded superior and durable improvements in pain and function at 6 to 12 months. For medial epicondylitis, PRP achieved clinical outcomes equivalent to surgical debridement. Furthermore, objective imaging data confirmed that PRP actively promotes structural tissue remodeling in patellar tendinopathy and partial-thickness rotator cuff tears. Conversely, PRP demonstrated no significant superiority over placebo or HA in the treatment of hip osteoarthritis.

Conclusion: PRP is a validated and effective long-term therapeutic alternative for several MSK degenerative conditions and tendinopathies. However, its application is not universally beneficial and widespread clinical integration remains challenged by formulation heterogeneity and logistical costs.

Keywords: Platelet rich plasma, Musculoskeletal degeneration, Regenerative medicine.

Abbreviations: MSK: Musculoskeletal; NSAIDs: Non-Steroidal Anti-Inflammatory Drugs; HA: Hyaluronic Acid; PRP: Platelet-Rich Plasma; LR-PRP: Leukocyte-Rich Platelet-Rich Plasma; LP-PRP: Leukocyte-Poor Platelet-Rich Plasma VEGF: Vascular Endothelial Growth Factor; PDGF: Platelet-Derived Growth Factors; IGF-1: Insulin-like Growth Factor-1; TNF- α: Tumor Necrosis

Factor Alpha; DASH: Disabilities of the Arm, Shoulder and Hand; IKDC: International Knee Documentation Committee; ODI: Oswestry Disability Index; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; PRISMA-ScR: Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews

1. Introduction

Musculoskeletal (MSK) degeneration represents one of the most formidable and costly challenges confronting modern medicine. These diseases compromise patient mobility, diminishing independence and quality of life and impose sizable financial costs on healthcare systems globally[1].

Treatment can be broadly categorized into conservative or surgical intervention. Conservative management largely comprises physical therapy orthotics and bracing and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs). While these measures are effective for symptomatic relief, they do not alter the natural progression of the disease[2]. On the other hand, surgical interventions comprise options such as joint arthroplasties, joint fusions or tendon repairs. Though often curative, these procedures entail significant perioperative risks, require post-operative rehabilitation and may not be suitable for patients presenting with mild or moderate disease.

Therein lies a potential third management option, for patients who straddle either end of the spectrum and are left with little option in the management of their condition. These are patients who have failed to achieve satisfactory outcomes with conservative treatment but are also deemed unsuitable for surgical intervention. Historically, this gap has been transiently addressed by intra-articular injections of corticosteroids and Hyaluronic Acid (HA). However, these are inherently limited treatments. Corticosteroids function as strong anti-inflammatory agents, offering significant pain relief after administration. But their mechanism of action is distinctly catabolic or destructive with studies showing repeated intra-articular administration has been linked to reduced cartilage volume[3]. Their use in tendinopathies can result in reduced tendon strength and a paradoxical increase in rates of tendon damage[4]. Hyaluronic acid and other forms of viscosupplementation aim to restore synovial fluid viscoelasticity, yet its role is predominantly that of a biolubricant, failing to address the fundamental biological decline in joint homeostasis. Their results are also transient and short-lasting[5].

Platelet-Rich Plasma (PRP) has often been brought up as a potential therapeutic agent that plugs this therapeutic gap. It is postulated that PRP primarily achieves its effects via modulating the microenvironment in which it is introduced, shifting degenerative processes towards reparative function. This paper seeks to provide a comprehensive evaluation of PRP's clinical utility, by analyzing the maturing and burgeoning evidence base behind PRP. Specifically, the authors aim to consolidate disease specific outcomes with PRP, with appropriate evidence-based recommendations.

2. Mechanism and Preparation

Platelets are commonly understood to be an essential cellular component for hemostasis, forming clots to stop bleeding. Crucially, platelets also serve as reservoirs for proteins stored within intracellular alpha-granules. These proteins are bioactive and aid in tissue repair[6].

Upon activation, platelets undergo degranulation, releasing growth factors. This release occurs in two specific chronological instances: a large initial burst of growth factors occurs within the first hour (releasing ~70% of stored factors), followed by a sustained low-level secretion over subsequent days[6]. The key factors released are Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor-β (TGF-Beta), Vascular Endothelial Growth Factor (VEGF) and Insulin-like Growth Factor-1 (IGF-1).

PDGF is a strong stimulator for connective tissue cells, influencing replication of fibroblasts and osteoblasts while upregulating the synthesis of extracellular matrix proteins. TGF-β serves as a critical factor in cartilage and tendon development, modulating the SMAD signaling pathway to stimulate type I and type II collagen synthesis. It also acts as an immunomodulator, suppressing the expression of pro-inflammatory cytokines like Interleukin-1Beta and Tumor Necrosis Factor Alpha (TNF- α) which drive catabolism in osteoarthritis. VEGF performs its role in angiogenesis, helping to bring nutrition and increase oxygen tension to damaged tissues. IGF-1 promotes cell survival and proliferation, acting synergistically with PDGF to enhance matrix production[6-8].

PRP can be derived via multiple methods, each form containing variable components. It is important to note that this heterogeneity in product can similarly lead to variable outcomes in treatment[9]. PRP is derived through the differential centrifugation of whole blood (Figure 1), exploiting the specific gravity differences of cellular components[6,9].

The Single-Spin protocol utilizes a relatively low centrifugal force ("soft spin") for a short duration. This separates the blood into three layers: a bottom layer of RBCs, a thin middle layer (buffy coat) containing platelets and leukocytes and a top layer of plasma. In single-spin systems, the operator harvests the upper plasma layer just above the buffy coat. Because the spin is gentle, many platelets remain suspended in the plasma, but the heavier leukocytes are largely trapped in the buffy coat or RBC layer and are not harvested. This results in a Leukocyte-Poor PRP product (LP-PRP).

The Double-Spin protocol employs two distinct centrifugation steps. The first "soft spin" separates RBCs from the plasma/buffy coat mix. The RBCs are then discarded. The remaining plasma and buffy coat are transferred to a second chamber and subjected to a "hard spin." This second spin forces the platelets and leukocytes to form a thick pellet at the bottom of the tube. The platelet-poor plasma supernatant is removed and the pellet is resuspended in a small volume of plasma. This results in a Leukocyte-Rich PRP product (LR-PRP).

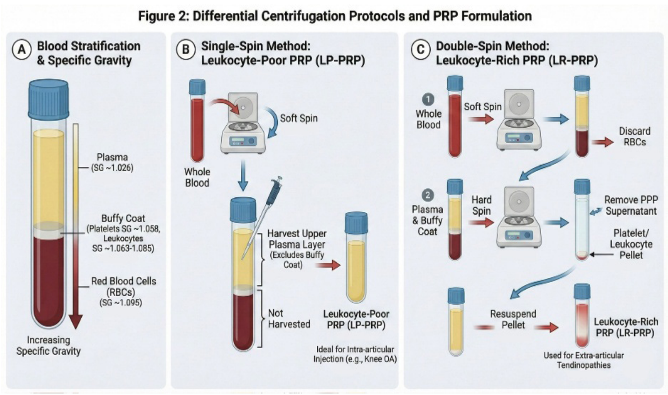

Figure 1: PRP is derived through the differential centrifugation of whole blood.

3. Methodology

A rigorous methodological framework was applied to the selection and synthesis of evidence. This review was conducted in accordance with the principles of the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) guidelines.

3.1. Search Strategy and Data Sources

A comprehensive, systematic search was executed across three primary databases: PubMed/MEDLINE, Embase and the Cochrane Library. The search was performed on 1 November 2025. The search strategy employed controlled vocabulary (MeSH terms) and keywords including: "Platelet-Rich Plasma," "PRP," "Osteoarthritis," "Tendinopathy," "Fasciitis," "Epicondylitis," "Facet Joint arthritis," and "Regenerative Medicine."

The temporal scope was strictly defined. While seminal papers from the early 2010s were reviewed for historical context, the primary analysis focused on high-level evidence published between 1st November 2015 and 1st November 2025. This focus on recent data is critical because earlier studies often failed to report formulation details (leukocyte content), rendering them less useful for deriving modern recommendations and protocols.

3.2. Usability Criteria and Study Selection

The initial search identified more than 400 citations. To refine this broad pool into a clinically relevant and methodologically robust body of evidence, strict usability criteria were applied. Priority was given to high-level evidence, specifically Level I study such as randomized control trials and Level II studies including systematic reviews. Retrospective Cohort studies were considered when they contributed unique long-term follow-up data beyond 2 years, that were not otherwise available from randomized trials.

Eligible studies were limited to adult human participants over the age of 18. These participants had confirmed diagnoses of chronic degenerative MSK conditions. The intervention of interest was autologous platelet-rich plasma injection. Included studies were required to include comparisons to options such as Hyaluronic Acid, Corticosteroids, Saline/Placebo. In order to ensure relevance and comparability across studies, outcomes had to be reported using validated patient-reported measures such as WOMAC, VAS, IKDC, VISA-A or DASH.

Animal studies were omitted. Studies focusing on acute trauma were also excluded, as the underlying etiology and biology of these conditions were not generalizable to our paper's aims. Finally, small case series with fewer than 10 patients were excluded in order to minimize bias and error, improving the overall statistical reliability of the evidence base.

3.3. Selection Process

Following the PRISMA flow, duplicates were removed, titles/abstracts were screened for relevance and full-text articles were assessed for eligibility. The final analysis synthesized data from 3 RCTs and 10 Meta-analyses published in the 2015-2025 window (Figure 2).

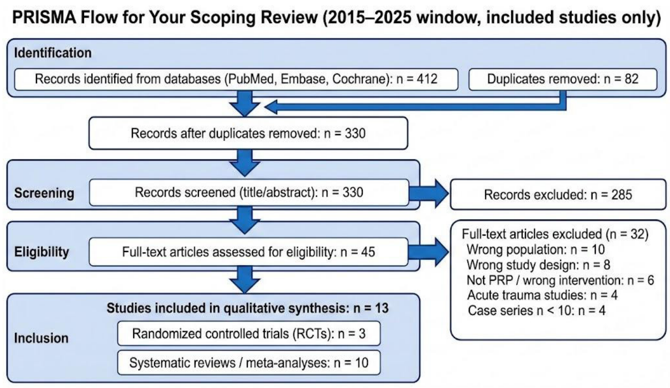

Figure 2: PRISMA flow Chart.

4. Conditions

4.1. Knee Osteoarthritis (OA)

Knee OA is a chronic progressive disease involving hyaline cartilage degradation, subchondral bone remodeling, osteophyte formation and synovial inflammation. The primary treatment goal with PRP, is to shift management from simple analgesia towards disease modification, aiming to slow the trajectory towards advanced OA.

4.1.1. PRP *vs.* Hyaluronic Acid (HA): A landmark 2025 meta-analysis by Xu et al., which pooled data from 42 randomized controlled trials involving over 4,000 patients, provides the definitive stance on this comparison.[11] The authors found that intra-articular PRP provided significantly greater pain relief than HA, as reflected by lower VAS scores. Functional outcomes were also better in the PRP group, with superior WOMAC function scores. In terms of durability and long-term efficacy, HA provides relief that peaks at 6 to 8 weeks, declining by 3 to 4 months. PRP has a slower onset with effects peaking at 6 to 12 months, but it tends to provide relief sustained at up to a year.

The Standardized Mean Difference (SMD) for WOMAC pain at 12 months was -0.57 (95% CI: -0.61 to -0.54) favoring PRP. This represents a moderate-to-large clinical effect size, superior for long-term management[10].

4.1.2. PRP *vs.* Corticosteroids (CS): Comparison with corticosteroids demonstrates a clear crossover pattern in efficacy. In the short term, particularly within the first 0 to 4 weeks, corticosteroid injections tend to produce better outcomes. During this immediate period, PRP is less effective. Over the mid- to long term, however, this relationship reverses. The effect of corticosteroids diminishes relatively quickly as the drug is metabolized and inflammatory processes recur, whereas the therapeutic effect of PRP peaks at the 6 to 12-month period. By 6 months, patients treated with PRP report significantly lower pain scores than those who received corticosteroids. Safety considerations further strengthen this distinction, as repeated corticosteroid injections have been associated in longitudinal studies with accelerated cartilage volume loss and subchondral insufficiency fractures, concerns that are not similarly described with PRP. This pattern was reinforced by the 2024 meta-analysis by Khalid, et al., which found the most pronounced benefit for PRP at 6 months post-injection, with a standardized mean difference of -1.24 (95% CI, -1.58 to -0.90) compared with corticosteroids, representing a large effect in favour of PRP[3].

4.1.3. Recommendations: For Knee OA, PRP portends significant benefits in both pain relief and functional outcomes compared to HA or Corticosteroids. However, PRP remains costly, logistically more challenging to prepare and lacks good short-term benefit. The authors of this paper would like to put forth that PRP is a safe alternative to HA and corticosteroids, it can be recommended as a treatment option for patients seeking longer lasting pain relief and potentially better functional outcomes. This is echoed by an acknowledgement of PRP's potential use in Knee OA by the AAOS (American Academy of Orthopaedic Surgeons), particularly for mild-to-moderate OA (Kellgren-Lawrence grades I-III)[11].

Leukocyte-Poor PRP (LP-PRP) is recommended to avoid post-injection inflammation. Most successful protocols in the meta-analyses utilized a series of 2 to 3 injections spaced 1 to 2 weeks apart, rather than a single injection. This repeated dosing is postulated to sustain continued growth factor release, modulating the synovial microenvironment. Clinicians have to be aware of the primary side effect of a post-injection inflammatory flare, typically self-limiting pain and swelling lasting 24 to 48 hours (Figure 3). This occurs in 15% to 30% of patients[3].

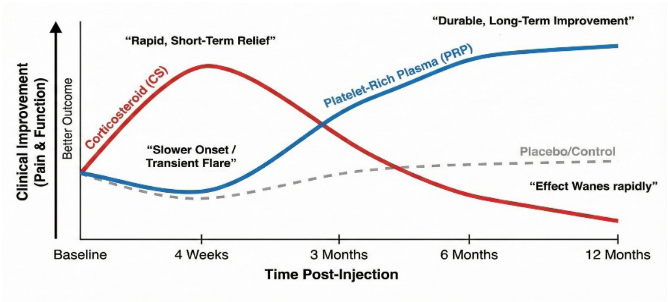

Figure 3: Post-injection inflammatory flare.

4.2. Hip Osteoarthritis

Hip OA presents a greater therapeutic challenge than knee OA. The hip joint is deeply seated, requiring ultrasound or fluoroscopic guidance for accurate access and its tight, non-compliant capsule limits injection dispersion.

4.2.1. PRP *vs.* Placebo *vs.* Corticosteroids: A high-quality network meta-analysis by Gazendam, et. al. provided comparisons between Placebo, PRP, HA and Corticosteroids[12]. This meta-analysis assessed intra-articular injections for hip osteoarthritis, comparing corticosteroids, platelet-rich plasma, hyaluronic acid and saline/placebo. The critical finding was that saline injections performed as well as the active injectables for pain and functional outcomes. No injectable class, including PRP, showed clear superiority over placebo in the pooled analysis. There thus remains no firm evidence supporting the use of PRP over other classes of injectables. This was also further supported by a systematic review and meta-analysis published in 2023 (Am. J. Sports Med.) and updated by Santiago, et al. in 2025, which compared PRP against HA[5,13]. The overall conclusion from the 2 papers found no superiority of PRP use over HA. When comparing PRP against HA, PRP showed benefit in pain relief against the baseline, but the comparative efficacy against HA was not statistically significant at 12 months (SMD = -0.31, p = 0.73). Both treatments offered relief, but PRP did not demonstrate the clear superiority seen in the knee[13]. In a critical and counter-intuitive finding from the 2025 review, a combination of PRP with HA, showed worse pain outcomes than patients who had received PRP alone. This was attributed to the restrictive hip capsule being distended by a larger volume injection, resulting in worse pain outcomes.

4.2.2. Recommendations: There is a paucity of evidence that supports the use of PRP in hip OA. Clinicians have to be aware of the reported non-superiority of PRP over saline, HA and Corticosteroid preparations. With the increased challenges posed by cost, safety and logistics, PRP is not recommended in use for hip OA.

4.3. Plantar Fasciitis

Chronic plantar fasciitis, is a degenerative condition rather than a primary inflammatory condition. It is histologically characterized by the disorganization of collagen, the presence of microtears and myxoid degeneration of the plantar fascia. Consequently, anti-inflammatory treatments, such as corticosteroids, may alleviate symptoms but do not address the underlying pathology[14].

4.3.1. PRP *vs.* Corticosteroids: A comprehensive 2025 meta-analysis by Zuo, et al., incorporating 24 randomized controlled trials, provides the highest-quality evidence to date for PRP in plantar fasciitis[14]. The findings demonstrate a distinct time-dependent treatment effect. In the short term, particularly within the first 0 to 4 weeks, corticosteroid injections remain superior. Over the mid to long term, however, PRP consistently performs better than corticosteroids in both pain and functional outcomes. At 6 months, PRP showed a standardized mean difference of -1.04 in VAS compared with corticosteroids, favouring PRP. Functional outcomes, as measured by AOFAS scores, were also superior in the PRP group at 3, 6 and 12 months, indicating more durable symptom control and a faster return to daily activities. Overall, this temporal crossover effect closely mirrors the outcomes seen in Knee OA.

4.3.2. Structural Remodelling and Safety: The most compelling argument for PRP in this condition is safety and structural integrity[14]. Corticosteroid injection, although effective for short-term pain relief, carries recognised risks, particularly fat pad atrophy and plantar fascia rupture. Ultrasound-based studies have shown that PRP treatment is associated with a reduction in plantar fascia thickness, a finding that is postulated to reflect healing and collagen remodelling. Unlike corticosteroids, PRP is not associated with tissue atrophy or rupture, making it an especially attractive option when longer-term structural integrity is a priority.

4.3.3. Recommendations: PRP is recommended for patients with chronic plantar fasciitis (>3 months), who have failed physiotherapy, footwear modification and oral analgesia. It can also be considered for athletes who require durable symptom resolution without risk of tissue atrophy or rupture.

LP-PRP is preferred to minimize post-injection inflammation. Clinicians should consider the use of Ultrasound-guided intrafascial injections. Patients may expect a mild post-injection inflammatory flare for 24-48 hours, with gradual improvement peaking at 3-6 months, with durability beyond 12 months[14].

4.4. Patellar Tendinopathy

Patellar tendinopathy is a chronic degenerative disorder. The underlying pathology is characterized by collagen fiber disorganization, neovascularization, mucoid degeneration and reduced tensile strength. These changes develop due to repetitive overload-particularly in jumping sports-and lead to persistent pain and impaired functional performance.

Conservative measures, particularly eccentric loading programs, remain first-line therapy, but many athletes develop chronic, recalcitrant symptoms. In this context, PRP offers a biologically targeted approach intended to stimulate matrix remodeling, promote fibroblast proliferation and reverse the degenerative microenvironment.

4.4.1. PRP *vs.* Corticosteroids: Corticosteroid injections are not recommended for patellar tendinopathy due to well-established risks, including tendon weakening, collagen disruption and an increased likelihood of tendon rupture. As such, modern RCTs rarely include steroid comparisons[15].

A high-quality randomized controlled trial published in 2024 by van der Heijden et al. provided evidence supporting PRP. This study compared PRP against dry needling and sham injections. This study was also unique in its use of MRI and Ultrasound Elastography to compare tendon healing between both treatment arms[16]. At 52 weeks, the PRP group showed a mean VAS reduction of -5.9 points (95% CI: –7.8 to –3.9; $p < 0.001$). Imaging data showed signs of better tendon healing (improved signal intensity, reduced cross-sectional area) only in the PRP group. The authors postulate that this exhibited objective verification that PRP is actively remodeling the tendon tissue, rather than acting as an analgesic or as a placebo[16].

4.4.2. Recommendations: PRP is recommended for patients with chronic patellar tendinopathy who have not responded adequately to first-line conservative management. Recommend consideration as first line therapy in athletes and highly active individuals, where tendon integrity and long-term durability are essential. The recommended dosing regimen is for a single ultrasound-guided intratendinous PRP injection for patellar tendinopathy with LR-PRP. The injection should be delivered directly into the diseased segment of the tendon, often accompanied by controlled needle fenestration. Treatment may be associated with transient post-injection discomfort lasting 24 to 48 hours. A structured, gradual return to loading is recommended to provide mechanical stimulus to optimise tendon remodeling. Symptomatic improvement typically emerges by 6 to 8 weeks, with maximal gains achieved between 3 and 6 months[16].

4.5. Lateral Epicondylitis (Tennis Elbow)

Lateral epicondylitis is a chronic degenerative tendinopathy of the common extensor origin, particularly the Extensor Carpi Radialis Brevis (ECRB) origin. Histology again demonstrates collagen disorganization, angio-fibroblastic hyperplasia and microtears, rather than acute inflammation. Repetitive wrist extension and gripping activities contribute to overload of the ECRB tendon, leading to progressive mechanical failure and impaired load tolerance.

Most patients initially respond to activity modification, physiotherapy and bracing. However, a subset will develop persistent pain lasting >3 months and these cases form the primary population in whom PRP has been most extensively investigated. Notably, the pathology is superficial, well-vascularized and easily accessible, making it technically well-suited for intratendinous injectable therapy[17,18].

4.5.1. PRP *vs.* Corticosteroids: Lateral epicondylitis exhibits an example where PRP and corticosteroids again show a significant crossover effect. Multiple high-level trials, including the 2023 meta-analysis by Hohmann et al., demonstrate a well-defined crossover pattern in pain and functional outcomes[17]. Corticosteroids are superior in the short-term, offering an anti-inflammatory effect, producing rapid symptom relief. However, this benefit is short-lived, as steroids do not address the underlying degenerative microenvironment. As steroid effects dissipate after 3 to 4 months, patients frequently experience a return or rebound of pain. In contrast, PRP-treated patients continue to show progressive improvement. By 6 months, PRP consistently outperforms corticosteroids in both pain and function. The 2023 meta-analysis demonstrated a significant advantage for PRP, with an SMD of –0.44 favoring PRP for DASH scores at 24 weeks. Recurrence rates are markedly lower in the PRP group, whereas steroid-treated patients experience high rates of symptom recurrence (often between 3 to 6 months).

4.5.2. Recommendations: PRP is recommended for patients with chronic lateral epicondylitis who have not responded adequately to physiotherapy and activity modification. It can also be considered for use in patients who experience recurrence after corticosteroid administration. Recommended dosing regime is for a single ultrasound-guided intratendinous PRP injection with LR-PRP. The injection should be delivered directly into the diseased segment of the common extensor origin, accompanied by controlled needle fenestration. Treatment may be associated with transient post-injection discomfort lasting 24 to 48 hours. Gradual reintroduction of eccentric wrist extensor training after 1 to 2 weeks. Symptom improvement expected at 6 to 8 weeks, with maximal benefit achieved by 3 to 6 months. Substantially lower recurrence rates compared with corticosteroids[17].

4.6. Medial Epicondylitis (Golfer's Elbow)

Medial epicondylitis is a chronic tendinopathy affecting the flexor–pronator origin, most commonly involving the Pronator Teres (PT) and Flexor Carpi Radialis (FCR). It follows the same biological principles as lateral epicondylitis, of being a degenerative pathology rather than inflammatory. Histopathological analysis reveals collagen dysfunction, mucoid degeneration, reduced tendon tensile strength.

The condition is frequently associated with repetitive valgus stress of the elbow or forceful wrist flexion/pronation, as seen in throwing athletes, racquet sports players and manual laborers. Unlike lateral epicondylitis, medial epicondylitis presents additional clinical complexity due to the close proximity of the ulnar nerve and the Ulnar Collateral Ligament (UCL)[18,19].

4.6.1. PRP *vs.* Corticosteroids: PRP has emerged as a promising intervention for recalcitrant medial epicondylitis. A 2022 systematic review (Alzahrani et al.) and supportive prospective studies demonstrate that PRP achieves significant reductions in pain, improved functional scores, durable symptom relief lasting 12 or more months and lower recurrence rates compared to steroids[18,19].

4.6.2. PRP *vs.* Surgery: The most striking finding is the comparison between PRP and surgical debridement.

The systematic review reported that PRP outcomes were equivalent to surgical medial epicondyle release for chronic refractory cases-achieving similar improvements in grip strength, pain and return-to-sport timelines.

This parity with surgical treatment is particularly meaningful given that surgery carries risks of ulnar nerve traction injury, elbow stiffness and surgical morbidity. These results strongly support PRP as a viable pre-surgical alternative for medial epicondylitis[18,19].

4.6.3. Recommendations: We recommend PRP injections for chronic (more than 3 months) medial epicondylitis not responding to physiotherapy. Athletes with valgus-loading sports (throwers, javelin, racquet players) and individuals with prior steroid exposure or recurrence after steroid injection, may potentially see the greatest benefits from treatment. Based on current data. PRP administration is a suitable alternative to surgical release. LR-PRP is preferred for extra-articular tendonitis, performed via ultrasound-guided intratendinous injection into the flexor–pronator origin. Clinicians should consider needle fenestration to enhance biologic effect. The ulnar nerve should be identified and protected throughout the procedure. Patients can expect localized discomfort for 24 to 48 hours. Following the treatment, patients should be allowed gradual return to loading after 1 to 2 weeks. Progressive improvement is expected from 6-8 weeks, with maximal gains at 3 to 6 months. PRP has shown to have lower recurrence rates than corticosteroids and comparable long-term outcomes to surgical debridement[18,19].

4.7. Rotator Cuff Disease

As part of the focus of this paper, we will be primarily discussing the degenerative rotator cuff pathologies. The degenerative disease trajectory typically begins with tendinosis and progresses to partial-thickness tears before advancing to full-thickness defects. The pathophysiology is driven by a combination of intrinsic degeneration (hypovascularity, collagen disorganization) and extrinsic factors (subacromial impingement, overload and overuse).

Partial-thickness tears occupy a unique zone of mechanical vulnerability-they are painful, structurally compromised and have the potential to propagate into full-thickness tears over time. The biological environment is characterized by impaired matrix homeostasis, increased metalloproteinase activity and insufficient intrinsic healing capacity. These features make the rotator cuff a viable target for augmentation, especially in early-stage disease.

4.7.1. PRP *vs.* Corticosteroids for Partial-Thickness Tears: Corticosteroid injections are widely used for rotator cuff-related shoulder pain, but their benefits are transient and palliative. Steroids suppress inflammation but simultaneously inhibit collagen synthesis and tenocyte viability-factors associated with tendon weakening and potential tear progression.

PRP offers a regenerative alternative that aims to reverse the degenerative microenvironment rather than merely suppress symptoms. A 2023 randomized controlled trial by Tanpowpong, et al.[20] compared intratendinous PRP with subacromial corticosteroid injection for partial-thickness supraspinatus tears. The results demonstrated superior functional improvement in the PRP group, reflected in higher ASES and Constant scores at 6 months. There was greater pain reduction at mid- and long-term follow-up, with MRI evidence of structural healing, with an average reduction in tear size (~3 mm decrease) in the PRP group. Conversely, there was no structural improvement-or slight progression-in the corticosteroid cohort.

The imaging response is of particular importance in the rotator cuff, where tendon integrity directly affects the likelihood of future surgical intervention. PRP's ability to enhance tendon morphology offers a meaningful advantage over corticosteroids, whose effects are confined to short-term analgesia.

4.7.2. PRP as an adjunct to surgical repair: Beyond non-operative management, PRP has been investigated as an adjunct during arthroscopic rotator cuff repair, typically administered as a gel, fibrin matrix or activated platelet concentrate applied to the tendon-bone interface. Evidence shows that re-tear rates are reduced when PRP is incorporated. Structural integrity on postoperative ultrasound or MRI is improved with PRP application. The effects are more pronounced in larger tears, where vascularity and native healing potential are limited. However, despite the imaging findings, improvements in pain or functional scores are present, but less significant. PRP has strong potential as a biological augment during surgery for rotator cuff repairs, but clinicians should be aware of the paucity of evidence showing significant pain and functional score benefits despite imaging findings[21].

4.7.3. Recommendations: PRP can be recommended for symptomatic partial-thickness supraspinatus tears confirmed on imaging. Patients who might receive the most significant benefits from PRP application, would be patients failing physiotherapy and not suitable for or declined surgical intervention. Younger, active individuals aiming to prevent tear progression also represent another potential group for PRP intervention. PRP has a potential role as an adjunct for surgical repair, especially in large or massive tears where re-tear risk is high. Further comparative studies are required to determine PRP use as a surgical adjunct, compared to other recognized treatments such as collagen patch augmentation.

Intratendinous PRP under ultrasound guidance is recommended for partial-thickness tears. LP-PRP is preferred to minimize post-injection inflammation within the subacromial space. For surgical augmentation, PRP can be delivered as a gel or fibrin matrix directly onto the repair site following tendon fixation. Patients can expect mild post-injection discomfort for 24 to 48 hours. Early symptomatic improvement begins around 4 to 6 weeks. Maximal benefit occurs at 3 to 6 months, correlating with tendon remodeling timelines. Imaging may demonstrate meaningful reductions in tear size or improved tendon quality. In surgical cases, PRP may reduce re-tear rates and enhance repair longevity[20,21].

4.8. Degenerative Spinal Pathology

Degenerative spinal pain arises primarily from pathology in two structures: the intervertebral discs and the zygapophyseal (facet) joints. The intervertebral disc demonstrates poor intrinsic healing due to its avascular nature, relying almost exclusively on diffusion for nutrient delivery. As degeneration progresses, the nucleus pulposus loses proteoglycan content, leading to dehydration, reduced osmotic pressure and annular fissuring. This biomechanical collapse is accompanied by upregulation of pro-inflammatory mediators, which sensitize pain nociceptors and contribute to discogenic low back pain.

Facet joint degeneration, by contrast, represents an arthritic process affecting the synovial-lined posterior elements. Cartilage thinning, subchondral sclerosis and capsular laxity combine to produce axial low back pain. Conventional treatments-including NSAIDs, physiotherapy, corticosteroid injections and Radiofrequency Ablation (RFA)-provide variable symptom relief but do not restore tissue health or modify disease progression.

4.9. PRP for Discogenic Back Pain

An RCT by Tuakli-Wosornu, et al. (2016) evaluated intradiscal PRP against contrast agent control in patients with strictly confirmed discogenic pain[22]. The study demonstrated significant improvement in VAS pain and ODI functional scores at 8 weeks and sustained through 1 year. There were greater return-to-activity rates in the PRP arm with no major adverse events, discitis or neurological sequelae. Imaging follow-up with MRI showed stability or mild improvement in treated discs.

A more recent prospective cohort study by Akeda, et al. (2022) further validated these findings[27]. Their results demonstrated progressive pain reduction over 6 to 12 months with improvement in ODI and Roland-Morris scores. Imaging follow-up with MRI exhibited improved T2-weighted signal intensity in some treated discs. This study also supported the excellent safety profile, even in repeated-injection protocols.

4.10. PRP for Facet Joint Arthropathy

4.10.1. PRP *vs.* Steroids: A prospective study by Wu, et al. demonstrated that while both steroids and PRP improved pain in the early period, PRP achieved superior pain relief at 6 months, with a greater proportion of patients achieving sustained benefit[24]. Steroid effects waned rapidly, whereas PRP accumulated in effectiveness over time-mirroring the temporal profile seen in peripheral tendinopathies.

4.10.2. PRP *vs.* radiofrequency ablation: RFA is an established modality for facet-mediated pain, with strong evidence supporting its short- to mid-term efficacy[23]. Although PRP has not been directly compared with RFA in randomized trials, its biologic mechanism offers a non-destructive alternative. Unlike RFA, which works via thermal neurolysis, PRP does not ablate neural structures and may therefore preserve facet joint capsule integrity and paraspinal musculature. While this theoretical advantage is biologically plausible, comparative clinical trials are still lacking[23].

4.10.3. Recommendations: The authors recommend patients with discogenic low back pain confirmed by MRI and/or provocative discography to be considered for PRP injection. Another patient group to be considered for PRP would be patients with chronic facet-mediated pain unresponsive to physiotherapy and NSAIDs. There is imaging evidence that PRP has protective and disease modifying effect on these conditions, although there is a paucity of long-term studies showing significant disease slowing.

For discogenic back pain, It is recommended for single injection under fluoroscopic guidance into the nucleus pulposus with LP-PRP to minimize inflammatory flare within the disc. For facet joint arthropathy, Ultrasound or fluoroscopic guidance may be utilized for injection into the facet joint capsule. Either LR-PRP or LP-PRP may be used; evidence does not yet strongly favour one. Patients may expect post-procedural discomfort lasting 24 to 72 hours. Improvement is gradual, often beginning at 4 to 8 weeks. Best outcomes typically observed between 3 to 6 months. Effects may last up to 12 months or longer in responsive patients[22-26].

5. Future Directions and Standardization

As a modality of treatment, PRP shows significant promise in its use for the management of MSK degeneration and tendinopathies. Complicating research findings and thus the synthesis of recommendations for its use, are the highly variable preparation methods of PRP. Future research necessitates a focus on standardization, mandating the reporting of platelet count, leukocyte count and activation method in all studies to enable meaningful dose-response analysis. A second crucial area of research is the identification of synovial fluid biomarkers, such as IL-1Beta levels, which can predict a patient's individual response to Platelet-Rich Plasma (PRP).

Furthermore, shelf-stable, off-the-shelf options like lyophilized PRP powders are currently under development. These offer standardized commercial options which may show differing results from autologous PRP preparations and should be areas for future study.

6. Conclusion

Through this scoping review of evidence from 2015 to 2025, the authors have found PRP to be a validated, effective and often superior therapeutic option for the management of MSK degeneration and tendinopathies. Key findings show that PRP has longer term efficacies compared to other forms of injectable therapies (HA or corticosteroids) for multiple conditions. Conditions which benefit particularly from PRP injections are knee osteoarthritis, medial and lateral epicondylitis, patellar tendinitis and degenerative spine pathology. Of note, PRP has shown similar outcomes when compared to surgical debridement for medial epicondylitis, providing a potentially less invasive treatment modality for this condition.

However, caution still must be practiced when considering PRP. It should not be inferred from this paper that PRP is suitable for all degenerative conditions. PRP is still considerably more expensive, time-consuming to prepare and logistically demanding when compared to ready off the-shelf solutions such as HA or Corticosteroids. PRP has also failed to show long term (longer than 1 year) benefits in many degenerative conditions, despite the promise of imaging improvements. It remains to be seen whether there is truly a significant benefit for degenerative disease in the utilization of PRP.

In summary, PRP represents a significant, evidence-based alternative for commonly used injectables for degenerative conditions. It deserves consideration for addition into a clinician's armamentarium for the treatment of these conditions.

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