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Therapeutic approaches to reducing atrophic acne scarring

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Abstract Atrophic acne scars are a common and undesirable outcome of acne vulgaris related to both its severity and delay in treatment. Such scars can be classified according to the depth and shape of the collagen loss: ice pick, boxcar, or rolling. The presence of atrophic acne scars can compromise the self-esteem and psychologic well-being of patients, creating a challenge for both the patient and the dermatologist.

Introduction

Atrophic scarring is often a common and unfortunate permanent complication of acne vulgaris with an estimated prevalence of 11-14% of patients, creating a significant impact on quality of life.[1] Scarring is the net result of damage to the skin during the healing of active acne lesions and may affect at least 95% of patients with acne; scarring is associated with acne severity and delay in treatment.[2] Atrophic scars represent depressions in the skin, reflecting an absence and disorganization of dermal collagen and elastin. They are classified according to the depth and shape of the loss of collagen as ice pick, boxcar, and rolling scars.[3] Sixty to seventy percent of such scars are the ice pick type, which represents conical depressions with borders converging onto a single point in the deep portion of the dermis or subcutaneous tissue. Boxcar scars have edges that descend vertically and are divided into shallow or deep scars that comprise 20-30% of scars. Rolling scars are relatively shallow, curved depressions and comprise the remaining 15-20% of scars.[4]

Treatment of acne scarring creates a challenge for both patients and dermatologists. Many options are available: laser surgery, radiofrequency intervention, chemical peels, chemical reconstruction of skin scars (cross) technique, dermabrasion, needling, subcision, punch techniques, fat transplantation, and other tissue augmenting agents.[5] Each scar type has a different structural cause warranting a personalized approach. Little literature exists about the safety and efficacy of combining such procedures and devices.

Laser surgery

Laser surgery is an effective treatment and is easier to use than other modalities. Different types of lasers, including nonablative and ablative lasers, are very useful in treating acne scars, with the exception of deep ice pick scars. The mechanism involved concerns stimulating the fibroblasts to replace lost dermal components of the collagen and elastin to fill the scar defect.[6]

Ablative lasers

Traditional lasers, such as the carbon dioxide and erbium:yttrium-aluminum garnet (Er:YAG) laser, are the most commonly used ablative lasers for the treatment of acne scars.

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The ablative 10,600-nm carbon dioxide laser emits far infrared light that targets absorption by water molecules. This laser provides significant and sustained clinical improvements with a single treatment session; however, its use is limited due to the ensuing prolonged recovery.[7]

The Er:YAG laser is an ablative laser that emits light at a wavelength of 2940 nm. Water molecules absorb 2940-nm wavelengths significantly more efficiently than they do light from the 10,600-nm CO2 laser. As a result, the Er:YAG laser reduces damage to surrounding structures, with the laser energy being confined to a more superficial depth. Because of reduced heat generation, there is a reduced coagulative effect, and hemostasis can be more difficult to maintain during and after the procedure.[8]

Nonablative lasers

Skin remodeling with nonablative lasers has become increasingly popular for the treatment of acne scars. These systems do not remove the tissue; rather, they aim to resurface the skin through thermal induction of collagen remodeling in the dermis by targeting water as its primary chromophore. They decrease the risk of side effects and the need for postoperative care. Among the nonablative lasers most commonly used are the 1320- and 1064-nm neodymium-doped yttrium aluminum garnet (Nd:YAG) and the 1.450-nm diode lasers.

The 1.320-nm Nd:YAG laser cools the surface of the epidermis while penetrating into the deeper layers of the skin with infrared wavelengths. These wavelengths target the underlying water and collagen without disrupting the epidermal layer.[9]

The 1064-nm Nd:YAG laser penetrates more deeply into the dermis and exhibits a greater extent of absorption by oxyhemoglobin and melanin. There are several varieties of 1064-nm Nd:YAG lasers, including the short-pulsed, long-pulsed, and Q-switch lasers. In general, clinical outcomes for atrophic scars range between 20% and 30% mean improvement; however, recovery and side effects are favorable compared with ablative systems.[10]

The 1450-nm diode laser in the infrared spectrum targets the water in the upper portion of the dermis, remodels the skin's underlying collagen, and promotes formation of new collagen. Studies of patients with acne treated with the 1450-nm laser atrophic show outcomes equal to or greater than those treated with Nd:YAG lasers.[11]

Fractional photothermolysis

A new concept in skin laser therapy, known as fractional photothermolysis, was designed to create microscopic thermal wounds to achieve homogeneous thermal damage at a particular depth within the skin.[12] Fractional lasers, both ablative and nonablative, are based on the well-established concept of fractional damage to the skin, which enables rapid healing compared with conventional ablative lasers because the intervening skin remains intact for the reparative process. The benefits of this system include less downtime and fewer side effects compared with the conventional ablative laser and more effective tissue regeneration compared with nonablative methods.[13]

Nonablative fractional photothermolysis

This type of laser uses water as the chromophore and produces fractional photothermolysis by coagulating multiple columns of tissue that are separated by surrounding uncoagulated tissue. These columns of coagulated tissue create units, known as microthermal zones, that penetrate through the epidermis down to and into the deep portion of the dermis. The epidermis is coagulated, but the stratum corneum remains structurally intact and continuous.[12] Healing with this procedure is much faster because the fractionated nature of the treatment involves 15-30% of the skin surface area in any given treatment session. A heat shock zone and untreated tissue surround the coagulated microthermal zones, which permits rapid healing and remodeling of the treated areas. The faster healing time translates into less downtime and greater patient tolerance.[14] One of the most important lasers to use this technology is the 1550-nm erbiumfiber glass (Figures 1-3).

Microneedling radiofrequency

A revolutionary method of acne scar therapy is microneedling radiofrequency. Radiofrequency is nonionizing electromagnetic radiation with a frequency range between 3 and 300 GHz. This method does not use laser-light interactions but rather employs a fractional nonablative bipolar radiofrequency device and microneedling to remodel collagen and scars. The pulse of the energy is delivered via a fractional technique into the deeper part of the dermis, heating the region to induce skin injury and then eliciting a wound healing response that stimulates remodeling of the dermal collagen. Energy and heat break down the scar tissue, with minimal damage to the upper layers of skin. This process is gentle and has very little, if any, downtime, resulting in the disappearance of 25% to 75% of scars. Temporary erythema may occur.[15]

Chemical peeling

The process of destroying the outer damaged layers of the skin to variable depths depends on the concentration of the chemical agent being applied. Peels are stratified into four groups based on the histologic level of necrosis that they cause.[5]

1. Very superficial: Destruction of the stratum corneum without creating a wound below the stratum granulosum: glycolic acid 30-50% applied briefly for 1-2