

ACNE SCAR; A REVIEW OF CLASSIFICATION AND TREATMENT

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Abstract

Acne is a common disease that is more common in adolescents, with more than 80% of the cases and 5% of older people experiencing it. Approximately 14% of the cases have psychological and social consequences for the individual. The main types of acne scars, which include icepick, rolling, and boxcar are discussed in this article. This classification system for acne scar enables the physician to identify precisely the subtypes of the wound. After defining the type of wound, appropriate and effective treatment protocols can be developed. There are numerous treatments for acne scar, the most important of which are discussed in this article.

Keywords: Acne scars, icepick scars, rolling scars, boxcar scars, acne scar treatment.

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INTRODUCTION

Acne vulgaris prevalence is about 90% among teenagers and in some case it remains to adulthood with a main psychosocial effect [1-3]. Scarring result of these acne usually appearance in face and body of patients that has negative effect on general patient functional and social well-being[4]. Many inflammatory skin diseases eventually lead to scarring, the most important of which are acne, wounds, and deep burns[5]. Acne scars are categorized into hypertrophic, atrophic, or keloidal with atrophic is the most common. Atrophic scars are additionally divided into icepick, rolling scars, and boxcar[6]. Ideal treatment can occur base on scar type[6].

Many methods utilize for acne scar treatment including laser, cosmetic filler, microneedling, local tumescent, Subcision, chemical peels, onion extract.

The aim of this study is introducing of type of scar related to acne and therapeutic method for each one.

Pathogenesis

The acne pathogenesis is associated with many agents, like enhanced sebum production, change of the quality of sebum lipids, androgen motion, the proliferation of Propionibacterium acnes in the follicle, and follicular hyperkeratinization[7]. Raised sebum excretion contributes to the improvement of acne. Neutral and polar lipids produced by sebaceous glands serve a variety of functions in signal transduction and are included in biological pathways[8, 9].

In addition, fatty acids do as ligands of nuclear receptors like PPARs. Sebaceous gland lipids exhibit direct pro-and anti-inflammatory properties, while the induction of 5-lipoxygenase and cyclooxygenase-2 pathways in sebocytes leads to the creation of pro-inflammatory fats. Moreover, hormones similar to androgens control sebaceous gland size and sebum secretion. Androgens only promote sebocyte proliferation in cell culture; whiles PPAR ligands are needed for the induction of differentiation and lipogenic activity[10]. On the other hand, keratinocytes and sebocytes are stimulated by P. acnes via TLR, CD14, and CD1 molecules[11]. Pilosebaceous follicles in acne lesions are envired by macrophages expressing TLR2 on their surface. TLR2 activation leads to a triggering of the nuclear transcription factor and thus the production of cytokines/chemokines, phenomena observed in acne lesions. Furthermore, P. acnes induces IL-8 and IL-12 release from TLR2 positive monocytes[8, 12].

Many people that have inflammatory acne are disposed to broad scarring, which is challenging to treat. The information about acne scarring pathogenesis is little. Scarring is a result of abnormal wound healing or resolution after the injury that happens in the sebaceous follicle through inflammation of acne. Immune responses of Cell-mediated related to the clearances of antigen and tissue damage. Studies showed that in timed inflamed wounds of identified period (6 hours, 24 hours, 48 hours, 72 hours, and 6 to 7 days) the number of CD4 T cells present in wounds from scares was about half those originate in lesions of without scares. In wounds of 6 to 48 hours, the amounts of blood vessels, macrophages, and vascular bond molecules were great and comparable in both patients sets, while the numbers of Langerhans cells and the level of cellular activation was low in lesions from scares, suggestive of an unsuccessful answer to the causal antigens. However, for scares treatment there was an response upregulation with more cellular activation, influx of macrophages and skin homing memory/effector cells[13, 14].

Types of acne scar

Acne scars are divided into three main groups. icepick scars, rolling scars, and boxcar scars[15] (**Figure 1**).

The reason for the placement of acne scars in these three main categories is that the scars have both natural biology as well as specific physical properties.

Depth, width, and 3D architecture are three crucial factors in determining the type of acne scar.

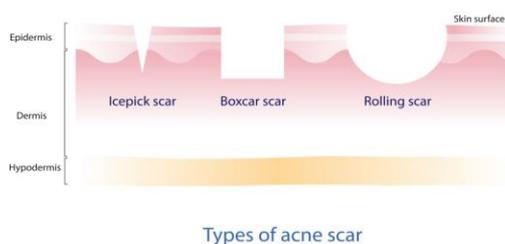


Figure 1. A novel classification system: 3 basic scar types—icepick, rolling, and boxcar

Rolling Acne Scars

The rolling acne scars on the skin resemble strips from the dermis to the subcutaneous tissue.

They are usually 4 to 5 mm wide. Anchoring the abnormal fibrous layer of the dermal layer to the subcutaneous layer results in the shading of the healthy skin surface [15] (Figure 2).

Correcting and treating the subcutaneous layer makes it successful in treating this type of scar.



Figure 2. Rolling scars along the cheek.

Boxcar Scars

Boxer scars are divided into two shallow boxer scars and deep boxer scars according to their depth. Boxcar scars are round to rectangular depressions with sharply demarcated vertical edges, similar to varicella scars. These scars are wider at the surface than icepick scars. They are not tapered to a point at the deep layer [15].

These types of scars are either shallow (0.1 to 0.5 mm) or deep (greater than 0.5 mm) and are usually 1.5- to 4- mm in diameter (Figure 4).

These scars may need to be removed if they are more than 3 mm in diameter (deeper boxcar scars). However, if these scars are not sincere, they can be treated with fractionated laser therapy [4, 6].



Figure 4. Boxcar scars on the cheek.

Icepick Scars

Icepick scars are <2 mm (deep narrow) cylindrical depressions that occur at the infundibulum. And extends vertically to the deep dermis layer or subcutaneous layer [15].

These types of scars are not always, but are usually recognized with a wider surface opening than the deep layer (Figure 5). Their depth is below that arrived with regular skin-resurfacing alternatives.

Due to the Icepick scars depth, punch excisions and AFL are rather useful [4, 6, 16].



Figure 5. Icepick scars on the cheeks.

The difference between the three main types of scars is illustrated in Figure 6.



Figure 6. The difference between the three main types of scar.

Other less common scars

In addition to these three main types of scars, there are other scars, including sinus tracts, hypertrophic scars, and keloidal scars [15, 17]. These types of scars are less common and may develop after acne treatment, which is discussed below.

Hypertrophic and Keloid Scars

Hypertrophic and keloidal scars are associated with excess collagen deposition and decreased collagenase activity [16].

Hypertrophic scars are pink, raised, reddish, pruritic lesions caused by an overgrowth of fibrous connective tissue but unlike keloids, they do not extend beyond the margins of the acne. They are more commonly seen than keloids and may be smaller in size than them (Figure 7). These scars are usually caused by thermal injuries and injuries involving the deep dermis layers of the skin and are prevalent in all races. These scars remain in the borders of the main wound [8].

Keloids are raised, reddish-purple lesions produced by overgrowth of fibrous connective tissue and develop after healing of a skin injury. After an injury has occurred, the skin cells and fibroblasts begin multiplying at the site of the wound to repair the damage. In the case of keloid formation, these cells do not stop after the wound has been filled. These scars proliferate beyond the borders of the main injury [8]. In people with dark skin, hypertrophic and colloid scars are more common [15].

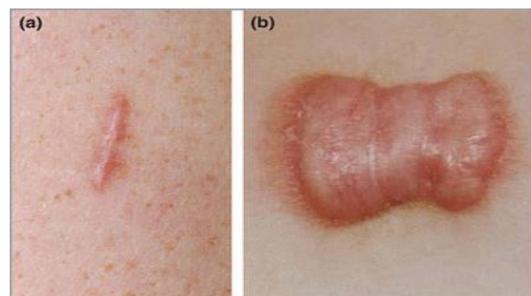


Figure 7. (a) Hypertrophic and (b) Keloid Scars

Treatment of acne scar

Several methods have been used for acne scarring treatment [18, 19]. Each method can select for scar treatment base on scar typing. Table 1 shows methods that utilized for each scar type.

Table 1. Methods for acne scar treatment bas on scar type in various studies

Type of scar	Treatment procedure
Rolling acne scar	<ol style="list-style-type: none"> 1. IPL[20] 2. PDL[21] 3. Picosure laser[6] 4. Local tumescent anesthesia[6] 5. Trichloride acid peel[6] 6. Ablative fractional co₂ laser[22] 7. Hyaluronic acid gel injection[23] 8. Subcision[24] 9. Fractional non-ablative erbium[25] 10. Microneedling[26, 27] 11. Er:YAG laser[28] 12. 1450-nm Midinfrared Laser and 30% Trichloroacetic Acid Peels[29] 13. Subcision and 1320-nm Nd:YAG Nonablative Laser[30, 31] 14. 70% TCA [32] 15. combined subcision and dermaroller[33] 16. Microneedling combined with PRP[34]
Boxcar scar	<ol style="list-style-type: none"> 1. Excision[15] 2. NAFL or AFL laser[6] 3. TCA peel[6] 4. AFL LP Erbium[6] 5. 1,540-nm fractional laser[25, 35] 6. Er:YAG laser[28] 7. 1450-nm Midinfrared Laser and 30% Trichloroacetic Acid Peels[29] 8. Subcision and 1320-nm Nd:YAG Nonablative Laser[30] 9. 70% TCA [32] 10. Combined subcision and dermaroller[33] 11. Microneedling combined with PRP[34] 12. Fractional bipolar RF [36]
Hypertrophic and Keloidal scar	<ol style="list-style-type: none"> 1. NAFL[6] 2. TCA peel[6] 3. PDL[37] 4. Triamcinolone Acetonide[38] 5. Corticosteroid injections[39] 6. Silicone gel sheeting[40] 7. Fluorouracil[41] 8. Onion extract[42] 9. fractional CO₂ laser[43, 44] 10. 70% TCA [32] 11. combined subcision and dermaroller[33] 12. cryosurgery[45] 13. oral isotretinoin[46] 14. Focused Radiofrequency[47] 15. combined intralesional triamcinolone and verapamil therapy[48] 16. pressure garment therapy (PGT)[49] 17. intense pulsed light (IPL)[50] 18. fractional carbon dioxide laser with low,medium or high-dose isotretinoin[51, 52] 19. Microneedling and Platelet-Rich Plasma[53]
Icepick scar	<ol style="list-style-type: none"> 1. Excision [6] 2. Fractional ablative erbium laser[6] 3. Fractional ablative co₂ laser[6] 4. RF[6, 54] 5. Microneedling[6] 6. TCA peel[6] 7. 70% TCA [32] 8. combined subcision and dermaroller[33] 9. Platelet-rich plasma[55-58]

Silicone-based therapies

One of the main option for hypertrophic scars treatment is silicone-based [59]. Numerous silicone products are presented for prevention and treatment of acne scar[60]. Silicone gel sheeting (SGS) has ability in increasing of stratum corneum hydration and decreasing of water evaporation from the skin, proposing occlusion and hydration is the mechanism of silicone-based products action[40]. Because of hydration the

oxygen permeability is increased. Thus decreasing hypoxia-induced angiogenesis and tissue growth[61, 62].

Corticosteroid injections

Intraregional steroid injections have been used for treatment of hypertrophic and keloids scars[39]. However studies support corticosteroid injections using is second-line therapy to treatments with silicone-based product. Triamcinolone is a

commonly intralesional steroid therapy that improve scars through fibroblast proliferation inhibition, collagen synthesis decreasing and collagenase inhibitors inhibition[63].

Laser therapy

There are several types of lasers on the market that are used to treat skin problems. Clinical applications of skin laser devices are determined by the wavelength, laser light, and amount of laser absorption in the skin. Two general categories are defined for skin laser devices including ablative and non-ablative laser(NAR). The Ablative Laser such as CO₂, Erbium Yttrium-Aluminum-Garnet (Er:YAG), contains strong wavelength light that often destroys the outer layer of the skin. Non-ablative lasers can penetrate the inner skin layer and enhance collagen formation in this area, thereby helping to improve skin regeneration[5, 64-66].

Scar treatment with laser is an adjunct treatment after silicone and intralesional corticosteroids according to the UICRSM algorithm .PDLs lasers with 585-nm is used for treatment of hypertrophic scars and keloids[67]. In a meta-analysis study an average 72% rate improvement of hypertrophic scars and keloids by PDL laser was demonstrated[37]. A systematic analysis exhibits the PDLs laser have better effect on scar treatment compared to fractional nonablative laser 1540nm, neodymiumdoped yttrium aluminium garnet laser 532 nm, CO₂ laser 10 600 nm and erbium:YAG laser 2940nm[68]. Some studies shows good effect of ablative fractional laser compared to PDLs in scar treatment[69, 70].

Fluorouracil

Scar treatment with 5-FU was first suggested by Fitzpatrick in 1999[71]. The more effective of 5-FU tattooing has been confirmed than intralesional corticosteroids[72]. However The 5-FU injections in combined with intralesional corticosteroids and PDL treatments showed most effective in scar treatment[73-75].

Intense Pulsed Light (IPL)

Recently intense pulsed light (IPL) is found as an effective agent in scar treatment. IPL mechanism is not fully detected. But it possibly targets vascular proliferation that is essential for collagen overgrowth and it has effect on pigmentation that made during scar development [76-79].

Micro needling

Micro needling is a method that involves using thin needles to create hundreds of very thin holes on the skin. The small holes created by the microopen machine allow the skin to begin to regenerate by producing collagen and elastin. This process improves wrinkles, fine lines, pimples, wounds and pores [26]. A main concern related microneedling is clinical results dependent on subjective evaluation by physicians and/or volunteers. Meanwhile after Micro needling treatment the histopathological response are few[2, 80-82].

Chemical peeling

Chemical peeling is the most common cosmetic trials in scar treatment and has been utilized for years. This procedure is used chemical agents in which epidermis and dermis destruction controlled .Chemicals peels are categorized based on penetration depth including superficial (epidermis-papillary dermis), medium (papillary to upper reticular dermis), and deep peels (mid-reticular dermis)[83]. These chemical agent including resorcinol, tretinoin, glycolic acid, lactic acid, salicylic acid, and trichloroacetic acid for superficial peels, phenol, TCA 35% to 50%, and Jessner solution (resorcinol, lactic acid, and salicylic acid in ethanol) Medium-depth peeling agents and Baker-Gordon or Litton phenol formulas for deep peeling agents[84-86].

Radiofrequency

Radiofrequency (RF) is used initially for skin regeneration. In this procedure the electromagnetic radiation produce an electric current that heats dermis and cause skin contraction and neocollagenesis. RF has reduced infection and risk

of scarring compared to ablative lasers[87-89].

Dermabrasion

Dermabrasion contains of manual dermasanding for removing epidermis and upper dermis used hydrogen peroxide and sandpaper for hemostasis, or using of rotating motorized hand piece attached to a serrated wheel, diamond-embedded fraises, and wire brush. Superficial skin layers removing cause smoother wound healing process and new collagen forming[90-92].

Subcision method

Subcision is a simple, safe, up-to-date method, with a different mechanism underlying the treatment of atrophic scars such as pimples - suture and chickenpox. Subgenus and RF fractional together are the best treatment for atrophic (depressed) scars. The subcutaneous procedure uses a method of releasing connective tissue or fibrotic tissue to treat and remove the pimple. The subsection is performed with a standard device with special needles called the needlepoint. The subcutaneous procedure is used to treat acne or so-called deep acne scarring[24, 93].

Cosmetic filler

Recently, the injection of fillers have been advanced in scar treatment, these fillers contain temporary fillers such as semi-permanent and permanent fillers[94]. Several cosmetic fillers have been developed for treatment of acne scars by swelling of tissue in these scars and stimulating of collagen production [95]. Many of acne scars respond successfully to cosmetic fillers, in some case these fillers combined with other component to increase their function[96]

Mesotherapy

Mesotherapy is one of the rejuvenation techniques that inject hormones, vitamins and plant extracts into the skin to help regenerate and tighten the skin as well as remove fat[97].

Carboxy therapy

Carboxy therapy is a medical method in which carbon dioxide is used for therapeutic purposes. During treatment with medical sterile carbon dioxide gas applied to the skin or adipose tissue, a sign of oxygen deficiency is sent and the organism replaces carbon dioxide with oxygen within minutes[98].

Combinational method

Many studies have investigated the efficacy of combination therapeutic method to treat acne scars. In meta-analysis study the PRP combined with ablative fractional CO₂ laser was investigated for acne scars treatment by investigative clinical trial results and patient improvement rates were significantly increased after combination laser and PRP than laser alone[99]. In another systematic review study the efficacy of PRP adding to the microneedling was investigated for acne scars treatment and they showed the PRP addition to microneedling improves acne scar and furthermore improves subjective patient satisfaction[53].in numerous other studies the combination of dot peeling with Subcision and fractional laser irradiation[93], Subcision-suction method[100], carbon dioxide (CO₂) laser with subcision[100], fractional carbon dioxide (CO₂) laser resurfacing with punch elevation[101], Fractional Erbium-YAG Laser and Platelet-Rich Plasma[102], Microneedle Fractional Radiofrequency and Topical Poly-Lactic Acid[103], Autologous Cell Regeneration Techniques with Dermabrasion[104] and promising results were recorded.

CONCLUSION

There are no comprehensive guidelines available to optimize acne scar treatment. There are various multiple management options, both medical and surgical, and laser devices are useful in obtaining significant improvement. Further primary research, such as randomized controlled trials are needed to quantify the benefits and to establish the duration of the effects, the cost-effective ratio of different treatments, and the

evaluation of the psychological improvement and the quality of life of these patients.

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