Facial Reanimation With Masseteric Nerve

Babysitter or Permanent Procedure? Preliminary Results

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Abstract: The authors are presenting a series of 10 cases of complete unilateral facial paralysis submitted to (I) end-to-end microsurgical coaptation of the masseteric branch of the trigeminal nerve and distal branches of the paralyzed facial nerve, and (II) cross-face sural nerve graft. The ages of the patients ranged from 5 to 63 years (mean: 44.1 years), and 8 (80%) of the patients were females. The duration of paralysis was no longer than 18 months (mean: 9.7 months). Follow-up varied from 6 to 18 months (mean: 12.6 months). Initial voluntary facial movements were observed between 3 and 6 months postoperatively (mean: 4.3 months). All patients were able to produce the appearance of a smile when asked to clench their teeth. Comparing the definition of the nasolabial fold and the degree of movement of the modiolus on both sides of the face, the voluntary smile was considered symmetrical in 8 cases. Recovery of the capacity to blink spontaneously was not observed. However, 8 patients were able to reduce or suspend the application of artificial tears. The authors suggest consideration of masseteric-facial nerve coaptation, whether temporary (baby-sitter) or permanent, as the principal alternative for reconstruction of facial paralysis due to irreversible nerve lesion with less than 18 months of duration.

Key Words: facial reanimation, masseteric nerve, nerve substitution technique

(*Ann Plast Surg* 2010;64: 31–34)

In the treatment of facial paralysis, the best results are typically observed when function of the facial nerve is reestablished. There are some clinical situations, however, in which facial nerve lesions are irreversible. Because the consequent atrophy of the mimic muscles is only considered permanent after approximately 2 years,[1] there is an interval during which it is possible to reestablish muscle contractions through electrical impulses from other nerve sources.

In 1971, Smith[2] described the use of cross-facial nerve grafts whereby the fibers of selected branches of the facial nerve from the unaffected side are redirected to reinnervate muscles on the paralyzed side. Techniques for replacing the facial nerve with other cranial pairs were subsequently described: the trigeminal nerve in 1978 (Spira)[3] and the hypoglossal nerve in 1979 (Conley & Baker).[4]

In 1984, Terzis[5] introduced the babysitter procedure, using hypoglossal-facial nerve anastomosis and cross-facial nerve graft concomitantly. For slightly more than 2 decades, clinical studies of facial reanimation using temporary or permanent nerve substitution technique concentrated primarily on the use of the hypoglossal nerve.[6]

Received September 15, 2008, and accepted for publication, after revision, December 19, 2008.
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ISSN: 0148-7043/10/6401-0031
DOI: 10.1097/SAP.0b013e3181999ea9

In 1995, Zuker[7] described the use of the masseteric nerve (trigeminal nerve branch) with gracilis muscle transplant in reanimation of congenital bilateral facial paralysis. The high success rates obtained with this technique in treating unilateral facial paralysis (Faria et al)[8] motivated the authors to use the masseteric nerve to substitute the facial nerve in cases of paralysis persisting up to 18 months.

PATIENTS AND METHODS

In the period from July 2006 to February 2008, 10 patients with unilateral facial paralysis were submitted to substitution of the facial nerve with the masseteric branch of the trigeminal nerve. Age, sex, cause and duration of paralysis of each patient are shown in Table 1. Ages varied from 5 to 63 years (mean: 44.1 years), and the majority of the patients were female (80%). The duration of paralysis varied from 0 (immediate reconstruction) to 18 months (mean: 9.7 months). With the exception of 2 cases submitted to excision of parotid tumor and 1 case of facial nerve avulsion due to dog bite, all patients were evaluated with electroneuromyography and showed no evidence of nerve regeneration. In all cases, the procedure was performed in conjunction with cross-face nerve graft, through coaptation of the sural nerve to the buccal branches of the contralateral facial nerve.

Surgical Procedure

By means of preauricular incision on the paralyzed side and sub-Superficial Muscular Aponeurotic System undermining, the most peripheral branches of the extraparotid facial nerve were identified and dissected retrogradely. The zygomatic and buccal branches, whether separate or united into a common proximal trunk, were selected and sectioned in all cases.

In the area outlined by the anterior border of the parotid gland, posterior border of the masseter muscle, zygomatic arch cranially, and parotid duct inferiorly, the masseteric branch of the trigeminal nerve was exposed with blunt dissection of the masseter. The nerve was then sectioned as distally as possible to facilitate approximation of its stump to the facial nerve branches located more superficially, which were sectioned more proximally or distally depending on their distance from the masseteric nerve. Nerve coaptation was performed with a microscope and interrupted epineural sutures of 10-0 Nylon (Fig. 1).

In the same surgery, a preauricular incision was made on the nonparalyzed side which was undermined under the Superficial Muscular Aponeurotic System. Upon electrical stimulation, the nerve which produced the best contraction of the zygomatic muscles and consequently the appearance of a smile was selected. This branch was then sectioned. Its proximal stump was sutured to a sural nerve graft which crossed the midline through the intramuscular tunnel and the distal stump was positioned in front of the tragus on the paralyzed side.

All patients had postoperative follow-up and each was photographed and filmed.

TABLE 1. Demographics

Patient No.	Age	Sex	Duration of Paralysis (mo)
1	63	F	0
2	5	M	6
3	36	F	6
4	41	F	7
5	55	F	7
6	23	F	10
7	46	M	12
8	55	F	15
9	61	M	16
10	56	F	18

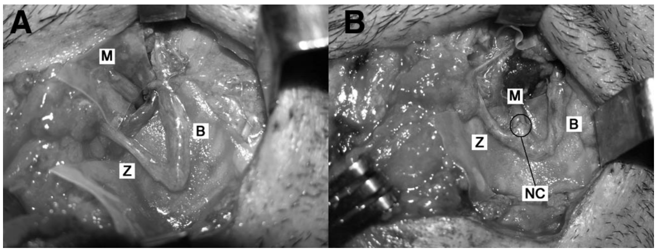

FIGURE 1. Surgical technique. A, Masseteric nerve, zygomatic and buccal branches united in a common trunk. B, With microsurgical nerve coaptation. M indicates masseteric nerve; Z, zygomatic branches; B, buccal branches of the facial nerve; NC, microsurgical nerve coaptation.

RESULTS

In this study, there was one case of immediate postoperative hematoma on the paralyzed hemiface which required surgical reintervention. The length of hospital stay varied from 1 to 3 days (mean: 1.3 days).

Initial facial movement was observed in the malar region between the third and sixth month postoperatively (mean: 4.3 months). Postoperative follow-up period varied from 6 to 18 months (mean: 12.6 months) (Table 2).

All patients were able to produce the appearance of a smile when asked to clench their teeth. Comparing the definition of the nasolabial fold and the degree of movement of the modiolus on both sides of the face, the voluntary smile was considered symmetrical in 9 cases. Pre- and postoperative images of clinical examples are shown in Figures 2 and 3.

TABLE 2. Beginning of Movements and Postoperative Follow-Up Period

Patient No.	First Contractions (mo)	Follow-Up (mo)
1	4	18
2	3	16
3	3	12
4	4	8
5	5	16
6	3	18
7	5	8
8	5	9
9	6	6
10	5	15

FIGURE 2. Patient 6. A, Preoperative view of the face at rest. B, Postoperative view of the face at rest. C, Preoperative view of the face during voluntary smile. D, Postoperative view of the face during masticatory movement.

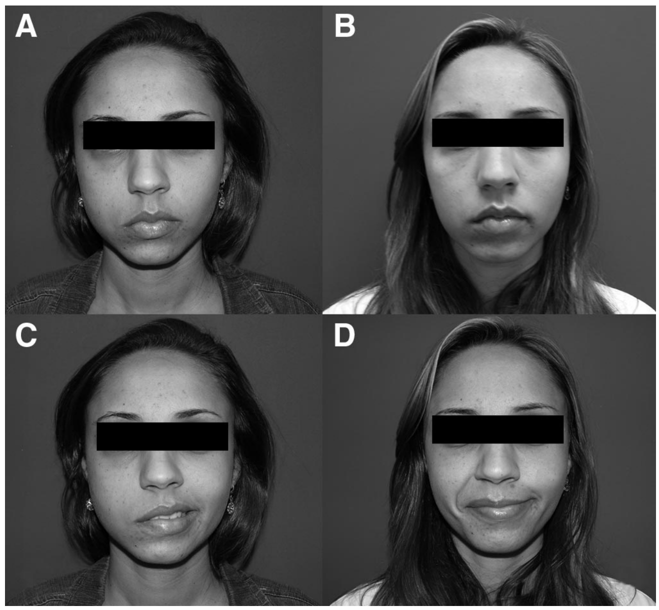

FIGURE 3. Patient 7. A, Preoperative view of the face at rest. B, Postoperative view of the face at rest. C, Preoperative view of the face during voluntary smile. D, Postoperative view of the face during masticatory movement.

Another patient who had been submitted to parotidectomy presented localized contractions capable of discretely raising the upper lip, but without provoking adequate movement of the modi-

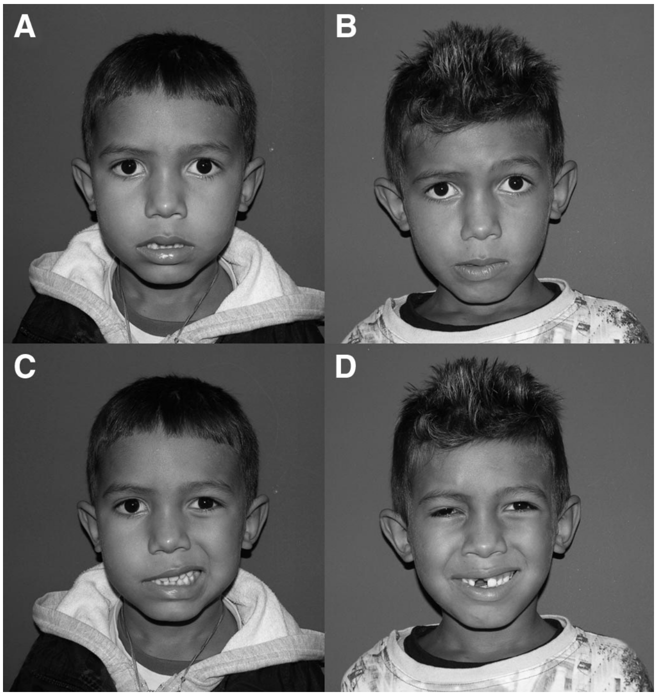

FIGURE 4. Improved eyelid closure of patient 2. A, Preoperative view of the face at rest. B, Postoperative view of the face at rest. C, Preoperative view of the face during voluntary smile. D, Postoperative view of the face during masticatory movement.

olus. When the patients were stimulated to smile spontaneously, none were able to maintain the same degree of symmetry observed in the voluntary smile.

Recovery of the capacity to blink spontaneously was not observed. However, 8 patients showed improvement in palpebral closure with masticatory movement (Fig. 4) and, therefore, reduced or suspended the application of artificial tears. Two of these patients complained of ocular discomfort during mastication.

Two other patients were submitted to shortening of the lower eyelid, and one of them also required gold weight implant. By the end of this study, no contraction of the muscles of the frontal region or of the lower lip depressors was observed.

DISCUSSION

The facial nerve is the only cranial nerve capable of determining emotional movements. In the cases of irreversible nerve lesion, recovery of these movements is theoretically still possible with cross-facial nerve graft sutured to the facial nerve branches of the nonparalyzed side.

Due to the length of the graft, the estimated time for the axons to cross the midline and conduct the electrical impulses to produce facial expressions on the other side is relatively long. The babysitter concept aims to facilitate faster recovery of muscle activity by means of the closest axonal source while the nerve regenerates through the cross-facial graft.[9]

Although the rates of atrophy of the tongue have been significantly reduced with partial sacrifice of the hypoglossal nerve, the results are not reproduced consistently. As the quantity of motor fibers cannot be modified, it is possible to conclude that the greater the number of fibers deviated in the direction of the mimic muscles, the greater the chance of recovering facial movement, but the chances of tongue atrophy are also greater and vice versa. Moreover, control of facial movements obtained using this technique is not easily understood by the patients.

The consistent results of reanimation of long-standing facial paralysis with muscle transplants innervated by the masseteric branch[10] gave rise to the idea of using it as an option for facial nerve substitution in cases of paralysis persisting less than 2 years.

There are 3 reasons for our focus on microsurgical coaptation of the masseteric branch of the trigeminal nerve to the zygomatic and buccal branches of the facial nerve: (1) to reduce nerve fiber dispersion, concentrating them in the functionally more important regions of the middle third of the face (eyelids and upper lip); (2) the prognosis of the temporal and marginal branches of the mandible is naturally worse when compared with the zygomatic and buccal branches; (3) synkinesis between the zygomatic and buccal branches is already common in the cases of lesion and primary repair of the extratemporal facial nerve trunk.

Approximation and alignment of the masseteric branch for coaptation to the zygomatic and buccal branches is technically easy. Additionally, there is a smaller difference in caliber between the stumps when compared with the caliber of the facial nerve trunk. Although salivary fistula is considered a potential complication of intraparotid nerve dissection, none were observed in this study.

The greatest limitation of substituting the facial nerve with the trigeminal nerve branch is related to obtaining emotional movements. Therefore, in all cases cross-facial sural nerve graft was performed. Coaptation of the nerve graft stump to the branches of the facial nerve of the paralyzed side should be performed as soon as the Tinel sign crosses the midline and reaches the parotid region. However, the big question we face now is whether or not the results observed with this technique could be improved by using the cross-facial nerve graft. Theoretically, we could gain emotional movements, but we could also lose movements already obtained.

Some patients seem to be developing compensatory mechanisms, or rather, they produce more natural and automatic movements. The chewing movement, from the point of view of the authors, is much more agonist to the smile than the movements of the tongue and, therefore, the movements obtained with the masseteric-facial technique would be more easily interpreted by the patient.

The potential for spontaneous smile without the need to bite down when using the trigeminal nerve has already been observed in facial reanimation with muscle transplants.[11,12] The postoperative follow-up time in this study was insufficient to evaluate this potential. Our clinical observations, however, suggest that the patient's age, IQ and participation in the rehabilitation process, in addition to the time elapsed from surgery, are also contributing factors in this process.

The average time for clinical manifestation of reinnervation was considered short (4.7 months). Muscle contractions in the malar region were followed by movement of the lips and finally the eyelids. Symmetry of the shape and intensity of the smile was achieved in 9 of the 10 patients. There was significant improvement of the palpebral closing mechanism in 8 of the 10 patients. The worst result of this series was observed in a patient submitted to partial resection of facial muscles for treatment of recurrence of adenoid cystic carcinoma of the parotid, with preservation of only the most distal branches of the facial nerve.

No functional deficits produced by sacrificing the masseteric branch of the trigeminal nerve were observed. Small branches along its course that would not compromise adequate positioning were preserved whenever were possible. If there is complete denervation of the masseter muscle, its function may be taken over by the temporalis muscle.[13]

In this study, substituting the facial nerve with the masseteric branch improved facial balance at rest, symmetry of the voluntary smile, and lower eyelid function without significantly compromising mastication. Therefore, although reestablishing involuntary movements and emotional expressions is still a challenge in facial reanimation, the authors suggest consideration of masseteric-facial nerve coaptation, whether temporary (baby-sitter) or permanent, as the principal alternative for reconstruction of facial paralysis due to irreversible nerve lesion with less than 18 months of years of duration.

REFERENCES

1. Langohr HD, Langohr U, Dietrich K, et al. Representative enzymes of energy supplying metabolism in the normal and denervated human brachial biceps, deltoid and anterior tibial muscles [in German]. *J Neurol*. 1975;209:255–270.
2. Smith JW. A new technique of facial animation. In: Hueston VT, ed. *Transcripts of the Fifth International Congress of Plastic and Reconstructive Surgery*. Melbourne, Australia: Butterworth; 1971:83–84.
3. Spira M. Anastomosis of masseteric nerve to lower division of facial nerve for correction of lower facial paralysis. Preliminary report. *Plast Reconstr Surg*. 1978;61:330–334.
4. Conley J, Baker DC. Hypoglossal-facial nerve anastomosis for reinnervation of the paralyzed face. *Plast Reconstr Surg*. 1979;63:63–72.
5. Terzis JK. "Babysitters." An exciting new concept in facial reanimation. In: Proceedings of the 6th International Symposium on the facial nerve. Rio de Janeiro, Brazil: Kugler and Ghendini Publications; 1990.
6. Kalantarian B, Tiangco DA, Terzis JK. Gains and losses of the XII-VII component of the "baby-sitter" procedure: a morphometric analysis. *J Reconstr Microsurg*. 1998;14:459–471.
7. Zuker RM, Goldberg CS, Manktelow RT. Facial animation in children with Mobius syndrome after segmental gracilis muscle transplant. *Plast Reconstr Surg*. 2000;106:1–8.
8. Faria JC, Scopel GP, Busnardo FF, et al. Nerve sources for facial reanimation with muscle transplant in patients with unilateral facial palsy: clinical analysis of 3 techniques. *Ann Plast Surg*. 2007;59:87–91.
9. Mersa B, Tiangco DA, Terzis JK. Efficacy of the "baby-sitter" procedure after prolonged denervation. *J Reconstr Microsurg*. 2000;16:27–35.
10. Bae YC, Zuker RM, Manktelow RT, et al. A comparison of comissure excursion following gracilis muscle transplantation for facial paralysis using a cross-face nerve graft versus the motor nerve to the masseter nerve. *Plast Reconstr Surg*. 2006;117:2407–2413.
11. Lifchez SD, Matloub HS, Gosain AK. Cortical adaptation to restoration of smiling after free muscle transfer innervated by the nerve to the masseter. *Plast Reconstr Surg*. 2005;115:1472–1479; discussion 1480–1482.
12. Manktelow RT, Tomat LR, Zuker RM, et al. Smile reconstruction in adults with free muscle transfer innervated by the masseter motor nerve: effectiveness and cerebral adaptation. *Plast Reconstr Surg*. 2006;118:885–899.
13. Brenner E, Schoeller T. Masseteric nerve: a possible donor for facial nerve anastomosis? *Clin Anat*. 1998;11:396–400.