

Pulsed-Dye Laser for Treating Ecchymoses After Facial Cosmetic Procedures

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Objective: To assess the safety and efficacy of a 595-nm pulsed-dye laser in the treatment of ecchymoses after facial cosmetic procedures.

Methods: Twenty consecutive patients with ecchymoses after facial cosmetic procedures underwent treatment with the pulsed-dye laser. A 10-mm spot size was used, with pulse duration of 6 milliseconds, fluence of 6 J/cm², and cryogen spray for 30 milliseconds with a 20-millisecond delay. The ecchymotic area was outlined; the lateral half was treated on postoperative day 5 or 6 and the medial half on postoperative day 7 to 10. Clinical photographs were obtained before and after each treatment. Three blinded independent observers evaluated the photographs and graded the ecchymoses on a scale of 0 to 3, with 3 indicating severe ecchymosis.

Results: The most common procedures associated with ecchymoses are cervicofacial rhytidectomy, facial liposculpting, thread lift, and minimally invasive subperiosteal midface-lift. Pulsed-dye laser treatment resulted in a 63% mean improvement in ecchymosis scores within 48 to 72 hours. The only adverse effects were mild edema and discomfort. Maximal efficacy of the laser treatment was observed when it was performed between 5 and 10 days postoperatively. Patient satisfaction was universally high.

Conclusions: Treatment with the pulsed-dye laser is safe and effective for expeditious resolution of postoperative ecchymoses after facial cosmetic procedures. It has the potential for wider application in treating postoperative ecchymoses on other areas of the body and after trauma.

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FACIAL COSMETIC PROCEDURES are often associated with unsightly postoperative ecchymoses, which may be a source of anxiety for patients and can be difficult to camouflage with makeup. Left untreated, ecchymoses can require up to 2 weeks to resolve and potentially can limit social activities. Although efforts to prevent ecchymoses with perioperative use of such agents as *Arnica montana* have been somewhat successful,¹ there have not been any significant advances in methods for treating ecchymoses after they have developed.

The pulsed-dye laser (PDL) is widely accepted as the treatment of choice for cutaneous vascular lesions.^{2,3} The medical applications of laser technology are based on the principle of selective photothermolysis.⁴ This process has 3 prerequisites: a laser wavelength that is preferentially absorbed by the targeted structure or chromophore, an exposure duration less than or equal to the thermal relaxation time of the target tissue, and sufficient laser energy per unit area (fluence) to reach damaging temperatures in the target struc-

ture with minimum collateral injury.² The principal chromophore for the PDL is hemoglobin in the red blood cells (RBCs). Current PDL technology achieves selective photothermolysis with minimal adverse effects.

Ecchymoses, which are fairly common after facial surgery, are caused by extravasation of RBCs into the soft tissues as a result of soft-tissue injury. We evaluated the safety and efficacy of the PDL in targeting these extravasated RBCs and, thereby, in promoting rapid resolution of ecchymoses after facial cosmetic surgery.

METHODS

The study was conducted in a private plastic surgical practice. Twenty consecutive patients with ecchymoses after facial cosmetic surgical procedures were enrolled in the study. Informed consent was obtained from all patients. All surgical patients in the practice are routinely instructed to stop taking aspirin, nonsteroidal anti-inflammatory drugs, and vitamins (especially vitamin E) for 2 weeks before a surgical procedure. All surgical procedures were performed by one of us (E.F.W.). No intraoperative hemostatic agents or drains were

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used. Standard pressure dressings were applied at the end of the procedure. Cold compresses were applied to the surgical site for the first 48 hours, which is routine in our practice. Patients were followed up closely during the postoperative period. All patients were seen on postoperative days (PODs) 1 and 3. Subsequent follow-up visits occurred at 48- to 72-hour intervals for up to 14 days after the procedure.



Figure 1. Eye protection was used during treatment with the pulsed-dye laser (Vbeam; Candela Laser Corp, Wayland, Massachusetts).

On POD 5 or 6, areas of facial ecchymoses were outlined, and the lateral half of the ecchymotic area was treated with the PDL (Vbeam; Candela Laser Corp, Wayland, Massachusetts). All treatments were performed in an office setting by a physician or nurse with extensive experience with the PDL. Standard laser precautions were observed, including eye protection (**Figure 1**). No topical anesthesia was used. Laser settings included a spot size of 10 mm, pulse duration of 30 milliseconds, fluence of 6 J/cm², and cryogen setting of 30 milliseconds set to be delivered 20 milliseconds before each laser pulse. Three sequential passes were made with the laser at each treatment. Patients returned after 48 to 72 hours, when the untreated (medial) third of the ecchymotic area was treated using the same settings. Patients returned after another 48 to 72 hours for follow-up. Clinical photographs were obtained before and after each treatment. Three independent observers blinded to the treated areas evaluated the photographs and graded the ecchymoses on a scale of 0 to 3 (0, no ecchymoses; 1, minimal ecchymoses; 2, moderate ecchymoses; and 3, severe ecchymoses) (**Figure 2**). Because no standardized ecchymotic grading scale exists, one of us (E.F.W.) developed this scale in an attempt to objectively standardize the results. Mean scores were calculated for before and after laser treatment for each observer and for each treatment session. A cumulative mean was computed for all 3 observers, and statistical analysis was performed on the difference between the means scores before and after treatment.



Figure 2. Ecchymosis grading scale developed for the present study. Ecchymoses were graded by 3 blinded observers on a scale of 0 to 3, as follows: 0, no ecchymosis (A); 1, minimal ecchymosis (B); 2, moderate ecchymosis (C); and 3, severe ecchymosis (D).



Figure 3. Resolution of postoperative ecchymoses. A, Postoperative day 6 after rhytidectomy and lipotransfer to the perioral area (upper and lower lips, nasolabial folds, labiomandibular folds, and prejowl areas). Note grade 3 ecchymoses on the lips and chin, outlined as medial and lateral halves before the first laser treatment. B, Postoperative day 8. There was complete disappearance of discoloration in the lateral half of the ecchymotic area 48 hours after treatment with the pulsed-dye laser and persistent ecchymosis in the untreated medial half of the white lip. C, Postoperative day 10. There was nearly complete resolution of ecchymotic discoloration in the white lower lip and chin 48 hours after treatment of the medial (control) area and persistent ecchymosis in the untreated pink lip.

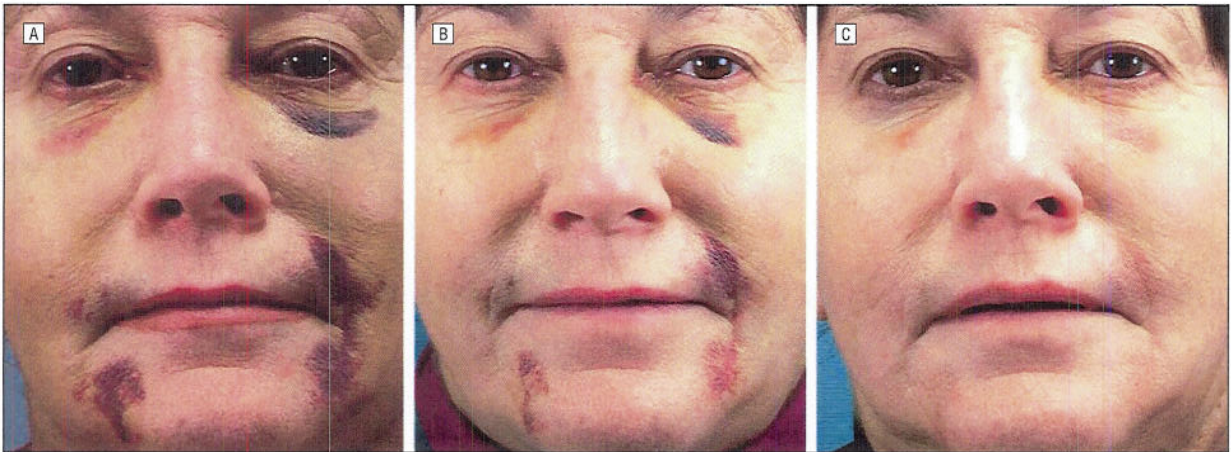


Figure 4. Resolution of postoperative ecchymoses. A, Postoperative day 6 after contour thread lift and lipotransfer to the face. Note grade 3 ecchymoses on the infraorbital and perioral areas. B, Postoperative day 8. There was marked improvement 48 hours after laser treatment to the lateral half of the ecchymotic areas only. The medial half was left untreated to serve as a control. C, Postoperative day 10. There was nearly complete resolution of all ecchymoses 48 hours after treatment of the control medial areas.

RESULTS

All patients completed the study. All were white women who ranged in age from 42 to 80 years, with Fitzpatrick skin types I to IV and without any important comorbid conditions. Procedures commonly associated with postoperative ecchymoses were facial lipotransfer, cervicofacial rhytidectomy, contour thread lift, and the minimally invasive subperiosteal midface-lift. These procedures were performed alone or in combination.

Treatment with the PDL resulted in substantial improvement or resolution of postoperative ecchymoses within 48 to 72 hours (**Figure 3** and **Figure 4**). Mean ecchymosis scores improved from 2.71 to 1.01 (**Table**). This translated to a mean (SD; SE) difference of 1.70 (0.45; 0.10), which was a 63% improvement in the mean ecchymotic score after laser treatment. The difference of 1.70 was statistically significant (95% confidence interval, 1.46-1.91; $t=16.62$; $P<.001$, paired t test). The maximal efficacy of laser treatment was observed when it was performed on or after POD 5.

Laser treatments were well tolerated. Patients were highly satisfied with the outcome and frequently observed that improvement in appearance of the ecchy-

Table. Mean Ecchymotic Scores by Observer

Observer	Before Laser Treatment	After Laser Treatment	Difference (% Change)
1	2.70	1.05	1.65 (61)
2	2.70	1.15	1.55 (57)
3	2.75	0.85	1.90 (69)
Mean	2.71	1.01	1.70 (63)

motoc area occurred within 24 hours after treatment. The only adverse effects reported were mild discomfort and edema. Dyspigmentation was not observed in any patient. The importance of this study lies in the ability to reduce postsurgical ecchymosis in half the time (reduced from 2 weeks to 1 week) compared with comparable cases not treated with the PDL. This enables patients to return to their everyday activities much earlier, which will have substantial emotional benefit.

COMMENT

The flashlamp-pumped PDL was the first laser developed on the basis of principles of selective photother-

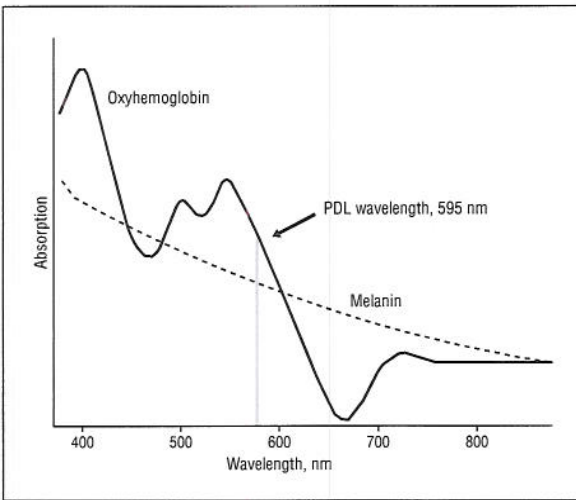


Figure 5. Absorption curves of oxyhemoglobin and melanin. Oxyhemoglobin has 3 absorption peaks, at 418, 542, and 577 nm. The 595-nm wavelength of the pulsed-dye laser (PDL) (Vbeam; Candela Laser Corp, Wayland, Massachusetts) is near the third absorption peak.

molysis.⁵ It has been used extensively for treatment of vascular lesions, with intravascular hemoglobin being its principle chromophore. The PDL used in our study (Vbeam) has a wavelength of 595 nm, which is in proximity to the third absorption peak of oxyhemoglobin (**Figure 5**). We sought to use the principle of selective photothermolysis in targeting the hemoglobin within extravasated RBCs in an effort to facilitate resolution of disfiguring ecchymoses. To our knowledge, this is the first study of its kind to evaluate the use of a PDL in the treatment of ecchymoses.

During the course of this study, we observed that the best response to laser treatment was on POD 5 or after. In an earlier pilot project, we attempted to treat patients early in the postoperative period, just as areas of ecchymoses started to appear, as early as POD 2 or 3 (unpublished observations). However, we found that responses to laser treatment were suboptimal and that, despite treatment, the ecchymoses often worsened over the next 2 or 3 days. This led to our defining POD 5 or 6 as the time of initial treatment in the present study. There are 2 possible explanations for this observation. First, the initial extravasation of RBCs from surgical trauma occurs at a deeper plane (subcutaneous and deep dermis), and second, there is overlying tissue inflammation and edema. Both of these factors result in less of the laser energy reaching the target chromophore and, therefore, a suboptimal response. We found that, until POD 5, the ecchymotic area darkens progressively, which is likely from migration of the extravasated RBCs into the superficial dermis and progressive agglutination and lysis of RBCs with release of hemoglobin into the interstitium. The enhanced response to laser treatment at this time is likely owing to the higher susceptibility of the more superficial RBCs to laser destruction. In addition, by POD 5 there is less tissue edema and inflammation, with more of the laser energy reaching the target chromophore.

The exception to this was our anecdotal observation in patients with superficial ecchymoses treated after filler in-

jections (eg, hyaluronic acid [Restylane; Medicis Aesthetics Inc, Scottsdale, Arizona]) in the perioral area. These patients seem to have an impressive response to the PDL when treated immediately after bruising occurs following the injection. Often the treated area lightens substantially within minutes after the laser treatment, sometimes returning to its prebruised appearance. We propose that this occurs because the bruising induced by less invasive procedures such as filler injections is in a more superficial plane and, therefore, more readily responsive to the PDL.

Although the laser energy is absorbed predominantly by hemoglobin, it is also absorbed by melanin, which is a competing chromophore. In general, use of the PDL is safest in patients with Fitzpatrick skin types I to IV.⁵ The darker the skin type, the greater the risk of pigmentary changes and the lower the intended clinical response of vascular lesions.⁵ Although we did not stratify our results by skin type, we did anecdotally observe a better clinical response in patients with lighter skin types (I and II) compared with darker skin types (III and IV). This is most likely because of competitive absorption of laser energy by melanin in the darker skin types. We did not observe dyspigmentation in any patients in our study; however, we did note transient hyperpigmented changes that lasted 3 to 4 weeks. Permanent dyspigmentation is a well-recognized but uncommon adverse effect of PDL treatment. Levine and Geronemus,⁶ in their series of 500 patients with vascular lesions treated with the PDL, reported a 1% risk of hyperpigmentation and a 2.6% risk of hypopigmentation. Other adverse effects observed in their study included a 0.1% risk of atrophic scarring and a 0.04% risk of dermatitis.

The PDL used in our study (Vbeam) has a range of spot sizes from 5 to 10 mm, pulse durations from 1.5 to 40 milliseconds, and fluence levels of up to 25 J/cm². In addition, this PDL has a dynamic cooling device that sprays a cryogen on the area being treated and, thereby, decreases treatment-associated discomfort and potential adverse effects, including dyspigmentation.⁵ The settings used in our study (10-mm spot size, 6-millisecond pulse duration, and 6-J/cm² fluence) were chosen on the basis of clinical treatment guidelines recommended by the manufacturer (Candela Laser Corp) for the treatment of facial erythema due to rosacea. During earlier pilot trials, we tried alternative laser settings in an effort to define the ideal treatment settings (unpublished observations). The variables altered included spot size, pulse duration, and fluence. Although fluences higher than 6 J seemed to be more effective, they also caused more discomfort and had the potential for more adverse effects such as edema, dyspigmentation, and possible scarring. Shorter pulse durations were also tried and, in some cases, seemed to induce purpura. Previous studies that evaluated the risk of purpura with PDL treatment found that pulse durations of 6 milliseconds or longer typically do not induce purpura.⁷ Because our study was designed for treatment of an essentially cosmetic problem, we elected to use conservative settings with the lowest risk of adverse effects, with excellent patient tolerance. Patient satisfaction was universally high, and the only adverse effects reported by our patients were mild discomfort during treatment and minimal posttreatment edema.

We recognize the small sample size of our study and that, to our knowledge, this study is the first of its kind. Further research of this interesting application of the PDL may be needed before its widespread use for treatment of ecchymoses. Future applications may include routine treatment of ecchymoses after filler injections, post-surgically on other areas of the body, and after trauma.

In conclusion, we report the safety and efficacy of the PDL in expediting resolution of disfiguring ecchymoses after facial cosmetic procedures. The treatment was well tolerated, and adverse effects were minimal. Although further research is needed, future applications may include widespread use in ecchymoses of any etiology.

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