Use of intense pulsed light in the treatment of scars

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Summary

Background Reducing erythema and infiltration of inflamed, hypertrophic, and colloidal scars have been a challenge for healthcare providers. Peer-reviewed scientific data for intense pulsed light systems are lacking.

Objective A chronicle of three patients who have participated in the treatment of inflamed, hypertrophic, and colloidal scars, using intense pulsed light.

Methods Intense pulsed light with a selection of wavelengths, pulse durations, and energy densities was used on patients with inflamed, hypertrophic, and colloidal scars.

Results A definite improvement in scar tissue was observed and achieved in all the cases.

Conclusion Intense pulsed light source with the correct outputs is an effective tool for the treatment and improvement of inflamed, hypertrophic, and colloidal scars.

Keywords: intense pulsed light, polychromatic light, laser, scars, keloid

Introduction

Cutaneous physiological repair can sometimes be disrupted, leading to abnormal scarring such as prolonged inflammation, hypertrophic, or keloid scarring.

The postoperative care for these conditions can be timely and difficult, with the need for massage, press therapy, and corticoid injections.

Lasers have shown their versatility in some treatment of scars, especially the pulsed dye laser at 585-nm wavelength. Intense pulsed light (IPL) is a new process in dermatology and is very often labeled as a "false laser" because of its broadband light emission. The objective here is to demonstrate, on three types of abnormal new or old scars, hypertrophic or keloid and in cosmetically visible areas such as lip, neck, or chest, that intense pulsed light is a remarkable, versatile tool. Using a multicolor filter configuration, we can work on irregular scarring, achieving in a few treatments almost normal light and a soft texture of the skin.

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Methods and materials

The intense pulsed light source is the Pulsar® IPL system, and is manufactured by Excel Photonix Systems, Crosshands, Carmarthenshire, UK. The Pulsar is a multifunction IPL system that can deliver polychromatic light ranging from 490 to 950 nm in wavelength and in variable pulse durations to suit the application.

Intense pulsed light is already well established in hair removal and photorejuvenation using the principle of photothermolysis, which states that selected light energy will be absorbed by specific chromophore in a target tissue with minimal absorption by the surrounding tissue. The idea of using intense pulsed light for scar treatment has stemmed from reading publications on the effects of pulsed dye lasers on scars and from looking at satisfactory results and publications in other dermatological application such as hair removal and photorejuvenation using IPL.

The main filters used in our three cases are 515, 550, 590, and 610 nm. These filters were empirically used on three types of scars: thin and red, thick and white, and inflammatory and retracting.

Figure 1 January 26, 2002, 550 nm, four passes at 20 J/cm^2.

Figure 2 March 15, 2002, 515 nm, four passes at 20 J/cm^2.

Figure 3 May 28, 2002, third session, 550 nm, four passes at 20 J/cm^2. Immediate erythema postsession.

Methods

First case

A young patient, 22 years of age, has an inflamed weeping scar on the neck, still persistent 1 year after a subtotal thyroidectomy.

We decided to use the 515 nm and the 550 nm filters alternately, with a repeat treatment every 6 weeks. The energy density was 20 J/cm^2 with four successive flashes to obtain intense erythema. Except for an uncomfortable sensation of burning and erythema that faded within 24 h, we observed a clear reduction in weeping of the scar, and a disappearance of the central white tissue.

Figure 4 September 23, 2002, no weeping and clear smoothness of scar.

Figure 5 December 18, 2002, tough and thick sternum scar, 610 nm, six passes, 20 J/cm^2.

Figure 6 March 10, 2003, result 1 month[1] after the third session, flattening, and no weeping of the scar.

Figure 7 June 20, 2003 last session 550 nm, six passes, 18 J/cm^2.

Second case

A 48-year-old female patient has a colloidal scar on the sternum, both thick and sensitive, following surgery for a heart bypass. No treatment for the scar was offered except for physiotherapy after 1 year, and the patient refused to accept the idea of *in situ* injection of corticosteroids, so we proposed to thin out and soften the scar by using IPL and the application of silicone pads (Cicacare/Smith-Nephew).

We needed four sessions of IPL treatment.

In the session we used 610 nm filter at 20 J/cm^2 and six successive flashes to "warm" the scar to restart a deep scarring process. We then used filters 515 nm and 550 nm alternately, thereby creating a superficial impact at the same fluence with multiple successive flashes stopping only when the patient was showing discomfort. No anesthetic cream was used, except for cold clear gel, which was replaced after each treatment flash.

We were surprised to notice that the scar had flattened and softened, making it less of an irritation to the patient.

Third case

A patient 70 years of age had a basocellular carcinoma of the upper lip. After removal of the carcinoma and suture, adhesive strips (Urgo-Strip®) were used.

Eight days after the operation, the sutures were removed and the scar looked as if it were healing normally.

In the 6 weeks that followed the surgical procedure, the scar stayed inflamed and sensitive. Also, we observed a retraction, causing a disfigurement (asymmetry) of the upper lip.

We proposed to the patient that she undergoe some IPL treatments in addition to a regular self-massage.

Figure 8 Final result, soft textured keloid.

Figure 9 April 16, 2002, baso-cellular carcinoma of the upper lip.

After four sessions, alternating between the 515 nm and 550 nm filters, we observed no weeping of the scar and a recovery *ad integrum* of the symmetry of the upper lip.

Protocol: intense pulsed light for Pulsar® (Excel Photonix Systems Ltd.).

Flash lamps are gas-discharge lamps of high intensity filled with xenon or krypton gas. These sources of light produce an optical radiation when an electrical current is passed through the gas. These lamps work in a pulsed mode and convert electrical energy stored in capacitor banks into optical energy covering the spectrum of light from UV, through the visible to the infrared. This light is polychromatic.

The treatment area of the quartz is 5 cm^2, but with the help of a PTFE masking block, a specific smaller area can be targeted for treatment and, at the same time, reduce the discomfort of the patient. In fact, refrigerated clear gel needs to be used with the Pulsar® as the quartz does not have an integral cooling system. The refrigerated gel needs to be applied for each treatment area.

In the three cases, other than an uncomfortable sensation of warmth and an erythema that lasted for 24 h, there were no complications.

If the scar is old, fibrous, or raised, we prefer to start treating with the 610 nm filter, then alternate between the 550 nm and 515 nm filters every 6 weeks. For thin, new, or erythematic scars, we only use the 550 nm and 515 nm filters.

Where it is possible, we combine a massage and a silicone pad to the IPL sessions, for comfort and to speed up recovery.

Discussion and conclusions

Apart from a second surgical procedure with all its risks, the treatment of scars can also involve the application of silicone pads, synthetic compress, massage, kneading, and injection *in situ* of corticosteroids or bleomycin.

The advantage of IPL is the possibility of changing the range of the spectrum of light to be used. This is the main difference from a laser which is a monochromatic

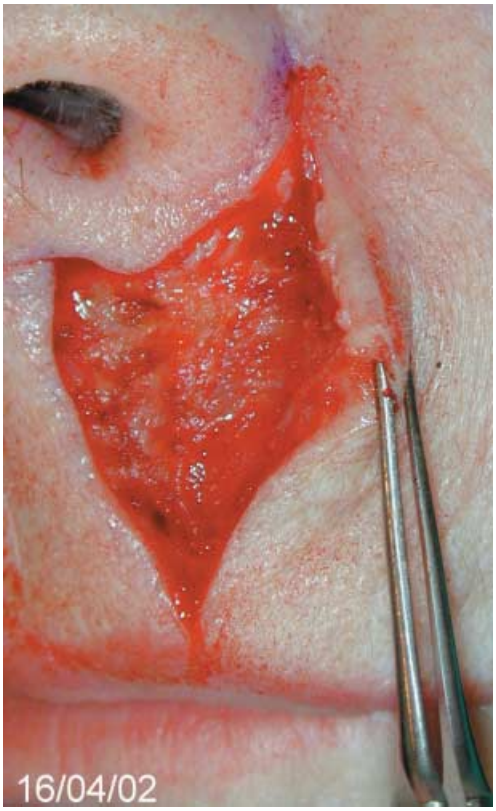

Figure 10 April 16, 2002, surgical ablation.

Figure 11 April 16, 2002, sutures following surgery.

source. Finally, the complexity of use is in the selection of the correct filter and the appropriate energy density.

The present use of the Pulsar® outside the depilation mode is user friendly because of its preset parameters. These correspond to a certain number of pulses, and pulse durations and delays. Apart from the filters, we can only alter the fluence. For scars, we have used a series of two to three successive pulses with a total maximum duration of 54 ms with pulse delays between 8 and 16 ms.

The filters are full glass filters (not dichroic) and the cavity is cooled by water, therefore blocking the water-absorbing wavelengths (near to far infrared). The cut-ons for the four filters used on the three patients are 515 nm (yellow green), 550 nm (yellow orange), 590 nm (orange red), and 610 nm (red), with a cut off at around 950 nm, respectively. The 610 nm filter is mostly used for hair removal, and because scars are usually red or white, no target chromophore will be reached by this filter, which is only used to warm collagen superficially and penetrate deeper to retrigger or break scar process. The 550 nm and 515 nm filters equally warm the collagen with a vascular impact that lightens erythematic scars.

Furthermore, the idea was not just to use the correct filter in relation to the color of the scar, but instead to concentrate on the penetration and thermal properties of light rays. With this in mind, the light was transmitted to tissue via noncooled quarts, with approximately 1 mm layer of clear cold gel on the skin. No local anesthetic was used before or during the treatments aside from new cold gel between each flash. In addition, we favored the use of medium energy densities rather than high fluence double flashes to make the treatment tolerable for the patients, and to avoid the risk of epidermal burns.

The combined use of different filters stimulates the scarring process that stabilizes after a few treatments. We think that the concomitant use of the press therapy or massage is useful to perpetuate the effect of intense pulsed light.

From a physiopathology point, flash lamps can act on both mechanisms put forward by nonablative laser remodeling:

- Vascular action (due to their shorter wavelengths, therefore release of vasoactivity)
- Mediators by the endothelial cells (activation of the platelets and freeing of the PDGF, the strongest stimulant for fibroblasts)

Figure 12 April 23, 2002, eighth day after the operation, removal of the sutures.

Figure 13 June 7, 2002, retraction and inflammatory thickening of the scar line, 515 nm, six passes, 17 J/cm^2.

- Nonvascular (thermal) effect (because of their long wavelengths, action is launched on the system equilibrium of heat shock proteins (HSPs) and of the transforming growth factor-beta (TGF-β), both strong modulators of the proliferation and fibroblastic synthesis)

The TGF-β is a cytokine "complex", with paradoxical effects depending on its surrounding. It has many subunits β 1, 2, and 3, many receptors, coreceptor and soluble receptors, latent and active forms.

The understanding of its regulation, effects, and role in photorejuvenation is far from being clear. What we do know, however, is that long-lasting high heat does transform latent into active form and that, to date, there is no study available to clarify or establish the action of nonablative lasers. Two studies suggest optimizing trials by the use of chromophores, autologist blood to treat atrophic scars, or exogenous chromophores to treat keratosis.[4,5] These studies are opening the way for so-called photodynamic photorejuvenation or photoremodeling.

From these three cases of abnormal scar processes, hypertrophic labial and cervical old or sternal old keloid scars, we would like to suggest the interesting use of IPL.

Figure 14 December 4, 2002, improvement of the scar, reduction of the retraction, 550 nm, six passes, 19 J/cm^2.

It is up to each one of us to define a protocol; the Pulsar® nonetheless allows us to use different filters on top of the usual depilation and photorejuvenation. The physiopathogeny is hardly known but is centered around the freeing of HSPs (high spot proteins) and vasoactive mediators.

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