

Platelet-Rich Plasma in Acne Scar: A Comprehensive Review

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Abstract

Background: Acne scars can have a significant impact on a patient's quality of life, leading to a search for effective treatment modalities. Platelet-rich plasma (PRP) has emerged as a potential therapeutic option in dermatology due to its regenerative and wound healing properties. **Objectives:** This review aims to provide an overview of the current literature on the use of PRP in acne scar treatment. It explores the mechanisms of action, efficacy, safety, and comparative analysis of PRP with other commonly used treatments. **Conclusions:** Platelet-rich plasma (PRP) shows promising potential as a therapeutic option in the treatment of acne scars. The regenerative and wound healing properties of PRP have been demonstrated to stimulate tissue regeneration, collagen synthesis, and overall improvement in scar texture. Comparative analysis suggests that PRP offers unique advantages in terms of its regenerative properties, patient suitability, and potential long-term results compared to other commonly used treatments in acne scars.

Keywords: Acne scars, Platelet-Rich Plasma, PRP, Regenerative Medicine, Wound Healing.

1. Introduction

Acne scars are a frequent side effect of acne, a chronic inflammatory skin disorder that affects millions of people. Acne can be upsetting, but the scars it leaves behind can have a profound effect on a person's self-esteem and quality of life. Atrophic scars (depressed or pitted scars) and hypertrophic or keloid scars are two types of acne scars (raised scars). Scars can be emotionally and mentally uncomfortable, leading in certain cases to social anxiety, low self-esteem, and even melancholy [1].

Platelet-rich plasma (PRP) has gained popularity in recent years as a possible treatment for a variety of dermatological diseases, including acne scars. PRP is a concentrated type of plasma derived from the patient's blood that has a greater concentration of platelets and growth factors than regular blood. Platelets play an essential role in wound healing and tissue regeneration, and their concentration in PRP has demonstrated promising benefits in encouraging skin renewal [2, 3].

Utilizing the regenerative qualities of platelets to increase the healing process and diminish the appearance of acne scars is the principle behind PRP in dermatology. PRP includes several growth factors, including, among others, platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF- β), vascular endothelial growth factor (VEGF), and epidermal growth factor (EGF). It has

been established that these growth factors increase collagen creation, angiogenesis (formation of new blood vessels), and inflammation modulation, all of which are required for scar remodeling and regeneration [4].

The potential applications of PRP in dermatology extend beyond acne scars. It has been explored in various other skin conditions, such as wound healing, hair loss, photoaging, and even in combination with other aesthetic procedures. However, in the context of acne scars, PRP holds promise as a minimally invasive, autologous treatment option that may improve scar texture, volume, and overall appearance [5].

The purpose of this review is to provide a comprehensive analysis of the available evidence regarding its efficacy, mechanisms of action, and future prospects. Understanding the potential benefits and limitations of PRP in acne scar management can help clinicians and patients make informed decisions regarding treatment options, leading to improved outcomes and enhanced quality of life for individuals affected by acne scars.

2. Mechanisms of Action

Platelet-rich plasma (PRP) has a complex biological basis, and its therapeutic effects in acne scars can be attributed to various mechanisms **Table (1)** [6]

Table (1) Mechanisms of Action of Platelet-Rich Plasma (PRP) in Acne Scar Treatment[6]

Mechanisms of Action	of
Composition	and PRP is a concentrated solution of platelets and growth factors obtained from

Growth Factors	the patient's own blood. Key growth factors include PDGF, TGF- β , VEGF, and EGF.
Stimulation of Tissue Regeneration	PRP promotes tissue regeneration by stimulating fibroblast proliferation and migration. It attracts and activates stem cells, contributing to tissue repair and scar remodeling.
Collagen Synthesis	PRP activates fibroblasts to produce collagen, a crucial component of the extracellular matrix. It modulates the balance between collagen synthesis and degradation by inhibiting MMPs, preserving collagen integrity.
Wound Healing and Inflammation Modulation	PRP exhibits anti-inflammatory properties, reducing inflammation associated with acne scars. It promotes angiogenesis and releases cytokines and chemokines, creating a favorable wound healing environment.
Specific Mechanisms in Acne Scars	PRP targets acne scars by stimulating collagen production, promoting tissue regeneration, and modulating inflammation. It improves scar texture and volume, reduces scar severity, and enhances blood supply to the scar area.

Composition and Growth Factors:

PRP is derived from the patient's own blood through a process of centrifugation. The resulting PRP is a concentrated solution containing a higher number of platelets and growth factors compared to normal blood. Platelets are small blood cells involved in the clotting process and play a crucial role in wound healing and tissue repair [7].

Within PRP, there are several growth factors that contribute to its regenerative properties. Some of the key growth factors found in PRP include PDGF, TGF- β , VEGF, and EGF. These growth factors have various functions that collectively promote tissue regeneration, collagen synthesis, and wound healing [8].

Stimulation of Tissue Regeneration:

PRP exerts its regenerative effects by promoting tissue regeneration. The growth factors present in PRP help stimulate the proliferation and migration of fibroblasts, which are cells responsible for producing collagen, a key component of the extracellular matrix. Collagen provides structural support to the skin and plays a vital role in scar remodeling [9].

Additionally, PRP enhances the recruitment of stem cells to the site of injury. Stem cells have the potential to differentiate into various cell types and contribute to tissue regeneration. PRP can attract and activate these stem cells, promoting their involvement in the healing process and potentially leading to improved scar outcomes [10].

Collagen Synthesis:

Scar remodeling involves the essential process of collagen synthesis. The activation of fibroblasts and their enhanced production of collagen fibers are stimulated by PRP. Key growth factors found in PRP, especially PDGF and TGF- β , have a significant role in this mechanism by communicating with fibroblasts to increase collagen production. Additionally, PRP adjusts the equilibrium between collagen synthesis and degradation. It achieves this by inhibiting matrix metalloproteinases (MMPs),

which are enzymes responsible for collagen breakdown. Through the reduction of MMP activity, PRP aids in preserving the strength and solidity of newly formed collagen, ultimately leading to an improved texture and appearance of scars [11].

Wound Healing and Inflammation Modulation:

Acne scars are a consequence of the inflammatory response triggered by acne lesions. PRP exhibits anti-inflammatory properties that can help modulate the inflammatory response associated with acne scars. The growth factors within PRP, such as TGF- β and VEGF, play roles in reducing inflammation and promoting angiogenesis, which is the formation of new blood vessels [12].

PRP also enhances the release of cytokines and chemokines, which are signaling molecules that regulate the inflammatory process. This modulation of inflammation helps create a more favorable wound healing environment, facilitating scar remodeling and reducing scar severity [13].

Specific Mechanisms in Acne Scars:

In the context of acne scars, PRP may target and improve scar appearance through its ability to stimulate collagen production, promote tissue regeneration, and modulate inflammation. By enhancing collagen synthesis and remodeling, PRP can help fill in depressed or pitted scars, improving their texture and volume. The regenerative effects of PRP may also lead to the formation of healthier, more uniform tissue, reducing the visibility of acne scars [14].

Furthermore, the anti-inflammatory properties of PRP can mitigate the inflammatory response associated with acne scars, potentially minimizing redness and swelling. By promoting angiogenesis, PRP may also improve the blood supply to the scar area, supporting tissue repair and regeneration [9].

3. Efficacy of PRP in Acne Scars

To evaluate the effectiveness of PRP in treating acne scars, several clinical studies and trials have been conducted. These studies assess various parameters to measure improvement, such as scar severity, texture, and patient satisfaction. Numerous clinical studies and trials have investigated the efficacy of PRP in improving acne scars. These studies often employ a combination of subjective and objective assessment methods to evaluate treatment outcomes. Subjective assessments typically involve self-assessment by patients or physician evaluations, while objective assessments may include scar severity scales, texture analysis, and histological evaluations [15].

A systematic review published in the *Journal of Cosmetic Dermatology* concluded that PRP treatments showed improvement in acne scar severity, texture, and overall patient satisfaction. However, it also emphasized the need for larger, well-designed randomized controlled trials to confirm these findings [16].

Parameters to Assess Improvement:

When evaluating the efficacy of PRP in acne scar treatment, several parameters are commonly used to measure improvement:

Scar Severity:

Various scar severity assessments, including the Global Acne Scarring Classification (GASC), the Goodman and Baron Qualitative Grading Scale, and the Quantitative Global Acne Scar Severity Scale (GASS), are used to evaluate the severity of acne scars before and after PRP therapy. These scales classify scars according to their depth, kind, and size, and provide a consistent measurement for measuring progress [17].

Scar Texture:

Texture analysis methods, such as surface roughness measurements or skin surface profilometry, are employed to quantify improvements in scar texture. These methods analyze parameters like skin roughness, irregularity, or smoothness to assess the impact of PRP treatment on scar surface characteristics [18].

Patient Satisfaction:

The success of PRP therapy must be determined based on patient-reported outcomes, such as satisfaction and improvement ratings. Frequently, self-assessment questionnaires, visual analog scales, and validated patient satisfaction ratings are utilized to collect subjective patient feedback and overall satisfaction with the outcomes of PRP therapy [19].

Reported Outcomes and Significant Findings:

The reported outcomes of trials examining PRP for the treatment of acne scars are encouraging. Numerous studies have indicated improvements in the severity of scars, including decreases in scar size, color, and depth. Texture research reveals that following PRP therapy, scar surfaces are smoother and more uniform. In addition, patient satisfaction rates have been typically excellent, with patients reporting scar improvement and enhanced confidence [20].

4. PRP Preparation and Application

Platelet-rich plasma (PRP) is obtained through many stages, including blood collection, centrifugation, and activation techniques. PRP is applied to acne scars using a variety of methods, including intradermal injections, microneedling, and combination treatments. In PRP therapy for acne scars, identifying the correct PRP concentration, frequency of treatments, and managing potential side effects and consequences are all key concerns [21].

PRP Preparation:

Blood collection from the patient is the initial stage in the preparation of PRP. Blood is typically collected from the arm of the patient using a sterile venipuncture procedure. Blood is drawn in accordance with the intended final PRP volume and the procedure being followed [7].

Following blood collection, the blood is treated by centrifugation. Blood components are separated by centrifugation based on their density. Generally, a two-step centrifugation procedure is employed. The first spin separates red blood cells from plasma, whereas the second spin divides plasma into layers, with the platelet-rich layer at the bottom. Once the PRP layer has been collected, it can be stimulated to release the growth factors and other bioactive chemicals contained within the platelets. Common activation techniques for PRP include adding calcium chloride or thrombin. Activation promotes the restorative effects of PRP by initiating the release of growth factors. [22].

PRP Application Techniques:

Intradermal Injections:

In intradermal injections, PRP is injected directly into the dermal layer of the skin. This approach permits the exact administration of PRP to particular acne scars. A fine-gauge needle or a dermal roller can be used to achieve a uniform dispersion [23].

Microneedling:

Microneedling, also known as collagen induction treatment, is the process of generating microchannels in the skin with a device containing thin needles. PRP is

topically given to the treated region during or soon following microneedling. Microchannels improve the absorption and penetration of PRP into the deeper skin layers [24].

Combination Therapies:

PRP can be used in combination with other treatment modalities to enhance its effects on acne scars. For example, PRP may be combined with laser therapy, chemical peels, or dermal fillers. The specific combination approach depends on the individual patient's needs and the expertise of the treating dermatologist [14].

Optimal PRP Concentration and Frequency of Treatments:

The appropriate concentration of PRP for the treatment of acne scars is still debatable and may vary across practitioners. Concentrations generally range from three to five times the platelet count at baseline. However, larger concentrations do not necessarily lead to better outcomes, and further study is required to determine the optimal PRP concentration. Also, variable is the frequency of PRP treatments for acne scars. Typically, a first set of treatments is administered with several weeks between each session. The precise number of sessions is determined on the severity of the scars, the individual's response to therapy, and the treatment methodology

employed. Periodic maintenance treatments may be necessary to sustain the effects [15].

Side Effects and Complications:

Due to the fact that PRP therapy employs the patient's own blood components, the risk of adverse responses is minimal. However, like with any medical procedure, side effects and consequences are possible. Common adverse effects at the injection or treatment site include transient redness, swelling, bruising, and minor pain. Typically, these symptoms disappear after a few days. Infection, allergic reactions, and injury to blood vessels or nerves are uncommon consequences. These dangers can be mitigated by adhering to strict sterile practices, utilizing high-quality equipment, and assuring the practitioner's experience Table (2) [25].

5. Comparison with other modalities

Platelet-rich plasma (PRP) is just one of several commonly used treatments for acne scars. It is important to compare PRP with other modalities such as chemical peels, laser therapy, and dermal fillers to evaluate their relative advantages and disadvantages in terms of efficacy, safety, cost-effectiveness, and patient suitability. Additionally, assessing the potential synergistic effects of combining PRP with other modalities is crucial [2].

Table (2) Efficacy, Safety, Cost-effectiveness, Patient Suitability, and Synergistic Effects of Acne Scar Treatments[25].

	PRP	Chemical Peels	Laser Therapy	Dermal Fillers
Efficacy	Stimulates regeneration and collagen synthesis, gradual improvement in scar texture and volume	Improves scar appearance, exfoliates top layers of skin	Targeted treatment, precise scar type targeting	Immediate volume correction
Safety	Autologous, low risk of adverse events when proper sterile techniques are followed	Temporary side effects like redness, peeling, and sensitivity to sunlight	Risk of side effects like redness, swelling, and hyperpigmentation	Risk of complications like bruising, swelling, and infection
Cost-effectiveness	Cost may vary depending on treatment protocol, potential reduction in repeated treatments	Generally more cost-effective, lower cost per session	Can be more expensive, multiple sessions may be required	Costlier, periodic maintenance treatments
Patient Suitability	Versatile, suitable for a wide range of patients	Not suitable for all skin types or certain conditions	May not be suitable for all skin types or certain conditions	Suitable for volume correction in depressed or atrophic scars
Synergistic Effects	Can be combined with other modalities for	N/A	Can be combined with other modalities for enhanced results	Can be combined with other modalities for

enhanced results

enhanced results

Chemical Peels:

Chemical peels involve the use of chemical solutions to exfoliate the top layers of skin, therefore boosting cell turnover and diminishing the look of acne scars.

Both platelet-rich plasma (PRP) and chemical peels have demonstrated success in the treatment of acne scars, however the degree of improvement may vary depending on the severity of the scars and the peel solution employed. Due to its capacity to induce tissue regeneration and collagen formation, PRP may provide more focused and individualized therapy. Both medicines have a safety profile that is usually favorable. Chemical peels can induce transient adverse effects including redness, peeling, and photosensitivity. Since treatment employs the patient's own blood components, PRP carries a minimal chance of unwanted responses. To reduce the danger of infection, however, adequate sterile procedures must be followed during PRP preparation and administration. Chemical peels are often more economical than PRP treatments. Chemical peels are often administered in a number of treatments, with a lower cost per session than PRP therapy. However, the total number of sessions may vary based on the needs of the particular patient [26].

Chemical peels may not be optimal for persons with specific skin disorders or allergies, although they are suitable for the majority of patients. PRP is autologous, meaning it is extracted from the patient's own blood, which decreases the chance of allergic responses or bad effects. PRP may be a better alternative for those seeking a natural and individualized therapy [27].

Laser Therapy:

Laser treatment targets acne scars with laser devices that give regulated energy to the skin. PRP and laser treatment have both been shown to be effective in reducing acne scars. Laser therapy can give precise and regulated treatment for distinct scar types, such as atrophic or hypertrophic scars. With its regenerative and collagen-stimulating qualities, PRP can improve scar remodeling and texture overall. There is a risk of transient redness, edema, and hyperpigmentation with laser treatment. Being autologous, PRP carries a reduced risk of adverse effects. However, laser treatment may be associated with an increased risk of consequences if it is not administered by a skilled practitioner or if it is used in the wrong context. Laser therapy is typically more costly than PRP treatments. Laser treatments can be expensive, and numerous sessions may be necessary to get

ideal results. Treatments utilizing platelet-rich plasma (PRP) may be more cost-effective in the long run, especially given the possible reduction in the need for recurrent treatments [28].

Laser treatment may not be appropriate for all skin types or medical issues. PRP is typically well-tolerated by the majority of patients, giving it a flexible treatment choice for a vast array of people. PRP may be modified based on the patient's blood composition, making it suited for patients seeking a customised treatment [1].

Dermal Fillers:

Dermal fillers are chemicals that are injected into the skin to restore volume and fill up depressed acne scars.

Dermal fillers give instant effects by physically filling in acne scars' depressed regions. In contrast, PRP stimulates tissue regeneration and collagen production, resulting in a progressive improvement in scar texture and volume. The decision between platelet-rich plasma and dermal fillers is determined by the kind of scar and the anticipated treatment outcomes. Complications associated with dermal fillers include bruising, edema, and infection. Being autologous, PRP carries a reduced risk of adverse responses. As with any injection-based therapy, however, adequate sterile protocols must be followed during PRP preparation and administration to reduce the risk of infection. Dermal fillers can be more expensive than PRP treatments, especially when maintenance treatments are required periodically. Treatments with PRP may produce longer-lasting benefits, minimizing the need for recurrent procedures over time [29].

Fillers are appropriate for individuals with depressed or atrophic acne scars who require urgent repair of volume. PRP is appropriate for people seeking a natural and regenerative scar improvement method. Combining PRP with dermal fillers can boost the regeneration benefits and extend the duration of the outcomes [27].

Synergistic Effects of Combining PRP with Other Modalities:

Combining PRP with additional treatments for acne scars, such as laser therapy, chemical peels, or dermal fillers, may have synergistic results. The combination therapy can simultaneously target many elements of scar repair, hence improving overall results. Combining PRP with microneedling, for instance, can enhance the absorption and penetration of PRP into the skin, hence optimizing its restorative benefits. These

combined techniques can give individuals with acne scars with complete and individualized therapy alternatives [29].

6. Future Directions and Challenges

The use of PRP in the treatment of acne scars continues to expand, and continuing research illuminates possible improvements and new patterns. However, a number of unexplored territories and obstacles remain.

Refining PRP Preparation Protocols:

Future study may concentrate on optimizing the concentration and mix of growth factors and cytokines by perfecting PRP preparation techniques. This may entail examining the effect of various centrifugation procedures, activation methods, or the inclusion of additional bioactive compounds on the regeneration characteristics of PRP. In addition, advances in biotechnology may lead to the creation of PRP preparation kits that are more uniform and repeatable.

Optimizing Treatment Protocols:

Current treatment regimens for acne scars entail numerous sessions separated by several weeks, although the ideal number and frequency of PRP treatments are currently being investigated. Future research may examine the influence of varied treatment intervals, modifications in PRP concentration, or combination methods with other modalities on the therapy's efficacy and efficiency. In addition, studies may seek to find variables that might assist indicate which patients are most likely to benefit from PRP treatment.

Emerging Trends and Technologies:

Emerging trends and technology may affect the use of PRP therapy to the treatment of acne scars, as the area of PRP therapy continues to evolve. Using innovative delivery technologies, such as PRP-loaded scaffolds or hydrogels, may improve the targeted distribution and sustained release of growth factors into scar tissue. In addition, the use of adjunctive treatments, such as stem cells or gene therapy, might further enhance PRP's regenerative potential.

Limitations and Challenges:

Despite the positive outcomes described in the existing research, a number of limitations and obstacles must be addressed. Many studies testing the efficacy of PRP in the treatment of acne scars are limited and lack established standards, making it difficult to make clear findings. There is a need for larger, well-designed randomized controlled trials to offer conclusive proof of PRP's effectiveness and determine the most effective treatment protocols.

A further obstacle is the lack of consensus about PRP preparation processes, such as the optimal concentration, volume, and activation mechanisms. It is difficult to evaluate data and establish the best successful technique due to the considerable variance in procedures among research. Standardizing PRP preparation techniques might improve outcomes comparability and repeatability.

In addition, the existing research contains insufficient long-term follow-up data, making it difficult to judge the sustainability of PRP therapy results for acne scars. Future research should strive to incorporate longer follow-up periods in order to investigate the long-term effects and maintenance of findings.

In addition, the expense of PRP therapy might be prohibitive for certain patients, as it may not be reimbursed by insurance and can be more costly than other traditional therapies. Exploring cost-effective ways and evaluating the cost-benefit ratio of PRP therapy in the treatment of acne scars may be beneficial.

7. Conclusion

Existing research indicates that PRP may improve acne scars by promoting tissue regeneration, collagen production, and wound healing. The findings of a comparative investigation reveal that platelet-rich plasma (PRP) offers significant benefits in terms of its regeneration characteristics, patient appropriateness, and prospective long-term outcomes. To optimize PRP preparation techniques and treatment settings, and to undertake bigger, well-designed randomized controlled trials, further research is required. In spite of these obstacles, PRP therapy is a valuable treatment option for acne scars.

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