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ORIGINAL ARTICLE

Split-face comparison of radiofrequency versus long-pulse Nd-YAG treatment of facial laxity

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Abstract
Background and objective. To improve photoaging skin with laser treatment, multiple sessions have been considered necessary to achieve results comparable with one radiofrequency (RF) treatment. We compared single-treatment improvements obtained by the long-pulse 1064 nm Nd:YAG laser and RF device.
Study design/Materials and methods. In a split-face study, patients with sagging skin were treated once with laser (left side) and once with RF (right side) energy.
Results. Improvement judged by six blinded observers was greater for wrinkles and laxity (30% median) on the laser-treated side and essentially the same with both modalities (15% median) for texture, pores, and pigmentation. Improvement was maintained for at least 2–6 months on both facial sides without adverse effects.
Conclusion. With a single treatment, both the long-pulse 1064 nm Nd:YAG laser and ThermaCool RF device provide a modest degree of improvement in both wrinkles and laxity of facial skin and similar improvement in texture, pores, and pigmentation.

Key words: *Laser, pores, RF device, rhytids, skin texture*

Introduction

When photoaging occurs, skin becomes lax and begins to sag. Excessive skin laxity in the face has traditionally been corrected by rhytidectomy, a lifting procedure that requires a surgeon, general anesthesia, a recovery period, and the potential for complications (1). For patients who fear surgery or are poor candidates for rhytidectomy, non-invasive polychromatic intense pulsed light (IPL) or lasers at various wavelengths (532 nm, 585 nm, 1064 nm, 1320 nm, 1450 nm, and 1540 nm) offer treatment alternatives (2).

When the long-pulse 1064 nm Nd:YAG laser is used, the epidermis is cooled to prevent injury while the near-infrared laser energy penetrates deeply enough to cause heat-induced injury to the dermis, resulting in collagen production and improved quality of the skin (2,3). The absorption coefficient of melanin for 1064 nm radiation is lower than for shorter wavelengths, so patients with dark skin can be treated with minimal risk of pigmentation abnormalities (3–5). Lasers of longer wavelengths (e.g. the Cool Touch 1320) also have this advantage (6,7). The long-pulse 1064 nm Nd:YAG laser has been used to remove hair (8–12) and leg veins (5,13,14) as well.

Radiofrequency (RF) energy has also been used to non-ablatively tighten facial skin (1,15–19). RF devices take advantage of the resistance (impedance) in living tissue exposed to an electric current. The greater the impedance of subcutaneous tissue, for example, the more heat produced, and the greater the thermal injury to the dermis and other tissues (1,15).

RF devices have been used in electrocauterization and electrodesiccation. Unlike these traditional devices, the ThermaCool TC (Thermage, Inc., Hayward, CA, USA) is equipped with a capacitor membrane at the treatment tip that enables the user to deliver energy in a uniform, intense, and continuous pattern to the dermis. The device's cryogen spray cools and protects the epidermis while deeper tissues become heated and undergo thermal injury. The healing response is associated with collagen remodeling (20) and tightening of the skin (17) without post-treatment morbidity (1).

The purpose of this study was to compare improvements in photoaging parameters – wrinkles, pores, skin texture, skin laxity, and pigmentation –

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obtained with long-pulse 1064 nm Nd:YAG laser energy and RF energy.

Materials and methods

Seven patients (Fitzpatrick skin types II–IV) participated in the split-face study. All were more than 30 years of age and had mild to moderate sagging skin. Most patients also had wrinkles, abnormal pigmentation, large pores, and skin texture concerns. All gave informed consent and were offered crossover treatments in the event that the outcome on one side of the face was dramatically different from the outcome on the other. (No patient took advantage of this option.) Patients with a history of keloids and skin conditions that might be adversely affected by Nd:YAG laser or RF treatment were excluded.

The left sides of faces were treated with long-pulse 1064 nm Nd:YAG laser (GentleYAG, Candela Corporation, Wayland, MA, USA) radiation and the right sides were treated with RF energy (ThermaCool TC, Thermage). Each patient received a single split-face treatment delivered by a triple-pass technique for both modalities. Laser treatment parameters (50 J/cm^2 fluence, 10 mm spot size, 50 ms pulse duration, and 2 Hz repetition rate with DCD [Dynamic Cooling Device], 40/20 ms) were the same for each patient, as was the RF fluence of 73.5 J/cm^2. For RF treatment, exposure duration and cooling during each exposure period were controlled by a 1 cm^2 treatment tip surface. Each patient received 150 pulses at a setting of 73.5 (13.5 J/pulse) for a total energy of 2025 J. Topical anesthetic (Photocaine, University Pharmacy, Salt Lake City, UT, USA) was applied to the entire face for 30 minutes before treatment. Patients were given Percocet (10 mg oxycodone and 650 mg acetaminophen) and 10 mg Valium (diazepam) 30 minutes before treatment.

Clinical improvements in wrinkles, texture, pores, laxity, and pigmentation were independently evaluated by six observers from digital photographs (side views and oblique views). Observers were presented with a pair of photographs; one taken before treatment and the other taken after treatment. They did not know which treatment modality had been used or when (i.e. before or after treatment) either photograph had been taken. Observers compared both photographs of each pair, indicated which photograph showed improvement over the other, and estimated the amount of improvement (0–20%, 20–40%, 40–60%, 60–80%, 80–100%) for each skin parameter.

Results

The results of the blinded observer evaluations for the patients as a group are shown in Figure 1. For each skin parameter, improvement ranges were expressed as single numbers to allow calculation of the median improvement in each skin parameter for the patients as a group. For example, the 0–20% range was expressed as 10, the 20–40% range as 30, and so on. Data from unclear photographs or incomplete observer responses were not included in the analysis.

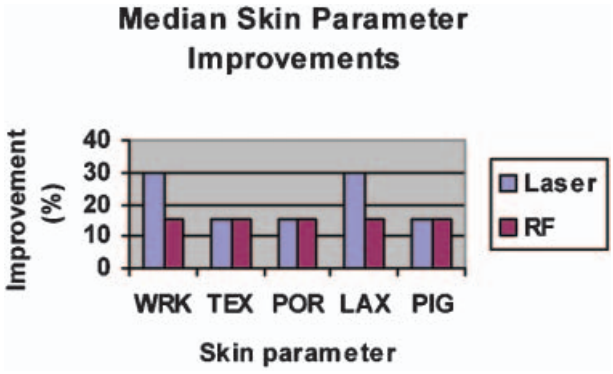

Figure 1. Median improvement (%) in skin parameters of seven patients treated once with laser energy (left side of the face) and once with radiofrequency (RF) energy (right side). Overall improvements in wrinkles and laxity were higher on the laser-treated side than on the radiofrequency-treated side. (For explanations of the abbreviations, see Figure 2 graphs.)

As shown in Figure 1, improvement was (i) greater for wrinkles and laxity (30% median) on the laser-treated side of the face and (ii) essentially the same (15% median) with both modalities for texture, pores, and pigmentation. Subtle changes were apparent immediately on the RF-treated side. No adverse effects occurred with either modality. No blisters of fat atrophy were observed at a 73.5 setting with the 1 cm fast tip of the RF device. The improvement level was maintained for at least 2–6 months for laser- and RF-treated sides and no scars were detected. No abnormal pigmentation occurred in any patient and pigmentation actually improved on both the RF- and laser-treated sides of some patients.

Responses of individual patients were similar for all five skin parameters (Figure 2). Patients 1, 3, 4, and 7 showed the greatest improvements in all skin parameters with both modalities. Improvements by both modalities for patient 3 are shown in Figure 3. Responses of patient 6 were greater with laser energy for all skin parameters except pigmentation, to which patient 6 failed to respond with both modalities (Figures 2 and 4). Patients 2 and 5 showed the lowest responses in all skin parameters. Patients were generally satisfied with the outcomes on both facial sides, however, and none expressed disappointment.

Discussion

To the author's knowledge, this is the first study to directly compare the single-treatment efficacy of a long-pulse 1064 nm Nd:YAG laser with that of an

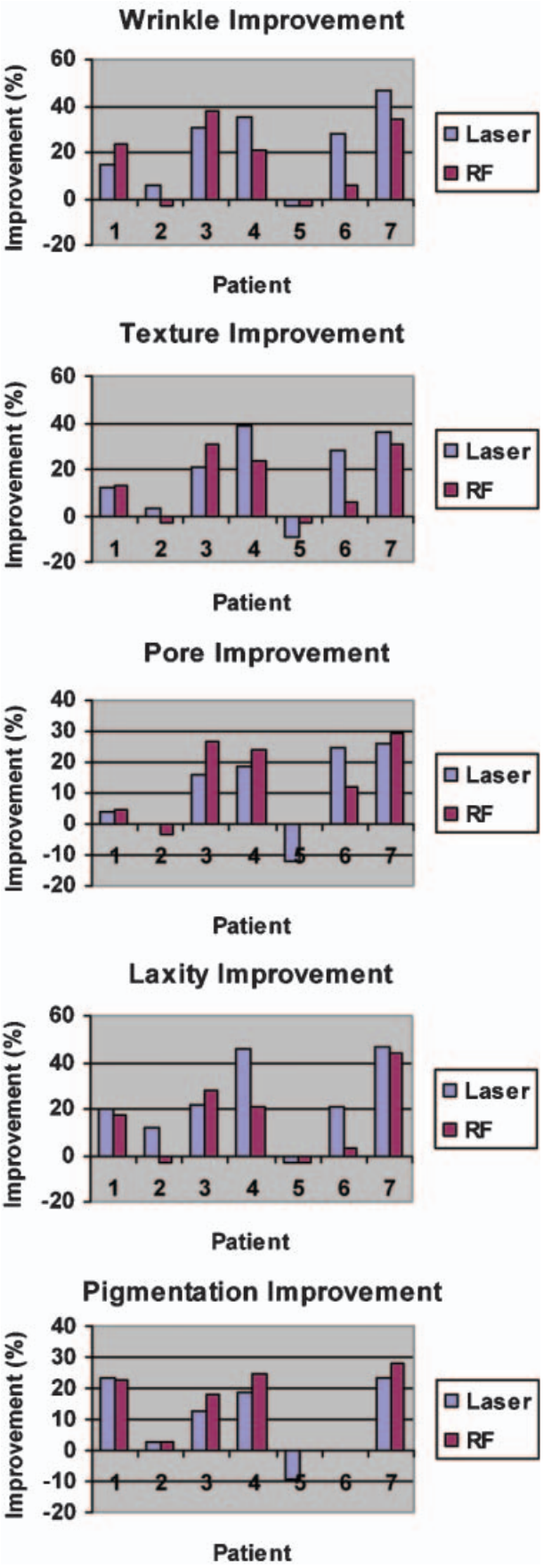

Figure 2. Net improvements per observer in skin parameters of individual patients treated once with laser energy (left side of the face) and once with radiofrequency (RF) energy (right side). Net improvements per observer were calculated by subtracting the sum of after-treatment responses from the sum of before-treatment responses and dividing by the number of observers. The quotient is the improvement (%) per observer. Negative responses occurred when observers noted 'improvements' on untreated sides rather than treated sides.

RF device in wrinkles, texture, pores, laxity, and pigmentation. Some degree of improvement in each skin parameter was evident in all subjects by both treatment modalities. For wrinkles and laxity, the non-ablative laser appeared to provide greater improvement than the RF device. For skin texture, pores, and pigmentation, the two modalities yielded similar results. The responses of individual patients to the laser and RF device were consistent for all five skin parameters (Figure 2).

Regarding the long-pulse 1064 nm Nd:YAG laser, patients in our study were given a single treatment, whereas other reports (2,3) indicate multiple treatments to improve skin quality. Dayan and colleagues (3) treated 34 patients at least seven times and took photographs before the first and after the final treatment. Patients were followed for 1–6 months and photographs were evaluated by three blinded physicians. No adverse events were reported. Physician-obtained Fitzpatrick scale scores showed a reduction of 11.9% for coarse wrinkles, an improvement of 17.3% for skin laxity, and 20.0% overall improvement.

In our study, improvements in wrinkles and skin laxity were up to 46% for individual patients (Figure 2) and the median for patients as a group was 30% (Figure 1). These results differ from those of Dayan and colleagues (3), perhaps due to their 22 J/cm^2 fluence, which is lower than the 50 J/cm^2 used in our study.

Lee (2) treated 150 patients three to six times with the long-pulsed KTP 532 nm laser, a long-pulsed 1064 nm Nd:YAG laser, or both lasers. Fifty patients comprised each treatment group. With the long-pulsed 1064 nm laser, Lee reported an improvement of 10–20% in redness, 0–10% in pigmentation, 10–30% in skin tone/tightening, 20–30% in skin texture, and 10–30% in rhytids. Photographs taken before and after each treatment were evaluated by patients, the treating physician, and an observer. (The report did not state that evaluators were blinded.) Mild erythema and edema were noted.

Again, differences in skin parameter improvements may be due to the lower fluences (24–30 J/cm^2) reported by Lee.

The ThermaCool RF device has been investigated for tissue tightening in facial skin (1), tightening the lower face and neck (18), periorbital tissue tightening (19), and neck and cheek laxity (15). Patients were given a single treatment in each of these studies. It is difficult to compare results of our study with those of these earlier studies because different

Figure 3. The top two photographs show the radiofrequency-treated side of the face of patient 3 before (left) and 6 months after (right) a single treatment. The bottom two photographs show the laser-treated side of the same face before (left) and 6 months after (right) a single treatment. In this patient, blinded observers considered improvements in wrinkles, texture, pores, laxity, and pigmentation to be slightly greater on the laser-treated side of the face (see Figure 2).

skin parameters were studied and results were expressed differently.

Ruiz-Esparza and Gomez (1) reported that 14 of 15 patients treated with a prototypic RF device (Thermage) had cosmetic improvement of up to 50% in nasolabial fold softening, cheek contour, mandibular lines, and marionette lines. Patients had minimal discomfort and no downtime. Improvement was noticeable within 1 week in some cases.

Using the ThermaCool RF device, Hsu and Kaminer (18) treated the cheeks, jawline, upper neck, or combinations of these areas in 16 patients. Patients with all three areas treated reported satisfaction in 36% of cases, whereas those with one or two areas treated reported satisfaction in 25% of cases. Satisfaction was higher among younger patients and when more areas were treated. Responses were better when higher energies per pulse were applied.

In an 86-patient study of periorbital wrinkle reduction, Fitzpatrick and colleagues (19) reported: (i) a Fitzpatrick wrinkle score improvement of 1 point or more in 83.2% of treated periorbital areas; (ii) improvement of 28.9% of areas treated; (iii) satisfaction with wrinkle reduction in half of treated patients; and (iv) low rates (compared to ablative treatments) of edema and erythema.

Alster and Tanzi (15) treated 50 patients with mild to moderate cheek or neck laxity. They reported mean clinical scores corresponding to 25–50% improvement in nasolabial and mesolabial folds in cheeks (93% of patients) and similar improvement in submandibular and upper neck skin laxity (85% of patients). Five patients (all more than 62 years of age) showed no improvement, consistent with earlier findings (18).

In each of these studies, the authors gave patients a single treatment. In contrast, the authors of studies evaluating the long-pulse 1064 nm Nd:YAG laser treated patients three to seven times (2,3).

The results of our study suggest that for improving skin quality, a single treatment with a long-pulse 1064 nm Nd:YAG laser provides results comparable to those obtained with a single treatment using an RF device. At the time of this study, the 1 cm fast tip and three passes comprised 'state-of-the-art' treatment with the ThermaCool RF device. Since then, newer settings and tips have become available and may provide safer, faster, and more cost-effective treatments. In addition, new protocols for providing safer, faster, more comfortable, and less expensive treatments with the long-pulse 1064 nm Nd:YAG laser have become available as well.

The 50 ms laser pulse duration used in this study is consistent with a recommendation based on the difference between the relaxation times of the epidermis and hair (the target structure) (12). If the laser-emitted pulse duration exceeds the cooling time of the epidermis, the epidermis has sufficient time to cool without incurring thermal damage between pulses. The optimal pulse duration will provide appropriate thermal damage to the target

Figure 4. (A) The radiofrequency-treated side of the face of patient 6 before (left) and 5.5 months after (right) a single treatment. (B) The laser-treated side of the face of patient 6 before (left) and 5.5 months after (right) a single treatment. Blinded observers considered improvements in wrinkles, texture, pores, and laxity to be considerably greater on the laser-treated side of the face (see Figure 2). Neither treatment modality improved pigmentation in this patient.

structure – thus improving skin quality – without injuring the epidermal layer.

The results of our single-treatment study are comparable with those of other authors who gave multiple treatments. We attribute this to our more aggressive treatment parameters (e.g. higher fluences). The settings we chose were the highest we could give to our patients without causing a blister, scab, or scar.

Our encouraging results justify an additional study with more patients to further optimize treatment parameters and evaluate the duration of beneficial effects.

Conclusion

With a single treatment, both the long-pulse 1064 nm Nd:YAG laser and ThermaCool RF device

provide a modest degree of improvement from baseline in both wrinkles and laxity of facial skin and similar improvement in texture, pores, and pigmentation.

Acknowledgement

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