Surgical Correction of Crow’s Feet Deformity With Radiofrequency Current

Min-Hee Ryu, MD; David Kahng, MD; and Yongho Shin, MD, PhD

Abstract

Background: There are many published surgical techniques for the correction of crow’s feet deformity, but subsequent contour irregularities and early recurrence are often reported.

Objective: The authors present a radiofrequency (RF) technique to treat crow’s feet that can prevent complications while simultaneously maintaining long-term results.

Methods: From April 2010 to February 2012, a total of 52 consecutive patients (3 men and 49 women) underwent surgical correction of crow’s feet with an RF current. Following elevation of the skin flap in the temporal area, the lateral portion of the orbicularis oculi muscle was partially elevated and splayed. Then the RF current was applied to the elevated muscle flap until the target temperature of 60°C to 80°C was reached. Clinical outcomes were observed through photographs with patients in a natural smiling position.

Results: Mean (SD) patient age was 52.7 (2.2) years (range, 31-73 years). Patients were followed postoperatively during a mean period of 23 months (range, 15-36 months). There were no recurrences of crow’s feet during the follow-up period. No major complications were noted.

Conclusions: The main advantage of this surgical technique is preserving continuity of the orbicularis oculi muscle while selectively decreasing muscle tone. Hence, this technique may prevent any contour irregularities. The RF current causes irreversible muscle fibrosis, which in turn provides long-lasting results. While the early results of this series show promising long-term efficacy and a good safety profile, the small number of patients and short-term follow-up period warrant further study.

Level of Evidence: 4

Keywords
oculoplastics, crow’s feet, radiofrequency, orbicularis oculi muscle, wrinkles

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Crow’s feet is the term generally used to describe wrinkles that are formed on the lateral aspect of the eyes with aging. The wrinkles are caused by persistent accordion-like contractions of the lateral orbicularis oculi muscle during facial expression. Laxity and ptosis of this muscle also contribute. There are many surgical techniques for correcting crow’s feet described in the literature, such as lateral splaying of the orbicularis oculi muscle flap, division of the orbicularis oculi muscle, and partial resection of the orbicularis oculi muscle.¹⁻⁶ These surgical treatment modalities have been reported to produce good outcomes, but contour irregularities might also be formed at the surgical sites where the orbicularis oculi muscle was divided or excised. With those techniques, recurrence is still likely.

Dr Ryu is a plastic surgeon in private practice in Seoul, South Korea. Dr Kahng is a plastic surgeon in private practice in Los Angeles, California. Dr Shin is a plastic surgeon in private practice in Seoul, South Korea.

Corresponding Author:
Dr Yongho Shin, BK DongYang Plastic Surgery Clinic, 1-2 Nonhyeon-dong, Gangnam-gu, Seoul 135-010, Korea.
E-mail: psd shin@naver.com
To further improve the outcome of surgical treatment of crow’s feet deformity and to decrease recurrence, we developed a unique surgical technique combining elevation and splaying of the lateral orbicularis oculi muscle with the application of a radiofrequency (RF) current to selectively reduce muscle tone. In this article, we present and discuss our procedure and the treatment outcomes.

METHODS

Between April 2010 and February 2012, a total of 52 consecutive patients presented with crow’s feet that were clinically mild to severe and received combined surgical and RF treatment, in conjunction with other facial rejuvenation procedures. Twelve patients underwent subbrow skin excisions, 9 had upper blepharoplasty, and 17 had a facelift concurrent with the treatment for their crow’s feet deformity. As is the custom in our clinic, verbal consent for the study was obtained. Only patients who had received botulinum toxin regularly but now wanted permanent results were included in the study. Patients who were not surgical candidates because of increased morbidity and mortality were excluded from the study.

The type of anesthesia applied was either general anesthesia (15 patients) or intravenous sedation with local anesthetic (37 patients). All 52 patients had bilateral muscle splaying, and RF current was delivered with the RF-1000 device and a 17-gauge guide needle with custom-designed RF probes (Daesung Medical Co, Seoul, Korea). With an internal thermistor, the targeted tissue temperatures remained localized within a 60°C to 80°C range, thus limiting heat dissipation and damage to adjacent tissues. The device is not approved by the US Food and Drug Administration and not sold in the United States, but in South Korea, it is cleared by the Korea Food and Drug Administration and sold as a safe medical device. No additional procedures were performed on the superficial surface of the skin, such as chemical peels or laser resurfacing. Clinical outcomes were evaluated with postoperative photographs, with patients in a natural smiling position. Photographs were taken of the lateral periorbital region in the oblique view and compared with preoperative photographs to evaluate the degree of improvement of the crow’s feet deformity.

SURGICAL TECHNIQUE

Preoperatively, patients were asked to smile naturally, and the bilateral crow’s feet wrinkles were marked. A “zigzag” incision line along the temporal hairline was designed. Local anesthetic (with 1% lidocaine containing epinephrine [1:100 000]) was injected into the temporal hairline. Then, 30 to 50 mL of tumescent solution was injected into each side of the temporal region of the crow’s feet deformity area. After the incision was made, the skin flap was elevated into the subcutaneous plane. The borders of the dissection were wider than the actual crow’s feet deformity on the skin surface. Subcutaneous undermining was performed to the lateral orbital rim medially, to the eyebrow superiorly, and to the cheek inferiorly. Once the sentinel vein came into the visual field during dissection, efforts were made to preserve it (Figure 1). Following elevation of the skin flap, mainly from the areas where the wrinkles were marked, the orbicularis oculi muscle flap is spread vertically through blunt dissection with Metzenbaum scissors. Then, the muscle is dissected to the submuscular areolar space.

Figure 1. The skin flap is elevated in the temporal region. The borders of the dissection are the lateral orbital rim medially, the eyebrow superiorly, and the cheek inferiorly. Blunt dissection is carried out subcutaneously with blunt Metzenbaum scissors. The sentinel vein (arrow) is preserved.

Figure 2. Following elevation of the skin flap, mainly from the areas where the wrinkles were marked, the orbicularis oculi muscle flap is spread vertically through blunt dissection with Metzenbaum scissors. Then, the muscle is dissected to the submuscular areolar space.
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current in the muscle, an electrical current was generated that coagulated tissue in the vicinity of the probe tip, and the biomechanical properties of the muscle changed after coagulation. Coagulation temperatures are typically in the range of about 60°C to 80°C. The current was applied at an interval distance of 5 mm. The end point of coagulation is a color change of the muscle flap, from pink to gray. RF current and the number of repetitions were adjusted to the degree of muscle hypertrophy. The muscle was splayed out in the cephaloposterior direction and secured to the temporal fascia under normal tension with PDS 5-0 sutures (Ethicon, Inc, Somerville, New Jersey; Figure 5). The skin flap was also pulled up in the cephaloposterior direction, and then the excess skin was trimmed and the wound was closed. All patients had silastic drains and gentle compression dressings applied.

RESULTS

In the 52 patients (3 men and 49 women) who received bilateral RF current with the splaying of the orbicularis oculi muscle flap, there were no recurrences of crow’s feet during the postoperative follow-up period. The mean (SD) age was 52.7 (2.2) years (range, 31-73 years). Patients were followed postoperatively during a mean period of 23 months (range, 15-36 months). During the follow-up period, no recurrence of crow’s feet and no contour irregularities were seen.

Only 1 postoperative complication was encountered. One patient (1.9%) had a unilateral hematoma, on postoperative day 1, which was surgically drained. In our study, there were no major complications such as facial nerve injury, eyelid dysfunction, or skin necrosis.

Clinical results are shown in Figures 6 through 8.

DISCUSSION

Application of an RF current in the field of medicine has been diverse. It is utilized to create thermal lesions to obliterate tumors and also employed in the coagulation of blood vessels. In the field of plastic surgery, it has been applied in the volumetric reduction of hypertrophic muscle such as the masseter and gastrocnemius muscles.
Figure 6. (A) This 54-year-old woman presented with severe crow’s feet deformity. (B) Seventeen months after surgical correction of crow’s feet deformity using radiofrequency current. The patient also underwent a concurrent facelift and upper and lower blepharoplasty.

Figure 7. (A) This 59-year-old woman presented with severe crow’s feet deformity. (B) Twenty months after surgical correction of crow’s feet deformity using radiofrequency current. The patient also underwent a concurrent subbrow skin excision. Note that fat grafting could be used to correct the remaining depressions.
The RF current is an energy source with ionic fluctuations. It produces frictional heating at a temperature of 60°C to 80°C, which causes tissue coagulation and hence protein denaturation. Unlike lasers and electrocautery where the temperature reaches over 400°C to cause tissue coagulation, the RF current causes thermal coagulation at a significantly lower temperature, therefore providing controlled, focal tissue coagulation while limiting injury to the surrounding tissues. With an internal thermistor, the targeted tissue temperatures stay localized within a 60°C to 80°C range, thus limiting heat dissipation and damage to adjacent tissues. A fine probe and needle device are utilized, so that the target tissue can be precisely and selectively coagulated. When the lateral orbicularis oculi muscle is treated with the RF current, the muscle becomes denatured and forms irreversible muscle fibrosis. This maintains diminished muscle activity for a long-term sustained therapeutic effect.

Many surgical techniques have been described to correct crow’s feet deformities. Aston splayed out the lateral aspect of the orbicularis oculi muscle and pulled the muscle flap in the cephaloposterior direction prior to fixation of the flap. In some cases, he divided the muscle ring. Connell and Marten also described dividing the inferolateral portion of the muscle. Others have reported performing myomectomies. The ultimate goal of these techniques was to decrease the tone of the orbicularis oculi muscle to eliminate the formation of wrinkles. However, these procedures carried the risk of contour irregularities, which required additional procedures like autologous fat injections or grafting temporalis fascia or a piece of superficial musculoaponeurotic system (SMAS) to correct the contour deformities.

If muscle tone is not reduced via division or resection, the wrinkles are less likely to improve. To avoid the complications of myotomies or myomectomies and to maintain the continuity of the orbicularis oculi muscle, we employed a technique that combined both a partial muscle flap elevation and the application of the RF current to further decrease the muscle tone to treat crow’s feet deformities and prevent recurrences. No complications of contour irregularities or recurrence were seen in our patients, probably because muscle fibrosis was induced by the RF current, rather than the suture technique.

According to Aston, the amount of tension placed on the orbicularis oculi muscle flap during cephaloposterior fixation is also important in achieving a good surgical outcome for treating crow’s feet deformities. He described a direct relationship between the amount of tension to the number and depth of the crow’s feet as well as the thickness of the muscle. The more severe the crow’s feet deformity, the more tension that should be applied during fixation. He noted that 1 patient complained of a “pulled” appearance and sensation, which lasted for 18 months.

Figure 8. (A) This 56-year-old woman presented with severe crow’s feet deformity. (B) Twenty-four months after surgical correction of crow’s feet deformity using a radiofrequency current. The patient also underwent a concurrent lower blepharoplasty and subbrow skin excision.
postoperatively, because the muscle fixation was done at a higher tension. By using our technique with the RF current, no significant amount of tension was placed on the splayed muscle flap during fixation. In our series, patients did not complain of having a pulled appearance or sensation. Even in the immediate early postoperative period, patients had a natural appearance.

Transcutaneous nerve ablation and muscle cautery are options, but because the orbicularis oculi muscle is thin, it is difficult to target using a closed method, and thermal injury of adjacent tissue is possible, including thin skin and temporal nerve branches. Therefore, an open technique using the RF current is superior to closed methods. Botulinum toxin injections are also an easy and simple method to correct crow’s feet deformities; however, limited duration is a disadvantage. The RF current is recommended only for those patients undergoing some cosmetic facial procedure to which RF can be added as an adjunct procedure or for a select group of patients who want a stand-alone procedure for a more permanent result.

Any device that delivers thermal energy has an inherent risk of burns and malfunctioning. We believe this is an accepted risk for devices like this, especially if percutaneous devices are utilized. However, with an open procedure, the risk of burns is rare because the procedure is performed under direct vision.

A disadvantage of this procedure is prolonged edema and stiffness of the crow’s feet area, which can be resolved in 1 to 2 months. Some patients complained of stiffness in the treated area initially but, after 2 months, the stiffness spontaneously resolved without any subsequent treatment. Also, there was considerable dissection of the orbicularis oculi muscle that could lead to irregular scarring, which could be controlled by meticulous surgical dissection and even RF coagulation of the muscle.

**CONCLUSIONS**

Existing surgical methods for addressing crow’s feet deformity, such as division or resection of the orbicularis oculi muscle, have not solved the problem of contour irregularity and recurrence. With the method described here, contour irregularity can be prevented by preserving continuity of the muscle, and recurrence of crow’s feet can be minimized by obtaining sustainable irreversible fibrosis at treated areas by the RF current. This method offers an option that is not associated with contour deformities and still prevents the recurrence of crow’s feet. Therefore, this method can be applied as an alternative to conventional methods. While the early results of this series show promising long-term efficacy and a good safety profile, the small number of patients and limited follow-up period warrant further study.

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