

Supercharging the Smile: A Novel Dual Nerve Transfer for Facial Reanimation

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Background: Facial paralysis has profound effects on the functional and psychosocial well-being of patients. Various surgical facial reanimation techniques have been described to address this devastating condition. While traditional surgical approaches have proved successful in restoring either facial tone or facial movement, newer combination nerve transfer techniques are addressing the limitations of the traditional single nerve transfer approaches.

Methods: This study aimed to describe a promising new surgical approach to facial reanimation utilizing a dual nerve transfer to maximize both resting and active symmetry while minimizing postoperative synkinesis. Here, we use the masseteric nerve to selectively innervate the midface in combination with a hypoglossal facial nerve graft to reanimate the remaining facial regions.

Results: To date, we have performed this operation on four patients, all of whom tolerated the procedure well. Our patients are showing significant improvements in both resting facial tone and facial movement with no signs of synkinesis at 9 months postoperative.

Conclusions: We believe this dual nerve transfer to be superior in restoring the combination of tone, symmetry, and movement to the paralyzed face when compared with traditional single nerve transfer approaches. (*Plast Reconstr Surg Glob Open* 2022;10:e4124; doi: 10.1097/GOX.0000000000004124; Published online 17 February 2022.)

INTRODUCTION

Facial reanimation involves restoring function of the facial muscles in an attempt to improve both resting and active facial symmetry. Reanimation options depend on the degree of paralysis and intrinsic muscle viability.¹ In short-term paralysis with viable facial musculature, nerve transposition is a popular option. Two commonly utilized nerves are the hypoglossal and masseteric nerve.² Recently, combination nerve transfer techniques have emerged to address the individual shortcomings of traditional single nerve techniques. The purpose of this study was to introduce the facial plastic surgeon to our innovative technique for facial paralysis.

METHODS

Institutional quality improvement project approval was obtained under the Nova Scotia Health Authority Quality Improvement & Patient Safety Committee for the Central Zone. After obtaining informed consent, general anesthesia is initiated without paralysis. A standard modified Blair's incision is fashioned with an infratemporal extension to facilitate the harvest of the masseteric nerve. A sub-SMAS parotidectomy flap is elevated and the great-auricular nerve is identified. A generous portion is harvested to be used later as a jump graft. The facial nerve is identified using the tragal pointer and the posterior belly of the digastric as landmarks and traced in a retrograde fashion to the stylomastoid foramen, where it is divided. Next, the free distal segment of the facial nerve is rotated and an end to end anastomosis is accomplished between the transected facial nerve segment and the great-auricular nerve graft. A limited neck exploration is then performed to identify the hypoglossal nerve, inferior to the posterior belly of the digastric. The free end of the great-auricular nerve graft is then anastomosed to the hypoglossal nerve through an epineural window in an end to side fashion. In

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attempts to prevent hypercontracture, neurotomy of 40% of hypoglossal fibers is performed.³ This completes the XII-VII neurotization (Fig. 1).

Next, we identify the buccal branch of the facial nerve 1 cm below the lower margin of the zygoma. The buccal branch is dissected in a retrograde fashion to evaluate the arborization pattern of the proximal facial nerve and to determine the ideal location to selectively reinnervate the midface with the masseteric nerve. The donor nerve is identified in the subzygomatic triangle anterior to the mandibular condyle in the sigmoid notch. The nerve to masseter is stimulated intraoperatively for confirmation and traced distally to ensure adequate length for a tension free anastomosis to the buccal branch. An end to side or end to end anastomosis of the masseteric nerve to a robust buccal branch is then completed. This completes the targeted buccal specific V-VII neurotization (Fig. 2).

Postoperatively, patients are counseled to practice clenching in front of a mirror to produce a smile. Follow-up is arranged at the 3, 6, 9, 12, 18, and 24-month marks. Photographs and videos will be taken at each follow-up visit.

RESULTS

To date, we have performed our dual nerve transfer facial reanimation surgery on 4 patients with unilateral facial paralysis. All patients tolerated the procedure well, and there were no reported complications. Videos and photographs were taken of all patients preoperatively and again at 3, 6, and 9 months. Additional photographs and videos will be taken at the 12, 18, and 24-month marks. The cohort has had 9 months of follow-up to date. All patients have shown significant improvements in both resting tone and facial movement with minimal associated synkinesis (Table 1, Fig. 3). (See Video [online], which displays a demonstration of facial tone at rest and with dynamic movement in a patient 9 months after facial reanimation surgery.). The synkinesis subscore from the Sunnybrook Facial Grading System is reported for each patient in Table 1. We will continue to assess progress and quantify our data using a series of standardized facial movement

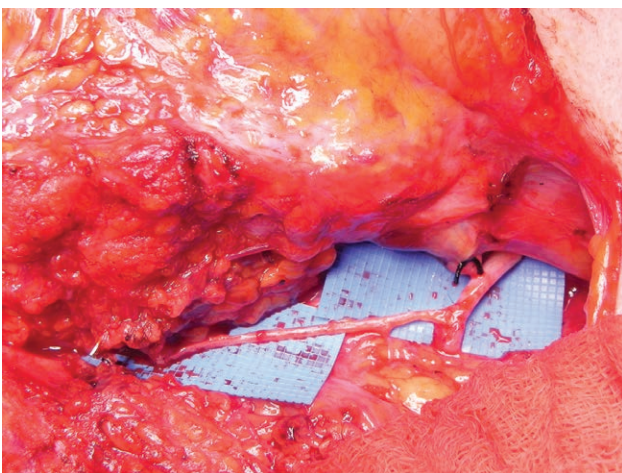


Fig. 1. An intraoperative view of the XII-VII neurotization.

Takeaways

Question: Is the proposed dual nerve transfer technique able to maximize resting and active symmetry in patients with unilateral facial paralysis?

Findings: Patients undergoing our dual nerve transfer technique are showing significant improvements in resting facial tone and facial movement with no synkinesis 9 months postoperatively.

Meaning: Our novel approach to facial reanimation is designed to maximize resting facial tone while supercharging active movement of the midface in patients with unilateral facial paralysis.

grading systems to allow for a comparison with traditional techniques in a later publication (See Video [online]).

DISCUSSION

A smile is perhaps the most important way people communicate positive emotions. Thus, reinstating and maximizing movement in the midface is essential in reanimating the paralyzed face. While previous studies using dual nerve transfer techniques have focused on separating the upper and lower divisions of the facial nerve to minimize synkinesis,⁴ our novel facial reanimation technique uses the masseteric nerve to selectively innervate the midface. The masseteric nerve offers close proximity, rapid functional recovery,⁵⁻⁸ and minimal donor site morbidity. Additionally, the intrinsic masseteric function of clenching the jaw is considered a more natural mechanism to initiate a smile than tongue movement.^{5,9} Our second nerve graft plugs the remainder of the facial nerve segments into the hypoglossal nerve. Hypoglossal nerve transfer is widely recognized for its ability to restore resting tone to the facial muscles,² improving facial symmetry while in repose. The negative perception of facial asymmetry has been well documented, and it has been found that humans can perceive asymmetry at

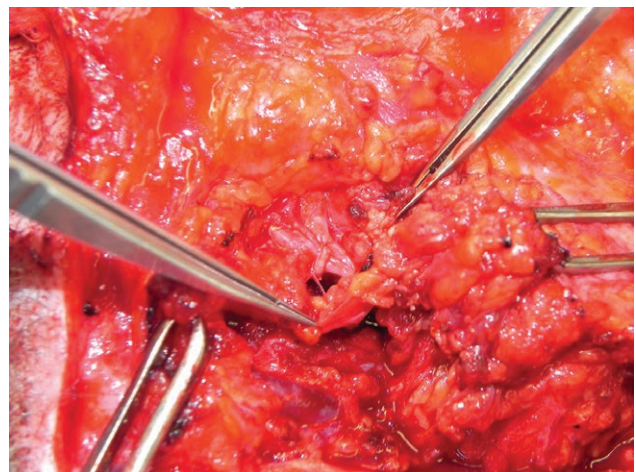


Fig. 2. End to side anastomosis of the masseteric nerve to the buccal branch of the facial nerve.

Table 1. The Sunnybrook Synkinesis Subscore and Facial Asymmetry Index for Each Patient Preoperative and 9 Months Postoperative

Patient	Sunnybrook Synkinesis Assessment Subscore*		Facial Asymmetry Index (cm)†	
	Preoperative	9 Months Postoperative	Preoperative	9 Months Postoperative
1	0	0	0.8	0.1
2	0	0	0.8	0
3	0	0	0.6	0.1
4	0	1	0.5	0

*Out of a maximum possible score of 15.

†Length from medial canthus to ipsilateral oral commissure at rest (cm).

the brow or oral commissure once a difference of 3 mm is reached.⁵

While facial reanimation traditionally involved single nerve transfer techniques, these procedures are often associated with significant postoperative synkinesis due to reinnervation of the entire mimetic musculature with a single motor source. Dual nerve transfer techniques have been found to significantly reduce postoperative synkinesis. For example, a recent publication by Yoshioka described transferring the masseteric nerve to the zygomatic branch of the facial nerve and transferring the hypoglossal nerve to the cervicofacial division. This surgical approach resulted in minimal synkinesis, as reported at the 18-month follow-up.¹⁰ Although similar, our technique involved selective innervation of the buccal branch rather than the zygomatic branch, allowing us to engage the elevators of the mouth without the risk of

cross innervation to the inferior orbicularis oculi muscle, again in an effort to reduce synkinesis associated with smiling.

This study is not without its limitations. Although we acknowledge that the short follow-up times and small sample size may limit inferences drawn from our results, we intend this publication to be an early proof of concept only.

CONCLUSIONS

Our novel approach to facial reanimation is designed to maximize resting facial tone while supercharging active movement of the midface in patients with unilateral facial paralysis. This procedure is well tolerated and has resulted in high patient satisfaction with early results superior to those achieved with traditional single nerve transfer techniques.



Fig. 3. Photos of a patient with unilateral facial paralysis who underwent reanimation surgery using the described dual nerve transfer technique. Preoperative (A) and 9-months postoperative (B) images of a facial paralysis patient in motion and at rest.

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PATIENT CONSENT

The patient provided written consent for the use of her image.

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