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Ultrasound-Guided Infiltration of Platelet-Rich Plasma for Conditions of the Musculoskeletal System

Leonardo Martínez Aparicio PhD. MD [1], Lázaro M. Martínez Estupiñan PhD. MD [2*], Yunier Fernández Rodríguez MD [3], Lázaro Martínez Aparicio MD [4].

[1]Doctor of Medical Sciences (PhD). Full Professor and Researcher. First and Second Degree Specialist in Orthopedics and Traumatology. University General Hospital "Martyrs of April 9th," Villa Clara, Cuba.

[2]Doctor of Medical Sciences (PhD). Full Professor and Researcher. First and Second Degree Specialist in Orthopedics and Traumatology. University General Hospital "Martyrs of April 9th," Villa Clara, Cuba.

[3]First Degree Specialist in Orthopedics and Traumatology, Instructor Professor. University General Hospital "Martyrs of April 9th," Villa Clara, Cuba.

[4]Second- Degree Specialist in Orthopedics and Traumatology, Full Professor. University General Hospital "Martyrs of April 9th," Villa Clara, Cuba.

***Corresponding Author:** Lázaro M. Martínez Estupiñan PhD. MD, Doctor of Medical Sciences (PhD). Full Professor and Researcher. First and Second Degree Specialist in Orthopedics and Traumatology. University General Hospital "Martyrs of April 9th," Villa Clara, Cuba. Telephone: +53 58514377.

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Abstract

Introduction: Platelet-rich plasma (PRP) is a product derived from the patient's own blood (autologous) with a concentration of platelets and other plasma bioactive elements above normal values. It is indicated for the treatment of articular cartilage lesions, muscle injuries, ligament injuries, and tendon injuries.

Objective: To present partial results from two contracted research projects and to disseminate the benefits of using platelet-rich plasma infiltration and its application under ultrasound guidance.

Method: A prospective study was conducted. The units of analysis were adults diagnosed with orthopedic injuries whose condition had not resolved with conservative treatment (for more than six months) and who were seen in the outpatient clinic of the Mártires del 9 de abril University General Hospital.

Results: In most musculoskeletal conditions, diagnostic methods such as ultrasound or plain radiography were used. Between two and three ultrasound-guided infiltrations were performed, and most patients tolerated the procedure well. Patients perceived an improvement or eradication of symptoms upon completion of treatment; a large percentage (41.66%) even showed clinical improvement from the first infiltration. 77.08% of all patients achieved good clinical progress with no pain or only mild pain.

Conclusions: The use of platelet-rich plasma for musculoskeletal conditions resulted in pain reduction from the first infiltration. The applied treatment protocol achieved clear clinical improvement in each of the conditions.

Keywords

Platelet-rich plasma; Infiltration; Ultrasound-guided infiltration.

Introduction

Platelet-rich plasma (PRP) is a product derived from the patient's own blood (autologous) containing a concentration of platelets and other bioactive plasma elements that exceeds normal levels. Beyond their key role in hemostasis, platelets actively participate in tissue regeneration by releasing various growth factors and cytokines that modulate angiogenesis, extracellular matrix remodeling, and the recruitment, proliferation, and differentiation of stem cells.

Based on this principle, platelet-rich plasma derivatives are used in regenerative medicine to treat various clinical conditions, including muscle tissue repair, tendon disorders, other musculoskeletal injuries, and tissue recovery following surgical procedures.

Orthobiologic products are indicated for the treatment of articular cartilage, muscle, ligament, and tendon injuries. Following the application of platelet-rich plasma, 95% of the growth factors begin to act within one hour. Additionally, protein synthesis and secretion continue for another 5 to 10 days. Subsequently, macrophages—which arrive at the injury site due to platelet-promoted vascular growth—take over the regulation of tissue repair by secreting their own factors (1).

The use of autologous PRP is a safe and effective treatment, associated with few, mild adverse effects. There is extensive clinical experience regarding its use in sports medicine, orthopedics, and traumatology (2). The proteins contained in alpha granules exert a strong influence on the repair processes of soft tissue injuries. Some of these proteins are absent in chronic injuries that fail to heal properly (3).

Ultrasound (US) has traditionally been used by radiologists; however, in recent years, its application in orthopedics has gained importance, particularly for soft-tissue assessment, procedure guidance, and the monitoring of certain musculoskeletal conditions. Its progressive adoption among orthopedists highlights the need to critically evaluate its utility, the training of professionals, and its perception within the clinical setting.

Ultrasound is a highly valued tool with both diagnostic and therapeutic applications; within this field, musculoskeletal ultrasound has emerged as a complementary tool in orthopedic practice. Its use has increased due to its ability to provide dynamic, non-invasive, and cost-effective imaging. Its integration depends on the institutional context, professional training, and the availability of suitable equipment. As more orthopedists acquire skills in ultrasonography, greater adoption and autonomy in its use are expected (4).

This article aims to present partial results from two commissioned research projects and to highlight the benefits of using platelet-rich plasma (PRP) injections, specifically under ultrasound guidance. The study's purpose is to replace lost tissue, stimulate regeneration and healing, reduce pain and inflammation, and improve joint function.

Materials and Methods

A prospective developmental research study was conducted. The units of analysis were adults diagnosed with orthopedic injuries whose conditions had not resolved despite conservative treatment (lasting more than six months) and who were treated at the outpatient clinic of the "Mártires del 9 de Abril" Provincial General Hospital between January 1 and December 31, 2025.

The study population consisted of all patients with orthopedic injuries for whom leukocyte-poor platelet-rich plasma treatment via ultrasound-guided injection was indicated—a total of 48 patients. Theoretical methods (analysis-synthesis, inductive-deductive, and historical-logical), empirical methods (document analysis), and mathematical-statistical methods were used to analyze the data.

Before opting for PRP therapy, a comprehensive medical assessment is performed to determine if it is the most appropriate treatment based on the patient's health status and expectations. These patients underwent clinical examination and assessment; subsequently, blood was drawn in the laboratory to obtain leukocyte-poor platelet-rich plasma. 3 cc of PRP are injected into the injured area on two or three occasions under ultrasound guidance (Figure 1) at 14-day intervals, and patients are evaluated in the clinic at six weeks, three months, and six months after the final injection.

Figure 1. PRP is administered to the injured area on two or three occasions under ultrasound guidance.

The orthopedic conditions treated with PRP injections were:
Tendon injuries. Tendinitis, tendinosis, and tendinopathies: Inflammation or degeneration of tendons, their sheaths, and their insertion points.

- Tennis elbow (lateral epicondylitis)
- Shoulder rotator cuff injury
- Biceps tendinopathy
- Achilles tendinopathy

Ligament injuries. Ligament tears: Injuries such as ligament tears.
Cartilage injuries. Osteoarthritis: Degeneration of articular cartilage.
Tolerance level regarding the procedure. Tolerance, acceptance, and satisfaction levels regarding the procedure were evaluated using the following criteria:

- Tolerates and willingly accepts the procedure; reports satisfaction with the procedure.
- Partially tolerates. Reports discomfort but tolerates and accepts the procedure; is partially satisfied.
- Does not tolerate. Reports discomfort and does not tolerate the procedure, despite partially accepting it; dissatisfied.

To assess the patient's progress and improvement, the Visual Analog Scale (VAS) for pain was used; based on pain assessment, patients were categorized into four groups:

- No pain.
- Mild pain.
- Moderate pain.
- Severe pain.

Data processing and analysis involved descriptive statistics—including absolute and relative frequency distributions and measures of central tendency (mean, standard deviation, mode, ratio, and percentage analysis)—using Microsoft Excel (Office 2010 for Windows).

Ethical considerations were observed throughout the research; the data obtained were used strictly for the stated objectives, and participants' personal information remained anonymous. Informed consent was obtained from all patients regarding the procedure and their participation in the study.

Results

Table 1 presents the distribution of selected patients according to clinical diagnosis, potential ultrasound or radiographic findings, the number of ultrasound-guided injections administered, and treatment tolerance. Diagnostic imaging methods—such as ultrasound or radiography—were applicable to the vast majority of musculoskeletal conditions, and between two and three ultrasound-guided injections were performed. Most patients tolerated the procedure well, with the exception of those suffering from plantar fasciitis.

Table 2 shows that the majority of patients perceived an improvement in symptoms upon completion of treatment; indeed, a large percentage (41.66%) showed clinical improvement as early as the first injection. Only in cases of joint lesions were there patients who showed no improvement or for whom improvement was perceived only after six months.

Table 1. Results of PRP use for musculoskeletal conditions regarding diagnosis and management.

Clinical diagnosis		Ultrasound diagnosis	Radiological diagnosis	Number of ultrasound-guided injections	Tolerance to the procedure
Joint conditions	Knee gonarthrosis	No	Yes	2	Tolerates
	Coxarthrosis	No	Yes	3	Tolerates
Tendon, fascial, and insertion injuries	Hand flexor tendinopathy	Yes	No	2	Tolerates
	Biceps B tendinopathy	Yes	No	2	Tolerates
	Chronic Epicondylitis	Yes	Yes	2	Tolerates
	Achilles tendinopathy	Yes	Yes	2	Tolerates
	Peroneus tendinopathy	Yes	Yes	2	Tolerates
	Plantar fasciitis	Yes	Yes	2	Partially tolerates
Capsular and ligament injuries	Scapular humeral periarthritis	Yes	Yes	3	Tolerates
Muscle injuries	Sub treble	Yes	No	2	Tolerates
	Chronicles	Yes	No	2	Tolerates

Source. Database.

Table 2. Distribution of patients according to diagnosis and clinical improvement (in weeks).

Diagnosis	Clinical improvement				
	First 2 weeks n/%	Between 4 and 6 weeks n/%	Between 6 weeks and 3 months n/%	Between 3 and 6 months n/%	More than 6 months or no improvement n/%
Joint conditions	6	7	4	2	3
Tendon, fascial, and insertion injuries	7	2	1	1	-
Capsular and ligament injuries	5	2	1	1	-
Muscle injuries	2	2	1	1	-
Total	20/41,66%	13/27,08%	7/14,58%	5/10,41%	3/6,25%

Source. Database.

Table 2 shows that the majority of patients perceived an improvement in symptoms upon completion of treatment; indeed, a large percentage (41.66%) showed clinical improvement as early as the first injection. Only in cases of joint lesions were there patients who showed no improvement or for whom improvement was perceived only after six months.

Upon completion of the study, it was confirmed that 25 patients (52.08% of the total) achieved a favorable clinical outcome with no pain; these results are shown in Table 3. It is observed that 41.67% of patients experienced a reduction in pain following treatment (with an increase in patients reporting mild to moderate pain after PRP infiltration), while only 6.25% continued to experience severe pain after the therapeutic intervention. Statistical analysis of the variables yielded highly significant results.

Table 3. Results based on pain assessment before and after ultrasound-guided PRP infiltration.

Scale	Pain assessment			
	Before		After	
	No.	%	No.	%
No pain	-	-	25	52,08
Mild	3	6,25	12	25,00
Moderate	11	22,92	8	16,67
Severe	34	70,83	3	6,25
Total	48	100	48	100

Source. Database.

Discussion

Platelets, also known as thrombocytes, are crucial blood components that play a fundamental role in coagulation. They originate from giant bone marrow cells called megakaryocytes—specialized cells responsible for platelet production via a process known as thrombopoiesis—which fragment into small particles that become platelets (5).

Platelets produce a range of biologically active substances stored in various cytoplasmic granules, including alpha granules. These granules contain a variety of growth factors and proteins that play important roles in platelet function; upon platelet activation, the granules fuse with the platelet membrane and release their contents into the bloodstream (6).

Alpha granules contain several growth factors—proteins that play a crucial role in regulating cell growth, proliferation, differentiation, and function. These include platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-ß), platelet factor 4 (PF4), interleukin-1 (IL-1), platelet-derived angiogenic factor (PDAF), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), platelet-derived endothelial growth factor (PDEGF), epithelial cell growth factor (ECGF), insulin-like growth factor (IGF), osteocalcin, osteonectin, fibrinogen, fibronectin, and thrombospondin (TSP). There are more than 200 such growth factors; they are vital to healing and regeneration processes and have driven advances in regenerative medicine (3,7).

PRP injections are an orthobiologic therapy widely used in orthopedics and traumatology; the resulting biostimulation creates a favorable environment for attracting progenitor cells and stimulating the natural healing response. This procedure does not require open surgery, thereby reducing risks and recovery time, while also being personalized to each patient's specific needs to optimize outcomes. (8) It is beneficial because it alleviates pain, significantly reduces discomfort, and improves joint mobility; this facilitates the recovery of joint function by promoting cartilage regeneration and potentially reducing the need for surgical interventions (9).

Ultrasound is highly useful for diagnosis and management in orthopedics. It aids in diagnosing soft-tissue injuries—such as tendinopathies and tendon ruptures—by allowing for the assessment of tendon and sheath thickness, echogenicity, and continuity. Regarding muscle and ligament injuries, it enables the differentiation between strains, tears, and hematomas (10). Furthermore, when assessing joint injuries, it detects intra-articular fluid and synovial thickening associated with inflammatory or traumatic arthritis and early-stage osteoarthritis; although it does not visualize deep cartilage, it can identify associated inflammatory or synovial changes. Similar utility is observed in peripheral nerve injuries, where compression or inflammation can be visualized—for instance, in conditions such as carpal tunnel syndrome or cubital tunnel syndrome (11,12).

Ultrasound-guided injection plays a pivotal role in percutaneous procedures for diagnosing and treating musculoskeletal disorders, particularly for therapeutic injections into joints, nerves, and tendons, as well as for the aspiration of calcium deposits and the removal of foreign bodies (12).

It also enables the highly effective and low-risk infiltration of medications or orthobiologics into injured tissues; this allowed the authors to perform ultrasound-guided platelet-rich plasma (PRP) injections with minimal risk and high procedural efficacy, resulting in high satisfaction among patients and their families. Ultrasound offers advantages as a procedural guide—such as for injections (as in this study), joint and soft-tissue aspirations, and biopsies—enhancing precision and safety while remaining cost-effective and accessible (13,14,15).

It also allows for immediate assessment during the consultation, facilitating early diagnosis and rapid clinical and management decision-making. Unlike magnetic resonance imaging (MRI) or computed tomography (CT), these studies allow for the dynamic visualization of structures, which is particularly useful for tendon or joint injuries. However, there are limitations: diagnostic quality depends on the examiner's experience and training—many orthopedists lack ultrasound training, limiting its direct use in the clinic—and the learning curve is steep; furthermore, the modality has low sensitivity for evaluating internal bone structures or intra-articular ligaments (16).

PRP therapy has garnered significant attention over the past two decades. Reviewed studies on the use of PRP for soft-tissue, muscle, or ligament injuries demonstrated a high level of evidence; 90% of reports showed Level 1 evidence and a "good to favorable" recommendation grade.

The authors consider the combination of ultrasound and PRP injection to be a safe, effective, and alternative procedure for cases that do not improve with conservative treatment; the condition can be resolved in this manner prior to suggesting surgery.

Conclusions

The results of this study demonstrate that obtaining PRP is simple and the procedure is well-tolerated by patients; it is used for various musculoskeletal conditions. Pain levels decrease starting with the first injection. The treatment protocol yields positive results for each condition, with evident clinical improvement within weeks of starting treatment. The combination of ultrasound and PRP injection is a safe, effective, and alternative procedure for cases that do not improve with conservative treatment; the condition can be resolved in this manner prior to suggesting surgery.

Conflict of interest

The authors declare that they have no conflicts of interest regarding the arguments presented in the article.

Author contributions

- **Conceptualization:** Leonardo Martínez Aparicio, Lázaro Martín Martínez Estupiñan.
- **Data curation:** Leonardo Martínez Aparicio, Lázaro Martín Martínez Estupiñan.
- **Formal analysis:** Leonardo Martínez Aparicio, Lázaro Martín Martínez Estupiñan.
- **Investigation:** Lázaro Martín Martínez Estupiñan, Yunier Fernández Rodríguez, Lázaro Martínez Aparicio.
- **Methodology:** Lázaro Martín Martínez Estupiñan, Leonardo Martínez Aparicio, Yunier Fernández Rodríguez, Lázaro Martínez Aparicio.
- **Project administration:** Leonardo Martínez Aparicio.
- Visualization: Leonardo Martínez Aparicio, Yunier Fernández Rodríguez.
- **Writing – original draft:** Leonardo Martínez Aparicio, Lázaro Martín Martínez Estupiñan, Lázaro Martínez Aparicio.
- **Writing – review and editing:** Leonardo Martínez Aparicio.

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