

Role of Platelet Rich Plasma in Management of Post Acne Scars

Sahar Al Mokadem, Mohamed Nasr, Amal Gamal Sherif

Department of Dermatology, Venereology & Andrology, Zagazig University Hospital, Egypt.

Corresponding Author: Amal Gamal Sherif

Email: amalsherif1991@yahoo.com

Abstract

Acne is a chronic inflammatory skin disease of the pilosebaceous glands, usually, starts in adolescence and lasting into adulthood, with outbreaks sometimes coinciding with changes in serum androgens. About 85% of teenagers and 40% of adults develop late-onset acne. It is one of the most prevalent dermatological diseases, influenced by genetics and environmental factors. Platelet-rich plasma (PRP) has potential benefits in the treatment of post-acne atrophic scars. PRP contains various growth factors contained in alpha granules and dense granules. Alpha granules contain seven fundamental growth factors: the platelet-derived growth factors (PDGF α , PDGF β , and PDGF γ), transforming growth factor-beta (TGF β 1 and 2), epithelial growth factor (EGF), and vascular endothelial growth factor (VEGF). These growth factors modulate cell proliferation, angiogenesis, and collagen induction which ultimately enhance the remodelling of post-acne atrophic scars.

Keywords: Platelet Rich Plasma, Acne Scars

Introduction

Acne is a chronic inflammatory disease of pilosebaceous glands with various clinical presentations include comedones, erythematous papules and pustules, less frequently nodules, deep pustules and pseudocysts affecting about 85% of teenagers and 40% of adults develop late-onset acne (1).

Acne scarring is an unfortunate and common complication that causes significant psychological distress for many people. Scarring can be atrophic or hypertrophic (2). Acne scars are caused by two factors: increased tissue formation and tissue loss or damage. Hypertrophic scars and keloids are both examples of increased tissue formation. The three primary scars, ice-pick, rolling, and boxcar, demonstrate the other cause, tissue loss or damage (3).

Pathogenesis

Pathogenesis of Acne:

Acne affecting the pilo-sebaceous unit is a multifactorial process involving both endogenous and exogenous factors, such as increased sebum production, altered follicular keratinization, inflammation, and bacterial colonization of the pilo-sebaceous unit by *Propionibacterium acnes* (*P. acnes*) (4).

Platelet-Rich Plasma

Platelet-Rich Plasma (PRP) has been defined as the portion of the plasma (fraction of blood), having a platelet concentration above the baseline value. In a healthy individual normal platelet count in whole blood is between $1.5- 4.5 \times 10^5 /\mu\text{L}$ (5). Platelet count in PRP has not been yet optimized. However, a platelet count of 4-5 times over baseline should be present in the concentrate for therapeutic effectiveness (6). Platelet concentrations consequently are increasing more than 1,000,000 platelets/ μL (7).

Platelet-Rich Plasma has been used with variable success for the treatment in specialties of dermatology, gynecology, plastic surgery and aesthetics, orthopedics, ear-nose-throat surgery, sports medicine and ophthalmology (8).

Safety of PRP:

Platelet-Rich Plasma is an autologous preparation, so it is safe and tolerant on infiltration. It rarely produces mild local inflammatory reactions or post puncture infection. It is free from risk of transmission of infections like Hepatitis B, Hepatitis C or HIV. It lacks action on nucleus, so it is devoid of any mutagenic effects. It therefore is also well accepted by patients (5).

Mechanism of Action:

Platelet-Rich Plasma is defined as an "autologous concentration of platelets in a small volume of plasma" and is considered to be a rich source of autologous growth factors (9). The membrane bound α -granules are an important intracellular storage pool of growth factors including PDGF, TGF- β and IGF-I that are needed for wound healing (10).

On activation, these α -granules fuse with the platelet cell membrane and activate secretory growth factors and proteins to a bioactive state. These secreted growth factors and proteins bind to their trans-membrane receptors on the target cells like epidermal cells, mesenchymal stem cells, fibroblasts inducing an internal signal transduction pathway, thereby increasing expression of various gene sequences in cells like cell proliferation, collagen synthesis, anti-apoptosis (11).

Time of Viability:

Irrespective of the method of activation intrinsic or extrinsic method the release of packed GFs starts within 10 minutes of clot initiation, and more than 95 percent of secretion is completed within one hour. So, PRP must be applied within 10 minutes of activation (5).

Methods of Application:

Methods of PRP application such as topical application after micro-needling or direct intra dermal injection are being investigated. Both techniques are easy to be performed and have no important side-effects (7). Side-effects might appear from mild bruising and occasional swelling to rarely infections (12).

Dermatological Indications:

Alopecia: either androgenetic alopecia (AGA) or alopecia areata (AA)

❖ **Androgenetic Alopecia (AGA)**

Androgenetic alopecia is the most common form of hair loss, but current treatment options are limited and moderately effective. We target potential treatment that not only stimulates hair growth but induces formation of new hair follicles. The mitogenic & antiapoptotic effects of PRP prolong survival of dermal papillae. PRP modulates angiogenesis and increase blood flow around hair follicles, thus improving cutaneous ischemic conditions. The use of PRP either alone or in combination with surgical procedures in the patients of androgenic alopecia thus holds promising results. Storing hair grafts in PRP can enhance graft survival, improve hair density and stimulate growth of transplanted follicular units. (13).

❖ **Alopecia Areata (AA)**

Platelet-Rich Plasma has not only proliferation-inducing effects, but also PRP is a potent anti-inflammatory agent, which can suppress cytokine release and thereby limit local tissue inflammation (14).

Since AA is characterized by an extensive inflammatory infiltrate, responsible for secretion of a variety of inflammatory cytokines, it is probable that the anti-inflammatory effects of PRP may be of great benefit in this condition. PRP is an effective and safe therapy option for AA (15).

Skin Rejuvenation

Skin aging is characterized by cellular changes and alterations in dermal extracellular matrix proteins caused by intrinsic and extrinsic factors. During aging, there is degeneration of connective tissue (16).

Remodeling of the extracellular matrix is necessary for rejuvenation of aged skin, and activated fibroblasts play role in this process. Since PRP contains several growth factors and cell adhesion molecules, it was hypothesized that PRP might play role in activation of fibroblasts, synthesis of collagen (especially type I collagen) and other matrix components (17). However, results of PRP are better on the face and neck revitalization (17).

Infraorbital dark circle

It can be a significant cosmetic problem, and many individuals try to find a treatment for this condition. It worsens with the aging and the process of skin sagging and altered subcutaneous fat distribution. Possible causes include excessive pigmentation, thin and translucent lower eyelid skin overlying the orbicularis oculi muscle and shadowing due to skin laxity and tear trough. Platelet-rich plasma may have the potential to improve infraorbital dark circle in terms of color homogeneity and little effect on the crow's feet wrinkles (18).

• **Scars and Contour Defects**

The presence of facial scars has both cosmetic as well as psychological effects. Scarring remains an ongoing challenge to prevent as well as to manage. Different treatment modalities have been used to ameliorate atrophic scars with varying degrees of success which include both invasive and non-invasive methods, but unfortunately, even with the most expensive techniques, it is difficult to achieve the goal of the complete improvement. Thus, there is an increasing demand for less invasive, highly effective, and affordable therapeutic procedures to treat scars (19).

Platelet-rich plasma has potential benefits in the treatment of post-acne atrophic scars. Platelet-rich plasma contains various growth factors contained in alpha granules and dense granules. Alpha granules contain seven fundamental growth factors: the

platelet-derived growth factors (PDGF α , PDGF β and PDGF γ), transforming growth factor-beta (TGF β 1 and 2), epithelial growth factor (EGF) and vascular endothelial growth factor (VEGF). These growth factors modulate cell proliferation, angiogenesis, and collagen induction which ultimately enhance the remodeling of post-acne atrophic scars (20). The dense granules contain bioactive factors including serotonin, histamine, dopamine, calcium, and adenosine. These bioactive factors modulate inflammation (21).

- **Acute and Chronic Ulcers**

The treatment of diabetic foot ulcer is a big challenge. PRP is used either as topical or perilesional injections. Platelet-rich fibrin matrix and a viscous fibrin meshwork rich in GFs, resulted in faster healing and reepithelization (22).

- **Wound healing**

Platelet-Rich Plasma can be used for treatment and stimulation of healing of wounds of all types including burns and also split-thickness skin graft donor sites used frequently for burn management. There is no evidence to suggest that autologous PRP is of value for treating chronic wounds (22).

- **Striae Distensae**

Striae distensae are dermal scars with linear atrophic depression. It acts as a challenging cosmetic problem for which present treatment modalities have limited results (7).

Histologically, in the early stage of striae distensae, there are dermal edema and perivascular lymphocytic cuffing and in the later stage, atrophy and loss of rete ridges occur. There is loss of normal random collagen distribution to the level of the mid dermis or deeper. Elastin stains reveal absent elastin fibers and reduced fibril in the papillary and reticular dermis within affected areas (9).

Injected PRP along with higher energy fluencies using radiofrequency device directly to the dermis have been shown to contain mitogenic and chemotactic growth factors important in wound healing. The thermal energy generated by bipolar radiofrequency, denatures the elastic fibers and collagen bundles while PRP stimulate wound healing, thus, providing synergistic benefits and good cosmetic results. Histological sections showed the increase of both collagen and elastic fibers were found in the papillary and reticular dermis as well as in subepidermal basal zones (17).

- **Laser resurfacing**

Fractional ablative carbon dioxide laser (FxCRL) resurfacing is an effective treatment for acne scarring and rhytides and stimulates dermal remodeling with minimal disruption to the epidermis via the generation of microcolumns of thermolysis that extend deep into the dermis (23). FxCRL laser in combination with intradermal PRP has a golden advantage of short downtime and good tolerability (24).

Na et al., (25) explained the role of PRP in reducing transient unwanted adverse effects and improving skin tightening after FxCRL laser skin rejuvenation.

The efficacy of PRP

The potential efficacy of PRP depends on several variables, such as the patient's physiologic status, preparation of PRP, and application modalities. These variables that can affect the composition and clinical efficacy of the PRP are illustrated in (26).

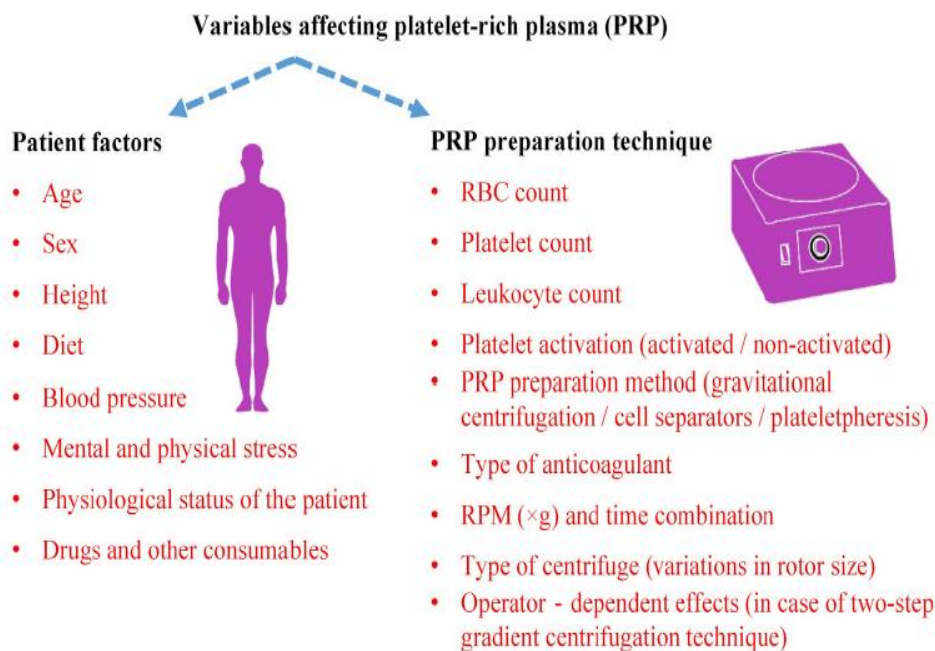


Figure (1):The variables that affect the potential efficacy of PRP therapy can be broadly classified into patient factors and PRP preparation technique. PRP, Platelet-rich plasma; RBC, red blood cell; RPM, revolutions per minute (26).

References.

1. **Bhate K, and Williams H (2013):** “Epidemiology of acne vulgaris.” Br J Dermatol; 168(3): 474–485.
2. **Hession M and Graber E (2015):** Atrophic acne scarring: a review of treatment options. JclinAesthet Dermatol; 8:50-58.
3. **Sardana K, Manjhi M, Garg V, et al., (2014):** Which type of atrophic acne scar (ice-pick, boxcar, or rolling) responds to nonablative fractional laser therapy. Dermal Surg; 40: 288- 300.
4. **Contasso E and French L (2014):** New insights into acne pathogenesis: propionibacterium acnes activates the inflammasome. J Invest Dermatol; 134: 310-313.
5. **Marx R (2004):** Platelet-rich plasma. J Oral Maxillofac; 62:489-496.
6. **Ehrenfest D, Rasmusson L and Albrektsson T (2009):** Classification of platelet concentrates: from pure platelet richplasma (P-PRP) to leucocyte- and platelet-rich fibrin (LPRF).Trends Biotechnol; 27: 158-167.
7. **Kim D, Je Y, Kim C, et al., (2011):** Can Platelet-rich Plasma Be Used for Skin Rejuvenation? Evaluation of Effects of Platelet-rich Plasma on Human Dermal Fibroblast. Ann Dermatol.;23:424-431.
8. **Bielecki T and Ehrenfest M (2012):** Platelet-Rich Plasma (PRP) and Platelet-Rich Fibrin (PRF): Surgical Adjuvants, Preparations for In Situ Regenerative Medicine and Tools for Tissue Engineering. Current Pharmaceutical Biotechnology. Bentham Sci Pub; 13(7):1121–1130.
9. **Watson R, Parry E, Humphries J, et al., (1998):** Fibrillin microfibrils are reduced in skin exhibiting striae distensae. Br J Dermatol; 138: 931-937.
10. **Mata J (2013):** Platelet rich plasma. A new treatment tool for the rheumatologist? Reumatol Clin; 9: 166-71-166.

11. **Sharif P and Abdollahi M (2010):** The role of platelets in bone remodeling. *Inflamm Allergy Drug Targets*; 9:393-9.
12. **Banihashemi M and Nakhaeizadeh S (2014):** An introduction to application of platelet rich plasma (PRP) in skin rejuvenation. *Rev Clin Med*; 1(2): 38-43.
13. **Uebel C, Silva J, Cantarelli D, et al., (2006):** The role of platelet plasma growth factors in male pattern baldness surgery. *Plastic and Reconstructive Surgery*; 118(6):1458-1466.
14. **El-Sharkawy H, Kantarci A, Deady J, et al., (2007):** Platelet-Rich Plasma: Growth Factors and Pro- and Anti-Inflammatory Properties. *Journal of Periodontology*; 78(4): 661–669.
15. **Trink A, Sorbellini E, Bezzola P, et al., (2013):** A randomized, double-blind, placebo- and active-controlled, half-head study to evaluate the effects of platelet-rich plasma on alopecia areata. *British Journal of Dermatology*; 169(3): 690–694.
16. **Wlaschek M, Tantcheva I, Naderi L, et al., (2001):** Solar UV irradiation and dermal photoaging. *Journal of Photochemistry and Photobiology B Biology*; 63: 41–51.
17. **Yuksel E, Sahin G, Aydin F, et al., (2014):** Evaluation of effects of platelet-rich plasma on human facial skin. *Journal of Cosmetic and Laser Therapy*; 16(5): 206–208.
18. **Mehryan P, Zartab H, Rajabi A, et al., (2014):** Assessment of efficacy of platelet-rich plasma (PRP) on infraorbital dark circles and crow's feet wrinkles. *J Cosmet Dermatol*; 13(1): 72–78.
19. **Bhargava S, Cunha P, Lee J, et al., (2018):** Acne Scarring Management: Systematic Review and Evaluation of the Evidence. *Amer J Clin Dermatol*; 19(4): 459–477.
20. **Leo M, Kumar A, Kirit R, et al., (2015):** Systematic review of the use of platelet-rich plasma in aesthetic dermatology. *Journal of Cosmetic Dermatology*; 14(4): 315–323.
21. **Foster T, Puskas B, Mandelbaum B, et al., (2009):** Platelet-Rich Plasma. *The American Journal of Sports Medicine*; 37(11): 2259–2272.
22. **Martinez M, Martí A, Solà I, et al., (2012):** Autologous plateletrichplasma for treating chronic wounds. *JohnWiley& Sons, Ltd.*; 10 (2) :1-56.
23. **Lynch M., and Bashir S. (2015):** Applications of platelet-rich plasma in dermatology: A critical appraisal of the literature. *Journal of Dermatological Treatment*; 27(3): 285–289.
24. **Gawdat H, Hegazy R, Fawzy M, et al., (2014):** Autologous platelet rich plasma: topical versus intradermal after fractional ablative carbon dioxide laser treatment of atrophic acne scars. *Dermatol Surg.*; 40:152-161.
25. **Na J, Choi J, Choi H et al., (2011):** Rapid Healing and Reduced Erythema after Ablative Fractional Carbon Dioxide Laser Resurfacing Combined with the Application of Autologous Platelet-Rich Plasma. *Dermatologic Surgery*; 37(4): 463–468.
26. **Khan S and Abhijit M (2021):** Variables affecting the potential efficacy of platelet-rich plasma in dermatology. *J Am Acad Dermatol*; 84(1):47-48.