

# Non-ablative scar revision using a long pulsed frequency doubled Nd:YAG laser

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**OBJECTIVE:** Unsightly scars often are the only reminder of a previous surgical or traumatic wound. Surgical or ablative scar revision is sought by patients, sometimes unnecessarily. When the aesthetic drawback is mainly a result of hyper-vascularity or hyperpigmentation, these problems can be specifically targeted with a wavelength that is well absorbed by the two above mentioned chromophores. Some degree of epidermal tightening can also be achieved, which is sometimes useful in slightly atrophic scars.

The average improvement after 2–3 sessions was 81% (75%–100%) clearance, as judged by an independent observer who reviewed pre- and post-treatment photographs. No undesired effects were reported. All our patients were satisfied and required no further treatment.

**METHODS:** Selective photothermolysis by means of a long pulsed frequency doubled Nd:YAG laser

(DioLite<sup>™</sup> 532, IRIDEX Corporation, Mountain View, CA, USA) was used to eliminate the unsightly vascular and pigmented components of 23 mature scars (scars older than 2 years) in 22 consecutive patients. Energy densities of 17–22 j/cm<sup>2</sup> were used with a 500 micron spot, or 65–90 j/cm<sup>2</sup> with a 200 micron spot.

**RESULTS:** overall scar clearance averaged 81% after 2.4 treatments. Facial scars showed the best clearance averaging 94% after 2 treatments. Inframammary scars were the most difficult to clear averaging 46%. Postoperative undesired effects were immediate erythema and swelling that subsided within 2–10 hours and microcrusting on 19/22 (88%) patients that resolved within one week. No other temporary or permanent undesired effects such as purpura, hypo- or hyperpigmentation were noticed, even in patients with darker skin types. *J Cosmetic & Laser Ther* 2003; 5: 1–5

## Introduction

Dealing with unsightly scars is one of the most challenging tasks for the plastic surgeon. When the scars are due to traumatic events, their position, shape and depth can vary considerably. With traumatic scars, the original fresh wound is often contaminated. The margins of viable tissue are not always evident, and some wounds may be allowed to heal by secondary intention.<sup>1</sup> In other cases, superficial wounds are not treated optimally because the major effort is dedicated to the treatment of higher priority

injuries (ATLS). Furthermore, when the wound has healed and the scar is maturing, many patients fail to avoid UV exposure. Some patients even pursue suntans, trying to “mask” the disfiguring effect of the immature, red scar, often because they have not been properly instructed to avoid UV exposure. In all the aforementioned cases, the final result can be hyperpigmentation and fine telangiectasias in the scar area, which aggravate the aesthetic problem in a way that is sometimes considered irreversible. Many of these patients seek help by consulting surgeons who propose classic surgical scar revision techniques. These

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are designed to eliminate tension, to change the shape of the scars, to correct uneven tissue apposition or to fill tissue defects. All these methods are obviously invasive, require some kind of anesthesia, and lead to a new cicatrisation process that has a significant degree of unpredictability. Too many patients leave the consultation after their question: “Doctor, are you sure I will look better after the operation?” is answered with an insufficient degree of reassurance.

Scars may present structural changes at various depths. In some cases the main disfiguring effect of a scar is due to its colour mismatch with the surrounding skin. The shapes of these scars can be linear, macular or mixed, depending on the trauma that caused them. The discoloration may be due to hyperpigmentation, hypervascularity or a mixture of both. When these changes are inflammatory or post-inflammatory, they may fade in up to 18 months if adequately protected from UV exposure.<sup>2</sup> Mature scars that are hypervascular or hyperpigmented have little or no chance of improving spontaneously. This aspect can be best diagnosed using a viewing aid. Light reflected from the skin has two components: regular reflectance, or “glare” arising from the surface, and light backscattered from within the tissue. The regular reflectance contains the visual cues related to surface texture, whereas the backscattered component contains the cues related to pigmentation, erythema, infiltrates, vessels, and other intracutaneous structures. Unlike the backscattered component, regular reflectance preserves the plane of polarization of polarized incident light. Thus, viewing skin through a linear polarizer, under crossed linearly polarized illumination,

Type of Scar	Number of Sites
Hyperpigmented	3
Hypervascular	11
Combination	9

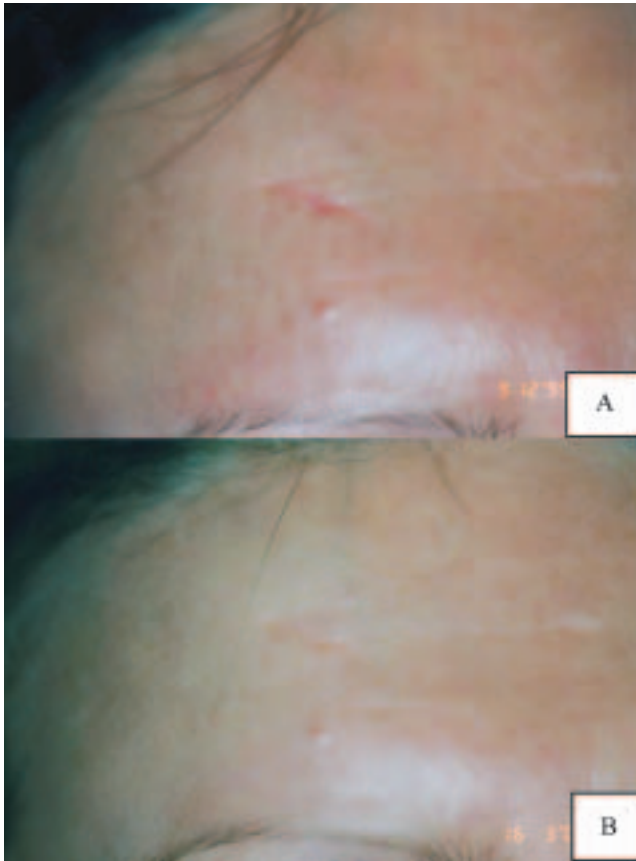
Table 1

virtually eliminates reflectance and gives the appearance of viewing “into” the skin.<sup>3</sup>

Various treatment modalities have been used to improve the appearance of scars. During the past decade, both ablative and non-ablative forms of laser surgery have emerged as primary treatment options for the various categories of scars. Several different wavelength lasers have been used to treat scars. CO<sub>2</sub> lasers and Erbium lasers have offered an ablative approach and have proven particularly useful for treating acne scarring. Pulsed dye laser at 510 and 585 nm has been shown to improve the texture, size and color of erythematous scars and have been shown to help prevent hypertrophic scar formation as a prophylactic approach.<sup>5</sup> We chose a 532 nm diode pumped KTP laser (DioLite<sup>™</sup> 532, IRIDEX Corporation, Mountain View, CA, USA). Since it is effective on superficial vascular and pigmented lesions<sup>6</sup> and has oxyhemoglobin absorption characteristics similar to those of PDL, we believed that it would be effective at eliminating the unsightly vascular and pigmented components of the scar without compromising the integrity of the skin. In order to avoid treating scars that might eventually improve spontaneously, this study

Pt. #	Location of Scar	Type of Scar Hypervascular (V) Hyperpigmented (P) Combination (C)	Cause	# Trx	Clearance	Comments
1	Forehead	V	Cut wound	1	90%	
2	Forehead	V	Cut wound	2	92%	
	Temporal	V	Cut wound	2	94%	
3	Leg	C	Abrasion	3	68%	
4	Hips	P (multiple, small scars)	Liposuction	2	69%	Skin type IV
5	Cheek	C	Cut wound	3	82%	
6	Hip	C	Stab wound	3	70%	
7	Knee	V	Avulsion	3	68%	
8	Cheek	V	Abrasion	3	84%	
9	Perioral	P	Burn	1	96%	
10	Cheek	V	Cut wound	3	80%	
11	Thigh	C	Sclerotherapy	1	80%	
12	Breast	C	Breast augmentation	3	46%	
13	Leg	C	Phlebectomy	1	70%	
14	Neck	V	Thyroid surgery	3	64%	
15	Forehead	C	Cut wound	2	88%	
16	Cheek	V	Cut wound	2	66%	
17	Buttock	P	Burn	2	82%	
18	Rt. Canthus	V	Cut wound	2	90%	
19	Nasal Tip	V	Burn	2	92%	
20	Glabella	V	Blunt trauma	2	80%	
21	Chin	C	Surgery	3	92%	
22	Knee	C	Surgery	3	68%	

Table 2



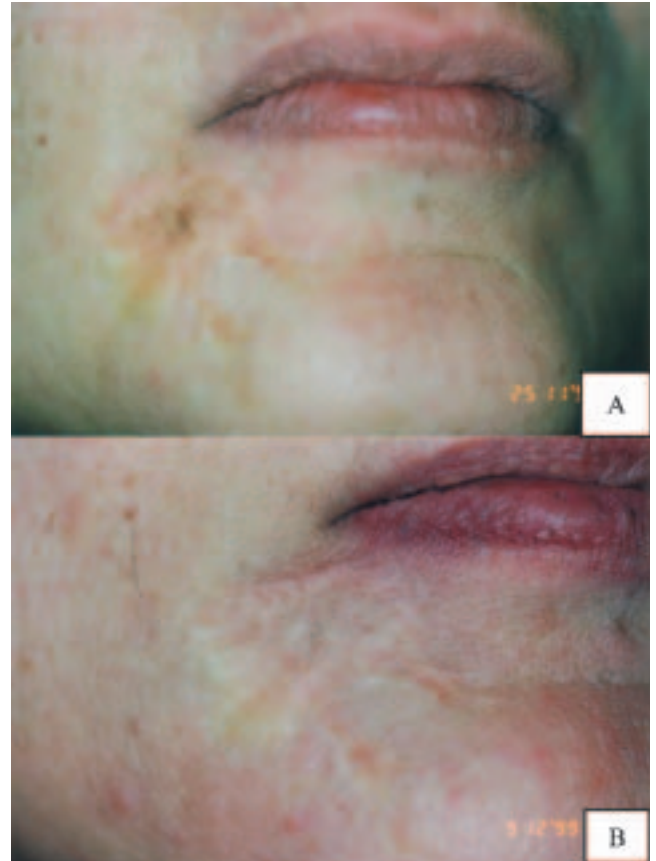
**Figure 1**  
Female patient with mature cut wound vascular scar on the forehead. A) Pre-treatment. B) 3 months after a single treatment with the DioLite 532 showing 90% clearance of the vascularity of the scar.

examines the effect of treatment on only mature scars (scars 2 years old or older).

## Materials and methods

A total of 22 patients accepted treatment on 23 anatomic sites. All patients were charged a fee for treatment. There were 18 females and 5 males giving a ratio of 3:1. Patients ranged in age from 18 to 59 years (mean age of 38 years) with Fitzpatrick skin types II – IV. The age of the scars ranged from 2 years to 54 years with a mean of 18 years. Scars were viewed and evaluated under cross-polarization and were identified as hyperpigmented, hypervascular, or a combination (Table 1).

All patients were treated with the DioLite 532 (IRIDEX Corporation) laser. The DioLite 532 is a diode pumped frequency doubled YAG laser producing green light at 532 nm delivered through a pencil-like handpiece. Spot sizes are available in 200, 500, 700, 1000 and 1400 microns. The spot sizes used in this study were 200 or 500 microns, permitting selective tracing of vessels within the scar without treating healthy tissue. All patients were viewed under cross-polarized illumination during treatment. Energy density used was 22 J/cm<sup>2</sup> for vascularity and 17 J/cm<sup>2</sup> for pigmentation. The laser automatically selected pulse duration, which ranged from 2 to 14 ms.



**Figure 2**  
Female patient with mature perioral pigmented burn scar. A) Pre-treatment. B) 2 weeks after a single treatment with the DioLite 532 showing 96% clearance of the scar.

Endpoints observed were vessel disappearance for vascular scars and darkening or greying of pigmentation for pigmented scars.

No anesthesia was required or used. Prior to treatment a thin (0.5–1 mm) layer of water-based gel was applied to the target area prior to treatment and left in place during treatment to serve as a heat sink. This was sufficient to provide both comfort and epidermal protection during the procedure. After treatment a thermal water based soothing cream was applied. Patients were advised to avoid sun exposure to the treated area and to apply sunscreen. Camouflage or make-up was permitted as desired. Patients were evaluated at 4 weeks after treatment. If required, additional treatment was provided. Photographs were taken and evaluated by an independent observer.

## Results

All patients had positive results. The average number of treatments required was 2.4. Average improvement after a single treatment was 52%. 18/22 (81%) of patients desired a second treatment. Average improvement after 2 treatments was 86%. Forty percent of patients desired a third treatment. Overall, excellent clearance of scars was achieved averaging 81% (Table 2).

Facial scars showed the best clearance averaging 94%

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after 2 treatments. Inframammary scars were the most difficult to clear averaging 46%.

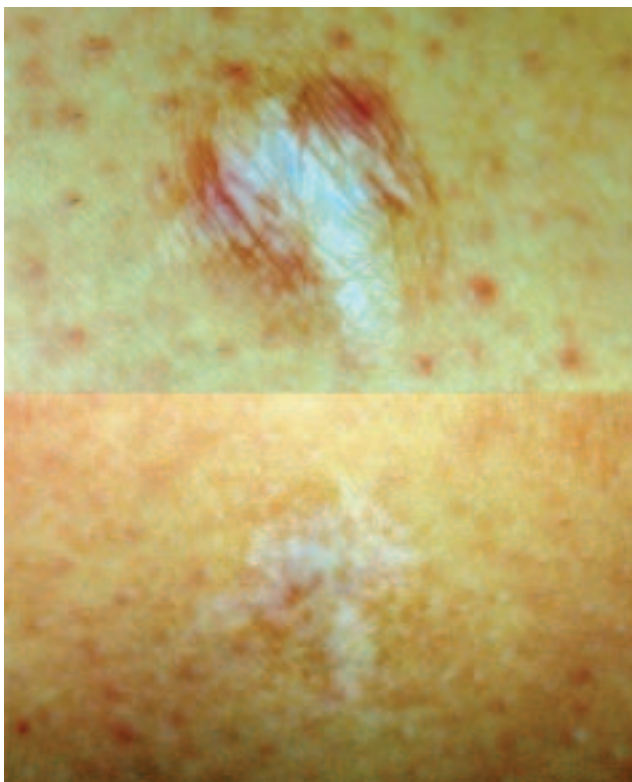
Postoperative undesired effects were immediate erythema and swelling that subsided within 2–10 hours and micro-crusting on 19/22 (88%) patients that resolved within one week. No patients experienced any purpura during or following treatment. Treatment did not induce any hypo- or hyperpigmentation even in patients with darker skin types.

Photographs of clinical results are shown in Figures 1, 2, 3 and 4.

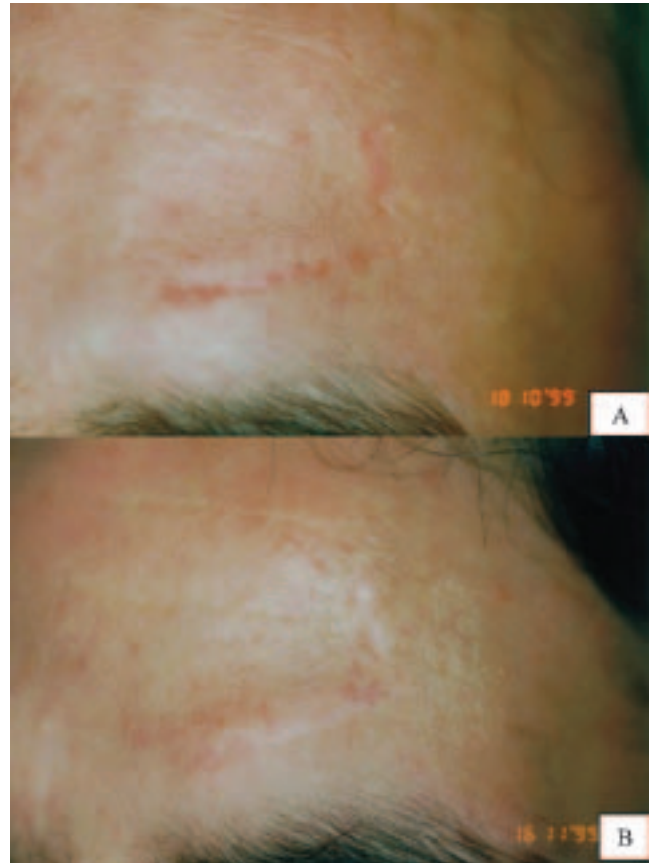
## Discussion

The 532 nm laser action mechanism is selective photothermolysis of small cutaneous blood vessels and hyperpigmentation. By eliminating the neovascularization around the scar and persistent hyperpigmentation, it is possible to reach a more uniform colour and texture of the scar compared to the surrounding skin, greatly improving the overall appearance.

In our study, some improvement in the texture, pliability and thickness of several scars was noted which would not be explained by the simple ability of the laser to treat vascular and pigmented lesions. In previous work the 585 nm Pulsed dye laser (PDL) has been shown to improve the colour, size, texture, flexibility and pruritis of erythematous and hypertrophic scars.<sup>4, 9, 10</sup> Authors have speculated on the mechanism of action including the possibility that the laser injury increases fibroblast



**Figure 3**  
Female patient with a 12 year old stab wound caused by a small shapeless pole. Skin color and texture are more homogeneous. Some degree of epidermal tightening is visible.



**Figure 4**  
Male patient with mature vascular forehead cut wound scar. A) Pre-treatment. B) 2 weeks after a second treatment with the Diolite 532 demonstrating 92% clearance of the scar.

activity resulting in the production of collagen and elastin. It is also possible that the direct thermal injury by the laser beam alters the collagen at the molecular level. The 532 nm laser and PDL have equivalent oxyhemoglobin ( $320 \text{ cm}^{-1}$  extinction coefficient for oxyhemoglobin for both lasers) absorption and should function similarly in tissue.

Preliminary studies have explored the possibility of using lasers that target oxyhemoglobin to prevent hypertrophic scar formation.<sup>5</sup> Results are open to question primarily since all of the scarred areas treated were less than one year old and still actively healing. Since scar maturation typically takes a year or longer, it is difficult to assert with certainty that scars treated early in the healing phase would have become hypertrophic had they remained untreated. This may potentially be another application for the 532 nm laser. Although similar results on vascular scars may be possible with the 585 nm<sup>8</sup> or 595 nm pulse dye systems,<sup>11</sup> the 532 nm laser offers several substantial advantages. The mild flushing and swelling which can last 2–6 hours typically produced by the 532 nm laser, are generally preferred to the purpura which can last 7–14 days produced by the pulsed dye laser. Higher melanin absorption may produce a better response with pigmented and pigment/vascular combination scars. Although not observed in this study, due to the higher melanin absorption there may also be a greater risk of epidermal injury on darker skin types with the 532 nm laser especially if pulses are overlapped. This may explain

the significant incidence of microcrusting experienced in this study.

## Conclusion

The diode pumped 532 nm laser is a safe and effective approach for improving the cosmetic appearance of

mature scars. In selected cases this treatment modality can be the first line of treatment for hyperpigmented and hypervascular mature scars. All our patients were satisfied and required no further treatment. However, if surgical scar revision has to be performed anyway, this non-ablative procedure does not impose any significant delay since the healing process lasts no more than three weeks.

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