Erbium:YAG Laser Resurfacing for Refractory Melasma

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BACKGROUND. **Melasma is a facial dyspigmentation which is a common complaint in patients with darker skin tones. Many current therapies used for this condition are ineffective and can cause significant adverse effects.**

OBJECTIVE. **The purpose of this study was to evaluate the role of erbium:YAG laser resurfacing in the management of refractory melasma.**

METHODS. **Ten female patients with melasma unresponsive to previous therapy of bleaching creams and chemical peels were included in this study. Full face skin resurfacing using an erbium: YAG laser (2.94 μm) was performed using 5.1–7.6 J/cm^2 energy. Clinical evaluations using the Melasma Area and Severity Index (MASI) and melanin reflectance spectrometry measurements were taken preoperatively and at 0.5, 1, 1.5, 3, and 6 weeks and 3, 5, and 6 months postoperatively. Adverse effects after laser resurfacing such as prolonged erythema, infection, and hyperpigmentation were recorded.**

RESULTS. **There was marked improvement of the melasma immediately after laser surgery using the parameters outlined; however, between 3 and 6 weeks postoperatively, all patients exhibited post-inflammatory hyperpigmentation. Decreased MASI and melanin reflectance spectrometry measurement scores were noted after biweekly glycolic acid peels and at the end of 6 months, significant clinical improvement in the melasma was seen compared to the preoperative evaluation.**

CONCLUSION. **Erbium:YAG laser resurfacing effectively improves melasma; however, the almost universal appearance of transient post-inflammatory hyperpigmentation necessitates prompt and persistent intervention. The use of this laser therapy is recommended *only* for refractory melasma.**

MELASMA IS an acquired hyperpigmentation involving the cheeks, forehead, nose, and upper lip. It is a common complaint in patients with darker skin tones. Although the exact pathogenesis is unknown, melasma is believed to be associated with a multifactorial etiology. Genetic and racial predilection, exogenous estrogen/progesterone therapy, and ultraviolet light exposure have been implicated in the pathogenesis and exacerbation of melasma.[1–3]

Current therapies for melasma include the use of bleaching creams such as hydroquinone and kojic acid and chemoexfoliants such as retinoic, glycolic, or trichloroacetic acid.[4] These treatments are associated with several side effects such as irritant dermatitis, unwanted pigmentary alteration, exogenous ochronosis, and poor control of tissue damage.[5,6]

The erbium:YAG (Erbium: Yttrium-Aluminum-Garnet) laser (Continuum Biomedical, Dublin, CA) emits light with a 2,940 nm wavelength that is highly absorbed by water-containing tissue. This property enables the erbium:YAG laser to ablate skin with minimal residual thermal damage, thereby potentially minimizing the risks of post-inflammatory hyperpigmentation. The purpose of this study was to evaluate the role of erbium: YAG laser resurfacing in the management of refractory melasma.

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Materials and Methods

Ten female patients (39 to 59 years, mean = 45.6 years) with melasma (mean duration = 8.7 years) were enrolled in the study after informed consent had been obtained. All 10 subjects had skin phototypes II to V. Each had been unresponsive to previous therapy of bleaching creams and chemical peels. The average number of glycolic acid peels performed in each patient was 6.5 and the average duration of topical hydroquinone use was 6 months. In addition, eight patients had also used topical retinoic acid and/or azelaic acid for several months (average = 3.5) without apparent clinical improvement. No topical or other treatment had been used within six months of study entry. Exclusion criteria included concomitant use of isotretinoin or hormonal therapy, concurrent cutaneous infection or inflammation, and presence of ectropion.

After the face was cleansed with an antibacterial soap, nerve blocks of the first, second, and third trigeminal branches were performed using 1% lidocaine with 1:200,000 units of epinephrine. Protective goggles were placed on the patient and hair-bearing areas were covered with damp towels. The erbium:YAG laser was then calibrated to 1.0–1.5 J with a 5 mm collimated spot at 8 Hz (5.1–7.6 J/cm^2) and the full face was treated with 3 consecutive passes. Laser spots were placed with approximately 30% overlap using identical laser technique in each patient: (1) vertical pass; (2) horizontal pass; (3) diagonal pass (beginning superiorly on the forehead and moving down to the chin). The skin was gently wiped with saline-soaked gauze after each pass to remove any partially-desiccated tissue. Postoperative skin care consisted of liberal use of topical emollients (Theraplex, Medi-

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cis Dermatologics, Phoenix, AZ), ice packs, and cool compresses. All patients received prophylactic antibiotics (Zithromax, Pfizer Labs, New York, NY) and antiviral medications (Famvir, SmithKline Beecham, Philadelphia, PA) for 7 to 10 days which were initiated 1 day preoperatively. Oral corticosteroid therapy was also prescribed for 5 days.

The patients were evaluated at baseline and at 0.5, 1, 1.5, 3, and 6 weeks and 3, 5, and 6 months postoperatively. Melanin reflectance spectrometry measurements using a Dermaspectrometer (Cortex Technology, Hagland, Denmark) were obtained in order to provide an objective assessment of skin color. The mean of three measurements taken from the darkest skin regions involved in each patient was calculated.

Patients were also evaluated clinically using the Melasma Area and Severity Index (MASI) scoring system.[7] The face was divided into four areas: forehead, right malar region, left malar region, and chin, corresponding to 30%, 30%, 30%, and 10% of the total face, respectively. The severity of the melasma in each of these four regions was assessed based on three variables: percentage of the total area involved (A), darkness (D), and homogeneity (H). A numerical value was assigned for the corresponding percentage area involved: 0 = no involvement; 1 = <10% involvement; 2 = 10–29% involvement; 3 = 30–49% involvement; 4 = 50–69% involvement; 5 = 70–89% involvement; and 6 = 90–100% involvement. The darkness of the melasma (D) compared to the normal skin and the homogeneity of the hyperpigmentation (H) were rated on a scale of 0 to 4 (0 = normal skin color without evidence of hyperpigmentation; 1 = barely visible hyperpigmentation/specks of involvement; 2 = mild hyperpigmentation/small patchy areas of involvement <1.5cm diameter; 3 = moderate hyperpigmentation/patches of involvement >2cm diameter; 4 = severe hyperpigmentation/uniform skin involvement without any clear areas). To calculate the MASI score, the sum of the severity grade for darkness (D) and homogeneity (H) was multiplied by the numerical value of the areas (A) involved and by the percentages of the four facial areas (10–30%). These values were summated to obtain the total MASI score: Forehead 0.3 (D+H)A + Right malar 0.3 (D+H)A + Left malar 0.3 (D+H)A + Chin 0.1 (D+H)A.

Photographic documentation using a computer digital imaging system (Mirror Image, Kirkland, WA) was obtained preoperatively (baseline) and at each subsequent follow-up visit.

Results

Reepithelialization after erbium:YAG laser resurfacing was completed within 4 to 7 days. No cases of scarring, cutaneous infection, or ectropion formation were observed.

The mean preoperative melanin reflectance spectrometry measurement was 48.8 which decreased to as low as 41.2 on the fourth postoperative day. At the third postoperative week, the melanin readings increased to a maximum of 48, followed by a steady decline after the sixth postoperative week, so that a final value of 43.6 was measured at postoperative month 6. (Figure 1) The baseline mean MASI score of 19.1 decreased to 4.1 on postoperative days 7–10. The clinical scores then increased to >20 at 3–6 weeks postoperatively, but again fell to below baseline value (10.6) at 6 months (Figure 2).

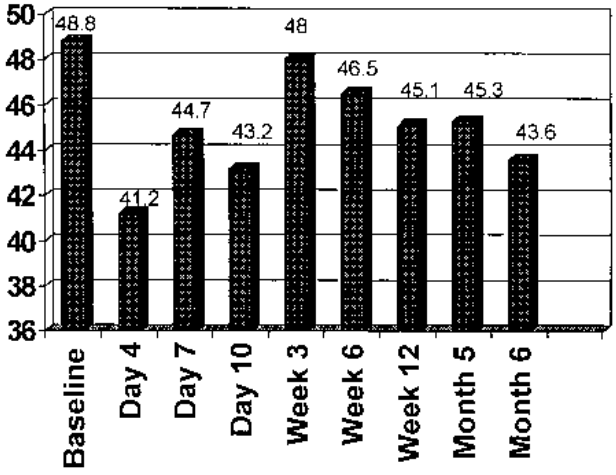

Figure 1. Mean melanin reflectance measurements.

The increase in the MASI scores and melanin indices coincided with the development of post-inflammatory hyperpigmentation which was differentiated clinically from melasma by the involvement of additional facial areas than were observed originally. The pigment worsening was treated with biweekly 30–40% glycolic peels and topical sunscreens and 20% azelaic acid application daily as tolerated by the patients.

At the end of the study period, universal clinical improvement of pigmentation was observed. (Figure 3) Statistical analysis using the Wilcoxon Signed-Rank Test revealed significant differences in the mean MASI

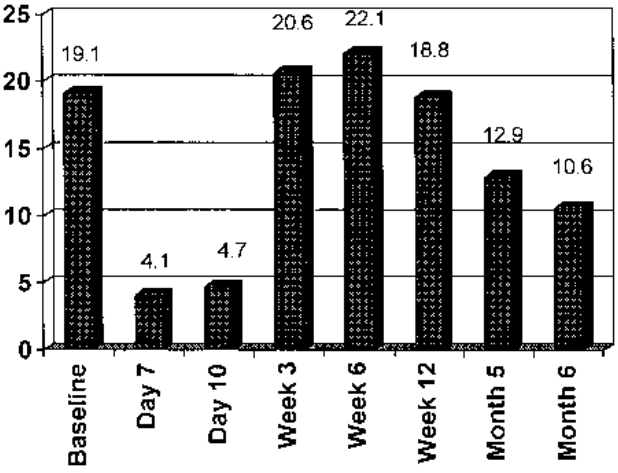

Figure 2. Mean melasma area and severity index (MASI) scores.

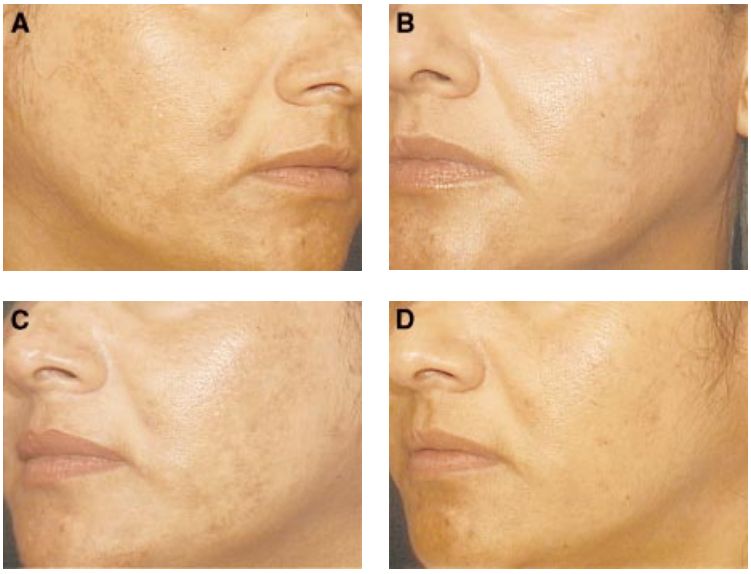

Figure 3. A) A 44-year-old woman with skin type IV and recalcitrant melasma at baseline. B) One week after erbium:YAG laser surgery treatment. C) Three weeks postoperatively with pigment worsening. D) Marked improvement of melasma 12 weeks after laser resurfacing and four 30–40% glycolic acid peels.

scores and mean melanin reflectance spectrometry measurements prior to laser treatment and 6 months postoperatively ($p = 0.0277$).

Discussion

The management of melasma is a challenge. Despite the various topical bleaching creams and chemical peeling agents available, there still remains a subset of patients unresponsive to these therapies.

The erbium:YAG laser is an excellent ablative tool since its energy is highly absorbed by water-containing tissue and is delivered at a pulse duration less than the thermal relaxation time of cutaneous tissue. These features limit heat dissipation, thus creating a residual thermal damage zone not exceeding 50 μm in depth.[8] Postoperative healing time is subsequently reduced and the risk of post-inflammatory hyperpigmentation is potentially diminished.[9] Several studies have shown the efficacy of erbium:YAG laser resurfacing for mild photodamage with more rapid healing and lower incidence of complications compared to carbon dioxide laser resurfacing.[10–13]

This study demonstrated initial marked improvement in melasma after erbium:YAG laser resurfacing. Three to 6 weeks following laser therapy, post-inflammatory hyperpigmentation developed which responded well to biweekly glycolic acid peels and daily use of sunscreens and topical azelaic acid cream as tolerated. Although several properties of the erbium:YAG laser are theoretically excellent for cutaneous resurfacing, the resultant inflammatory dermal reaction stimulates the activity of melanocytes in melasma-irradiated skin, leading to a temporary worsening of the pigmentation.

Erbium:YAG laser resurfacing effectively improves melasma; however, the almost universal appearance of transient post-inflammatory hyperpigmentation necessitates prompt and persistent intervention. Therefore, the use of this laser therapy is recommended only for recalcitrant melasma.

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