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Guidelines for the Usage of Platelet Rich Plasma (PRP) in Musculoskeletal (MSK) Disorders

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Knowledge Partner

Orthobiologix Clinic

Regenerative Treatments for Joint Pains

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Disclaimer

The information presented in this document is intended for educational and clinical guidance purposes only. It is based on current evidence, expert consensus, and evolving clinical practices related to Platelet-Rich Plasma (PRP) therapy in musculoskeletal conditions.

This document does **not constitute medical advice** and should not replace clinical judgment or individualized patient care. Treatment decisions must be tailored to each patient's specific condition, response, comorbidities, and preferences, and should be made by qualified healthcare professionals.

While efforts have been made to ensure accuracy and relevance, the authors and contributors do **not assume any legal liability** or responsibility for the use, misuse, or outcomes of applying the information herein. PRP use in some indications may be considered off-label or experimental, and clinicians are encouraged to consult local regulatory and ethical guidelines.

Patients should be appropriately informed about the **risks, benefits, and alternatives** before undergoing PRP therapy.

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1. Introduction

Musculoskeletal (MSK) injuries or pathologies affect millions of individuals across the globe and contributes to significant socioeconomic burden. The most frequent patient complaints involve pain, swelling, restricted function, thereby affecting mental health, quality of sleep, participation at work, and decreased overall quality of life (QoL). Conventional treatment modalities include non-pharmacological approaches such as physical therapy; pharmaceuticals such as oral and/or injectable non-steroidal anti-inflammatory drugs (NSAIDs), opioids or corticosteroids; and surgical intervention. Nonetheless, these aforesaid approaches have drawback, continually aiming to reduce pain rather than targeting the underlying pathophysiology.

Over the last two decades, there has been a significant interest in the use of regenerative medicine modalities, derived from both autologous and allogenic sources, for the management of various MSK indications. Among these, autologous PRP is the most widely used and researched modality.

Platelet-Rich Plasma (PRP) therapy has evolved into a cornerstone modality within the field of regenerative musculoskeletal medicine. It holds promise as a minimally invasive, autologous treatment option that capitalizes on the body's intrinsic healing potential. The biologic basis of PRP, concentrated platelets delivering growth factors, cytokines, and other bioactive molecules, lends it the capacity to modulate inflammation, promote angiogenesis, and accelerate tissue repair across a wide range of orthopaedic and sports medicine applications.

However, PRP remains a technically sensitive intervention. Variation in preparation techniques, dosing, composition (leukocyte-rich vs. poor), and clinical indications has led to a spectrum of outcomes and, often, confusion among practitioners. Recognizing this gap, a multidisciplinary Core Committee, comprising leading orthopaedic surgeons, interventional pain specialists, and translational researchers from across India, convened to form the Advanced Regenerative Medicine India Group.

This guideline document is the result of a collaborative effort to harmonize and standardize PRP therapy protocols specifically tailored for musculoskeletal conditions in the Indian clinical context. Evidence synthesis was conducted from PubMed-indexed literature, focusing on Level 1 to Level 3 studies. The group's goal was not only to consolidate best practices but also to establish a practical, evidence-informed framework that clinicians can trust and implement confidently.

This first edition aims to demystify essential components, from patient selection and procedural technique to centrifugation parameters and follow-up care. We recognize that the field is rapidly evolving, and this living document will be periodically updated in response to emerging evidence and clinical experience.

2. Clinical Protocols for PRP Therapy

1. Comprehensive Evaluation

A thorough **clinical and radiological assessment is mandatory** before considering PRP therapy. Accurate diagnosis and case selection are essential for optimal outcomes.

2. Patient Selection Criteria

Patients suitable for PRP therapy typically present with **chronic musculoskeletal conditions** unresponsive to standard conservative treatments such as physical therapy, analgesics, or lifestyle modifications. for at least 3 months, unless the pain is excruciating, and who exhibit pathology amenable to biological healing processes.

These may include:

- Chronic soft tissue injuries
- Early osteoarthritis (OA)
- Chronic tendinopathies
- Partial ligament tears

💡 *Refer to the attached list of indications.*
However, clinical judgment remains paramount, as there are no absolute indications.

3. Contraindications

A. Absolute Contraindications

PRP therapy is contraindicated in the following conditions:

1. Active infections (local or systemic)
2. Active malignancy or metastasis
3. Severe anaemia
4. Bleeding disorders (e.g., thrombocytopenia, platelet dysfunction, von Willebrand disease)
5. Septic arthritis or osteomyelitis

B. Relative Contraindications

These conditions require individualized assessment, possible modification, or postponement of PRP therapy:

1. **Anticoagulation therapy** – When discontinuation is not possible, PRP is not advisable.
2. **Hypertension** – Elevated blood pressure may cause premature platelet degranulation.
3. **Mental and physical stress** – Can trigger spontaneous release of platelet growth factors.
4. **Dietary influences** – Diets high in saturated fats, refined sugars, or simple carbohydrates may inhibit platelet aggregation.

5. **Substances reducing platelet activation** – Caffeine, quercetin (found in onions, apples, wine), and isoflavones (from soy, legumes, chickpeas).
6. **Medication interactions** – non-selective NSAIDs, aspirin, acetaminophen, and other anticoagulants may impair platelet aggregation.
   COX-2 inhibitors and statins are generally safe.
7. **Smoking** – Affects platelet function, oxygen delivery, and healing capacity.
8. **Alcohol use** – Has a dose-dependent inhibitory effect on platelet aggregation and stem cell activity.
9. **Past history** of malignancy
10. **Pregnancy** and **lactation**

4. Considerations for Low Platelet Count

Patients with low baseline platelet counts may yield suboptimal PRP. Evaluate:

A. Baseline CBC
B. Cause of thrombocytopenia
C. Risk-benefit profile before proceeding
D. Consider alternatives or rescheduling

3. Pre-Procedure Patient Instructions

1. **Following instructions should be carefully followed , before the scheduled procedure:**

   A. **Discontinue NSAIDs (Non-Steroidal Anti-Inflammatory Drugs) –** Stop taking all NSAIDs at least 5 days prior to the procedure.

   B. **Blood Thinners –** If Patient is on blood thinners, consult with prescribing physician regarding temporary discontinuation. These medications must be stopped before the procedure as advised by doctor.

   C. **Oral Steroids –** If taking oral steroids, discontinue them at least 3 weeks before the procedure, in consultation with doctor.

   D. **Intra-Articular Steroid Injections –** There should be a minimum gap of 4 weeks between the steroid injection and this procedure.

   E. **Hydration –** Stay well hydrated for 2–3 days before the procedure. Drink plenty of water unless otherwise advised.

   F. **Dietary Guidance –** Follow an anti-inflammatory and healthy diet in the days leading up to the procedure.

   G. **Transportation –** Arrange for transportation to and from the procedure, if necessary, as patient may not be able to drive yourself.

2. **Patient Expectations Management**

   Effective communication and patient education are essential during the consultation process. Please ensure the following points are discussed:

   A. Nature of PRP Therapy

   1. Explain that Platelet-Rich Plasma (PRP) therapy is a **biological treatment** that enhances the body's natural healing capabilities.
   2. Clarify that **PRP is not a guaranteed cure**, but a supportive intervention aimed at recovery.

   B. Outcome Variability

   1. Emphasize that the **response to PRP** varies between individuals.
   2. Factors influencing outcomes include:
      - Age
      - General health and lifestyle
      - Severity and duration of the condition
      - Adherence to post-procedure rehabilitation protocols

   C. Timeline of Relief

   1. Patients should understand that **improvement may be gradual**, and multiple sessions might be required.
   2. **Informed Consent** – Ensure that patients receive and sign a **detailed and condition-specific informed consent form**, outlining risks, benefits, and expected outcomes

4. Platelet-Rich Plasma (PRP) Preparation Guidelines

The efficacy and safety of PRP therapy rely on standardized preparation protocols. The following guidelines are intended to ensure consistent quality, sterility, and therapeutic effectiveness of PRP preparations.

A. Objectives of Standardized Preparation

Ensure:

- **Optimal platelet concentration**
- **High cell viability**
- **Sterility of the final product**

These parameters directly influence the therapeutic potential and clinical success of PRP applications.

B. Quality Control Measures

Quality control must be integrated at all stages to maintain:

- Safety and sterility
- Consistency of platelet yield
- Clinical reproducibility

C. Pre-Processing Checks

Prior to blood draw and centrifugation, ensure:

1. **Patient Evaluation**

   Obtain a **baseline Complete Blood Count (CBC)** to assess:

   - Platelet count
   - Haemoglobin levels
   - White blood cell count
   - CRP

2. **Anticoagulant Mixing**

   Immediately invert collection tubes **gently and adequately** post-draw to ensure proper anticoagulation and prevent clotting.

3. **Equipment Calibration**

   Verify and maintain **regular calibration** of equipment such as centrifuge machines:

   Confirm **RPM** and **g-force** settings per standard protocol.

D. Platelet Count Verification

1. Post-Processing Platelet Count

Analyse final PRP sample to:

- Confirm concentration factor
- Verify platelet dose meets clinical target

2. Alternative Estimation

If platelet count verification is not feasible:

- Use an **average draw volume of 60 mL** whole blood (for large joints)
- Assumes average baseline platelet count ~2 lakh/µL

E. Sterility Assurance

1. Aseptic Technique

Maintain strict aseptic technique during:

- Blood collection
- Sample processing
- PRP injection

2. Sterility Testing

While batch sterility testing may not be routine:

- Adhere to **sterile compounding protocols**
- Ensure clean environment and trained personnel
- Check the sterility of the consumables, kits, equipment periodically.

F. Documentation Requirements

Accurate documentation ensures traceability, audit readiness, and quality assurance. Record the following:

- Patient identification and demographics
- Date and time of blood collection and PRP injection
- Total volume of blood collected
- Type and amount of anticoagulant used
- Centrifugation parameters (RPM, duration, g-force)
- Final PRP volume
- Calculated platelet concentration or dose (if tested)
- Lot or batch numbers of collection kits
- Any protocol deviations or observed adverse events

5. PRP Types Based on Composition

1. **Leukocyte-Poor PRP (P-PRP / Pure PRP)**
   A. **Composition:** High platelet concentration, minimal leukocytes, and negligible red blood cells (RBCs).
   B. **Clinical Effect:** Promotes **anti-inflammatory** and **regenerative** responses with reduced cytokine-induced inflammation.
   C. **Preferred Use:** Ideal for **intra-articular injections** where minimizing post-procedure inflammation is critical.

2. **Leukocyte-Rich PRP (L-PRP)**
   A. **Composition:** High in platelets and leukocytes.
   B. **Clinical Effect:** Initiates a **stronger inflammatory cascade** via cytokine release, both pro- and anti-inflammatory, facilitating **tissue repair**, especially in chronic or degenerative settings.
   C. **Preferred Use:** Commonly used in **tendinopathies** and **ligament injuries** but may cause transient swelling or discomfort after injection.

3. **Platelet-Rich Fibrin (PRF)**
   A. **Composition:** A fibrin-based matrix rich in platelets and leukocytes, prepared **without anticoagulants.**
   B. **Clinical Effect:** Enables **slow, sustained release** of growth factors and cells, forming a **biological scaffold** ideal for healing.
   C. **Preferred Use:** Often utilized in **surgical applications**, **wound care**, and **oral / maxillofacial procedures** as a **gel** or **membrane.**

While clinical outcomes vary and evidence remains evolving, current practice generally Favors P-PRP for joint-related therapies and L-PRP for soft tissue conditions.

6. PRP Preparation Techniques

1. **Preparation Parameters for PRP**

   To ensure consistency, efficacy, and reproducibility in PRP therapy, the following preparation parameters are recommended:

   A. **Centrifugation Method**

   - **Double-spin centrifugation** is preferred for achieving optimal platelet separation and concentration.

   B. **Anticoagulant**

   - **ACD-A (Acid Citrate Dextrose – Formula A)** is the anticoagulant of choice to preserve platelet integrity during collection and processing.
   - Heparin 1000U/ml (1 ml for 10ml of blood) if ACD-A is not available or possible.
   - Sodium Citrate is another alternative.

   C. **Target Platelet Concentration**

   - Aim for a final PRP concentration of **1.0 – 1.5 million platelets/µL** in the injectable product.

   D. **Minimum Effective Dose**

   - A total platelet dose of **at least 5 billion** is recommended for therapeutic efficacy, particularly in the treatment of **large joints** (e.g., knee, shoulder).

2. **Blood Collection Protocol for PRP Preparation in Musculoskeletal Applications**

   Proper blood collection is critical for obtaining high-quality PRP. Adhere to the following protocol for optimal outcomes:

   A. **Blood Volume**

   - Collect **40–60 mL of peripheral blood**, depending on the clinical requirement.
   - Higher volumes are typically needed for **large joints or extensive musculoskeletal areas.**

   B. **Needle Size**

   - Use a **21-gauge needle** for venipuncture.
   - This gauge provides an optimal balance between **patient comfort** and **adequate blood flow.**

   C. **Venipuncture Site**

   - Preferred site: **Antecubital fossa**
   - Recommended veins:
     a. **Median cubital vein**
     b. **Cephalic vein**

c. **Basilic vein**

- These veins are generally large, superficial, and easily accessible.

D. Collection Tubes and Anticoagulant

- Use **sterile blood collection tubes preloaded with anticoagulant.**
- **Recommended anticoagulant:**
  a. **ACD-A (Acid Citrate Dextrose Solution A)**
  b. Preserves platelet function and prevents clotting during processing.
- **Immediately invert tubes** gently after collection to ensure thorough mixing with anticoagulant and prevent coagulation.

3. PRP Preparation Techniques

The technique used for PRP preparation critically influences the **composition, sterility,** and **customizability** of the final product. Two primary methods are utilized:

A. Open System (Manual / Laboratory-Based Method)

Overview

- Utilizes manual **double-spin centrifugation.**
- Allows for **customization** of volume and cellular content.
- Must be performed under **strict aseptic conditions** (e.g., biosafety cabinet or laminar flow hood).

Standard Protocol

i. **Blood Collection**
Draw peripheral venous blood into sterile tubes containing an anticoagulant (preferably **ACD-A**).

ii. **First Spin (Soft Spin)**
Separates red blood cells (RBCs) from plasma and buffy coat.

iii. **Transfer Step**
Aspirate the plasma and buffy coat into a sterile secondary tube.

iv. **Second Spin (Hard Spin)**
Concentrates platelets into a pellet at the bottom of the tube.

v. **Final Preparation**
Remove the platelet-poor plasma (PPP) and resuspend the platelet pellet in the remaining plasma to form PRP.

vi. **Sterility Maintenance**
All steps must be performed in a **sterile field** (biosafety cabinet or LFH).

Advantages

- Customizable **platelet and leukocyte concentration**
- Flexible **PRP volume and dosing**

Disadvantages

- Higher **risk of contamination**
- **Labor-intensive** and time-consuming
- Requires **trained personnel** and sterile infrastructure

B. Closed System (Commercial Kit-Based Method)

Recommended to use any of the DCGI approved PRP kits listed in the DCGI website for medical devices.

Overview

- Employs **pre-sterilized, sealed kits** for the entire process.
- Minimizes exposure of blood components to the external environment.

Core Principles

- Integrated design for **collection, separation, and extraction.**
- Utilizes **single- or double {R-spin centrifugation** within a **closed, self-contained system.**

Advantages

- **Standardized PRP** product with minimal operator variability
- **Lower contamination risk**
- **Quick and user-friendly** protocol

Disadvantages

- **Higher per-use cost**
- Limited ability to **customize volume** or **cellular composition**

7. Centrifuge Specifications and Parameters for PRP Preparation

1. **Double-Spin (Two-Spin) Method**

   The double-spin technique is widely adopted for producing PRP with high platelet yield and controlled leukocyte content.

   A. First Spin (Soft Spin)

   - **Purpose:** To separate red blood cells from the platelet- and leukocyte-rich plasma (buffy coat).
   - **Relative Centrifugal Force (RCF): 100–300 g**
   - **Duration:** 5–10 minutes
   - **Outcome:** RBCs are pelleted at the bottom, while platelets and leukocytes remain in the plasma above.

   B. Second Spin (Hard Spin)

   - **Purpose:** To concentrate platelets by pelleting them from the plasma.
   - **Relative Centrifugal Force (RCF): 400–700 g**
   - **Duration:** 10–17 minutes
   - **Outcome:** Platelet-rich pellet is formed; platelet-poor plasma (PPP) can be discarded or partially retained depending on desired final concentration.

   🔍 Note: Always refer to the specific centrifuge or kit manufacturer's protocol for optimal RPM and time settings. System designs vary, and manufacturer-validated parameters ensure reliable PRP quality.

2. **Centrifugal Force (RCF) Calculation**

   RCF is the **standardized measure of centrifugal force** and ensures reproducibility across centrifuges with different rotor radii.

   Formula:

   - $\mathbf{RCF = 1.118 \times 10^{-5} \times r \times RPM^2}$

   Where:

   - **RCF** = Relative Centrifugal Force (in g)
   - **r** = Rotor radius (in cm)
   - **RPM** = Rotations per minute
   - $\mathbf{1.118 \times 10^{-5}}$ = Conversion constant

Example:

- For a rotor radius of 15 cm at 3000 RPM:
- RCF = $1.118 \times 10^{-5} \times 15 \times (3000)^2 = 1510.45$ g

Application:

This formula is essential for converting RCF to RPM specific to your centrifuge model, allowing accurate replication of PRP preparation protocols across varied equipment.

3. Mathematical Formulas for PRP Preparation

These formulas help evaluate the efficiency and quality of PRP production, allowing clinicians and technicians to optimize procedures.

A. Platelet Yield Efficiency

- Determines the percentage of total platelets from whole blood that are recovered in the PRP.
- Platelet Yield Efficiency = (PRP Volume × PRP Platelet Concentration) ÷ (Blood Volume × Blood Platelet Concentration).

B. Amplification Factor

- Indicates how concentrated the platelets are in PRP compared to baseline blood.
- Amplification Factor = PRP Platelet Concentration ÷ Blood Platelet Concentration.

C. Relative Centrifugal Force (RCF)

- Used to calculate the centrifugal force applied, factoring in rotor size.
- RCF = $(RPM^2) \times 1.118 \times 10^{-5} \times$ Rotor Radius (cm).
- These formulas support data-driven improvements in technique, consistency across procedures, and tailored PRP therapy.

8. Guideline for Use of Image Guidance and Injection Technique

1. **All PRP injections**, whether into joints, tendons, or soft tissues, **are recommended to be performed under image guidance** (ultrasound or fluoroscopy) to ensure **accuracy, safety,** and **optimal outcomes.**
2. Employ **real-time visualization** to guide the needle and monitor progress.
3. **Confirm precise needle tip placement** within the target structure before delivering PRP.
4. If joint **effusion is present,** aspirate before injection to:
    A. Decompress the joint and remove the inflammatory load.
    B. Confirm needle positioning, to rule out vascular placement.
5. **Administer PRP slowly and steadily** to minimize pain and reduce the risk of tissue injury.
6. After completion, **withdraw the needle carefully** and apply a **sterile dressing** over the injection site.

9. Dosing Strategies for PRP Therapy

Single Dose vs. Multiple Doses

1. **Overview**

   The ideal PRP dosing strategy depends on the **nature of the condition, PRP composition** (volume and concentration), and **individual patient factors.**

   A. It is recommended to start with a **maximal dose.**

   B. If required, repeat the injection after **3 weeks** based on clinical response.

2. **Key Principle**

   Avoid underdosing. Insufficient platelet volume or concentration can lead to **suboptimal outcomes.** Always aim for a **therapeutic platelet concentration** and total platelet dose.

3. **Single vs. Multiple Doses**

   A. Single High-Concentration Injection

   - Best for **acute injuries** or **localized lesions.**
   - Provides a **strong initial regenerative stimulus.**

   B. Multiple High-Concentration Injections (2–3 doses)

   - Preferred in **chronic conditions** or **larger treatment areas** such as **knee osteoarthritis.**
   - Injections are typically spaced **1–4 weeks apart** to maintain biological activity and modulate inflammation over time.

4. **Maximal Dose & Influencing Factors**

   A. Maximal Dose Targets:

   - Platelet concentration: **3–7× baseline**
   - Platelet count: **~1–1.5 million/µL**
   - Total dose: Aim for **≥5 billion platelets** in large joints

   B. 3-Week Interval Strategy:

   - Provides time to assess the **biological effect** and **symptomatic relief** before considering a repeat dose.

5. **Dosing Considerations**

   Key factors influencing dosing decisions:

   A. **Severity and chronicity** of the condition

   B. **Initial patient response** to the first injection

   C. **Size and location** of the lesion

   D. **Patient compliance** and ability to follow up

10. Post-Procedure Care and Rehabilitation: Instructions

1. **Immediate Post-Procedure Care (First 24–48 Hours)**
   A. **Expect** mild-to-moderate soreness, swelling, and occasional bruising at the injection site.

   B. **Use** only **acetaminophen** (paracetamol) for pain relief.
      - **Avoid** NSAIDs (e.g., ibuprofen, diclofenac) for **2 weeks** to preserve the healing response.

   C. Apply the R.I.C.E. protocol:
      - **Rest** the affected area.
      - **Ice:** 15–20 minutes every 2–3 hours.
      - **Compression** using elastic bandage if recommended.
      - **Elevation** to reduce swelling and discomfort.

2. **Activity Progression & Rehabilitation Phases**
   Phase 1: Days 1–7
      - **Rest** and **protect** the injection area.
      - **Begin** only **gentle, pain-free movements.**
      - **Avoid** weight-bearing or strenuous activity.

   Phase 2: Weeks 1–3
      - **Initiate** controlled range-of-motion exercises.
      - **Introduce** light strengthening activities (non-weight-bearing as appropriate).
      - **Avoid** high-intensity or heavy-load exercises.

   Phase 3: Weeks 3–6+
      - **Progress** to functional strengthening and proprioception training.
      - **Begin** sport-specific or occupational training under **supervision of a physiotherapist.**
      - **Return to full activity** only after individualized evaluation and clearance.

3. Monitoring, Red Flags & Follow-Up

Watch for Red Flags:

- Severe or increasing pain
- Fever or signs of infection
- Redness spreading from the injection site
- Numbness, tingling, or neurological changes
- Unusual or persistent swelling
- Immediate pain and swelling should raise the suspicion for an acute inflammatory reaction and usually reassurance will suffice whereas delayed pain and swelling warrants investigation to rule out infection and if infection confirmed, aggressive treatment must be initiated.

Schedule Follow-Ups:

- **3 weeks:** Clinical response assessment, rehab review, consider second injection if needed.
- **6 weeks:** Functional evaluation.
- **3 months:** Detailed clinical review; order imaging if indicated.
- **6 and 12 months:** Assess long-term outcomes.
- **Annual review** thereafter if necessary.

11. Indications in MSK Pathologies

Generally speaking, PRP is indicated for various joint, tendon and ligament inflammation from benign conditions.

1. **Tendinopathies:**
    A. Lateral Epicondylitis (Tennis Elbow)
    B. Medial Epicondylitis (Golfer's Elbow)
    C. Patellar Tendinopathy (Jumper’s Knee)
    D. Achilles Tendinopathy (mid-portion and insertional)
    E. Gluteal Tendinopathy
    F. Rotator Cuff Tendinosis (Partial Thickness tears)
2. **Ligament Injuries:**
    A. Medial Collateral Ligament (MCL) sprains
    B. Lateral Collateral Ligament (LCL) sprains
    C. Ulnar Collateral Ligament (UCL) injuries (elbow)
    D. Chronic Ankle Ligament Injuries (ATFL, CFL)
3. **Muscle Injuries:**
    A. Grade II muscle tears (hamstrings, quadriceps, calf, groin)
    B. Chronic muscle injuries
4. **Joint Pathologies:**
    A. Early to moderate Osteoarthritis (Knee, Hip, Shoulder, CMC joint, Ankle)
    B. Focal Chondral or Osteochondral Lesions
    C. Post-microfracture adjunct treatment
5. **Spine:**
    A. Discogenic low back pain
    B. Facet joint arthropathy
    C. Sacroiliac joint dysfunction
6. **Post-Surgical Applications:**
    A. Rotator cuff repair
    B. ACL reconstruction
    C. Meniscal repair
    D. Post-arthroscopy symptom management
7. **Foot & Ankle:**
    A. Chronic plantar fasciitis
    B. Achilles tendinopathy
    C. Peroneal tendinopathy
8. **Wound management**
    A. Burns, Chronic non healing ulcers, Diabetic foot
9. **Non-Union of fractures**

12. Specific Musculoskeletal (MSK) Indications for PRP Therapy with Evidence Grading

1. **Tendinopathies**

   PRP is frequently employed in chronic tendinopathies resistant to conventional treatment, aiming to stimulate tenocyte function and enhance collagen synthesis.

   A. **Lateral Epicondylitis (Tennis Elbow)**
      - Evidence Level: I
      - Strong support from multiple RCTs and meta-analyses
      - **Superior to corticosteroids**, comparable to dry needling or placebo in long-term relief

   B. **Patellar Tendinopathy**
      - Evidence Level: II–III
      - Mixed outcomes; favourable in **mild to moderate** cases
      - **Better than exercise** alone in some controlled studies

   C. **Achilles Tendinopathy**
      - Evidence Level: II–III
      - Variable results; beneficial in **chronic, non-responding cases**

   D. **Rotator Cuff Tendinosis (Including Partial Tears)**
      - Evidence Level: II
      - Effective for **pain reduction** and **functional improvement** when combined with physiotherapy

2. **Ligamentous Injuries**

   A. **Medial Collateral Ligament (MCL) Sprains**
      - Evidence Level: III–IV
      - Early evidence suggests **faster recovery** in **partial ligament injuries**, particularly in athletes

3. **Muscle Injuries**

   A. **Grade II Muscle Tears (e.g., hamstrings, quadriceps)**
      - Evidence Level: III
      - Some studies report **accelerated return to sport** and **lower recurrence rates**
      - Evidence still **preliminary**

4. **Joint Pathologies**

   A. **Osteoarthritis (OA)**

      Knee OA

      - Evidence Level: I
      - Robust RCT and meta-analysis support; superior to **hyaluronic acid and saline**

      Hip OA

      - Evidence Level: II–III
      - Less consistent data; outcomes **generally positive**

   B. **Focal Chondral Lesions**

      - Evidence Level: III
      - Often used as an **adjunct** to microfracture or other cartilage repair techniques

5. **Spinal Applications (Emerging Use)**

   A. **Discogenic Low Back Pain**

      - Evidence Level: IV
      - Early-phase studies suggest benefit in **annular repair** and **inflammation control**

   B. **Facet Joint / Sacroiliac (SI) Joint Pain**

      - Evidence Level: IV
      - Limited clinical trials: **anecdotal reports** suggest potential utility

6. **Post-Surgical Applications**

   - Evidence Level: I–II
   - Positive outcomes in:
     - **Rotator cuff repair**
     - **ACL reconstruction**
     - **Meniscal repair**
   - Benefits include enhanced healing and reduced re-tear rates in selected patient populations

7. **Foot and Ankle**

   Chronic Plantar Fasciitis

   - Evidence Level: I
   - PRP shown to **outperform corticosteroids** in long-term pain relief and functional improvement

13. Appendix

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Authors: *Sumbal Irshad, Usman Waleed, Muhammad Hassan Zafar, Muhammad Tayyab Ramzan, Muhammad Abdullah Tariq, Muhammad Hassan, Muhammad Ahmer Sohaib, Sana Liaquat, Sanwal Mehmood, Rana Shahzaib Ali, Tayyab Mumtaz Khan*
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Authors: *Stefano Zaffagnini, Luca Andriolo, Angelo Boffa, Alberto Poggi, Annarita Cenacchi, Maurizio Busacca, Elizaveta Kon, Giuseppe Filardo, Alessandro Di Martino*
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Authors: *Mario Simental-Mendía, José F Vilchez-Cavazos, Víctor M Peña-Martínez, Salvador Said-Fernández, Jorge Lara-Arias, Herminia Guadalupe Martínez-Rodríguez*
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Authors: *Mario Simental-Mendía, Carlos Alberto Acosta-Olivo, Alejandra Nohemí Hernández-Rodríguez, Oscar Rubén Santos-Santos, Santiago de la Garza-Castro, Víctor Manuel Peña-Martínez, Félix Vilchez-Cavazos*
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Authors: *N Singh, V Trivedi, V Kumar, N K Mishra, S Ahmad, S J Ayar, S S Kataria, H Kharbanda*
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Authors: *Rafal Kaminski, Marta Maksymowicz-Wleklik, Krzysztof Kulinski, Katarzyna Kozar-Kaminska, Agnieszka Dabrowska-Thing, Stanislaw Pomianowski*
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Authors: *Jane Fitzpatrick, Max K Bulsara, John O'Donnell, Ming Hao Zheng*
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Authors: *Leire Atilano, Nerea Martin, Jose Ignacio Martin, Gotzon Iglesias, Josu Mendiola, Paola Bully, Ayoola Aiyegbusi, Jose Manuel Rodriguez-Palomo , Isabel Andia*
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Authors: *Padma Badra Hewavithana, Mihiri Chami Wettasinghe, Gothami Hettiarachchi, Manel Ratnayaka, Hilary Suraweera, Nuwan Darshana Wickramasinghe, Pallegoda Vithanage Ranjith Kumarasiri*
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Authors: Thanathep Tanpowpong, Marvin Thepsoparn, Numphung Numkarunarunrote, Thun Itthipanichpong, Danaithep Limskul, Phark Thanphraisan
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Authors: *Allan K Mishra, Nebojsa V Skrepnik, Scott G Edwards, Grant L Jones, Steven Sampson, Doug A Vermillion, Matthew L Ramsey, David C Karli, Arthur C Rettig*
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Authors: *Raman Yadav, S Y Kothari, Diganta Borah*
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Authors: *Shahdan Y Kotb, Nahed M Sherif, Hala A Saleh, Sahar F Ahmed, Hossam M Sakr, Mohamed O Taeimah*
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Authors: *Asarn Wongjarupong, Saran Pairuchvej, Panyajarn Laohapornsvan, Vit Kotheeranurak, Khanathip Jitpakdee, Chunrutai Yeekian, Pongsthorn Chanplakorn*
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