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Corrugator Supercilii Muscle Terminal Nerve Ablation Using a Novel Thread Technique for the Treatment of Hyperdynamic Vertical Glabellar Furrows

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ABSTRACT

Background: A novel percutaneous corrugator supercilii muscle terminal nerve CSMTN ablation technique is proposed for the treatment of hyperdynamic vertical glabellar furrows (HVGF).
Technique: Two surgical marks are placed on each eyebrow. One is placed at the level of the lateral canthus and the second at the outer border of the limbus. At each of the four marks, the following steps are carried out: (1) a guiding needle is used to punch the frontal skin at 3 mm above the eyebrow (orifice A) and will then travel deeply at the level of the supraperiostium and emerge outside the skin 3 mm below the eyebrow (orifice B) at the palpebral skin; (2) the needle is then reentered exactly at orifice B and will travel underneath the skin at a more superficial level in the subcutaneous layer and then emerge outside exactly at orifice A. Both ends of the thread are gently pulled in a sawing motion with counter tension until no more resistance is felt from the anatomical structures involved, and then the loops of thread are withdrawn from orifice A.
Results: Forty-seven subjects underwent bilateral CSMTN ablation. In the first 10 cases, the authors performed only one neurotomy per eye and observed a 50 percent HVGF recurrence rate. Then, the authors chose to perform two neurotomies per side and had a three percent recurrence rate (1/37) with a high degree of patient satisfaction. Major complications such as deforming hematomas, eyelid ptosis, abscess, scar formation or adhesions were not observed during follow up.
Conclusion: This novel technique may represent a simple and permanent solution for HVGF.

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INTRODUCTION

Hyperdynamic vertical glabellar furrows (HVGF) are an aesthetic concern in the forehead. Several techniques have been applied in an attempt to eliminate HVGF, including botulinum toxin injection,[1] surgical[2] or radiofrequency nerve ablation,[3] muscle ablation[4,5] or percutaneous myotomy.[6] All these techniques present inherent limitations due to their invasive nature (i.e., surgical resection) or their short-lived action (i.e., botulinum injection). Thus, a minimally invasive procedure that can eliminate the HVGF permanently is still warranted.

Further insight into periorbital muscle distribution and innervation has allowed the development of novel techniques to reduce HVGF.[7-9] The corrugator supercilii muscle is located frontally underneath the eyebrow and its contraction draws the medial end of the eyebrow downward, and wrinkles the forehead vertically, thus, generating the HVGF (Figures 1-3). Several authors have shown that either endoscopic or open resection of the corrugator supercilii muscle's terminal nerve (CSMTN) can effectively reduce HVGF formation; however, these techniques are performed in patients undergoing facial lifting or blepharoplasty and require a longer convalescent time. In this paper, the authors describe a novel percutaneous technique that achieves CSMTN ablation for the treatment of HVGF.

TECHNIQUE

During the preoperative visit, the surgeon should discuss patient's expectations, surgical results and risks. The patient should be informed that only dynamic (and not static) wrinkles are being treated by the procedure. Data regarding concomitant medications and standard coagulation studies must be checked in order to evaluate bleeding risk.

In this study, all patients were seen by a senior surgeon and photographed prior to and after the procedure. Photographs were taken at rest and during muscle contraction.

Prior to the procedure, all subjects were adequately marked with a fiber-tipped blue marking pen. Two marks are placed on each eyebrow as surgical landmarks for the planned percutaneous neurotomies. One is placed on the eyebrow at the level of the lateral canthus (C) and the second on the eyebrow at the outer border of the limbus (L, see Figure 4).

> In this paper, the authors describe a novel percutaneous technique that achieves CSMTN ablation for the treatment of HVGF.

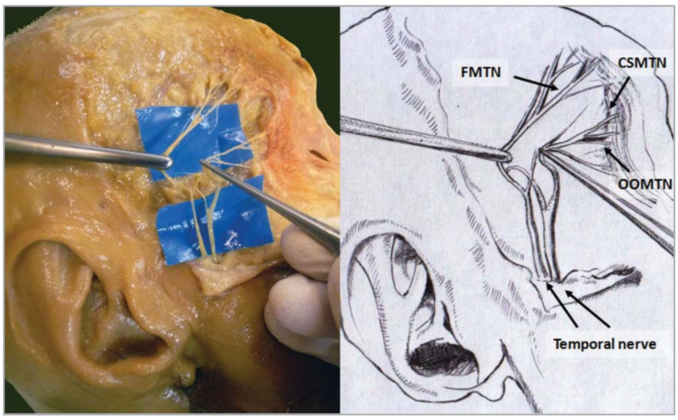
Following adequate skin preparation, skin was infiltrated with lidocaine 1% solution with epinephrine 1:200000 throughout the subcutaneous tissue and skin immediately below the blue marks, usually 1 ml per mark suffices. Successful frowning despite lidocaine infiltration (i.e., CSMTN neuroblockade) suggested that the procedure would be ineffective and, hence, the intervention was not carried out.

The authors recommend waiting for 15 to 20 minutes after infiltration in order to achieve adequate vasoconstriction. The procedure could be done under local anesthesia or mild sedation.

At each of the four marks (Figure 4), the following steps are carried out: (1) a guiding needle is used to punch the frontal skin at 3 mm above the eyebrow (orifice A) and will then travel deeply at the level of the supraperiostium (deep track, see Figures 2 and 5) and emerge outside the skin 3 mm below the eyebrow (orifice B) at the palpebral skin; (2) the needle is then re-entered exactly at orifice B and will travel underneath the skin at a more superficial level in the subcutaneous layer (shallow track, Figures 2 and 5) and then emerge outside exactly at orifice A; and (3) the vicryl thread surrounds several anatomical structures (orbicularis oculi muscle, CSMTN, blood vessels and subcutaneous tissue). Both ends of the thread are gently pulled in a sawing motion with counter tension until no more resistance is felt from the anatomical structures involved, and then, the loops of thread are withdrawn from orifice A[10] (Figure 5).

After the procedure, the authors applied pressure for 3–5 minutes with a cool compress in an attempt to minimize oozing and hematoma formation. The patient is left with no sutures; thread is only used to cut the targeted tissue.

FIGURE 1. Photographic image of a cadaver and its schematic representation showing the temporal nerve and its branches.



FMTN indicates frontalis muscle terminal nerve. OOMTN: orbicularis oculi muscle terminal nerve.

FIGURE 2. a) Photograph and **b)** its schematic graphic showing 1 cm-thick sagittal slice of human orbit and forehead. The slice is cleared with the Spalteholtz technique so we can see through the fat, connective tissues and nerves. We see the eyeball and the upper eyelid, the supercilium and under the skin the subcutaneous fat, reaching to the orbicularis oculi muscle (ORB). Dorsally from the RB there is the suborbicularis oculi fat reaching to the orbital septum which emerges from the orbital margin of the frontal bone (FB), the orbital septum descendent to the tarsal plate (TA). The corrugator supercilii muscle lies behind the ORB and is indicated as CSMTN, corrugator supercilii muscle terminal nerve. We do not see the nerve but the nerve is within this bulk of muscles. The dark spot above is a branch of the supraorbital vessels. A similar graphic **c)** is shown at the right, note both entry sites above (orifice A) and below (orifice B) the eyebrow and the vicryl thread surrounding the CSMTN through shallow and deeper tracks.

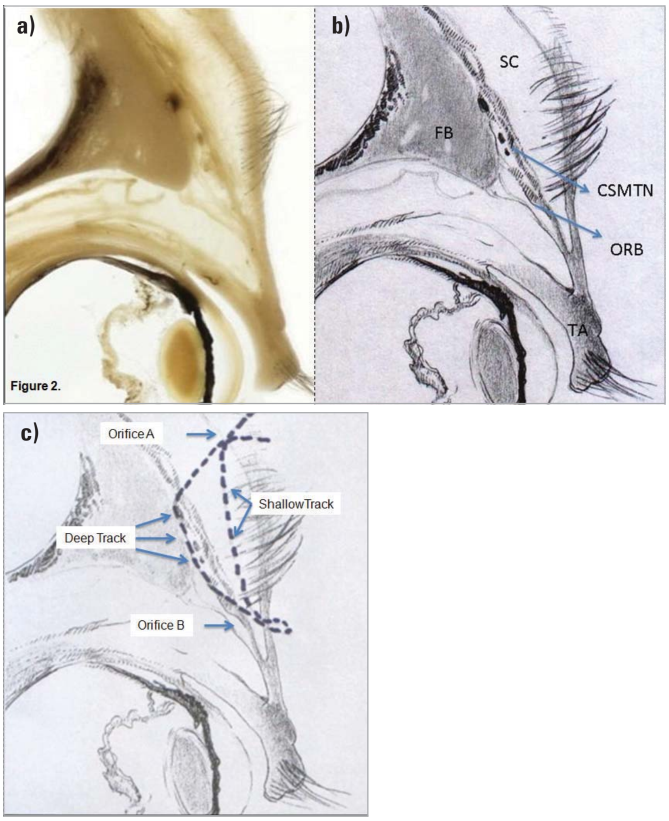


FIGURE 3. Schematic representation of the periorbital motor nerves. Periorbital muscles are indicated as follows: FM-frontalis muscle, CSMTN-corrugator supercilii, DSM-depressor supercilii, PM-procerus, and ZM-zygomatic major. Two branches of facial nerve are shown: TB-temporal branch and ZB-zygomatic branch. TB supplies the FM, superior orbicularis oculi muscle, the transverse head of the CSM and the superior end of the PM. ZB supplies the inferior orbicularis oculi muscle, inferior end of the procerus PM, the DSM, the oblique head of the CSM and the medial head of the orbicularis oculi muscle.

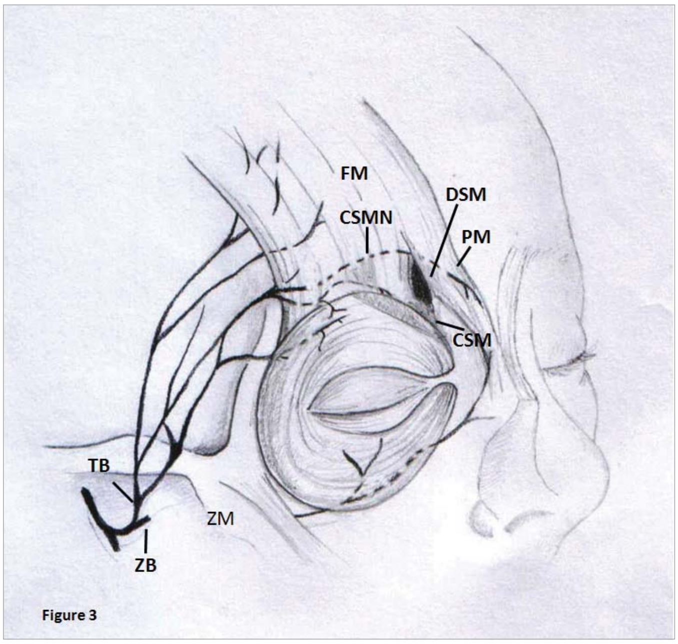


FIGURE 4. Schematic image of a female face showing the precise location of the preoperative surgical marks at each eyebrow. One point is located at the level of the lateral canthus (C) and outer limbus or lateral sclera-corneal border (L).

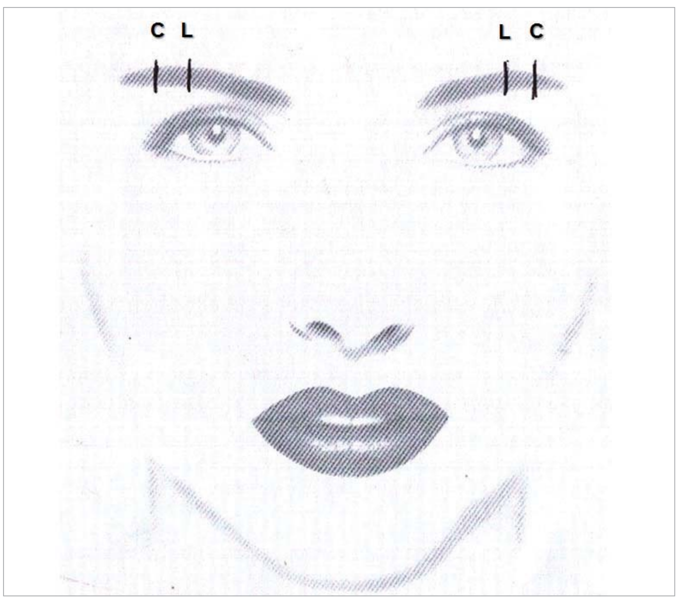


FIGURE 5. Schematic image of a female face showing the precise location of the preoperative surgical marks at each eyebrow. One point is located at the level of the lateral canthus (C) and outer limbus or lateral sclera-corneal border (L).

FIGURE 6. a) Photograph of a patient while scowling before the procedure. **b)** Bilateral bruising immediately is noted after the procedure. **c)** Photograph of the same patient 20 days after CSMTN ablation, demonstrating an improvement in frown lines.

FIGURE 7. Preoperative Photographs taken at rest a) before and b) after CSMTN ablation. This patient received a simultaneous treatment of Fractional CO_2 (Pixel CO_2, Alma laser, Israel) in the area.

RESULTS

The authors started using this technique in 2007 and have, since then, performed 47 bilateral procedures. In two patients, unilateral ablation was performed in order to correct facial asymmetries due to an adverse event of permanent facial paralysis, as previously reported by Marino et al.[11] and Niklison et al.[12] Eighty percent of the patients were female, age ranged from 35 to 67 years. In the first 10 cases, the authors performed only one neurotomy per eye and observed a 50 percent HVGF recurrence rate. At that point, the authors decided to perform two neurotomies per side and had a three percent recurrence rate (1/37). Even after recurrence, complete muscle contraction was not totally recovered, thus, patient satisfaction was still high (Figures 6 and 7). All patients were followed for a minimum time of 12 months and 30 percent of them until two years. The other 70 percent have not had more than 12 months of post-op follow up at the time of composition of this paper. Major complications such as deforming hematomas, eyelid ptosis, abscess, scar formation or adhesions were not observed during follow up. Mild discomfort due to the development of local bruising at the palpebral area may ensue (10% in our series) and may last up to two weeks (Figure 6c).

DISCUSSION

We described a novel percutaneous, crossed suture, manual technique to ablate the CSMTN and successfully relaxed the HVGF. This technique is effective, safe and rather straightforward. Our low rate of complications is likely related to the minimally invasive nature of this technique, which represents a major advantage over open CSMTN resection.

Removal/relaxation of HVGF has been an aesthetic goal for many years. A myriad of medical and surgical strategies have been tried for the treatment of HVGF. However, none of them have been adopted worldwide. It is the authors' opinion that this novel technique may represent a simple and permanent solution for HVGF.

DISCLOSURES

The authors have no relevant conflicts of interest to disclose.

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