A Proposed Method for Upper Eyelid and Infrabrow Tightening Using a Transcutaneous Temperature Controlled Radiofrequency Device With Opaque Plastic Eye Shields

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ABSTRACT

Laxity of the eyelid and periorbital area, a common manifestation of aging, is usually addressed via blepharoplasty and/or fat transfer. Given the trend toward safer, less invasive treatments preferred by those patients reticent to undergo more invasive procedures, viable alternatives have been sought. Transcutaneous temperature controlled radiofrequency (TTCRF) integrates noninvasive superficial RF treatment with automatic temperature feedback control of energy deposition, as a stimulator of overall collagen remodeling; however, the globe of the eye is particularly sensitive to RF energy. The purpose of the study was to propose a method by which TTCRF and other non-ablative modalities could be used in the eyelid and surrounding area with autocalcitrable opaque black haptic scleral contact lenses protecting the globe of the eye.

INTRODUCTION

Laxity of the eyelid and periorbital region is a universal and early manifestation of aging which increases over time, often addressed by blepharoplasty and/or transfer of autologous fat to remove lax skin and restore lost volume.\textsuperscript{1} While safe, effective, and commonly performed, many younger patients may be reticent to undergo these invasive procedures, especially in the presence of safe, effective alternatives with reduced risk and downtime.\textsuperscript{2,3} Trends such as these across the industry regarding the advent of less invasive methods have, in fact, been noted.\textsuperscript{2} Less invasive modalities such as intense focused ultrasound (IFUS)\textsuperscript{4} and fractional CO\textsubscript{2} laser have been demonstrated to be valid alternatives for upper lid and periorbital treatment. A brief review of blepharoplasty alternatives by Bae-Harboe and Grenenmo\textsuperscript{5} suggested RF as a potential non-invasive treatment with low downtime but variable degree of improvement limited to tightening and lifting. RF technology works by harnessing the impedance of skin when electrical current is passed through it, generating thermal energy to stimulate collagen contraction and neocollagenesis.\textsuperscript{5} Subsequent inflammatory response leads to other beneficial effects, ultimately causing collagen remodeling and a tightening effect. The technology has been demonstrated safe and effective for tightening in younger patients or as an adjunct to facelift surgery (as a touch-up or maintenance treatment). Javate and colleagues used nonablative, non-invasive RF for periorbital wrinkles with some success in a 2014 study.\textsuperscript{6} One potential RF-based alternative is transcutaneous temperature controlled radiofrequency (TTCRF). Using the a small probe with a 1 mm active tip monopolary RF emitters (requiring a grounding pad), skin temperature in small areas such as the periorbital region might be elevated to and held at the scientifically determined and specifically relevant temperature range of 40° to 45°C to stimulate collagen remodeling and tightening. Integrated temperature monitoring allows automatic adjustment of RF energy emission by the device based on real-time tissue temperature readings, which maximizes safety with optimal energy deposition. For transcutaneous applications forward-looking infrared (FLIR) thermal imaging is employed for this purpose.\textsuperscript{3}

While RF may seem to be an ideal modality for the periorbital area, the eyes are among tissues known to be extremely susceptible to damage by RF energy; any RF-based therapy to the periorbital area would have to account for this.\textsuperscript{7} Caruthers and Caruthers\textsuperscript{8} have described a minimally invasive technique using RF energy for periorbital treatment, but with TCRF, there is no potential for RF energy damage to the eye, the globe of the eye being protected by a steriley placed opaque black plastic shield. The purpose of this study was to propose a method for applying TCRF to the upper eyelid, periorbital area, and infrabrow and demonstrate its safety for future use in investigations.

RESULTS AND DISCUSSION

While RF may seem to be an ideal modality for the periorbital area, the eyes are among tissues known to be extremely susceptible to damage by RF energy; any RF-based therapy to the periorbital area would have to account for this.\textsuperscript{7} Caruthers and Caruthers\textsuperscript{8} have described a minimally invasive technique using RF energy for periorbital treatment, but with TCRF, there is no potential for RF energy damage to the eye, the globe of the eye being protected by a steriley placed opaque black plastic shield. The purpose of this study was to propose a method for applying TCRF to the upper eyelid, periorbital area, and infrabrow and demonstrate its safety for future use in investigations.

There were no major adverse events recorded. Treatment was safe and tolerable for all subjects. Figures 1 and 2 represent before and after photographs of patients undergoing treatment as per study protocol. One of the challenges with this study was obtaining consistent clinical photographs to record and measure improvement in lid laxity and brow ptosis. Challenges with comparative photography in matching upper lid laxity are affected by facial expression, brow position, and consistent lighting and positioning of the subject.

CONCLUSIONS

The use of autocalcitrable opaque plastic eye shields provides a safe method of treating the upper eyelid and infrabrow using TTCRF.

REFERENCES


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FIGURES

Figure 1: Digital photographs of a woman (age, 54 years) before (left) and after (right) 6 treatments one month apart with TTCRF for the eyelid and infrabrow, using opaque black plastic eye shields to protect the eye during treatment. Photos courtesy of Douglas Key MD.

Figure 2: Digital photographs of a woman (age, 60 years) before (left) and after (right) 3 treatments one month apart with TTCRF for the eyelid and infrabrow, using opaque black plastic eye shields to protect the eye during treatment. Photos courtesy of Douglas Key MD.

PATTERNS AND METHODS

Subjects (n=16, 36 women and 4 men, age range, 33-72) presented with mild to moderate lid laxity and infrabrow ptosis. Inclusion criteria included any anatomically nearby metallic implants or microscrofuscent implants, such as a pacermaker. The study was conducted using Good Clinical Practice Guidelines and informed consent was obtained from all subjects prior to inclusion.

Any makeup, fake eyelashes, and contact lenses were removed prior to treatment. The subject is placed in a supine position with the RF grounding pad placed on exposed chloride 3% w/v after autoclaving the pad on the upper back. Eye shields were cleaned with soap and water followed by chloroxylenol 0.5% w/v before autoclaving the pad on the lower back. Shields were impregnated thoroughly for rough or jagged edges before placement. The suction cup applicator was placed on the concave surface of the shield for placing and one drop of lubricant (mineral oil 42.5%, petrolatum 57.3%) was applied to the concave inner surface of the shield. A single drop of propylene glycol 5% ephedrine solution was applied to the treated eye; after 10 to 20 seconds the upper eye was then gently lifted using gaunt and while the patient looked downward, the lubricated shield was placed onto the globe of the treated eye under the upper, then lower lid using the suction applicator handle. After shield insertion, the patient was asked to open and close the eye for several times. A thin layer of ultrasound gel was then placed on top of the eye to the eyelid and periorbital area. The upper eyelid as well as the periorcular and subciliary areas were treated with an autocalcitrable opaque shield to the device. Using continuous movement in a small circular ‘daisy-chain’ motion to prevent overheating of any one area, the skin temperature was elevated to and held between 39°C and 41°C for approximately 6 minutes. FLIR thermal imaging was used to monitor skin temperature to maximize proper management of RF energy application and prevent hotspots. The tear trough and lower lid were avoided to mitigate the potential for unwanted subtaneous fat reduction. Each periorbital region was treated in sequence separately. Upon completion of treatment the suction cup was removed and the patient was asked to open their eye widely, to facilitate shield removal. If needed patients may flush the eyes with 0.9% saline. Carbonated sodium chloride 0.5% ephedrine solution was removed to prevent excess lubricant. Follow-up occurred 2-3 months after treatment.

There were no major adverse events recorded. Treatment was safe and tolerable for all subjects. Figures 1 and 2 represent before and after photographs of patients undergoing treatment as per study protocol. One of the challenges with this study was obtaining consistent clinical photographs to record and measure improvement in lid laxity and brow ptosis. Challenges with comparative photography in matching upper lid laxity are affected by facial expression, brow position, and consistent lighting and positioning of the subject.

Further refinement of safe methods for studying TTCRF for upper lid and infrabrow laxity would benefit from validated objective methods to accurately rate improvement, given the small size of the treatment area and possible subtlety of the outcomes. A 2014 study by Javate, et al\textsuperscript{7} proposed the use of a multipin facial positioning and imaging systems to document outcomes of RF therapy for periorbital thryoids. The imaging protocol provides a reproducible method of documenting outcomes by using software to analyze and combine photographs taken at a variety of angles at each treatment or follow-up session; changes are rendered graphically on a computer screen with measurements that can be statistically analyzed. Subjects (n=12) received 1 to 2 treatments and the imaging system showed average eyebrow lifting of 2.05 mm and average superior eyelid crease elevation of 0.98 mm after treatment, with average 3.52 mm and 1.84 mm eyebrow lifting and superior eyelid crease elevation, respectively, at 8-week follow-up. Results were statistically significant. Future study using this or similar technologies capable of objectively documenting subtle results for areas such as the periorbital would be the logical next step, although these modalities may not be available in every practice.

The use of autocalcitrable opaque plastic eye shields provides a safe method of treating the upper eyelid and infrabrow using TTCRF.