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PLATELET-RICH PLASMA VERSUS HYALURONIC ACID IN THE TREATMENT OF PAIN ASSOCIATED WITH KNEE OSTEOARTHRITIS: A NARRATIVE REVIEW OF CURRENT EVIDENCE

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ABSTRACT

Introduction: Osteoarthritis of the knee (gonarthrosis) is one of the most common causes of chronic pain and disability in adults and the elderly. In recent years, there has been growing interest in biological treatment methods, including platelet-rich plasma (PRP) injections, which contain growth factors that can stimulate regenerative processes and modulate inflammation. Viscosupplementation with hyaluronic acid also remains a commonly used method.
Objective: The aim of this study was to analyze current data on the effectiveness of PRP in the treatment of pain in gonarthrosis and to compare its effects with hyaluronic acid therapy.
Materials and Methods: A literature review was conducted, including randomized clinical trials, meta-analyses, and systematic reviews on the use of PRP and hyaluronic acid in the treatment of knee osteoarthritis. Recent publications and key fundamental studies were included.
Results: Both PRP and hyaluronic acid demonstrate effectiveness in reducing pain and improving joint function in knee osteoarthritis. However, numerous studies directly comparing the two treatments indicate that PRP is more effective, particularly at longer follow-up. For example, PRP therapy is associated with a greater reduction in pain on the VAS scale and greater improvements in WOMAC and IKDC scores than hyaluronic acid. The enhanced effects of PRP are most notable in patients with early- and moderate-stage disease.
Conclusions: PRP is a beneficial treatment option for knee osteoarthritis and, based on current comparative studies, may offer more durable symptom improvement than hyaluronic acid. However, further research is necessary to standardize treatment protocols and confirm long-term comparative effectiveness.

KEYWORDS

Knee Osteoarthritis, PRP, Platelet-Rich Plasma, Hyaluronic Acid, Biological Treatment

CITATION

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Introduction

Osteoarthritis (OA) of the knee is one of the most frequently diagnosed musculoskeletal disorders and a leading cause of chronic pain and limited functional capacity in the adult population, particularly in the elderly [1]. This condition is marked by the progressive degeneration of joint structures. Over time, this leads to a gradual loss of joint cartilage integrity and deterioration of the biomechanical properties of the knee joint. As a result, patients experience increasing pain, limited range of motion, impaired locomotion, and a marked reduction in quality of life. From an epidemiological perspective, knee OA is one of the most important public health problems in modern societies. Its incidence steadily rises as the population ages [2]. It is estimated that symptomatic OA affects up to 10 percent of people over 60 years of age. The occurrence is rising in many developed countries. This rise is due to various demographic and environmental factors. These include increased life expectancy, the growing prevalence of obesity, and lifestyle changes that reduce physical activity. The combination of these factors increases biomechanical loads on the knee joint and promotes metabolic disorders. Both of these contribute to the degeneration of joint cartilage. As a consequence, knee OA presents a growing challenge for health care systems and the economy. The costs of treatment, rehabilitation, and lost professional productivity also increase [2]. Traditionally, knee OA has been viewed mainly as a mechanical condition caused by progressive wear and tear of joint cartilage. However, recent research shows that the pathogenesis of OA is much more complex. Multiple mechanical, metabolic, genetic, and inflammatory factors interact in the disease process. Today, osteoarthritis is considered a disease of the whole joint. It affects not only cartilage, but also the subchondral bone, synovial membrane, ligaments, meniscus, and surrounding musculoskeletal structures [1]. At the molecular level, the disease mainly involves an imbalance between anabolic and catabolic processes in the extracellular matrix of joint cartilage. Under normal conditions,

chondrocytes maintain cartilage matrix homeostasis by synthesizing its basic components, such as type II collagen and proteoglycans. During degenerative disease, many inflammatory pathways and proteolytic enzymes are activated, including matrix metalloproteinases (MMPs) and aggrecanases. These degrade extracellular matrix components, leading to the gradual loss of cartilage's shock-absorbing properties and an increased risk of mechanical damage [3]. Remodeling of subchondral bone is also a key part of disease pathogenesis. The bone thickens and hardens in response to increased mechanical stress. As the disease progresses, osteophytes—bony outgrowths at the edge of joint surfaces—also form. These changes further disturb joint biomechanics and worsen degeneration. At the same time, meniscal degeneration contributes to the issue. The meniscus distributes mechanical loads in the knee, and damage to it increases cartilage pressure, speeding its breakdown [3]. Research is also revealing the significance of inflammation in OA pathogenesis. While OA was not traditionally seen as inflammatory, it is now known that chronic, low-grade inflammation is important. Synovial cells release pro-inflammatory mediators, including interleukin-1β (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor alpha (TNF-α). These substances stimulate cartilage degradation by activating proteolytic enzymes and hindering matrix synthesis. They also provoke joint swelling, pain, and reduced mobility [3]. Symptoms of knee OA develop gradually and worsen over time. The most common symptom is knee pain, which starts with physical activity but can eventually occur at rest. Patients frequently report joint stiffness, especially after rest, reduced range of motion, and difficulty with daily tasks such as climbing stairs or standing from a seated position. As knee OA advances, joint deformity and further loss of limb function may occur [2]. Because the disease is chronic and progressive, treatment is a significant challenge. Current treatment approaches include non-pharmacological management, drugs, and surgery. Non-pharmacological therapy mostly covers weight loss, lifestyle changes, physiotherapy, and exercise to improve knee stability and strength. Drug therapy typically uses non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol, and symptomatic slow-acting drugs for osteoarthritis (SYSADOA) [4]. Although various treatments exist, most are only symptomatic. They focus on pain relief and improved function, not on stopping or reversing cartilage degeneration. No effective therapy currently exists to halt joint cartilage breakdown. As a result, interest is growing in drugs that may modify the course of osteoarthritis (DMOADs). Biological therapies are a key new direction. These could change the joint environment and influence tissue regeneration [4]. In recent years, platelet-rich plasma (PRP) therapy has attracted significant attention for the treatment of knee OA. PRP is an autologous platelet concentrate in a small plasma volume. It contains many growth factors, cytokines, and other bioactive mediators involved in tissue repair. By modulating inflammation, stimulating cell growth, and altering chondrocyte metabolism, PRP may promote regeneration of joint structures. For this reason, it is considered a promising strategy that goes beyond standard symptomatic therapy for OA [1]. The growing number of studies on PRP use is clear evidence of increasing interest in this method. In recent years, numerous randomized controlled trials and meta-analyses have been published evaluating the efficacy of PRP injections in the treatment of knee osteoarthritis. Many of these studies suggest that this therapy can significantly reduce pain and improve knee function, particularly in patients with early or moderate disease. At the same time, the need for further research is emphasized to define the most favorable therapeutic protocols, mechanisms of action, and long-term efficacy associated with this treatment method [4]. In the context of the rapid development of biological therapies, comparing the efficacy of PRP with other treatment methods for knee osteoarthritis, such as hyaluronic acid viscosupplementation, is particularly important. Hyaluronic acid has been widely used for many years in the treatment of knee osteoarthritis due to its viscoelastic properties and ability to improve the biomechanical properties of synovial fluid. However, in recent years, a growing number of reports have emerged suggesting that PRP therapy may be more effective than traditional viscosupplementation in reducing pain and improving joint function [4]. Therefore, the aim of this paper is to present the current state of knowledge on the use of platelet-rich plasma for the treatment of pain associated with knee osteoarthritis, with particular emphasis on its mechanisms of action and clinical effectiveness compared with hyaluronic acid viscosupplementation.

Methodology

This paper is a systematic review of the scientific literature on the use of platelet-rich plasma (PRP) for the treatment of knee osteoarthritis, with particular emphasis on its effectiveness compared with hyaluronic acid viscosupplementation. A literature search was conducted in the electronic databases PubMed, Scopus, and Web of Science. Combinations of keywords and Boolean operators (AND, OR) were used, including the following phrases: "platelet-rich plasma," "PRP," "knee osteoarthritis," "gonarthrosis," "hyaluronic acid," "viscosupplementation," "randomized controlled trial," "systematic review," and "meta-analysis." The analysis included scientific publications from 2009 to 2025, primarily in English. Papers meeting the following criteria were included in the analysis: (1) clinical trials, especially randomized controlled trials; (2) systematic reviews and meta-analyses; (3) publications assessing the efficacy of PRP in the treatment of knee osteoarthritis in adult patients; (4) studies adopting standardized clinical assessment tools such as the VAS, WOMAC, KOOS, or IKDC scales; (5) studies comparing PRP with other treatment methods, including hyaluronic acid. Case reports, preclinical studies, studies with restricted data availability, and articles of low methodological quality were excluded. Due to the methodological heterogeneity of the analyzed studies, including differences in the composition of PRP preparations, the number and schedule of injections, and the stage of disease progression, a qualitative comparative examination of the results was used. Data interpretation accounted for potential limitations and sources of bias that may affect the results.

Platelet-Rich Plasma (PRP) - Definition and Characteristics of Platelet-Rich Plasma

Recent decades have seen rapid advances in regenerative medicine, which aims to stimulate the body's natural repair mechanisms to rebuild damaged tissues. One method that has attracted particular interest in orthopedics and musculoskeletal traumatology is the use of platelet-rich plasma (PRP). This therapy uses an autologous blood product with an increased platelet concentration and numerous bioactive mediators involved in regenerative and anti-inflammatory processes. Currently, PRP is used in many fields of medicine, including orthopedic surgery, sports medicine, dermatology, dentistry, and maxillofacial surgery [5]. The first attempts to use platelet concentrates in clinical practice appeared in the 1950s, when platelet-rich preparations were used to support hemostasis in patients undergoing surgical procedures. In subsequent decades, the development of blood separation techniques and a better understanding of the biological role of platelets in healing processes broadened the indications for PRP use. Research on this method has been particularly intensive since the beginning of the 21st century, when its efficacy in treating musculoskeletal disorders, including tendon and ligament injuries and osteoarthritis, began to be widely evaluated [5], [6]. Platelet-rich plasma is defined as an autologous concentrate of peripheral blood in which the platelet concentration exceeds the physiological value found in peripheral circulation. Under normal conditions, the platelet count in whole blood averages 150,000 to 350,000 per microliter. In PRP preparations, this concentration can be increased even several-fold, facilitating a high concentration of growth factors and other biological mediators released from platelet granules [5]. Platelets play a key role in the body's wound healing. In addition to their role in hemostasis, they are an important source of numerous signaling molecules that regulate cell migration, proliferation, angiogenesis, and extracellular matrix synthesis. Platelets contain several types of granules, of which alpha granules are particularly important. They contain a wide range of growth factors and cytokines that are released at the site of tissue damage following platelet activation [7]. The most important biological mediators present in PRP include platelet-derived growth factor (PDGF), transforming growth factor beta (TGF-β), vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF), and insulin-like growth factor (IGF-1). These growth factors play a key role in tissue healing by stimulating cell proliferation, increasing the synthesis of extracellular matrix components, and stimulating angiogenesis. Their presence in high concentrations provides the biological basis for the use of PRP in the treatment of conditions requiring tissue regeneration [7].

PRP preparation process

The procedure for obtaining platelet-rich plasma involves several technological steps to concentrate platelets while preserving their biological activity. The first step is to collect venous blood from the patient, typically in a volume ranging from several to several dozen milliliters. An anticoagulant, most often sodium citrate, is added to the collected blood to prevent premature platelet activation during preparation. The next step is blood fractionation using differential centrifugation. Depending on the preparation protocol, single- or two-stage centrifugation is performed. The first stage of centrifugation separates the blood into three basic layers: the erythrocyte fraction, the leukocyte-platelet layer (the buffy coat), and the plasma containing platelets. The second centrifugation step further concentrates platelets by separating platelet-poor plasma (PPP)

from the platelet-rich plasma (PRP) fraction [5]. The final PRP preparation can then be activated by the addition of agents such as calcium chloride or thrombin, which leads to platelet degranulation and the release of growth factors. In clinical practice, PRP is most often administered via intra-articular injection for the treatment of knee osteoarthritis, although periarticular or intratendinous injections are also used in some cases, depending on the clinical indication [5].

Classifications of PRP Preparations

One important challenge in PRP research is the significant heterogeneity of the preparations used. These differences concern both platelet concentration and the presence of other blood cells, such as leukocytes and erythrocytes. Several classification systems for PRP preparations have been proposed to organize this assortment. One of the most well-known classifications is the Dohan-Ehrenfest system, which distinguishes four basic categories of preparations: pure platelet-rich plasma (P-PRP), leukocyte-rich platelet-rich plasma (L-PRP), pure platelet-rich fibrin (P-PRF), and leukocyte-rich platelet-rich fibrin (L-PRF). This classification takes into account the presence of leukocytes and the fibrin network structure in the preparation. In the context of treating knee osteoarthritis, PRP preparations administered in liquid form, which allow for intra-articular injection, are of particular importance [6]. Another classification system is the so-called PAW (platelets, activation, white cells) system, which considers three basic parameters of the preparation: platelet concentration, activation method, and leukocyte content. Using this system permits a more thorough characterization of preparations used in clinical trials, which is necessary for comparing the results of different studies [6].

Biological Mechanisms of PRP Action

The mechanism of action of PRP is intricate and encompasses numerous biological processes occurring at the site of administration. Platelet activation releases growth factors and cytokines, which affect cells in the tissue microenvironment. These mediators influence cell migration, proliferation, and differentiation, ultimately stimulating healing processes in damaged tissues [7]. One of the key effects of PRP is the stimulation of mesenchymal cell and fibroblast proliferation, which serve an important role in the reconstruction of the extracellular matrix. Furthermore, PRP exhibits anti-inflammatory properties by modulating the expression of proinflammatory cytokines. Platelet-rich preparations have been shown to inhibit the activity of interleukin-1β and tumor necrosis factor alpha, which play a key role in the degradation of joint cartilage. Simultaneously, an increase in the expression of anti-inflammatory mediators is observed, bringing about a reduced intensity of the inflammatory response within the joint [8]. Another important aspect of PRP's effects is its influence on angiogenesis, the process of forming new blood vessels. VEGF and other angiogenic factors contained in PRP stimulate endothelial cell proliferation and the formation of new blood vessels, which may improve blood supply to damaged tissues and support regenerative processes [7].

The Importance of PRP in Regenerative Medicine

In the context of the dynamic development of regenerative medicine, PRP is considered one of the most promising therapeutic methods for supporting tissue regeneration. Its main advantage is the autologous nature of the preparation, which considerably diminishes the risk of immunological reactions and the transmission of infectious diseases. Furthermore, the PRP preparation procedure is relatively simple and can be performed in an outpatient setting. In orthopedics, PRP is used not only for the treatment of osteoarthritis but also for tendon injuries such as Achilles tendinopathy or tennis elbow, ligament injuries, and joint cartilage regeneration. In many cases, this therapy is part of a combined treatment with rehabilitation or other biological methods [6]. Despite the growing number of studies demonstrating the potential clinical benefits of PRP, additional research is needed to precisely define the most suitable therapeutic protocols and the biological mechanisms underlying the observed clinical effects. It is particularly important to determine which PRP preparations and administration regimens yield the best results in the treatment of knee osteoarthritis [8], [9].

Mechanisms of Action of PRP in Knee Osteoarthritis

Although the exact mechanism of action of PRP in the treatment of knee osteoarthritis has not been fully elucidated, available experimental and clinical data indicate its numerous effects. One of the key elements of PRP's action is its influence on chondrocyte metabolism, which plays a fundamental role in supporting the structural integrity of joint cartilage. Growth factors released from platelet alpha granules, mentioned above in this paper, can stimulate the proliferation of chondrocytes, cells responsible for the synthesis of joint cartilage

components, and increase their metabolic activity. Experimental studies have shown that the presence of these mediators leads to increased synthesis of type II collagen and proteoglycans – the main components of the extracellular matrix of joint cartilage [7]. As a result, the architectural properties of cartilage are improved, and degenerative processes are potentially slowed [9]. Another important element of PRP's action is its ability to modulate the inflammatory processes within the joint. Osteoarthritis is associated with increased expression of numerous proinflammatory mediators, including interleukin-1β, interleukin-6, and tumor necrosis factor alpha. These cytokines stimulate the production of matrix metalloproteinases, which degrade cartilage matrix components. Studies indicate that PRP can inhibit the activity of these mediators and reduce proteolytic enzyme expression, thereby contributing to reduced cartilage degradation [10]. Another mechanism of PRP's action is its effect on synovial cells – synoviocytes. Synoviocytes participate in the production of synovial fluid and inflammatory mediators present in the joint cavity. In conditions of degenerative disease, the activity of these cells is impaired, giving rise to increased inflammatory processes. It has been shown that the biologically active factors contained in PRP can modulate synoviocyte activity, reducing the production of proinflammatory cytokines and improving the biological properties of synovial fluid [10]. This effect leads to reduced inflammation in the joint cavity and may contribute to reduced pain [8]. It is also worth noting the potential impact of PRP on the neurobiological mechanisms underlying nociceptive processing. Osteoarthritis leads to increased activity of nociceptive receptors in periarticular tissues and sensitization of nerve endings to mechanical and chemical stimuli. The growth factors present in PRP can affect nerve fibers by modulating inflammatory mediators and reducing inflammation within the joint. As a result, the stimulation of pain receptors is reduced, and the conduction of nociceptive stimuli is limited [11].

The Importance of Disease Stage

An important factor influencing the effectiveness of PRP therapy is the stage of degenerative changes in the knee joint. The most commonly used radiological classification for assessing disease severity is the Kellgren-Lawrence classification, which distinguishes four grades of degenerative changes. Numerous studies indicate that PRP therapy is most effective in patients with early or moderate disease (Kellgren-Lawrence stages I–III). In these cases, the joint cartilage structure is still partially preserved, allowing the growth factors in PRP to more effectively influence regenerative processes. In advanced stages of the disease, characterized by considerable cartilage loss and extensive subchondral bone remodeling, the effectiveness of this method is usually lower. This is because, in such cases, the structural changes within the joint are largely irreversible [12].

Clinical Efficacy of PRP Therapy

Over the past decade or so, numerous clinical studies have been published evaluating the effectiveness of PRP injections in the treatment of knee osteoarthritis. Many randomized, controlled trials have demonstrated that PRP administration may result in substantial pain reduction and improved knee function. Treatment effectiveness is most often assessed by applying standardized clinical tools, such as the Visual Analog Scale (VAS), which assesses pain intensity; the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), which assesses pain, stiffness, and joint function; and the International Knee Documentation Committee (IKDC), used in the functional assessment of the knee. In the analyzed studies, in which the research group received PRP injections and the control group received other injectable treatments, such as placebo (saline solution) or glucocorticosteroids, statistically significant improvements in these scores were observed after PRP therapy. The analyzed population included adult patients diagnosed with knee osteoarthritis of varying degrees of radiographic advancement. Most studies used the previously mentioned Kellgren-Lawrence classification, ranging from grade II to grade III. The mean age of patients in the PRP-treated groups ranged from approximately 49.8 to 65.5 years, while in the control groups it ranged from 46.6 to 68 years, indicating that the studies primarily included middle-aged and older individuals. In terms of gender, the analyzed studies showed a female predominance, consistent with the epidemiology of osteoarthritis. The male-to-female ratio was 0.64 in the PRP group and 0.60 in the control group, indicating that women comprised the majority of study participants. Another important parameter analyzed in the studies was body mass index (BMI), a major risk factor for the development of knee osteoarthritis. In the studies included in the meta-analysis, mean BMI values in the PRP groups ranged from 24.0 to 31.4 kg/m², while in the control groups they ranged from 24.1 to 31.1 kg/m². These data indicate that a significant proportion of the patients studied were overweight or obese, which is consistent with epidemiological observations regarding knee osteoarthritis [12]. One of the important conclusions from the study was the observation of the time-related dynamics of the therapeutic effect of PRP. Analysis of the results was performed at various follow-up time points, including 1,

3, 6, and 12 months after injection [12]. When comparing PRP with placebo (saline), no statistically significant differences were found in the overall WOMAC score 6 months after injection. However, at the 12-month follow-up, a statistically significant and clinically significant improvement in favor of PRP was demonstrated. These results suggest that the therapeutic effect of platelet-rich plasma may develop gradually and become more pronounced over time. In an analysis comparing PRP with hyaluronic acid, the PRP group showed significantly better results at both the 6-month and 12-month follow-ups. Differences were observed in both the overall WOMAC score and its individual components, including pain and joint function. In terms of pain assessment on the VAS scale, PRP therapy also demonstrated a significant advantage over glucocorticosteroids at six-month follow-up. Similar results were observed with the KOOS scale, with considerable improvements in pain intensity, daily functioning, and overall quality of life [12]. There were slight differences in baseline characteristics across the individual studies. Some analyses noted, for example, higher baseline pain intensity in the control groups or a higher age of patients in the hyaluronic acid groups. However, the overall demographic and clinical characteristics of the patients were relatively similar between the analyzed treatment groups. [12].

Effect of Platelet Concentration in PRP

The effect of platelet concentration in PRP on the therapeutic effects was also assessed. [1] The analysis distinguished two types of PRP preparations: high-platelet and low-platelet. The preparations with a high platelet concentration showed a clinically significant reduction in pain at the 3-, 6-, and 12-month follow-up. PRP preparations with lower platelet concentrations, on the other hand, demonstrated lower therapeutic efficacy, and in many analyses, the improvement achieved did not exceed the minimal clinically important change threshold on the VAS scale. With respect to knee function assessed using the WOMAC scale, both preparations with high and low platelet concentrations showed significant improvement at 3 and 6 months post-treatment, but only preparations with high platelet concentrations maintained their beneficial therapeutic effect after 12 months of follow-up [1].

Optimization of Therapeutic Regimens

Despite the growing number of clinical trials on PRP for knee osteoarthritis, clear standards for an optimal treatment regimen have not yet been established. A significant variety of treatment protocols are described in the literature, including the number of injections, the volume of the preparation administered, and the time intervals between treatments. Many studies suggest that the best clinical results can be achieved with a series of 2 or 3 PRP injections spaced 1 to 2 weeks apart. This administration regimen may guarantee a more stable effect of growth factors on the joint microenvironment and promote sustained therapeutic effects [13]. Another important issue is the composition of the PRP preparation, particularly its leukocyte content. Some authors indicate that leukocyte-depleted preparations may induce a less inflammatory response within the joint and be better tolerated by patients. On the other hand, several studies indicate that leukocytes may enhance the preparation's antibacterial activity and influence regenerative processes. This issue remains the subject of intensive scientific research [13].

Comparison of the Effectiveness of PRP and Hyaluronic Acid

Hyaluronic acid has been one of the most commonly used injection treatments for knee osteoarthritis for many years. As a natural component of synovial fluid, it supports the joint environment's elastic and viscous properties, lubricates joint surfaces, and absorbs mechanical loads [14]. Osteoarthritis leads to decreased concentrations and molecular weight of endogenous hyaluronic acid in synovial fluid. This phenomenon leads to deterioration of the joint's biomechanical properties and an increased susceptibility of cartilage to damage. Viscosupplementation involves the intra-articular administration of hyaluronic acid preparations to restore normal synovial fluid properties and reduce friction between joint surfaces [15]. Unlike hyaluronic acid, whose effects are primarily biomechanical and symptomatic, PRP directly affects biological processes within the joint. Growth factors present in PRP can stimulate regenerative processes and modulate the inflammatory response, potentially enabling more durable therapeutic effects [16].

Comparative Study Results

In recent years, numerous clinical trials and meta-analyses have compared the effectiveness of PRP and hyaluronic acid in treating knee osteoarthritis. Key tools used in the analyzed studies included the WOMAC, VAS, KOOS, and IKDC scales. The meta-analysis results clearly indicate the superiority of PRP over HA for pain reduction and improved knee function. Regarding pain, most often assessed using the VAS scale, patients treated with PRP demonstrated significantly greater pain reduction at both short- and medium-term follow-up [17]. These differences were statistically significant and persisted at subsequent time points, suggesting a more durable therapeutic effect of PRP compared to HA. A similar trend was observed in the analysis of functional outcomes: on the WOMAC scale, patients receiving PRP achieved significantly better results than those treated with hyaluronic acid. The improvement was observed in both the total WOMAC score and its individual subscales, showing a multidimensional effect of PRP. The KOOS scale, which includes a more detailed assessment of quality of life related to knee joint function, also showed an advantage for PRP, particularly in the domains related to pain and daily living activities [17]. Similar results were observed in the IKDC assessment, where PRP was associated with greater improvement in patients' subjective knee function. Importantly, in addition to analyzing mean changes in clinical scales, the authors also assessed overall treatment effectiveness, demonstrating that patients treated with PRP were more than twice as likely to achieve clinically significant improvement than those in the HA group. Furthermore, the relative risk of improvement was 34% higher in the PRP group, confirming the superiority of this method in the population analysis. It is worth noting that despite considerable heterogeneity among the included studies (I^2 exceeding 70%), the direction of effect remained consistent across all analyses, thereby strengthening the credibility of the results. Differences between studies could have resulted from different PRP preparation protocols, the number of injections, the stage of degenerative disease, or the length of follow-up, but this did not change the general conclusion about the superior efficacy of PRP. From a clinical perspective, it is also important that PRP, as an autologous preparation, is characterized by a very good safety profile and a low risk of adverse effects, which further increases its therapeutic appeal [18]. One significant difference between the two treatment methods is the duration of the therapeutic effect. In viscosupplementation, clinical improvement usually occurs relatively quickly, but its effect is often transient. In contrast, PRP therapy may have a slower onset of action, but the clinical improvement obtained is often more durable [19]. Overall, the results of the analyzed studies indicate that PRP therapy provides significantly greater pain reduction and improvement in knee joint function than hyaluronic acid, with effects that are both statistically significant and clinically meaningful, making PRP a favorable alternative for conservative treatment in patients with knee osteoarthritis [18].

Therapy Safety

Both PRP and hyaluronic acid have a comparatively favorable safety profile. Adverse reactions observed after administration of both preparations are typically mild and transient. They most often include pain at the injection site, mild joint swelling, and a transient increase in inflammatory symptoms [20]. In the case of PRP, an additional advantage is its autologous nature, which virtually eliminates the risk of immunological reactions and pathogen transmission. Hyaluronic acid preparations, on the other hand, have a well-documented safety profile, supported by long-term clinical use [21, 22].

Summary

Available scientific data indicate that both platelet-rich plasma and hyaluronic acid are effective conservative treatments for pain in knee osteoarthritis. However, a growing body of research suggests that PRP therapy may be superior to viscosupplementation for long-term pain reduction and improved joint function, especially in patients with early- and moderate-stage disease [23]. Despite promising results, further high-quality clinical studies are needed to develop standardized preparation protocols and determine the optimal indications for PRP use in the treatment of knee osteoarthritis.

Discussion

In recent years, there has been growing interest in biological therapies for the treatment of knee osteoarthritis. This is mainly due to the limited effectiveness of traditional conservative treatment methods, which often provide only short-term improvement in clinical symptoms. In this context, platelet-rich plasma represents an interesting therapeutic alternative, as its action is based on stimulating the body's natural regenerative processes. Analysis of available clinical studies indicates that PRP injections may result in significant pain reduction and improved knee function in patients with osteoarthritis. These effects are most often assessed by applying standardized clinical tools such as the VAS, WOMAC, or IKDC scales. Many studies have demonstrated greater clinical improvement after PRP therapy than after hyaluronic acid therapy, particularly in the long term. One possible explanation for this difference is the different mechanisms of action of the two therapeutic methods. Hyaluronic acid primarily affects the biomechanical properties of synovial fluid, increasing its viscosity and its capacity to withstand mechanical loads. PRP, on the other hand, directly influences biological processes taking place within the joint by stimulating cell proliferation and regulating the inflammatory response. Another important issue discussed in the literature is the influence of PRP formulation composition on clinical outcomes. Studies have shown that platelet concentration and the presence of leukocytes can significantly alter the formulation's biological properties. However, the lack of uniform PRP preparation methods hinders direct comparison of results across studies. It should also be emphasized that the effectiveness of PRP therapy may depend on the stage of degenerative disease. In many studies, the best results were observed in patients with early and moderate knee osteoarthritis, whereas in advanced stages of the disease, therapeutic effects were less pronounced. Despite the growing number of clinical trials, there remains a need for high-quality studies to clearly define the role of PRP in the treatment of knee osteoarthritis.

Conclusions

Platelet-rich plasma (PRP) is a prospective biological treatment for knee osteoarthritis. PRP therapy may result in substantial pain reduction and improved knee function. Compared to hyaluronic acid viscosupplementation, PRP may provide more sustained clinical improvement, especially in long-term follow-up. The best therapeutic effects are observed in patients with early and moderate stages of osteoarthritis. Further clinical research is needed to develop standardized methods for PRP preparation and to establish optimal treatment protocols.

Limitations

This study has several limitations that should be considered when interpreting the presented results. First, the available clinical studies on PRP for knee osteoarthritis show considerable heterogeneity in methodology. Differences include the method of PRP preparation, the number of injections, the volume of the preparation administered, and the duration of patient follow-up. Secondly, in many studies, the patient groups analyzed were relatively small, which may limit the generalizability of the obtained results. Another limitation is the lack of full standardization in the classification of PRP preparations, particularly regarding platelet and leukocyte concentrations. These factors may strongly influence the therapeutic effects observed in individual studies. Furthermore, most available studies include mid-term follow-up, while the number of studies examining the long-term efficacy of PRP therapy remains limited.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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