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Cross Facial Nerve Grafting for Smile Restoration: Thoughts on Improving Graft Inset

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Summary: Cross facial nerve grafts (CFNGs) are one of the most ubiquitous and time-honored surgical tools used in facial reanimation. They may be used for targeting different mimetic muscles in the subacute setting as well as to innervate newly placed muscle flaps in varied facial subunits. In our experience, when used specifically for smile reanimation in two-stage strategies with either traditional "babysitting" approaches in nerve transfers or free functional muscle transfers, the second stage may present some challenges in CFNG identification as well as injury to the previously banked nerve graft. We present some technical modifications in the first-stage CFNG inset that can make the second stage easier and safer. These modifications include: (1) marking the course of the nerve graft with surgical metal clips and inserting loose circumferential sutures throughout the distal course of the nerve in the recipient area to avoid displacement; (2) transferring the nerve graft through the nasal sills rather than lips, protecting it from damage during insertion of free functional muscle transfer; and (3) routing the nerve from the lateral nose to the preauricular area over the zygomatic arch, allowing easier dissection and banking of adequate graft length to provide tension-free coaptation with the flexibility of nerve coaptation in variable positions. *(Plast Reconstr Surg Glob Open 2022;10:e4178; doi: 10.1097/GOX.0000000000004178; Published online 6 June 2022.)*

INTRODUCTION

Cross facial nerve grafts (CFNGs) are one of the most ubiquitous and time-honored surgical tools used in facial reanimation.[1–5] They may be used for targeting different mimetic muscles in varied facial subunits, such as the periorbita, midface, and lower lip,[6–10] in both the acute and subacute settings, complementing "babysitter" strategies, or for innervating free functional muscle transfers (FFMTs) and even grafts in long-standing paralysis.[11–14]

Traditionally, CFNG is transferred to the contralateral face through the upper lip in a subcutaneous, submucosal,[15–17] or periosteal tunnel[12,18] and banked directly in front of the preauricular incision in a straight line, usually tagged and tacked in place with a large identifiable permanent suture. CFNG can be used in single- and two-stage facial reanimation procedures. In two-stage strategies, we find that this technique may pose some challenges in the second stage. First, the initial identification and dissection of the previously placed CFNG can occasionally be difficult and risky. Second is the risk of nerve graft injury during placement of insertion sutures during second-stage FFMT. And, third is the lack of a "safe redundancy" allowing for flexible configuration and tension-free coaptation of the CFNG especially in cases of dually innervated FFMT and less frequently in "babysitter" strategies. In this article, we describe several technical modifications we implemented over the years in the transfer and inset of CFNGs on the recipient side, which help us with identification, dissection, protection, and coaptation of the graft in the second stage of reanimation.

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MATERIALS AND METHODS

Surgical Technique

Under general anesthesia, an adequate length of sural nerve, extending from the lateral malleolus up to a couple of inches caudal to the popliteal fossa, is harvested via several transverse skip incisions. When performed concomitantly with a nerve transfer, we usually start with dissection of the paralyzed side via a preauricular incision, dissecting in the sub superficial musculoaponeurotic system (SMAS) plane immediately superficial to the parotid-masseteric fascia. The nerve to masseter is dissected[19–21] while carefully preserving the intraparotid facial nerve branches. A

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tunnel is then dissected with Metzenbaum scissors ending with a small incision just posterior to the ipsilateral nasal sill. A 10-French red-rubber catheter is transferred via the tunnel. A similar sub-SMAS flap is raised in the healthy side up to the mobile SMAS. Branches of the zygomatic and buccal divisions of the facial nerve are identified, and specificity and redundancy are confirmed with bipolar nerve stimulation. The selected branches are dissected retrograde 1 cm into the parotid.[22] Similar to the paralyzed side, a tunnel is dissected to the healthy side alar base, and the red-rubber catheter is tunneled from the paralyzed to the healthy nasal sill and then to the healthy preauricular region (Fig. 1). The nerve graft is then sewn to one end of the red rubber catheter with 4-0 Nylon, the catheter is lubricated with gel, and the nerve is passed between both sides of the face. The previously chosen one or two healthy branches are divided and coapted to the sural nerve grafts using 9-0 Ethilon sutures. On the paralyzed side, the graft is laid cranial and parallel to the zygomatic arch and around 2 cm anterior to the incision is gently curved caudally and banked 1 cm anterior and parallel to the preauricular incisions in a straight line. Medium-to-large surgical clips are placed on both sides of the nerve for a distance of 3–4 cm to mark the course of the nerve in the lateral paralyzed face, and 4-0 nylon sutures are loosely looped around the nerve to avoid displacement (Figs. 2 and 3). Between 10 and 12 months later, the nerve is retrieved during the second-stage free functional muscle transplant (Fig. 4).

Takeaways

Question: When cross facial nerve grafts (CFNGs) are used for smile reanimation in two-stage strategies, the second stage may present some challenges in CFNG identification as well as injury to the previously banked nerve graft.

Findings: We present some technical modifications in the first-stage CFNG inset: (1) marking the course of the nerve graft and inserting loose circumferential sutures to avoid displacement; (2) transferring the nerve graft through the nasal sills rather than lip; and (3) routing the nerve from the lateral nose to the pre-auricular area over the zygomatic arch.

Meaning: The described modifications in CFNG techniques can make the second stage safer and easier.

DISCUSSION

CFNGs can be performed in either single-stage[13,16,23] or two-stage procedures. Similar to other authors,[12,15,24,25] we currently prefer performing the CFNG in the first stage of a two-stage approach in most patients, especially in dually innervated FFMT.[17] The argument for this is threefold. First, although stimulation of the nerves is not possible in subacute facial palsy, stimulating and mapping the recipient facial nerve branches is possible a year later allowing more accurate coaptation of the CFNG to the designated "previously paralyzed" recipient facial nerve branches. The second advantage is allowing end-to-end coaptation of the partially regenerated CFNG axons to regenerated facial nerve branches and rennervated recipient muscles. Finally, in the setting of dually innervating an FFMT, distal regenerated CFNG axons may more readily capture some available neuromuscular junctions of the FFMT before being filled with axons of the nearby nerve transfer. The obvious disadvantages of a two-stage procedure are the additional second surgery and the return to a scarred field.

One of the difficulties in the second stage is identification and dissection of the previously banked nerve

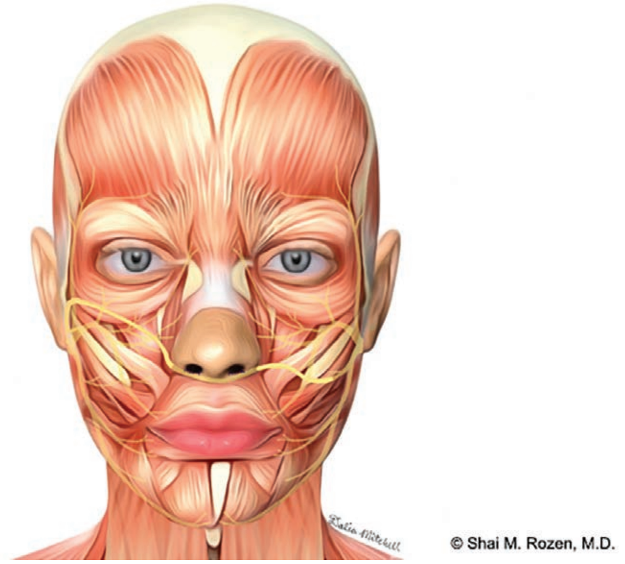

Fig. 1. Illustration demonstrating the path of the CFNG from the healthy (left hemiface) to the paralyzed side (right hemiface) of the face through the nasal sill.

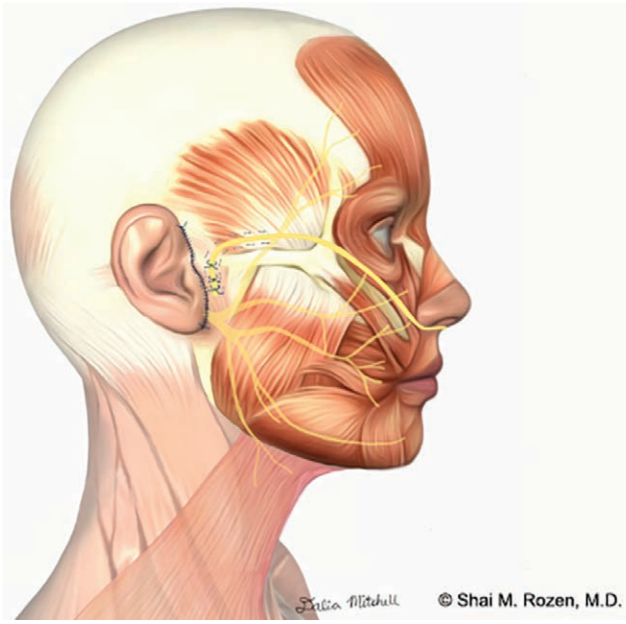

Fig. 2. Illustration demonstrating the position of the banked CFNG in the paralyzed right hemiface, and the area marked with metal clips and loose circumferential nondissolvable sutures.

Fig. 3. Intraoperative image demonstrating the inlay of the CFNG while corralling it with staples and gently placed circumferential nonabsorbable sutures, in preparation for a second-stage dually innervated free functional muscle transplant. Courtesy of Shai M. Rozen, MD.

due to scarring and possibly slight shifting of the graft in the first several weeks after surgery. To overcome this, in the past 5 years, we started marking or "corralling" the nerve graft in the paralyzed recipient area with medium/large surgical metal clips on both sides over the distal 3–4 cm while adding loose circumferential nonabsorbable monofilament sutures throughout the distal course of the nerve to avoid displacement (Figs. 2 and 3). Figure 4 depicts the same patient in Figure 3 11 months later during the second-stage FFMT with the CFNG fully dissected.

Another risk of injury to the CFNG, if previously placed in the muscular or submucosal plane of the upper lip, occurs when securing the insertion of the FFMT into the upper lip in the second stage. To address this, over the past five years, we have transferred the CFNG through the base of the nose (Fig. 1). This decreases the chances of direct injury from suture placement and from nerve devascularization if the nerve needs to be extensively mobilized out of the way.

Another challenge we faced on occasion in earlier years is insufficient length redundancy of the CFNG when used either as part of a "babysitter" strategy[12] or more frequently, when dually innervating an FFMT.[17] This can occur especially in the latter when unexpected donor vessel changes necessitate changing the neurovascular hilum location in relationship to the flap edges. The minimal 3–4-cm "redundancy" can sometimes provide significant flexibility and optimal placement of nerve coaptation and may be readily discarded if not needed. If the nerve is passed in a straight line through the upper lip to the preauricular region, the surgeon may be presented with inadequate length if modifications are needed. To overcome this problem, some authors curl up the remnant nerve graft in the preauricular region, making second-stage graft dissection and unraveling very difficult and exposing the graft to further injury. We, therefore, started routing the nerve in a longer curvilinear course from the lateral nose to the preauricular area (Figs. 1–3) through a tunnel over the zygomatic arch, which allows both an easier identification and dissection of the nerve while providing sufficient redundancy. Since applying this technique, injury to the CFNG during initial exposure has decreased (from 2/150 to 0/70 cases), and operative times of the nerve exposure and dissection portion have decreased by an estimated 20 minutes. We have not encountered any issues with the metal clips, which are left due to excess scarring or future MRIs.

Though we have used this technique safely in over 70 patients, it is not indicated in every case, and flexibility in decision-making should be the rule. In cases when only one stage is preferred by the patient or surgeon or in cases of weak but not flaccid facial paralysis, traditional crossing techniques via the lip can be used. This technique should also be avoided in patients with congenital facial deformities associated with facial nerve weakness or paralysis. These patients will often need nasal or orthognathic surgery, putting the CFNG at risk for injury in the area of transfer through the nasal sill.

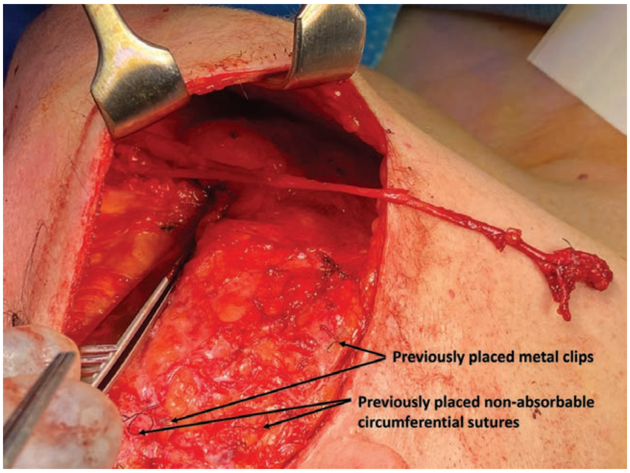

Fig. 4. Intraoperative image of the same patient in photograph 1, 11 months later with the previously placed CFNG fully dissected in preparation for the dually innervated free functional muscle transplant. Note the embedded metal clips and remnant nonabsorbable circumferential sutures placed previously. Courtesy of Shai M. Rozen, MD.

CONCLUSIONS

Traditional CFNG techniques present some challenges when used in two-stage techniques. The described modifications in CFNG techniques are safe, readily adoptable, and easy to perform during the first stage, enabling an easier and safer second-stage reanimation.

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