Nonsurgical Approaches to Skin Tightening

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New noninvasive technologies recently have been introduced to produce skin tightening without surgical intervention and include a combination diode laser/bipolar radiofrequency technology (Polaris™ WR), a monopolar volumetric high-radiofrequency energy source (ThermaCool™), and a broad-spectrum infrared light source (Titan™). Clinical indications, treatment protocols, and potential adverse reactions of these 3 systems are outlined in this article.

We are presently in the midst of a minimally invasive, no-downtime, low-complication, cost-effective revolution. Patients are looking for natural ways to stay young without the risks and stigmata associated with invasive facial rejuvenation procedures. In this setting, 3 promising technologies have been introduced that accomplish the aforementioned goals and are used for noninvasive tissue tightening as part of a trimodal approach to photorejuvenation (Table 1). High-energy technologies incorporating both light and radiofrequency (RF) have been shown to have the capability to induce nonsurgical skin tightening (Figure 1).

POLARIS™ WR

Combination technologies consisting of light sources plus RF recently have been introduced for the treatment of rhytides and potential tissue tightening. The Polaris WR system is a combination 900-nm diode laser and bipolar RF device (Table 2). The combination of 2 energy sources, (ie, light and RF) allows the delivery of less light energy (20%–40%), making treatment safe for a variety of skin phenotypes.

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TABLE 1

Trimodal Approach to Photorejuvenation*

Class 1: Epidermal (Vascular, Pigment Dyschromia, and Pilosebaceous Changes)

- LED
- KTP (532 nm)
- PDL (585–600 nm)
- IPL/RF (500–1100 nm)

Class 2: Dermal Collagen Stimulation

- Diode RF (800 nm) plus RF
- Nd:YAG (1064 nm, 1320 nm)
- Diode (1450 nm)
- Erbium:glass (1540 nm)

Class 3: Subcutaneous (Musculoskeletal/ Collagen/Fascial Tightening)

- Monopolar RF
- Infrared laser (1100–1800 nm)
- Diode/RF (800 nm) plus RF

*LED indicates light-emitting diode; KTP, potassium titanyl phosphate; PDL, pulsed dye laser; IPL, intense pulsed light; RF, radiofrequency.

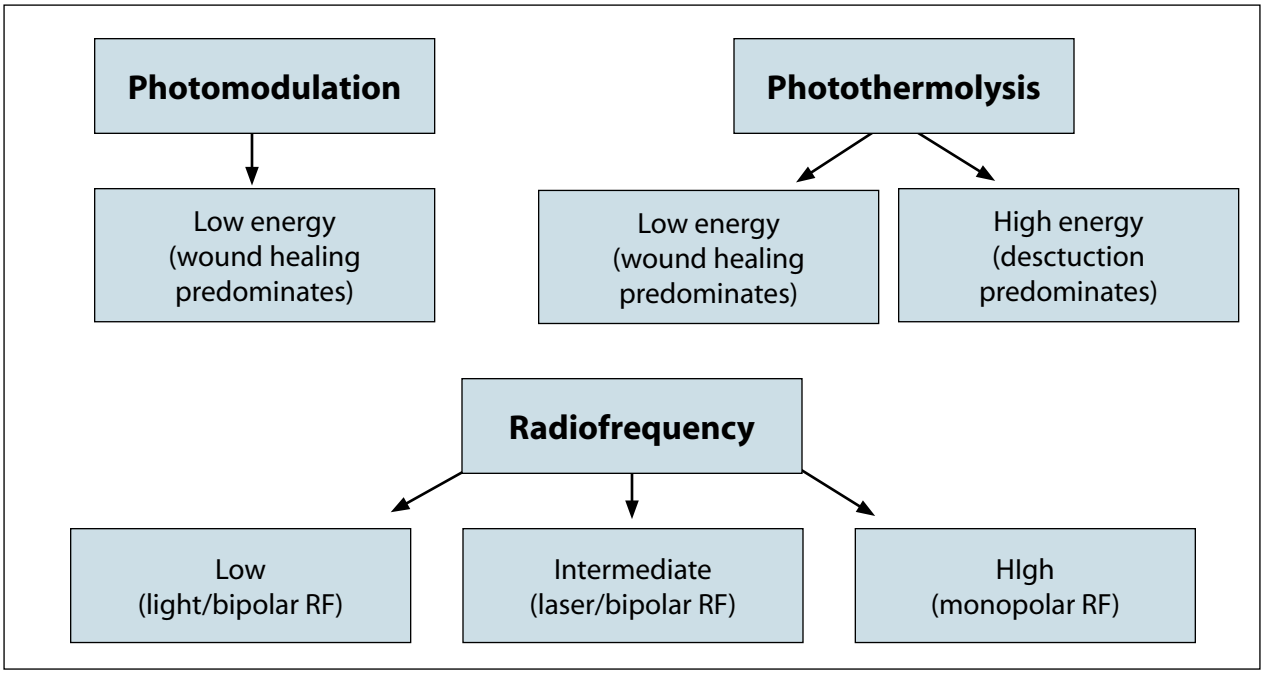

Figure 1. Light/radiofrequency tissue interactions. RF indicates radiofrequency.

Optical energy levels of 30 to 50 J/cm^2 and RF energy levels of 80 to 100 J/cm^3 are most commonly used in this setting, and 3 to 4 passes usually are performed. Penetration of approximately 2 mm can be achieved using these parameters. This combination of light energy plus RF heating allows effective dermal remodeling with the production of new collagen. Usually, 3 to 5 treatment sessions are performed at monthly intervals (Figure 2). Follow-up maintenance programs are recommended by most users 1 to 2 times per year.

Doshi and Alster[1] used this diode laser/RF device to treat 20 patients with mild to moderate rhytides and skin laxity. Patients received 3 treatments administered at 3-week intervals and were evaluated by the investigator and 2 independent assessors. Modest improvement in facial rhytides was observed in the majority of patients.

In another multicenter trial encompassing US and European locations, 23 patients with grades II to III Glogau wrinkling received 3 treatments with the diode laser/RF device (optical energy, 30 to 50 J/cm^2; RF energy, 80 to 100 J/cm^3) administered at 3-week intervals. More than 50% of patients exhibited greater than 50% improvement in the appearance of wrinkles, and all patients reported a noticeable improvement in skin smoothness and texture.[2]

The combination of light energy in the form of a 900-nm diode laser in conjunction with intermediate RF energy deliverance can accomplish pandermal remodeling, which has been beneficial in the reduction of rhytides.[3] Most of the energy is deposited in the superficial and mid dermis. Although not proven from a scientific point of view, clinical experience with this technology has included the observation of a variable degree of tissue tightening. The degree of energy penetration achieved with this technology does not produce deep volumetric tightening compared with higher energy RF sources that can penetrate into deeper tissue (ie, deep dermis, fat, and fascia).

Table 2

Polaris™ WR System Specifications*

Clinical Application	Wrinkle reduction
RF Energy	Up to 100 J/cm^3
Laser Type	900-nm diode
Light Fluence	Wrinkle reduction—up to 50 J/cm^2
Cooling on Skin Surface	5°C
Spot Size	8×12 mm
Pulse Repetition Rate	2 pps

*RF indicates radiofrequency.

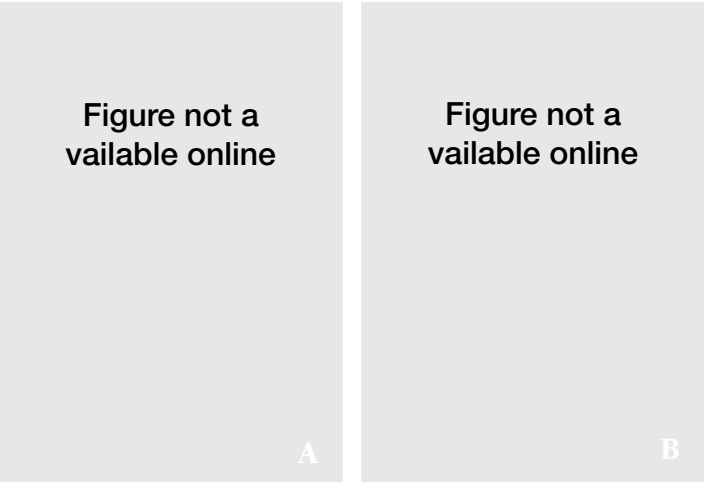

Figure 2. Patient before (A) and after (B) treatment with the Polaris™ WR system. Usually, 3 to 5 treatments are performed at monthly intervals (optical energy, 30 to 50 J/cm^2; radiofrequency, 80 J/cm^3)(See Table 2).

THERMACOOL™

ThermaCool is a high-energy monopolar technology employing a current within the treatment tip and coupled RF. It is capable of heating up to 2.5 mm in depth with a large amount of the RF energy deposited at deeper levels. The concept of deep volumetric heating theoretically allows tightening in 3-dimensional *X, Y,* and *Z* planes. Results of a study conducted by Kaminer et al[4] indicate that a major source of energy delivery involves the transfer of RF energy channeled through fibrous septae of adipose tissue, allowing for transmission to deeper tissues such as fat and fascia.

Although initially associated with variable clinical results and occasional reports of heat-induced lipoatrophy, recently introduced treatment modifications have improved the safety and efficacy of this technology for nonsurgical tissue tightening of the face and other areas of the body.[5,6] These modifications include a larger treatment tip, multiple passes, treatment to an observable end point, and treatment approaches based on vector 3-dimensional anatomy. The larger treatment tip (1.5 cm^2) enables coverage of a greater surface area. Other penetration depth tips (ie, shallow and medium) are in development.[7] Another modification to the treatment recommendations for this device is the use of multiple passes at more moderate energy levels; this technique has been shown to produce superior results with greater patient comfort and a lower side-effect profile.[8] Up to 5 passes with 400 to 600 pulses commonly are used with the new 1.5 cm^2 tip.[9] In addition, the new guidelines suggest treatment of a single side of the face with the end point being immediate tissue tightening. Also, treatment approaches are based on vector 3-dimensional anatomy, where anchoring points of muscle and fascia may be treated more aggressively with additional passes to augment the tissue tightening effect in these critical anatomic areas.

Suggested treatment parameters for this system are shown in Table 3. Even though immediate tissue tightening is the desired visual end point of treatment, the greatest effect most likely occurs secondary to delayed deep dermal remodeling, which can take as long as 6 to 12 months. Thus, only one treatment session is indicated until end results are assessed 6 to 12 months posttreatment. Individuals with thin skin, early signs of photoaging, and mild to moderate skin laxity are the best treatment candidates (Figures 3 and 4). Pain management is a concern with this device; however, the multiple-pass lower-energy regimens currently used have made it less of an issue. Diazepam, oxycodone and acetaminophen, meperidine, lorazepam, or a combination of these agents is most commonly used, though topical agents such as lidocaine/prilocaine 2.5% cream, lidocaine 4% topical anesthetic cream, or tetracaine cream left on for 30 to 60 minutes may be effective in selected cases.

Several peer-reviewed studies have documented the efficacy of this technology in noninvasive skin tightening. In one study, a single treatment (134 J/cm^2) was used to produce brow elevation. Patients exhibited an average 4.3-mm brow elevation and 1.9-mm superior palpebral crease elevation 3 months posttreatment.[10]

Improvements in neck and cheek laxity with this system have been documented by Alster and Tanzi.[11] Patients received a single treatment (single-pass method) with an average energy delivery of 74 to 134 J/cm^2 and were observed by independent investigators 6 months posttreatment.

TABLE 3

ThermaCool™ System Specifications*

RF Type	High-frequency generator
Frequency	6 MHz
Collagen Heating	>60°C
Polarity Shift	5 million times per second
Power	330 W
Cooling System	Cryogen cooling spray

*RF indicates radiofrequency.

Figure 3. Patient before (A) and after (B) treatment with ThermaCool™ system. Usually, 1 treatment, up to 5 passes (frequency, 6 MHz; collagen heating, >60°C), is performed. (See Table 3).

Finally, Fitzpatrick et al[12] studied this technology for periorbital tissue tightening. Patients received a single treatment (52–220 J/cm^2), and 83.2% showed improvement of at least one point in Fitzpatrick wrinkle scores.

Monopolar volumetric RF technology has been shown to induce variable degrees of tissue tightening, and results have improved with lower energy multiple-pass paradigms. Localized lipoatrophy and pain have been reported with this technology but can be minimized with the use of recently modified treatment protocols. Histologic results from a study conducted by B. Zelickson, MD, suggest that one treatment session is as effective as multiple treatments (oral communication, May 2005). However, additional studies are needed to further support this finding.

TITAN™

The final new technology discussed in this article is an infrared light source with a spectrum of 1100 to 1800 nm (Titan). This technology is used primarily for tightening of skin laxity in the submental area, jowls, abdomen, or arms (Table 4).

Pain has been reported to be more easily tolerated with this technology than with the high-energy ThermaCool device.[13] Ibuprofen usually is sufficient for pain management. Two treatment algorithms currently are being used with this technology. The first approach is the use of the highest tolerable fluence. The second method (similar to ThermaCool protocol) is the use of lower fluences with a higher number of pulses in concentrated areas. Although this device is early in its development in terms of peer-reviewed studies, positive results have been reported anecdotally for lifting of the eyebrows and lower face. The most favorable responses have been seen in individuals with submental laxity and jowls.

Common treatment guidelines include 2 to 4 passes of adjacent pulses with fluences of 36 to 46 J/cm^2 titrated to patient tolerance. Protocol for this technology is 2 treatments performed at monthly intervals.

In a published white paper, Zelickson et al[14] found collagen fibril denaturation consistent with fibril thermal contraction at a peak level of 1 to 2 mm. Contact cooling has a thermoprotective effect in the epidermis and superficial dermis.[14]

CONCLUSION

Three new technologies recently have been introduced for nonablative nonsurgical skin tightening. From a practical point of view, I use the Polaris WR system if the patient's primary concern is rhytide reduction and skin tightening is a secondary goal. For patients whose primary objective is tissue tightening, I use either ThermaCool or Titan, with greater clinical experience being evident with the former. The Polaris and the Titan systems have multiple treatment session protocols as part of their paradigm, while only a single-treatment session is most commonly required with the ThermaCool system.

Finally, it is important to note that, as with all other nonablative remodeling technologies, clinical results vary from patient to patient, and the devices reviewed in this article are most effective for treating patients with early signs of photoaging. In conclusion, the key to success with the aforementioned devices lies in choosing the appropriate patient, setting realistic patient

Figure 4. Patient before (A) and after (B) treatment with ThermaCool™ system. Usually, 1 treatment, up to 5 passes (frequency, 6 MHz; collagen heating, >60°C), is performed. (See Table 3).

TABLE 4

Titan™ System Specifications

Wavelength	1100–1800 nm
Fluence	5–65 J/cm^2
Spot Size	10×15 mm
Energy Control	Closed-loop photometric
Treatment Cycle	4–11 seconds

Xeo Console Specifications

Electrical	115V/20A or 230V/20A
Size	12″×19″×35″
Weight	110 lb

expectations, and understanding and using the optimal technique for each device.

REFERENCES

1. Doshi SN, Alster TS. Combination radiofrequency and diode laser for treatment of facial rhytides and skin laxity. *J Cosmet Laser Ther.* 2005;7:11-15.
2. Sadick NS, Trelles MA. Nonablative wrinkle treatment of the face and neck using a combined diode laser and radiofrequency technology. *Dermatol Surg.* 2005;12:1695-1699.
3. Sadick NS, Makino Y. Selective electro-thermolysis in aesthetic medicine: a review. *Lasers Surg Med.* 2004;34:91-97.
4. Kaminer M, Biesman B, Burns AJ, et al. Monopolar radiofrequency vs. bipolar radiofrequency vs. infrared lasers. what is new? *Skin & Aging.* 2004;Dec(suppl):8-11.
5. Hsu T, Kaminer MS. The use of nonablative radiofrequency technology to tighten the lower face and neck. *Semin Cutan Med Surg.* 2003;22:115-123.
6. Narins DJ, Narins RS. Non-surgical radiofrequency facelift. *J Drugs Dermatol.* 2003;2:495-500.
7. Ruiz-Esparza J, Gomez JB, Berber IR. Skin tightening with a nonablative radiofrequency system. *Cosmet Dermatol.* 2003;16:23-33.
8. Thermage treatment guidelines optimized for better results. *Cosmet Surg Times.* July 1, 2005:1.
9. Finzi E, Spangler A. Multipass vector (mpave) technique with nonablative radiofrequency to treat facial and neck laxity. *Dermatol Surg.* 2005;31:916-922.
10. Nahm WK, Su TT, Rotunda AM, et al. Objective changes in brow position, superior palpebral crease, peak angle of the eyebrow, and jowl surface area after volumetric radiofrequency treatments to half of the face. *Dermatol Surg.* 2004;30:922-928.
11. Alster TS, Tanzi E. Improvement of neck and cheek laxity with a nonablative radiofrequency device: a lifting experience. *Dermatol Surg.* 2004;30:503-507.
12. Fitzpatrick R, Geronemus R, Goldberg D, et al. Multicenter study of noninvasive radiofrequency for periorbital tissue tightening. *Lasers Surg Med.* 2003;33:232-242.
13. Ruiz-Esparza J. Near painless, nonablative, immediate skin contraction induced by low-fluence irradiation with new infrared device: a report of 25 patients. *Dermatol Surg*, 2006;32:601-610.
14. Zelickson B, Ross V, Kist D, et al. Ultrastructural effects of Titan infrared handpiece on forehead and abdominal skin. Paper presented at: 25th Annual Meeting of the American Society for Laser Medicine and Surgery; March 30–April 3, 2005; Orlando, Fla. ■