

Treatment of Ecchymosis with a Pulsed Dye Laser

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Ecchymosis is a common side effect after injury and surgery. A pulsed dye laser (PDL) is the gold standard for vascular lesions and can minimize ecchymosis. Heating induces hemoglobin modification due to oxidative and heat reactions with the formation of bilirubin and methemoglobin, resulting in color changes to brown-yellow. Therefore, downtime following cosmetic procedures can be shortened.

Key words: Laser surgery, ecchymosis, pulsed dye laser, hemoglobin

INTRODUCTION

Ecchymosis arises following hemorrhage and extravasation of red blood cells into the subcutaneous tissue, leading to local skin discoloration. Ecchymosis generally takes a few weeks to resolve, which is difficult for some patients. Recently, pulsed dye laser (PDL) treatment has been reported as effective for mitigating ecchymosis discoloration [1-3]. We evaluated the color change of red blood cells following PDL irradiation in vivo and ex vivo.

MATERIALS AND METHODS

Laser Equipment and Parameters

A flashlamp-pumped pulsed dye laser (V-beam Prima™, Candela Corporation, Wayland, MA, USA) was used for two patients with purpura after facial trauma and eyebrow lift surgery. None of the patients

had a bleeding tendency or a history of taking anticoagulant medication. The PDL was set to a 10 mm spot size, the pulse duration to 6 ms, and the fluence to 6 J/cm². The investigation conforms with the principles outlined in the Declaration of Helsinki.

CASE DESCRIPTION

Patients

Case 1. A 60-year-old female with Fitzpatrick skin type III. Three days after facial injury, purple and green ecchymosis was observed on her cheek.

Case 2. A 56-year-old male with Fitzpatrick skin type IV. A week after a brow lift, green ecchymosis was observed on his cheek.

RESULTS

The ecchymosis resolved after PDL treatment, as demonstrated in the photographs (Figs. 1 and 2).



Fig. 1 61-year-old female patient: a: Before treatment (3 days after facial injury), b: 3 days after pulsed dye laser treatment (6 days after facial injury).

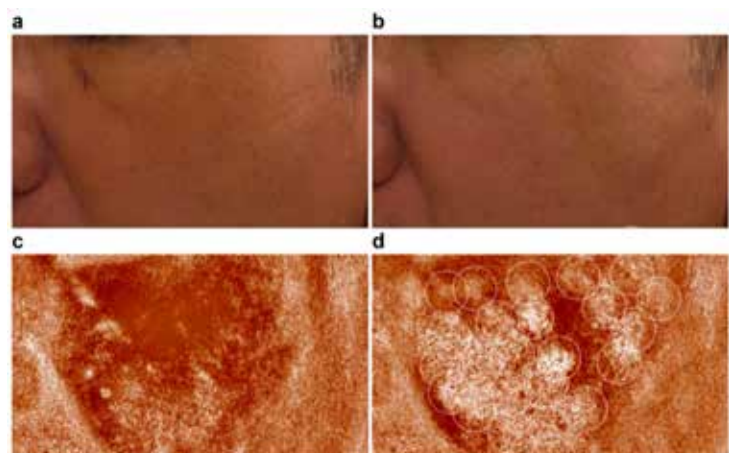


Fig. 2 56-year-old male patient: a: before treatment (6 days after surgery), b: 1 h after PDL treatment. Green ecchymosis changed to yellow. c: Before treatment (VISIA melanin mode), d: 1 h after PDL treatment (VISIA melanin mode). The color of the irradiated area was reduced.

Table 1

POD	color	pigment
0-6	Blue and purple	Deoxyhemoglobin
7-9	Green	Biliverdin
10-14	Yellow	Bilirubin

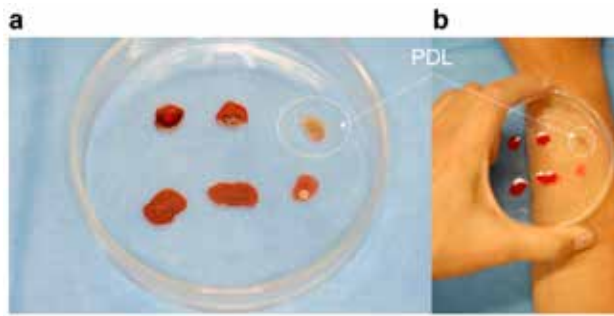


Fig. 3 a: Pulsed dye laser irradiated the dried blood on the glass. The color of the irradiated area changed to brown-yellow. b: The color of the irradiated area was less obvious than the purple and red skin color.

DISCUSSION

Ecchymosis is a common side effect after trauma, surgery, and cosmetic procedures. On days 0-6, the ecchymosis color is dark red, blue, or purple. On days 7-9 the color changed to green and on days 10-14 it changed to brown or yellow (Table 1). A pulsed dye laser (595 nm) targets the hemoglobin of extravasated red blood cells and changes its color. Brauer hypothesized that the laser-assisted resolution of ecchymosis is due to the preferential absorption of the 595 nm wavelength by oxyhemoglobin and deoxyhemoglobin in the extravasated blood [4]. This would explain why the best results were in areas of bruising that were violaceous to erythematous in color compared with the more sallow-appearing areas, which represents the degradation of bilirubin. Moreover, heating induces hemoglobin modification. Methemoglobin, which is

formed by photo-induced oxidation of hemoglobin, indicates that the temperature has reached the threshold value. The change is due to oxidative reactions with the formation of methemoglobin [5]. When blood is subject to heating, the first observable event is Met-Hb formation, followed by distorted heme protein formation and protein. We irradiated a pulsed dye laser to the dried blood on glass (Fig. 3a). The color of the irradiated area changed to brown-yellow. This color is less obvious in the color of skin than in purple and red (Fig. 3b). We hypothesized that immediate methemoglobin formation and slow degradation to bilirubin allow marked resolution of ecchymosis.

CONCLUSIONS

PDL treatment can reduce downtime by accelerating the resolution of ecchymosis after trauma or cosmetic surgery.

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STATEMENT OF CONFLICT

All authors have declared that there are no conflicts of interest.

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