

Use of Microneedling with Platelet Rich Plasma for Management of Atrophic Post-Acne Scars: Review Article

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ABSTRACT

Background: When the sebaceous follicle is damaged during acne inflammation, improper healing can occur, resulting in scarring. There are two types of acne scars: atrophic and hypertrophic. Atrophic scars can be further classified as rolling scars, icepick scars, or boxcar scars. Chemical peels, dermabrasion, microneedling, platelet-rich plasma (PRP), as well as the punch elevation technique are only few of the methods utilized to treat these scars.

Objective: Assessment of use of microneedling with platelet rich plasma for management of atrophic post-acne scars.

Methods: We scoured medical publications and databases including PubMed, Google Scholar, and Science Direct for information on Platelet Rich Plasma and Atrophic Post-Acne Scars between October 2000 and March 2021. However, only the latest or most comprehensive study was considered. The authors also assessed the usefulness of references drawn from similar books. Non-English documents have been overlooked due to a lack of resources to translate them. It was commonly recognised that scientific research did not include things like unpublished publications, oral presentations, conference abstracts, or dissertations.

Conclusion: Atrophic acne scars can be treated with microneedling as well as fractional CO₂ laser, but platelet-rich plasma has also been used on its own with positive results. Incorporating PRP into skin microneedling has decreased recovery time and toxicity.

Keywords: Atrophic post-acne scars, Platelet rich plasma, Microneedling..

INTRODUCTION

The pilosebaceous apparatus is affected by acne vulgaris (AV), a chronic inflammatory condition. There are two basic types of lesions seen in a clinical setting. Acne sufferers often struggle emotionally and physically, with disfiguring post-acne scars being the most visible outward manifestation of the condition ⁽¹⁾.

When the sebaceous follicle is damaged during acne inflammation, improper healing can occur, resulting in scarring. There are two types of acne scars: atrophic and hypertrophic. Atrophic scars can be further classified as rolling scars and icepick scars, or boxcar scars. Chemical peels, dermabrasion, platelet-rich plasma (PRP), microneedling and subcision, are only few of the methods utilized to treat these scars ⁽²⁾.

About eighty-five percent of teenagers deal with acne vulgaris at some point. Acne vulgaris (AV) most commonly appears during puberty, while it can also appear in infancy, adulthood, and even before birth. Disease tends to be more severe in females than in males. Furthermore, women are more concerned about their appearance and health than men ⁽³⁾.

Scarring can range from mild to moderate for up to 95% of AV patients, with 30% experiencing severe scarring. Eighty to ninety percent of acne scars are atrophic, while the remaining ten to twenty percent are keloidal or hypertrophic. Most persons who suffer from cystic acne or acne scars can trace their condition back to a parent who also suffered from severe acne ⁽⁴⁾.

Microneedling is a non-surgical therapy that uses tiny needles to puncture the skin in a controlled manner. It is low entry barrier, low cost, safety, and little training requirements have contributed to its swift rise to prominence and widespread adoption. Historically, it

has been employed as a treatment for face scars and to stimulate collagen production in the skin. Transdermal medication and vaccine delivery is a common application of the technology ⁽⁵⁾.

Principle and mechanism of action:

Micropunctures are made with microneedles, which cause a superficial puncture without breaking the skin's surface. Minimal superficial bleeding results from these microinjuries, and a cascade of growth factors including PDGF, TGF- β , connective tissue activating protein, connective tissue growth factor (CTGF), and fibroblast growth factor (FGF) are released to facilitate the body's natural wound healing process. The needles soften the brittle scar tissue, allowing new blood vessels to grow into it. Fibroblast migration, proliferation, and intercellular matrix synthesis are the initial events in the processes of neovascularization and neocollagenesis, respectively ⁽⁶⁾.

The depth of neocollagenesis, as measured with 1.5-mm needles, ranges from 5 to 600 μ m four microneedling treatments, each one month apart, resulted in a 400% increase in collagen and elastin deposition six months after the procedure, as well as a thickened stratum spinosum and normal rete ridges one year after the procedure, as determined by histological analysis. Collagen fiber bundles appear to have a regular lattice structure, as opposed to the parallel bundles seen in scar tissue ⁽⁷⁾.

One alternative theory for how microneedling works was suggested by Liebl *et al.* ⁽⁸⁾. Cells have a resting electrical membrane potential of about 70 mV, when needles approach the membrane, the inner

electrical potential quickly increases to 100 mV, causing an increase in cell activity and the release of various proteins, potassium, and growth factors into the surrounding tissue, where they recruit fibroblasts, which then produce collagen ⁽⁸⁾.

Microneedling's distribution of medicine straight into the vascularized dermis, without first penetrating the stratum corneum, improves the skin's absorption of numerous drugs. Drug distribution to the dermis may be improved because it has been shown to considerably increase the follicular infundibulum by 47%. The infundibulum's surrounding scales and sebum residues are also removed ⁽⁹⁾.

Various Instruments and Techniques of Microneedling

Microneedling devices come in several forms, with varying degrees of automation and needle lengths. Needle length variation is the most important factor to consider; quality needles should have a tip length to diameter ratio of at least 13:1. The severity of the patient's skin condition is the primary factor in deciding

the needle length to use. Needle lengths of 0.5-1 mm are typically advised for ageing skin and wrinkles, whereas 1.5-2 mm are typically used to treat acne scars and other atrophic scars ⁽¹⁰⁾.

The shortest possible interval between treatments is also a function of needle length. Microneedling treatments should be spaced further apart than the needles themselves. It is recommended to wait at least three weeks between dermaroller sessions using a 1.5 mm tool ⁽¹¹⁾.

Dermaroller

The typical medical dermaroller comprises a 12-centimeter long handle with a drum-shaped cylinder at one end that is covered with 192 small microneedles, often measuring between 0.5 and 3 millimeters in length and 0.10 to 0.25 millimeters in diameter ⁽¹²⁾.

Because their needles are shorter than 0.15 mm, patients can use home-care dermarollers on their own. They improve transdermal drug delivery and are used to minimize pore size, fine lines, and sebum production ⁽¹³⁾.

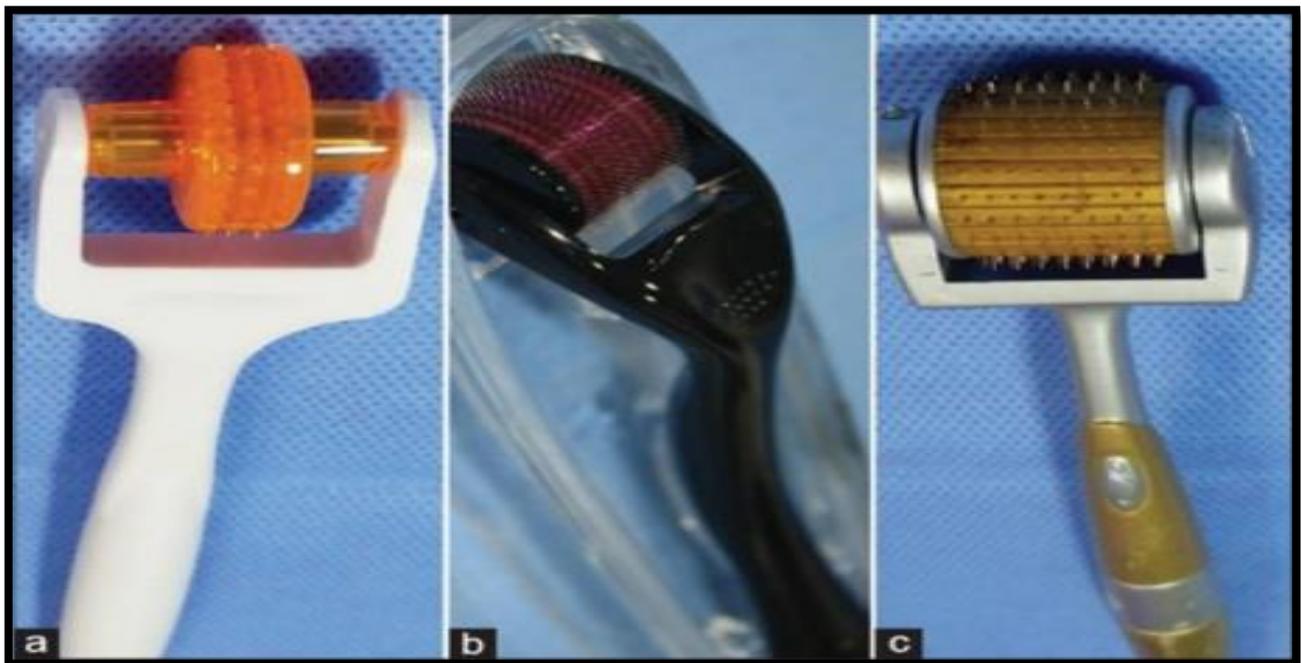


Figure (1): Several types of dermarollers are available. (a) Narrow drum dermaroller ideal for use around the eyes and nose, (b) 540-needle dermaroller and (c) Dermaroller with the usual number of needles, 192 ⁽¹²⁾.

Derma-stamp

These are smaller variants of the dermaroller, with a diameter of 0.12 mm and needle lengths ranging from 0.2 to 3 mm. The key benefit it has over standard dermarollers is that it allows for targeted treatment of specific scars. It induces infusion channels to form vertically in the skin, making it appropriate for usage on isolated scars like those left by varicella and wrinkles ⁽¹⁴⁾.

Dermapen

The disposable needles and guides of the automated microneedling device known as a Dermapen allow for precise needle length adjustments during fractional mechanical resurfacing procedures. There are 9–36 needles in rows at the tip. It has a high speed mode that vibrates at 700 cycles per minute and a low speed option that vibrates at 412 cycles per minute. It can be used multiple times on various patients and is easier to manoeuvre in tight spaces like the nose and around the eyes without causing any harm to the surrounding skin. Furthermore, this technology was developed to address the problem of inconsistent pressure application, which results in inconsistent penetration depths ⁽¹⁵⁾.

DermaFrac

DermaFrac is a type of microneedling that combines microdermabrasion, a serum infusion into deeper layers of skin, and light-emitting diode (LED) therapy. Wrinkles, hyperpigmentation, acne, enlarged pores, uneven skin tone, and superficial scars are just some of the skin issues that can be helped. The full face treatment using all four modalities takes around 45 minutes to finish. This non-invasive, low-cost therapy option allows for a tailored selection of serums to be infused, and has the added benefit of requiring no recovery time ⁽¹⁶⁾.

Fractional radiofrequency microneedling

To avoid damaging the epidermis, these tools use insulated needles to puncture the skin and emit radiofrequency currents, heating up the dermal and apocrine glandular components below. Long-term dermal remodeling (ne elastogenesis and neocollagenesis) is prompted by this method. Needle depth can be adjusted anywhere from 0.5 mm to 3.5 mm, allowing for precise targeting of different skin layers. Modulating the energy pulse's intensity and length allows for precise regulation of tissue damage. It is used to cure scars, hyperhidrosis, loose skin, and age spots, and to look younger overall ⁽¹¹⁾.

Microneedling has been observed to have a greater effect on rolling and boxcar scars than icepick scars. The recovery time is minimal, it can be used on any skin type, and it rarely causes post-inflammatory dyschromia. However, a minimum of four to six sessions is required for observable progress to be made ⁽¹²⁾.

Microneedling's scope has been broadened to include acne vulgaris thanks to the advent of fractional microneedling radiofrequency. It works to decrease sebum production by targeting the sebaceous glands directly. It has also been shown to inhibit the proliferation of comedone-forming keratinocytes ⁽¹⁶⁾.

Complications: Mild erythema, irritation, and edoema, which often decrease within hours to days, and pain during the treatment (which can be mitigated with topical anaesthetics) are the most prevalent adverse effects. Hyperpigmentation, reactivation of herpes simplex, and localized superficial infections are other, less frequent consequences (e.g., impetigo) ⁽¹²⁾.

Contraindications

Active inflammatory acne lesions, local infections (such as herpes or warts), blood diatheses, moderate to severe chronic skin illnesses (such as eczema or psoriasis), immunosuppression as well as keloidal tendency, are the few contraindications ⁽¹⁷⁾.

Platelet-rich plasma: The platelet concentration in platelet-rich plasma (PRP) is three to seven times higher than the mean platelet concentration in whole blood, making it an autologous plasma product with therapeutic potential. To promote cell differentiation, proliferation, and regeneration, platelets' alpha granules secrete chemokines, adhesion molecules, and growth factors upon activation ⁽¹⁸⁾.

Mechanism of action: Platelets serve critical roles in tissue regeneration beyond their well-known role in hemostasis. When blood vessels and tissues are damaged, platelets respond by activating and aggregating to stop the bleeding. Proteins and other physiologically active substances involved in tissue healing are then produced ⁽¹⁹⁾. Theoretically, PRP's biological effect stems from the possibility that platelet and plasma protein concentrations above the physiological level speed up the repair process. In addition, keeping the fibrin mesh intact may protect the long-term release of bioactive chemicals ⁽²⁰⁾.

Procedure for Platelet-Rich Plasma Preparation

Differential centrifugation, in which the acceleration force is modified to sediment certain cellular elements based on their relative differences in specific gravity, is used to create platelet-rich plasma. PRP can be prepared in a number of ways, but the two most common are the platelet-rich plasma (PRP) method and the buffy-coat approach ⁽²¹⁾.

A. Platelet-rich plasma method

At first, anticoagulant-filled tubes are used to collect whole blood. After that, the blood is spun at a constant acceleration to separate the RBCs from the rest of the blood, which forms three distinct layers: one thick layer rich in WBCs called the "buffy coat," one thin layer rich in platelets and WBCs called the "upper layer," and one thick layer rich in RBCs called the "lower layer." Pure platelet-rich plasma (P-PRP) is made by transferring the top layer and superficial buffy coat to a sterile tube. The complete buffy coat and a small number of red blood cells (RBCs) are transferred to create leukocyte-rich platelet-rich plasma (L-PRP). Soft pellets (erythrocytes-platelets) appear at the bottom of the tube after a second spin step is conducted at a faster speed. Platelet-poor plasma (PPP) is mainly found in the upper section, which is eliminated. To make PRP, pellets are homogenised in the plasma's bottom (third) ⁽²¹⁾.

B. Buffy coat method:

The buffy coat, which has a large number of leucocytes, is separated from whole blood by centrifugation and then collected. The difficulty lies in removing the buffy coat of WBCs and platelets from the RBCs underneath ⁽²¹⁾.

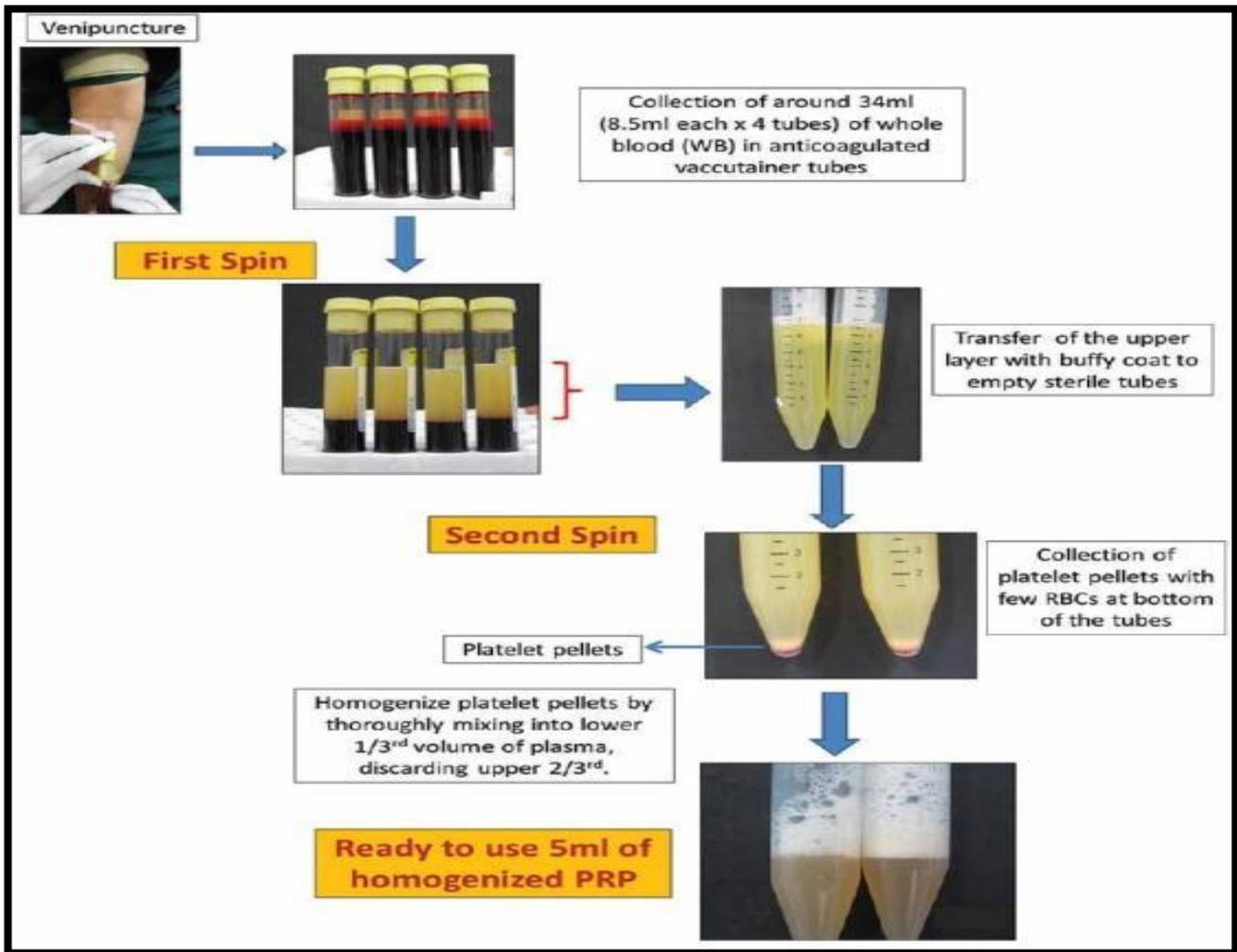


Figure (2): Instructions for making PRP (platelet-rich plasma) in the form of a flowchart ⁽²¹⁾.

Safety of platelet-rich plasma

Due to the fact that autologous platelet-rich plasma poses no risk of transmitting disease, it has gained widespread acceptance as a safe product. Systems that rely on bovine thrombin as an activator are no longer used since they can cause coagulation difficulties or secondary hypersensitivity ⁽²²⁾.

Some writers have speculated that platelet-rich plasma (PRP) has oncogenic potential, although this is not supported by the available evidence. Growth factors attach to membrane receptors and then activate intracellular signaling cascades, which maintain regular gene expression by way of many regulation mechanisms. Furthermore, it has not been shown that growth factors produced following local PRP treatment have an effect on the entire body ⁽²³⁾.

Post-Acne Scars

Both microneedling and fractional CO₂ laser therapy have shown promise in the treatment of atrophic post-acne scars, although platelet-rich plasma has also been shown to be beneficial on its own ⁽²⁴⁾. Incorporating PRP into skin microneedling has

decreased recovery time and toxicity ⁽²⁵⁾. Boxcar and rolling scars responded well to microneedling combined with PRP, while ice pick scars were less amenable to this treatment ⁽²⁶⁾. Patients with atrophic acne scars show physical and psychological improvements after microneedling was combined with platelet-rich plasma. Even though it's an intrusive process, it's cheaper than lasers and produces good results ⁽²⁷⁾.

Thirty individuals were enrolled in a trial, all of whom had atrophying acne scar lesions. Patients were randomly assigned to have one side of their face treated with fractional CO₂ laser followed by intradermal PRP injection, or the opposite. Three months of photographic and camera-based skin-analysis follow-up. The depth of the scars on both sides of the face diminished dramatically. However, the fractional CO₂ laser and PRP combination demonstrated much greater enhancement. Patients noticed improvements in scar appearance and skin texture. Seventy percent of our patients had dark skin, yet nobody experienced hyperpigmentation. Results improved when fractional CO₂ laser was used in conjunction with PRP. The fractional CO₂ laser's maintenance time was shortened

as a result. Using a skin analysis camera allowed for a completely unbiased evaluation of the findings⁽²⁸⁾.

CONCLUSION

Atrophic acne scars can be treated with microneedling as well as fractional CO₂ laser, but platelet-rich plasma has also been used on its own with positive results. Incorporating PRP into skin microneedling has decreased recovery time and toxicity.

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