Applied Lasers in Acne Scar Treatment: A Brief Review

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Abstract: Scar of Acne is a prevalent condition that may lead negative impact on the patients’ quality of life and is frequently might be worsened by aging. A number of options are available for the treatment of acne scarring, including retinoid, microdermabrasion, dermal fillers, and surgical techniques such as subcision. The aim of this study is to review the different laser modalities that have been applied in clinical studies for treatment of acne scars, and summarize current clinical approaches.

Methods: A Medline search spanning was performed on acne scarring. Search terms included "atrophic acne scars," "ablative," "non-ablative," "fractional," "non-fractional," "neodymium," "alexandrite," “pulsed dye” lasers, and results are summarized.

Results: Various types of lasers have been evaluated for the treatment of atrophic acne scars. While they are efficacious overall, they differ in terms of side effects and clinical outcomes, depending on patients’ skin and acne scar type. A new emerging trend is to combine lasers with other energy-based devices and/or topical.

Conclusions: Evaluation of the literature examining acne scar treatment with lasers revealed that clinical outcomes are dependent on various patient factors, including atrophic acne scar subtype, patient skin type, treatment modality, and side-effect profile.

Keywords: Acne, Scar, Laser therapy.

INTRODUCTION

Lesions caused by the obstruction of sebaceous gland duct in the face, neck, back, shoulders and chest are called pimples or so-called acne [1-3]. These lesions can occur in the form of blackheads, whiteheads, pustules, cysts and nodules. Acne or pimple is a skin disorder that occurs during adolescence and persists until the end of the youth period. Acne can be seen in most teens and remain by the end of youth age and even in those aged above thirty years. Pimples usually heal after a few years, but you can't ignore them because even if some pimples heal, the subsequent scar would remain until the end of life that is aesthetically problematic [1, 3, 8]. Fortunately, today, with the advancement of laser technology, numerous treatments are available along with different devices to treat acne scar that can significantly improve the appearance of individuals with an acne scar. The dermatologist is the person who decides on the type of device used to treat and the number of sessions [9-11].

TYPES OF ACNE SCAR

Acne can be mild, moderate, or severe. As it can be seen in the Figure 1, mild acne causes less irritated whiteheads or blackheads with or without a few red bumps or pustules. But severe acne, especially cystic acne, is likely to leave permanent scarring as it heals. Most of the time the light red or brown marks left behind by healed acne clears up over time on their own.

There are some classes of acne scars according to the available classifications. Table 1 summarizes the types of scars. Acne-induced scarring depends on three factors: severity of facial pimples, family history of
acne scars, and duration of acne before treatment [1,11-12].

Figure 1: Skin Acne.

The more severe the facial pimple is, the more likely the scar will develop. Scars are seen in almost 100% of raised and cystic acne. Some people are prone to scarring in the family, which means that the scarring remains in other family members after creation of a wound or skin lesion. These patients are more at risk of scarring due to facial pimples. The later a person begins to cure his/her illness, the more likely the risk of acne scars will be. If the person does not take any acne treatment measure for more than three years, the chance is greatly increased. This highlights the need for rapid treatment for facial pimples. Basically, acne scars are divided into raised and depressed groups. Different methods are used to treat scars caused by facial pimples [12-15].

Table 1: Types of Scar

<table>
<thead>
<tr>
<th>Scar acne</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial macular scar</td>
<td>It occur in epidermis and demnis surface as pigments in macula and erythema</td>
</tr>
<tr>
<td>Ice-Pick scar</td>
<td>Conical scar, with a upper wide surface area extending toward the reticulum</td>
</tr>
<tr>
<td>Rolling scar</td>
<td>Wavy form, there is a defect in the dermo-epidermal grafts due to subcutaneous fat injury</td>
</tr>
<tr>
<td>Boxcar scar</td>
<td>The oval form, the surface diameter is greater than the depth</td>
</tr>
<tr>
<td>Hypertrophic scar</td>
<td>Overgrowth of scar margins</td>
</tr>
<tr>
<td>Keloid</td>
<td>Excessive extra tissue outside the scar border</td>
</tr>
</tbody>
</table>

TREATMENT USING LASERS

There are several laser treatments for acne scar: excision, punch excision, subcision, dermabrasion, chemical peeling, ablative microdermabrasion, ablative invasive lasers, non-ablative non-invasive lasers, fractional lasers schematically shown in Figure 2 [1, 5, 12-16].

Laser systems used to treat acne scars are divided into three categories. Brief information of each category is summarized as below:

Category 1

It consists of carbon dioxide lasers and erbium lasers. These lasers are often used to treat acne-induced sunken lesions. These lasers remove superficial layers of skin with micron precision and stimulate the lower parts of the skin to produce collagen and thereby treating scarring. Numbing creams are used before using these lasers that make the laser treatment less painful. The treated site is usually red up to a few days, which can be improved by doctor-recommended care and the use of skin regeneration creams. Improvement of acne scars in this method takes an average of three laser sessions for one to three months [10-19].

Category 2

These are non-destructive Pulsed Dye Lasers (PDLs) used in the treatment of acne scars. These lasers make changes in the lower skin layers by preserving the upper layers and are usually used to treat acne-induced raised and red scars and do not require preoperative numbness [5, 20-24].

Category 3

There are a new generation of lasers known as fractional lasers used in the treatment of scar acne [1, 10, 16]. These lasers, which have been on the market for several years, work by destroying a small portion of the skin but leaving most of it intact. This allows the intact part of the skin to quickly heal its damaged part. This technology reduces the complications of destructive lasers and help the patient go back to his work faster, but requires more sessions in order to achieve therapeutic effects [15-16]. Fractional CO2 laser is a highly advanced technology in the treatment of acne scars; pimples, burns, pores, skin cracks; skin rejuvenation and tightening that are common seen in today’s society. Since most clients are employed or university students and can’t cover or dress their faces with a conventional Co2 laser for several weeks, it is a very acceptable method to treat a variety of skin lesions including rejuvenation, removing scars, acne,
burns or surgery, and skin cracks that is almost not painful and requires no rest or dressing [10, 15, 26-31]. Fractional Co2 laser is a modified Co2 laser that does not have the side effects of a conventional Co2 laser but we can use its good advantages in treating the following lesions. The fractional Co2 laser is used to treat the following lesions [29-31]:

- Moderately deep and deep wrinkles
- Scarring (skin fossa), or acne
- Skin aging
- Scarring from burns or cuts
- Postoperative scars
- Open skin pores
- Skin tightening
- Eyelid wrinkles
- Abdominal and body skin cracks
- Aging-induced spots

**Differences between a Conventional Co2 Laser and a Fractional Co2 Laser**

A fractional Co2 laser, unlike a conventional Co2 laser, requires no anesthesia or numbing medication. The patient can only be laser treated with a numbing cream with minimal discomfort [10, 11].

Also, unlike the conventional Co2 laser, the patient does not require dressing in this new fractional Co2 method and only uses skin regeneration creams and watch out for sunlight. Fractional Co2 skin regeneration takes between 6 and 10 days, whereas it takes between 2 and 3 weeks in the case of conventional Co2 lasers. In fractional method, the patient’s skin is red only for 6-10 days, whereas the redness can persist for 2-6 months in a conventional Co2 laser. Skin darkening is a rare event in a fractional Co2 laser. Fractional Co2 lasers can also be used on the neck and back of the hands or other parts of the body to treat a variety of skin lesions such as rejuvenation of the back of hands, skin spots, abdominal cracks, and burn or surgery scars [10, 23-31].

**Fractional Erbium Laser**

Fractional Erbium 2940 nm Laser is the newest laser in the treatment of facial wrinkles, open pores, acne scars, and face whitening. If you want to achieve a better understanding of the mechanism and effects of this laser, it's best to consider it as rival of the fractional CO2 laser, because its mechanism of action is very similar to fractional or fractional CO2 lasers. The only difference between Erbium 2940 and fractional CO2 laser includes its more invasive nature, less radiation penetration into the skin, fewer complications and less heat-induced skin damage, lower post-laser therapy burns, faster skin regeneration, so, it is subdivided into semi-invasive lasers (compared to fractional CO2). Therefore, it is better to use the above laser instead of the fractional CO2 laser for different treatments in the case of sensitive skins as well as on sunny days [16, 26]. Ultimately, this is an experienced physician who decides what type of device to use and for which skin
type (sensitive or non-sensitive- light or white to light brown or dark skin).

Photodynamic Therapy in the Treatment for Acne Scars

Photodynamic therapy (PDT)\(^1\) is an effective, fast, and non-toxic light-based procedure. Photodynamic therapy requires three components: a photosensitizer, a light source, and reactive oxygen spices.

Photosensitizers are topically applied solutions that cause certain types of abnormal cells to produce light-absorbing molecules called porphyrins. This change allows the light treatment to target the abnormal cells that are contributing to the acne. The use of photosensitizers distinguishes PDT from other forms of phototherapy [32].

After applying a photosensitizer mostly a topical one or either systemic intake, a medical light source is focused on the skin to activate it. This light source may provide blue light, red light, or intense pulsed light\(^2\) [32]. It is selectively absorbed by cancer and malignant cells and activated by appropriate laser or LED\(^3\) light [33]. These substances include photofrin, porphyrin, Aminolevulinic acid\(^4\), methylene blue, toluidine blue, curcumin, and so on. Radiation-induced activation of these substances leads to a release of free radicals, which are lethal to target cells. Photosensitizers may be administrated orally or injected, and the interval between drug use and treatment varies from minutes to several days depending on the substance and the tumor. This treatment is used to treat skin, head and neck, esophageal, stomach, lung, and bladder cancers and is being studied in the treatment of cancers such as prostate and pancreatic cancers. Photodynamic therapy has advantages over other effective cancer treatments such as surgery, radiotherapy, and chemotherapy, which include high operative speed, better effect on target tissue compared to surgery, less invasive property, less annoying side effects compared to radiotherapy, and chemotherapy [33].

5-ALA cream is rapidly applied to the skin and absorbed by hair follicles, adipose tissue, and growth bacteria or cells during the photodynamic laser therapy for acne scars. Light irradiation (Red light, IPL) results in damage to the target tissue, a decrease in number of the bacterium on the skin, and a decrease in the fat concentration in the producing glands, which ultimately improves the acne symptoms [34-37].

In summary, the therapeutic results of the use of 5-ALA creams with laser irradiation appropriate to the absorption peak of this photosensitizer in clinical studies have shown the efficacy of photodynamic therapy for acne scars. In addition, few therapeutic side effects have been reported in patients undergoing this treatment [36].

CONCLUSION

Laser and light based systems in particular have a key role in the management of acne scarring, which tends to be refractory to medical therapies. Fractional photothermolysis, the 1450-nm diode laser, and pulsed dye lasers have been used in the non-ablative treatment of acne scars as there have been reported significant success for such novel treatment approaches in compare to the conventional ones.


