Journal of Cosmetic and Laser Therapy
formerly Journal of Cutaneous Laser Therapy
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713399564

Evaluation of clinical, microscopic, and ultrastructural changes after treatment with a novel Q-switched Nd:YAG laser

Alexander L. Berlin [a]; Jacob Dudelzak [a]; Mussarrat Hussain [a]; Robert Phelps [b]; David J. Goldberg [ab]
[a] Skin Laser & Surgery Specialists of NY and NJ, New York, NY, USA
[b] Department of Dermatology, Mount Sinai School of Medicine, New York, NY, USA

First Published: 2008

To cite this Article: Berlin, Alexander L., Dudelzak, Jacob, Hussain, Mussarrat, Phelps, Robert and Goldberg, David J. (2008) 'Evaluation of clinical, microscopic, and ultrastructural changes after treatment with a novel Q-switched Nd:YAG laser', Journal of Cosmetic and Laser Therapy, 10:2, 76 — 79

To link to this article: DOI: 10.1080/14764170802071165
URL: http://dx.doi.org/10.1080/14764170802071165

Journal of Cosmetic and Laser Therapy. 2008; 10: 76–79

informa
healthcare

ORIGINAL ARTICLE

Evaluation of clinical, microscopic, and ultrastructural changes after treatment with a novel Q-switched Nd:YAG laser

ALEXANDER L. BERLIN[1], JACOB DUDELZAK[1], MUSSARRAT HUSSAIN[1], ROBERT PHELPS[2] & DAVID J. GOLDBERG[1,2]

[1]*Skin Laser & Surgery Specialists of NY and NJ, New York, NY, USA and* [2]*Department of Dermatology, Mount Sinai School of Medicine, New York, NY, USA*

Abstract

Background: The Q-switched Nd:YAG laser was among the first non-ablative lasers to be used. High-fluence photoacoustic Q-switched laser treatments were shown to produce results akin to those seen with some ablative lasers. Previous low-fluence, non-thermal, Q-switched Nd:YAG lasers produced almost no results. *Objective*: The purpose of this study was to evaluate a new combined photoacoustic/photothermal low-fluence Q-switched Nd:YAG laser in the treatment of facial photodamage. *Methods*: Ten individuals with photodamaged facial skin were enrolled in the study. Participants underwent six bi-weekly full-face treatments using a Q-switched Nd:YAG laser (RevLite, HOYA ConBio, Freemont, CA, USA) at 1064 nm, with an 8-mm spot size and fluence of 3.2 J/cm^2. Clinical improvement was evaluated through blinded investigator assessment of photographs obtained before and 3 months after the last treatment. Pre-auricular biopsies, performed before and 3 months following the last treatment, were processed for light and electron microscopy and analyzed for evidence of treatment-related changes. *Results*: Eight individuals completed the study with no serious or long-term complications. Blinded evaluator assessment documented improvement in a variety of different aspects of photodamaged skin. Biopsy specimens revealed changes consistent with wound repair under light microscopy, while electron microscopy confirmed new collagen deposition. *Conclusion*: A novel combined photoacoustic/photothermal Q-switched Nd:YAG laser can be used for non-ablative photorejuvenation. In addition to clinical improvement, histological and ultrastructural changes consistent with new collagen deposition were noted.

Key words: *Lasers and light sources, photorejuvenation*

Introduction

The quality-(Q-)switched neodymium:yttrium-aluminum-garnet (Nd:YAG) laser was among the first non-ablative lasers to be utilized for facial resurfacing and photorejuvenation. In the process, Q-switched lasers operating at high fluences, thought to produce photoacoustic effect in tissue, were utilized. These were demonstrated to induce clinical and histological changes akin to those seen with some ablative lasers (1–4). However, previous attempts at using lower fluences with Q-switched Nd:YAG lasers have shown almost no appreciable results.

A novel Q-switched Nd:YAG laser, operating at low fluences, is thought to generate both photothermal and photoacoustic tissue effect. The purpose of this study was to evaluate this new laser in the treatment of facial photodamage.

Materials and methods

The study protocol and consent form were approved by the Institutional Review Board of Pascack Valley Hospital, Westwood, NJ, USA. An explanation, including the risks, benefits, and potential complications, was given to all participants, and written informed consent was obtained prior to any treatment.

Ten individuals between the ages of 40 and 68 years old (mean: 58 years) with photodamaged facial skin, class I to III rhytids, and Fitzpatrick skin types I to III were enrolled in the study. All individuals underwent six bi-weekly full-facial treatments using a Q-switched Nd:YAG laser at 1064 nm, which is thought to produce both a photothermal and a photoacoustic effect in tissue (RevLite, HOYA ConBio, Freemont, CA, USA). No anesthesia was necessary prior to treatment. Three passes were

Correspondence: David J. Goldberg, Skin Laser & Surgery Specialists, Director, 250 Old Hook Road, Westwood, NJ 07675, USA. E-mail: drdavidgoldberg@skinandlasers.com

(Received 22 February 2008; accepted 28 February 2008)

ISSN 1476-4172 print/ISSN 1476-4180 online
DOI: 10.1080/14764170802071165

performed during each treatment session using an 8-mm spot size and fluence of 3.2 J/cm^2.

An immediate cutaneous response after each treatment was assessed and recorded. The individuals were then instructed on proper sun protection.

High-quality digital photographs (Canfield CR, Canfield Scientific, Fairfield, NJ, USA) were obtained at baseline and 3 months following the last treatment. These were assessed by a blinded evaluator for changes in various aspects of cutaneous photodamage, including rhytid severity and depth, skin texture/coarseness, pore size, dyspigmentation, erythema, skin laxity, and overall appearance. Improvement was graded on the following scale: none (0% improvement); poor (1–24% improvement); fair (25–49% improvement); good (50–74% improvement); and excellent (75–100% improvement). Three months following the last treatment, the participants were also asked to rate their improvement in the same categories using the same scale. Additionally, they were asked to rate changes in their perceived need for make-up application.

Finally, three individuals underwent 2-mm punch biopsies from clinically photodamaged and ultimately treated pre-auricular skin at baseline and 3 months following the last treatment. All biopsy specimens were split for processing for light and electron microscopy. For the electron microscopy, sampling bias was minimized by obtaining two to three sections for each specimen and by analyzing five to six areas within each section. All specimens were examined by a single blinded dermatopathologist for any treatment-related changes.

Results

Eight individuals completed the study, with two lost to follow-up. Treatments were tolerated well by the participants, and the immediate cutaneous response included only mild-to-moderate erythema, with no edema or purpura noted in any of the individuals. Three months following the last treatment, no incidences of erythema, edema, purpura, pigmentary changes, or scarring were noted.

Assessment of baseline and post-treatment photographs by a blinded evaluator revealed changes in a variety of different aspects of cutaneous photodamage (Table I; Figures 1 and 2).

Figure 1. Before treatment.

Light microscopy of baseline biopsies revealed a normal rete pattern and increased solar elastotic material within the papillary dermis, consistent with actinic damage. Biopsies obtained 3 months following the last treatment documented a slight decrease in elastosis, an increase in vascularity, and an increase in collagen deposition (Figures 3 and 4). Electron microscopy revealed an increase in the average diameter of the collagen fibrils post-treatment compared with baseline (Figures 5 and 6).

Discussion

Q-switched lasers have long been used in cosmetic dermatology for the removal of tattoos, pigmented and vascular lesions, and unwanted hair (5–11). Traditionally, these lasers, delivering pulse durations in the nanosecond range, were thought to generate acoustic waves within biological tissue. These waves then impart sufficient kinetic energy to the target to

Table I. Blinded evaluator assessment of improvement in the various aspects of photodamaged skin from baseline.

	Rhytid severity	Rhytid depth	Skin texture	Pore size	Dyspigmentation	Erythema	Skin laxity	Overall appearance
None (0%)	50%	50%	–	12.5%	12.5%	–	37.5%	–
Poor (1–24%)	12.5%	25%	25%	62.5%	12.5%	12.5%	62.5%	87.5%
Fair (25–49%)	37.5%	25%	50%	25%	37.5%	62.5%	–	12.5%
Good (50–74%)	–	–	25%	–	37.5%	25%	–	–
Excellent (75–100%)	–	–	–	–	–	–	–	–

Figure 2. After treatment with a combined photoacoustic and photothermal Q-switched Nd:YAG laser.

overcome internal cohesive forces, resulting in shattering of the tissue.

The effectiveness of Q-switched Nd:YAG lasers in photorejuvenation and improvement of acne scarring has been demonstrated in several published clinical studies (1–4). Although the exact mechanism of action for these indications has not been completely worked out yet, it is thought to involve non-specific dermal heating with subsequent collagen contraction. The ensuing neocollagenesis has been demonstrated through histological and ultrastructural examination of irradiated skin (4).

While effective for facial photorejuvenation, the photoacoustic effect can be quite non-specific, with

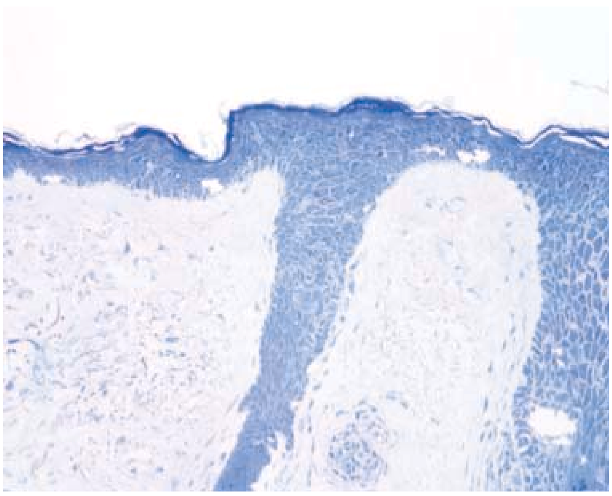

Figure 3. Biopsy before treatment.

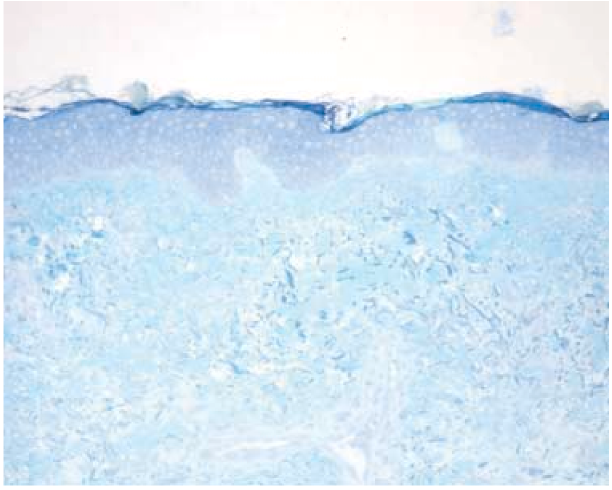

Figure 4. Increased collagen deposition 3 months after laser treatment.

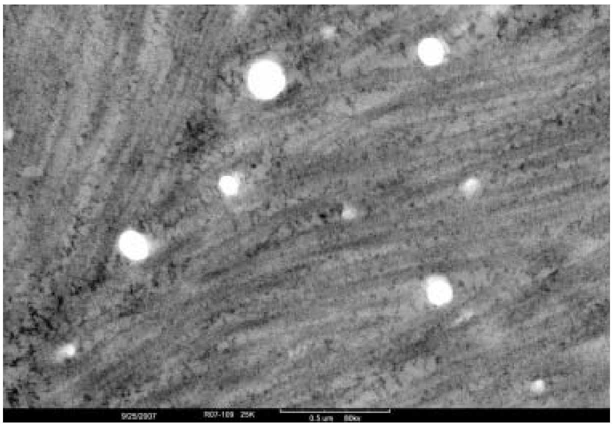

Figure 5. Electron microscopic biopsy before treatment.

resulting petechiae and pinpoint bleeding (3). Although generally short-lasting, such adverse effects may be somewhat disappointing to a patient seeking 'lunch-time' cosmetic rejuvenation with no downtime.

By utilizing lower output energy, the newer Q-switched Nd:YAG laser combines a photoacoustic

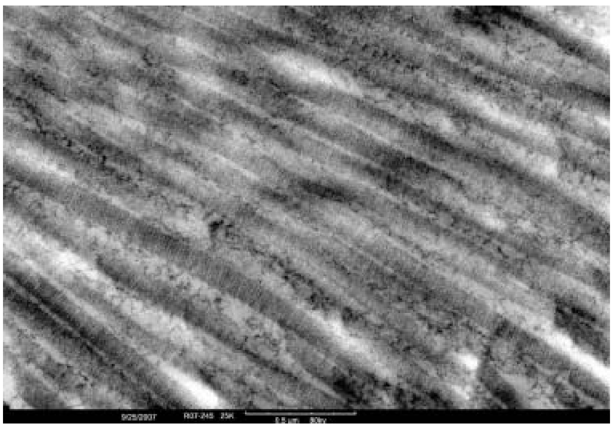

Figure 6. Increase in diameter of colagen fibers after laser treatment; consistent with new colagen formation.

effect with heat generation through conventional photothermolysis. This leads to collagen denaturation and new collagen deposition while avoiding the adverse effects that may be associated with higher fluences. This study demonstrated the safety of such treatments. As for the efficacy, improvement in the various components of photoaged skin was noted by the blinded evaluator. Light and electron microscopic evaluation of biopsy specimens revealed a trend toward decreased elastosis and increased new collagen deposition. While an increase in the average diameter of the collagen fibril was noted following treatment, this is most likely a result of the relatively long interval between the last treatment session and the biopsy, allowing for wound remodeling and the replacement of newly formed collagen III with collagen I.

Conclusion

In the present study, a novel low-fluence Q-switched Nd:YAG laser, thought to produce both photoacoustic and photothermal laser–tissue interactions, has been used for the treatment of photorejuvenation. In addition to clinical improvement in the various aspects of photodamaged skin, histological and ultrastructural investigations demonstrated evidence of new collagen formation.

Acknowledgement

Disclosure: The study was supported, in part, by a grant from HOYA ConBio.

References

1. Goldberg DJ, Whitworth J. Laser skin resurfacing with the Q-switched Nd:YAG laser. Dermatol Surg. 1997;23:903–6.
2. Cisneros JL, Río R, Palou J. The Q-switched neodymium (Nd):YAG laser with quadruple frequency. Clinical histological evaluation of facial resurfacing using different wavelengths. Dermatol Surg. 1998;24:345–50.
3. Goldberg DJ, Silapunt S. Q-switched Nd:YAG laser: Rhytid improvement by non-ablative dermal remodeling. J Cutan Laser Ther. 2000;2:157–60.
4. Goldberg DJ, Silapunt S. Histologic evaluation of a Q-switched Nd:YAG laser in the nonablative treatment of wrinkles. Dermatol Surg. 2001;27:744–6.
5. Kilmer SL, Lee MS, Grevelink JM, Flotte TJ, Anderson RR. The Q-switched Nd:YAG laser effectively treats tattoos. A controlled, dose–response study. Arch Dermatol. 1993;129:971–8.
6. Leuenberger ML, Mulas MW, Hata TR, Goldman MP, Fitzpatrick RE, Grevelink JM. Comparison of the Q-switched alexandrite, Nd:YAG, and ruby lasers in treating blue-black tattoos. Dermatol Surg. 1999;25:10–14.
7. Rosenbach A, Williams CM, Alster TS. Comparison of the Q-switched alexandrite (755 nm) and Q-switched Nd:YAG (1064 nm) lasers in the treatment of benign melanocytic nevi. Dermatol Surg. 1997;23:239–44.
8. Polnikorn N, Tanrattanakorn S, Goldberg DJ. Treatment of Hori's nevus with the Q-switched Nd:YAG laser. Dermatol Surg. 2000;26:477–80.
9. Goldberg DJ, Marcus J. The use of the frequency-doubled Q-switched Nd:YAG laser in the treatment of small cutaneous vascular lesions. Dermatol Surg. 1996;22:841–4.
10. Goldberg DJ, Littler CM, Wheeland RG. Topical suspension-assisted Q-switched Nd:YAG laser hair removal. Dermatol Surg. 1997;23:741–5.
11. Nanni CA, Alster TS. Optimizing treatment parameters for hair removal using a topical carbon-based solution and 1064-nm Q-switched neodymium:YAG laser energy. Arch Dermatol. 1997;133:1546–9.