Ablation of nerve tissue with radiofrequency-generated (RF-generated) heat is an established technique for treating patients with cardiac arrhythmias.\(^1,2\) The application of this concept to the ablation of motor nerve function in the face was introduced by Gregorio Hernandez-Zendejas and Jose Guerrerosantos\(^3\) in 1994, when they were attempting to find a less invasive treatment to provide forehead symmetry in patients with unilateral frontalis muscle paralysis from Bell's palsy or iatrogenic causes by ablating the function of the temporal branch of the facial nerve on the opposite side. During their study, they found that they could soften glabellar "frown" lines by ablating motor nerves to the muscles that act on the glabellar skin to produce creasing in that area. Subsequently, other authors—as referenced by Dr. Kim and his coauthors in "Percutaneous Selective Radiofrequency Nerve Ablation for Glabellar Frown Lines"—reported with varying success their attempts to similarly apply RF technology to soften glabellar skin lines.

My experience with motor nerve ablation through RF-generated heat began in 2006. The technique my colleagues and I applied has been published by Newman.\(^4\) Except for some minor differences, our technique was remarkably similar to that described by Kim et al. Dr. Kim and his coauthors obtained a significant improvement in glabellar skin lines for at least 12 months postoperatively in 21 of 27 patients (87%). This is interesting, considering that the same technique was applied in all 27 patients. One might expect that the six patients who did not maintain their good clinical result for at least 12 months were treated at the beginning of the study, but those six patients were Patients 4, 9, 15, 18, 20, and 23 (as reported in Kim’s Table 1). Even if those patients were not listed in the order in which they were entered into the study, one could assume that the patient with the longest follow-up time underwent the procedure first and the patient with the shortest follow-up time appeared last. Either way, these six patients were scattered throughout the study, rather than having been treated early in the authors’ learning curve. This indicates that there must remain an elusive technical problem yet to be solved before the production of consistent results. Achieving this end will require that researchers continue making technical refinements for the clinical application of RF energy to treat glabellar lines. To their credit, I believe that these authors have made at least three such refinements to the evolution of the RF nerve ablation technique in three technical areas: control of probe tip position, unipolar versus bipolar probe electrodes, and maximal heat generated in the target tissues.

**Control of probe tip position.** The long, thin probe illustrated by the authors is grasped by the surgeon at the probe’s proximal end and passed through the skin into the subcutaneous soft tissue. The surgeon must then manipulate the position of the tip to place the electrode near the target nerve. Typically, the probe is quite flexible, and this flexibility often makes accurate control of the tip position under the skin difficult. Even though the underlying course of a motor nerve can be identified with the external nerve stimulator and marked on the skin, the surgeon must precisely locate the nerve’s position between skin and bone levels. This requires small incremental adjustments of the tip position within the soft tissues, “searching” for the target nerve with the electrode in stimulator function. As the authors describe, the stimulation level of the electrode is progressively lowered as adjustments of tip position are made while continuing to stimulate a muscle contraction. In this way, the electrode is moved increasingly nearer to the target nerve until a muscle contraction can be obtained with the lowest stimulation level, which indicates that the electrode is very close to the nerve. Then, the electrode is switched to its ablation function to destroy the nerve. Clearly, the success of the nerve ablation depends on the surgeon’s skill in maneuvering the probe tip for positioning of the electrode. The authors enhanced the maneuverability of the probe tip by introducing their probe under the skin through a cannula that controlled the probe’s flexibility. This encasing cannula facilitated more...
precise manipulation of the electrode at the probe’s tip within the soft tissues, and I believe that this simple solution for the problem of probe flexibility greatly enhanced their rate of successful total nerve ablation and long-term positive results. I consider this a significant, inexpensive technical contribution made by the authors.

**Unipolar versus bipolar probe electrodes.** While a bipolar or unipolar electrode could deliver RF energy for nerve ablation, the authors elected to use a unipolar electrode. Unlike a bipolar electrode, a unipolar electrode would have a more spherical shape. Technically, it should be more efficient to place the smaller, more spherical electrode closer to the target nerve with a minimal stimulation level than it is to place a larger, elongated bipolar electrode. The shape of the unipolar electrode also produces a more focused spherical zone of ablation, which I expect enhances the effectiveness of the ablation function. One principle of this technology is that the closer the electrode can be positioned to the target nerve in stimulation function, the greater the effectiveness of the ablation function will be.

**Maximal heat generated in the target tissues.** When tissue temperature exceeds 90°C at the electrode, there is a tendency for the tissue around the electrode to become desiccated, producing an impedance shift. An impedance shift occurs when the desiccated tissue essentially insulates the probe tip and limits the amount of energy the electrode can emit, thereby preventing delivery of the total ablation dose. When only a partial injury to the nerve is produced, the glabellar skin may look smoother initially; however, within weeks, the nerve may recover from the partial injury with return of muscle function and the reappearance of frown lines. The authors avoided the impedance shift effect with a relatively long duration of energy delivery (70 seconds), which allowed them to deliver total ablation energy while limiting their maximum tissue temperature to 85°C. Maintenance of the tissue temperature in the target nerve site to less than 90°C may be an important principle for effective RF peripheral nerve ablation.

I feel that the authors’ modifications of the technique for RF energy nerve ablation to treat glabellar frown lines have advanced the effectiveness of the procedure. I sincerely hope that they will continue to pursue the challenge to perfect this application of RF energy because the procedure has the potential to become a useful tool in plastic surgery. While RF nerve ablation may not always produce the profound muscle paralysis obtained with botulinum toxin injections in the glabellar area, it can potentially provide a longer-lasting benefit without the “frozen” look characteristic of botulinum toxin injections. This technique can also target specific muscles, which is generally not possible with botulinum toxin.

With this said, even if this technique can be perfected to provide a long-lasting cosmetic improvement in every patient, there is a possible undesirable side effect of RF nerve ablation that must be mentioned. While this issue has not been problematic for cardiac patients, it is not clear at this point whether aesthetic patients will experience nerve “sprouting” from the proximal motor nerve segments over time, with possible reinnervation of the muscle in an abnormal pattern that may produce dyskinetic muscle function. If this event should occur, the complexity of locating these multiple regenerated nerves with the nerve stimulator and again ablating them with RF energy may prove difficult. I hope this concern is unwarranted.

I am grateful to the authors for their efforts to refine the clinical application of this technology for aesthetic surgery. Just as RF nerve ablation techniques are a standard treatment option for certain cardiac arrhythmia patients, I predict that this technology will find its place for the treatment of glabellar frown lines in the cosmetic surgery patient.

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