

## Treatment Modalities in Acne Scar

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### Abstract

**Background:** Acne Acne scarring is a frequent dermatological issue, and its severity is generally correlated with the severity of the underlying acne condition. The purpose of this extensive review article is to examine the use of platelet-rich plasma (PRP), plasma gel, and microneedling in the current therapy of acne scarring. **Conclusions:** Scarring from acne is difficult to cure and calls for a deep understanding of the underlying processes at play. Microneedling, platelet-rich plasma (PRP), and plasma gel treatments, as well as other similar approaches, show promise in a variety of dermatological contexts for accelerating wound healing and enhancing skin texture.

**Keywords:** Acne scarring, Platelet-rich plasma, Plasma gel, Microneedling, Wound healing, Skin rejuvenation.

### Introduction

Acne scars are a common and chronic dermatological issue that impact a sizable percentage of people all over the world. They are a typical consequence of acne and their effects may be felt even after the original breakout has subsided. Acne scars are of paramount concern to both patients and dermatologists [1] because to the substantial physical and psychological effects they may have on people.

Acne scars are significant not just because they are common, but also because they may have long-lasting effects on a person's physical and mental health. Acne scars are unsightly and may cause discomfort because of the changes they bring to the skin's texture, colour, and overall appearance. These outward manifestations of a past skin illness have been shown to negatively affect a person's sense of well-being, confidence, and body image [2].

The emotional cost of living with acne scars might be just as significant. Distress from having these scars visible may take many forms, from milder symptoms like shyness and anxiety to more serious ones like depression and a loss of confidence [3]. The emotional toll that acne scars may have on sufferers [2] highlights the need of providing them with thorough and efficient treatment choices.

Given the wide-ranging effects of acne scars, the purpose of this study is to investigate and assess the many methods for managing this dermatological issue. By exploring the many available treatments, we want to offer a useful guide for dermatologists, healthcare providers, and people who are looking to lessen the psychological and physiological effects of acne scars [4].

In order to better control acne scarring, modern treatments such as platelet-rich plasma (PRP), plasma gel, and microneedling are examined in this in-depth review study.

### Acne Vulgaris

Acne vulgaris, a common inflammatory skin disorder, primarily affects the pilosebaceous unit and is often self-limiting. Triggered by Cutibacterium acnes during adolescence under the influence of circulating dehydroepiandrosterone (DHEA), acne manifests as inflammatory and non-inflammatory lesions, predominantly on the face, but can also appear on the upper arms, trunk, and back [5]. It exhibits an extended course, typically appearing in adolescence and persisting into the early thirties, with a higher prevalence in females, urban populations, and certain races, such as Asians and Africans, who tend to develop severe acne [6]. Notably, in Egypt, the prevalence of acne varies from 28.9% to 91.3% among adolescents, reflecting the global significance of this skin disorder. Factors such as hormonal changes, genetics, lifestyle, and dietary habits contribute to its incidence, underscoring the need for comprehensive management strategies and awareness campaigns [7].

### Pathophysiology

The Acne vulgaris has a complex pathogenesis that includes both internal and environmental factors. However, the primary causes are microcomedones, which are the result of excessive sebum production and aberrant shedding of epithelial cells. Closed comedones, which develop from these microcomedones, are a prelude to more severe inflammatory acne lesions. Closed comedones may cause skin irritation when they burst due to pressure inside the follicle, releasing keratin and sebum.

Increased sebum production, altered keratinization, bacterial colonisation, inflammation, and hormonal effects, nutrition, and stress are all important players in the pathophysiology of acne [10]. Table 1

Table( 1) Key pathophysiological factors in Acne development

Factors	Pathophysiological role
<b>1. Sebum Production</b>	Excessive sebum production due to androgen stimulation
<b>2. Hyperkeratinization</b>	Abnormal keratinization leads to follicular obstruction
<b>3. Bacterial Colonization</b>	Propionibacterium acnes proliferation in blocked follicles
<b>4. Inflammation</b>	Immune response, release of cytokines, redness, and swelling
<b>5. Formation of Lesions</b>	Types of acne lesions formed: comedones, papules, pustules, nodules, and cysts
<b>6. Hormonal Influences</b>	Androgens stimulate sebum production, influence keratinization, and hormonal fluctuations contribute to acne
<b>7. Genetic Factors</b>	Genetic predisposition and family history's role in acne
<b>8. Diet</b>	Dietary choices can influence acne development; high-glycemic-index foods worsen acne, while diets rich in antioxidants and omega-3 fatty acids may reduce severity
<b>9. Psychosocial Stress</b>	Bidirectional relationship between stress and acne; stress hormones, skin barrier compromise, stress-related behaviors, and hormonal imbalances
<b>Clinical presentation</b>	blackheads, are a kind of noninflammatory lesion (whiteheads). Papules are the inflamed, red or pink pimples that commonly come before pustules and may be painful. Pustules are similar to papules but contain pus, with a white or yellow core surrounding by inflammation. Nodules are bigger, firm, and painful lesions that form deep into the skin. Acne cysts are among the most painful and disfiguring types of the condition because they are so huge and packed with fluid. Acne fulminans is an exceedingly uncommon and severe form of acne with systemic signs, whereas acne conglobata is characterised by linked nodules and abscesses. Athletes and those who wear restrictive clothing are particularly prone to acne mechanica [12-14], which is brought on by the skin's reaction to friction, pressure, or heat.
Acne occurs most often on the face, back, chest, and upper arms, all of which have a high concentration of sebaceous glands. All types of lesions, inflammatory and otherwise, are included. Pink papules, pustules, or cysts indicate inflammation; these lesions may lead to postinflammatory hyperpigmentation and permanent scarring if not treated. Acne lesions, including papules, pustules, and cysts, may be seen at any stage of development, and are present in the vast majority of individuals. Postinflammatory hyperpigmentation may develop from these lesions, and cysts and nodules can leave permanent scars [11].	
Acne subtypes	
Different types of acne have different symptoms and degrees of severity. Comedones, also known as open comedones or	
<b>Treatment of Acne Vulgaris</b>	

Table(2) Different treatment options for acne vulgaris [15-17];

Treatment Category	Mechanism of action
<b>Topical Therapy</b>	Various topical treatments for acne include Salicylic acid, which has comedolytic and anti-inflammatory properties; Benzoyl peroxide, effective for inflammatory acne; Topical antibiotics, such as erythromycin and clindamycin; Topical retinoids, the first-line therapy for acne; Dapsone, a relatively new medication with antimicrobial and anti-inflammatory properties; Azelaic acid, effective against both comedonal and inflammatory acne.
<b>Oral Therapy</b>	Oral antibiotics, like tetracyclines and sulfamethoxazole/trimethoprim, which work to reduce bacteria causing inflammation; Isotretinoin, a potent oral retinoid for severe or non-responsive acne; Spironolactone, for post-adolescent acne in females with low risk of adverse effects; Cephalosporins, which some clinicians find effective for inflammatory lesions.
<b>Combination Therapy</b>	Combination medications that enhance acne treatment's efficacy and adherence, such as erythromycin-benzoyl peroxide gel, clindamycin-benzoyl peroxide gel, and more.
<b>Hormonal Treatment</b>	Hormonal therapy primarily for females to reduce androgen levels, including oral contraceptives and spironolactone.

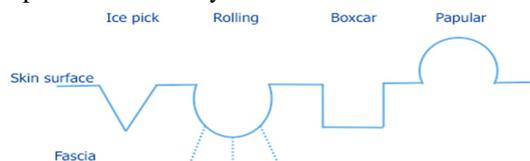
<b>Laser Therapy</b>	Laser therapies and light-based treatments, which are increasingly used as part of or in addition to medical acne treatment, though long-term safety and efficacy are still being clarified.
<b>Dietary Supplementation</b>	Nicotinamide and zinc supplementation, which can have benefits in the treatment of inflammatory acne.
<b>In-Office Procedures</b>	Intralesional corticosteroids for quick suppression of inflammation; Acne surgery for extracting comedones and draining pustules and cysts; Superficial chemical peels for exfoliation and anti-inflammatory effects; Laser treatment and phototherapy for reducing P. acnes levels, sebaceous gland function, and inflammation.

**Acne Scarring**

Most occurrences of acne occur on the face, and many patients suffer from scarring, the severity of which is correlated with acne grade. Nearly 80% of atrophic scars may be traced back to an abnormal wound healing response to cutaneous inflammation, which is what causes acne scars. Inflammatory lesions (papules and pustules) and post-inflammatory

lesions (scars) account for almost all scars (99 percent) [18].

Acne scarring is said to affect between 1% and 11% of the population. Acne scars may leave people feeling physically and mentally drained. Scars tend to become more noticeable with time because to natural ageing or photo damage [19]. One and Two Figures



**Fig. (1)** Acne Scar Types. Ice pick , Rolling scars ,Boxcar scars, Papular scars [20].



**Fig. (2)** Types of Acne Scars

**Pathogenesis of acne scar**

Acne scars develop as a result of the altered the body's natural reaction to the inflammation that causes acne lesions, which is wound healing. Damage to the skin's collagen and elastin fibres may be caused by the production of inflammatory mediators, cytokines, and enzymes when inflammation occurs. Scars may develop as the body attempts to heal these

wounds. Atrophic scars, the most prevalent form of acne scars, occur from the loss of tissue. Scars may be distinguished by their depth and width, as in the case of ice picks and boxcars, respectively (depressed and sharply demarcated). Keloid scars, or hypertrophic scars, form when too much collagen is deposited [21]. Table 3

**Table (3)** Pathogenesis of acne scars [21].

**Pathogenesis Factors**

**Inflammatory Response**

Acne starts with comedone formation and progresses to inflammatory lesions (papules, pustules, nodules, and cysts). Inflammation around the follicles is a significant trigger for scarring.

**Immune Response**

The body's immune system responds to inflammation by sending immune cells, which release enzymes and chemicals to combat infection. This immune response can inadvertently damage healthy tissue, contributing to tissue breakdown and scarring.

**Tissue Damage**

Inflammatory responses can destroy collagen and elastin fibers in the skin. Collagen provides structural support and elastin elasticity. The breakdown of these fibers leads to atrophic or depressed scars.

**Fibrosis and Healing**

Following the inflammatory response, the body initiates healing, with fibroblasts recruited to repair damaged tissue. An imbalance between collagen production and

degradation can lead to abnormal scar formation.

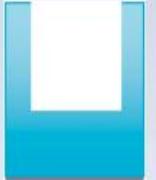
**Grading Systems of acne scar**

Acne Scars are often assessed and graded using standardised methods in order to establish their severity and inform subsequent treatment plans. The Goodman and Baron Qualitative Global Scarring Grading Method is a commonly used grading system that categorises scars as mild, moderate, or severe based on their appearance and distribution. The Acne Scar Assessment Scale (ASAS) allows for a more detailed evaluation of scar features by taking into account the type, size, colour, and texture of scars [1, 22].

**Acne scar treatment**

Atrophic acne scars may be broadly divided into three categories, as previously described by Jacob and colleagues: icepick scars, rolling scars, and boxcar scars. Incorporating a uniform and defined description of acne scars into clinical research and treatment protocols has been made possible by this categorization system. The aetiology of each scar led to its own classification. Acne scars may be effectively treated for each individual patient if they are categorised into several categories ( Table ) [23].

**Table (4)** acne scar treatment modalities according to the type of scar [21].

Acne Scar Subtypes	Description		Treatment Options	Treatment Efficacy*
Icepick	<2 mm and narrow Tapers as extends to deep dermis		Punch excision TCA CROSS Radiofrequency Laser skin resurfacing	+++ ++ + +
Rolling	4-5 mm wide Sloped and shallow borders  Caused by dermal tethering of otherwise normal skin		Subcision Fillers Dermabrasion Microneedling Radiofrequency Laser skin resurfacing	+++ +++ ++ ++ ++ ++
Boxcar	1.5-4 mm wide Round to oval depressions with sharply demarcated vertical edges Can be shallow (0.1-0.5 mm) or deep (≥0.5)		Shallow boxcar: Punch elevation Dermabrasion Microneedling Radiofrequency Laser skin resurfacing	+++ ++ ++ ++ ++
			Deep boxcar: Subcision TCA CROSS Punch excision/ elevation Laser skin resurfacing	++ ++ ++ ++

\*(+++) highly effective (++) effective (+) adequate.  
CROSS, chemical reconstruction of skin scars; TCA, trichloroacetic acid.

**1. Cosmetic Fillers**

In the Injectable fillers for cosmetic use have been more popular over the last decade, with temporary hyaluronic acid (HA) fillers giving way to semipermanent and permanent options ( Table 5). Several of these cosmetic fillers have been tried for atrophic acne scars, where they both added volume to the scar tissue and prompted the body to produce more collagen. Superficial rolling and boxcar scars react well to cosmetic fillers and have been paired with subcision to improve outcomes. Cosmetic fillers have been shown to be effective in treating atrophic acne scars, according to a recent Cochrane study [24].

Acne scar soft tissue fillers are included in Table 5 [21].

<i>Soft-Tissue Fillers</i>	<i>Duration of Action</i>	<i>Examples</i>
Hyaluronic acid filler	3–12 mo	Restylane, Juvederm, Belotero
Calcium hydroxylapatite	1–2 yrs	Radiesse
Poly-L-lactic acid	1–2 yrs	Sculptra, Newfill
Polymethylmethacrylate	Permanent	Artecoll, Artefill, Bellafill

## 2. Hyaluronic Acid

Hyaluronic acid is a naturally occurring component of the body's connective tissue that is made up of a water-retaining glycosaminoglycan polymer. Temporary fillers such as hyaluronic acids go out after three to twelve months [25].

Hydroxyapatite, or Calcium, Radiesse (calcium hydroxyapatite; Merz Pharma; Frankfurt, Germany) is a biocompatible, semipermanent filler made up of synthetic CaHA microspheres ranging in size from 25 to 45  $\mu$ m suspended in a water, glycerin, and carboxymethylcellulose aqueous gel. Collagen synthesis is boosted by calcium hydroxyapatite [26] because it triggers a local reaction from histiocytes and fibroblasts.

### Protein-Linked Lactic Acid

Inducing collagen formation by increasing the number of fibroblasts via a foreign-body response, the synthetic polymer poly-L-lactic acid (PLLA; Sculptra, Galderma, Fort Worth, TX) enhances skin texture over time. Due to its biostimulatory method of action, PLLA requires many injections to restore volume [27].

### Polymethylmethacrylate

Polymethylmethacrylate (PMMA) is a long-lasting filler made of microspheres of PMMA ranging in size from 30  $\mu$ m to 50  $\mu$ m suspended in bovine collagen. PMMA may be a more cost-effective option to temporary fillers since it can give volume to acne scars and promote collagen formation with only one treatment [28].

### Subcision

Orentreich and Orentreich<sup>24</sup> first reported the surgical technique of subcision in 1995. It is often done using a tribeveled hypodermic needle to disentangle the subdermal fibrous bands that cause rolling scars, while alternative devices, such as regular needles and blunt blades, have also been used. Subcision is most

successful on superficial, rolling scars and less so on deep, boxcar or icepick scars [29].

In order to improve the look of scars and skin texture, doctors have recently begun combining subcision with the use of cosmetic fillers and a nonablative 1,320-nm neodymium-doped:yttrium aluminium garnet (Nd:YAG) laser. Subcision is a well-tolerated and successful surgery to treat rolling and superficial boxcar scars and may be coupled with other therapies for acne scarring [30].

### Punching It Out

When dealing with icepick and deep boxcar scars, punch excision is a great alternative. Sutures are utilised to seal the incision after deep atrophic scar tissue is removed using a punch biopsy equipment. In order to eliminate unsightly extra traction in the skin, the scars should be 4–5 mm apart, or at least 4 weeks should pass between treatments. The elliptical or punch elevation technique is advised for scars thicker than 3.5 mm [31].

A new scar will grow after this procedure, although it should be less obvious than the old deep atrophic scar. A resurfacing technique performed 4–6 weeks following punch excision may also help the scar seem better. When treating acne scars, punch excision and laser skin resurfacing may be performed on the same day without compromising patient safety or results [15].

### Fight to the Top

Both shallow and deep boxcar scars may benefit from punch elevation. Punch excision and grafting are merged into one in this method. Scar tissue is removed with a punch biopsy instrument to the level of the subcutaneous fat; the raised tissue is then sutured or steri-stripped into place. The scar's cosmetic look is enhanced when the raised graft sinks down to the surface of the surrounding skin as the wound heals [32].

### Peeling Agents

A chemical peel is a noninvasive, minimally invasive, and very rapid outpatient treatment for treating acne scars. Medium and deep peels such as TCA (20–35%), alpha hydroxy acids (AHAs), salicylic acid (Salicylic Acid), and Jessener's solution (Salicylic Acid) are effective in treating moderate acne scars and acne lesions. Though effective for macular scars, chemical peels have limited use for deeper atrophic scars and should be used with caution in darker-skinned individuals due to the possibility for pigmentary abnormalities. Due to their high risk of dyschromia and scarring, deep chemical peels are no longer recommended for treating acne scars [33].

Over the last decade, chemical repair using TCA (CROSS) has been the treatment of choice for icepick, rolling, and boxcar scars. The CROSS technique involves applying a high concentration of TCA with a pointed wooden applicator to atrophic acne scars and pressing it into the skin until white icing forms. The epidermis is damaged by the high concentrations of TCA, but the wound healing process boosts collagen formation and reduces the appearance of scars [34].

#### Dermabrasion

Dermabrasion is the process of removing the epidermis and upper dermis by either manually sanding the area with sandpaper and hydrogen peroxide for hemostasis, or by utilising a spinning motorised hand piece equipped with a serrated wheel, wire brush, or diamond-embedded fraises. New collagen is created while the wound heals, giving the scar a smoother and more uniform look than it had before. However, dermabrasion is more successful on rolling and shallow boxcar scars caused by acne than on icepick scars [35]. The cosmetic look of superficial atrophic scars may be enhanced with only one dermabrasion treatment, which is one of dermabrasion's many benefits. However, dermabrasion is a painful operation that need for either local or general anaesthesia, and the results rely on the skill of the operator performing the surgery.

#### Microneedling

Acne scars may be treated with microneedling, and it won't break the bank. Acne scars are treated by rolling them with a sterile instrument fitted with thin, sharp needles. This produces a series of tiny punctures in the papillary and mid-dermal layers of the skin. By puncturing the dermis in this way, we set off a chain reaction of growth factors that ultimately leads to increased collagen formation. Microneedling is helpful for superficial boxcar and rolling scars since it only reaches the top dermis. Microneedling is often performed in a series of 3–5 treatments, each spaced 4 weeks

apart. Acne scars often recover somewhat for patients [36].

Because of the minimal risk of hyperpigmentation, microneedling might be an attractive alternative for patients with darker skin types who are looking to treat superficial boxcar and rolling scars [37].

#### RICH IN PLATELETS PLASMA

Several growth factors and cytokines may be found in the concentration of platelets in plasma known as plasma-rich plasma (PRP), which is a relatively new therapeutic technique. Treatments for tendonitis, persistent wounds, and baldness have all benefited from plasma-rich blood. Minor to moderate clinical improvement has been shown following intradermal or laser-assisted PRP administration, although only a small number of research have looked into PRP as a therapy for acne scars [38].

#### Radiofrequency

In its early stages, radiofrequency (RF) was employed in dermatology for skin regeneration. To induce neocollagenesis and tighten the skin, this tool employs electromagnetic radiation to create an electric current that warms the dermis. Because it is chromophore-independent, radiofrequency may be used safely on all skin types, unlike other energy-based modalities like the CO<sub>2</sub> laser, which can cause scarring and infection. From a monopolar RF device, subsequently bipolar and now fractional bipolar RF (FRF) [39] have emerged.

#### Lasers

Acne scars may be treated using laser surgery, which is becoming more common. Traditional ablative lasers destroy both the epidermis and the dermis, but nonablative lasers just destroy the dermis and are thus less invasive. Fractional laser resurfacing, which involves delivering energy in minute columns of epidermal and dermal tissue, has recently been utilised for acne scars. In terms of safety, recovery time, and results on the three kinds of atrophic acne scars, each of these laser treatments is unique [40]. Where We're Going and What We'll Have to Do

Personalized treatment approaches, improved platelet-rich plasma and plasma gel formulations, the investigation of combination therapies like PRP with microneedling, rigorous long-term follow-up studies to assess treatment durability, standardised treatment protocols, continuous safety monitoring, potential regulatory oversight, cost-effectiveness evaluations, and increased patient education are all potential next steps in the management of acne scarring. Acne scar

treatment in dermatology will develop along these lines.

#### Conclusion

Scarring from acne is difficult to cure and calls for a deep understanding of the underlying processes at play. Microneedling, platelet-rich plasma (PRP), and plasma gel treatments, as well as other similar approaches, show promise in a variety of dermatological contexts for accelerating wound healing and enhancing skin texture. Individualized strategies, cutting-edge formulations, and the investigation of combination treatments are emerging as crucial next steps after the success of these techniques in boosting wound healing and skin renewal. Challenges such as varied treatment responses, long-term result durability, cost-effectiveness, safety, and uniformity must be addressed to realise the promise of these therapies.

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