Facial Nerve Translocation for Low Tension Neurorrhaphy to Masseteric Nerve

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Introduction: The techniques of facial reanimation are continually evolving in search of the ideal method for rehabilitating the paralyzed face. In the past, alternative cranial nerve motor nuclei have been used to power facial musculature. The trigeminal nerve is gaining popularity as a promising nerve to drive facial motion, particularly in the lower face.

Objectives: This article describes a low-tension technique of using the transposed facial nerve to the trigeminal nerve (masseteric branch) for facial reanimation.

Methods: Six patients over 2.5 years were treated with facial nerve translocation with division at the geniculate and direct neurorrhaphy to the motor branch of the masseter. Patients were evaluated by physical examination, measurement of oral commissure excursion using MEEI FACE-gram software, video assessment, Sunnybrook Facial Grading System, Facial Disability Index, and Facial Clinimetric Evaluation Scale (FaCE).

Results: Patients demonstrated early motion within 4 months postoperatively and were placed into facial physical therapy. All demonstrated improvements in oral competence, strong oral commissure excursion with good symmetry, speech improvements, and variable results in facial tone. Synkinesis to the smile antagonists in the lower face was noted and treated with chemodenervation in three of six. No upper division synkinesis was noted.

Conclusion: The motor branch of the trigeminal nerve is an effective option for facial reanimation via facial nerve translocation and end-to-end neurorrhaphy. Variable results in facial tone were noted with excellent oral commissure excursion. This procedure is safe in the reoperated mastoid.

Key Words: Facial reanimation—Masseteric nerve—Mastoidectomy—Nerve transposition—Oral commissure excursion.

Otol Neurotol **40:**e562–e565, 2019.

The techniques of facial reanimation are continually evolving in search of the ideal method for rehabilitating the paralyzed face. In the past, various alternative cranial nerve motor nuclei have been used to power denervated facial musculature. Hypoglossal-facial (XII–VII) transposition, cross-facial nerve grafts (CFNG), spinal accessory, among others have all been described for reanimation of the paralyzed face (1). However, these techniques are not without other morbidities and are not suitable for all patients.

Hypoglossal to facial nerve transposition has been a widely used technique, and despite its good results with improved facial tone yet unpredictable outcomes in regard to oral commissure excursion (2).

Spira (3) was the first to describe the use of the masseteric nerve in facial reanimation in 1978. The trigeminal nerve is gaining popularity as a promising nerve to drive facial motion. The masseteric nerve has many advantages including low morbidity, relationship to the facial nerve, strong motor impulse resulting in strong oral commissure excursion, and fast reinnervation in most patients (2).

Surgical techniques that have been described when utilizing the masseteric branch of cranial nerve V for facial reanimation involve division of the main trunk of the facial nerve at the stylomastoid foramen. Different techniques also involve selective neurectomy of the cervical branch or mobilization of the lower division alone for neurorrhaphy with the masseteric nerve (1,2,4).

The purpose of this paper is to describe a low-tension technique of using the transposed facial nerve divided within the temporal bone to the trigeminal nerve (masseteric branch) in an end-to-end neurorrhaphy without selective neurectomy of peripheral facial nerve branches. In four out of six of the patients, this was safely performed in a reoperated mastoid.

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No funding was received.

The authors disclose no conflicts of interest.

DOI: 10.1097/MAO.0000000000002195

TABLE 1. *Patient demographics*

Patient	Age/Gender	Etiology	Time from Injury to Reanimation	Follow-up After Reanimation	Reop Mastoid	Complications
No. 1	47 years M	Meningioma	1 year	32 months	Yes	None
No. 2	47 years F	Glomus	Same	18 months	No	None
No. 3	63 years F	Acoustic neuroma	6 months	30 months	Yes	None
No. 4	56 years F	Meningioma	5.5 months	19 months	Yes	None
No. 5	22 years M	Temporal bone fracture	10 months	25 months	No	None
No. 6	33 years F	Chondro- sarcoma	14 months	26 months	Yes	None

METHODS

Retrospective review of six patients over 32 months who were treated with facial nerve translocation with division as proximal as the first genu with direct neurorrhaphy to the motor nerve branch of the masseter (see Table 1). Four of the six had previous transmastoid skull base surgery with fat and cement mastoid obliteration. Patients were evaluated by physical examination, measurement of oral commissure excursion using the MEEI FACE-gram software (MEEI, Harvard Medical School, Boston, MA), video assessment, Sunnybrook Facial Grading System, Facial Clinimetric Evaluation Scale (FaCE), and the Facial Disablitiy Index (FDI) (5).

The procedure as described below allows for tension free anastomosis of the main trunk of the facial nerve to the masseteric branch of the trigeminal nerve in an end-to-end neurorrhaphy fashion without neurolysis of select facial nerve branches.

The patient is positioned on the operating room table in a standard fashion. An incision is designed in a ‘‘Y’’ shape extending preauricular and postaruicular with slight extension into the neck (Fig. 1). If not previously performed, a complete mastoidectomy is performed in the usual fashion with opening of the previous postauricular incision. After the lateral semicircular canal is identified, the facial nerve is followed from the second genu inferiorly through the mastoid tip. The stylomastoid foramen is also drilled to allow for further mobilization of the facial nerve. The posterior tympanotomy is created (facial recess) and the fallopian canal is decompressed from proximal to the geniculate ganglion and the cochleariform process through the stylomastoid foramen. The nerve is transected at the geniculate with subsequent release of fibrous attachments from the surrounding temporal bone and the facial nerve is delivered to the stylomastoid foramen.

In cases of previous transmastoid craniotomy (e.g., translabyrinthine and other transtemporal approaches) facial nerve decompression is accomplished while maintaining the neo-dural seal. Cranioplasty material is removed with a drill until the medially positioned fat graft is identified. Only enough fat is removed to identify the epitympanum. The facial nerve is then identified in the fallopian canal at the second genu. Decompression can then proceed as described above in a previously unviolated mastoid. Once the nerve is transposed beyond the stylomastoid foramen, the mastoid can be resealed with cranioplasty material.

At this time, the facial nerve is dissected from the stylomastoid foramen into the parotid gland up to the pes anserinus. The lateral parotid is dissected from the upper division of the facial nerve and removed to expose upper division branching. Following dissection of the upper division, reflection of the main trunk of facial nerve at the pes can be performed, allowing adequate length for tension free coaptation (Fig. 2). The masseteric nerve is identified within the deep masseter muscle, bisecting the angle created by the condyle and the zygoma (6).

FIG. 1. ‘‘Y’’ shaped incision for facial translocation and facial dissection. Care is taken not to wrap the pre/postauricular incision superior to the auricle.

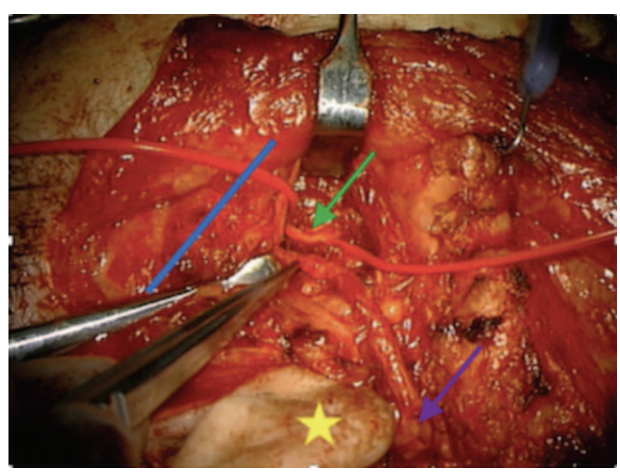

FIG. 2. Right sided operative view of the translocated right facial nerve to the masseteric nerve. Star indicates earlobe; blue line, zygoma; green arrow, masseteric nerve; purple arrow, pes of the facial with the main trunk reflected superior to it towards CN V.

FIG. 3. Preoperative smile left facial nerve paralysis and post-reanimation smile at 2.5 years.

The nerve of the masseter is divided before decussation into the muscle fibers and reflected to meet the transposed facial nerve for a tension free end-to-end neurorrhaphy (Fig. 2).

RESULTS

Six patients with unilateral facial paralysis were treated over a 2-year period from 2014 to 2016 with this low-tension technique where the facial nerve is divided at the first genu and translocated to perform a direct neurorrhaphy with the ipsilateral masseteric nerve. Time from injury to reanimation ranged from 5.5 months to 14 months. The etiologies of the facial paralysis of the six patients were temporal bone fracture ($n=1$), status post resection of cerebellopontine angle tumor ($n=4$), status post mobilization and resection of glomus tumor ($n=1$) (Table 1).

Incision considerations included care not to extend incisions superior to the auricle so as not to interrupt blood supply. No patients experienced the ischemia of the external ear to include duskiness, excessive edema, epidermolysis (Fig. 1).

TABLE 2. *FGS and FaCE scale results*

	Facial Grading System Results ($p=0.006$)		FaCE Scale Results ($p=0.036$–subject 1 excluded)	
Patient	Pre-Op	Post-Op	Pre-Op	Post-Op
1	16	44	41.6	23.3
2	42	48	36.7	51.7
3	24	53	42.9	72.9
4	No pre op	56	No score	No score
5	16	44	43.3	50
6	16	47	31.7	58.3
Mean	22.8	48.7	39.2	51.6

Despite four of six patients having previous transmastoid approaches to the skull base and obliteration of the mastoid cavity with fat and cement, there were no cerebral spinal fluid (CSF) leaks or other operative complications associated with reopening the skull base surgery exposure.

All patients experienced motion by 4 months and received physical therapy with a specialized facial therapist. Patients were assessed using the Sunnybrook facial grading system (FGS), Facial Clinimetric Evaluation Scale (FaCE), Facial Disability Index (FDI), and MEEI FACE-gram (Tables 2 and 3).

All six patients underwent the procedure without any significant postoperative complications. One patient experienced enough recovery of the upper division to warrant removal of her eyelid weight. Three patients required chemical denervation for synkinesis to the lower face during their rehabilitation period. Chemodenervation therapy was limited to the smile antagonists: mentalis, depressor anguli oris, buccinator, and platysma. We had no complaints of synkinesis or spasm while eating, including eye closure (Fig. 3).

DISCUSSION

Facial paralysis remains a cosmetic, functional, and psychological disability. Restoring facial expression and

TABLE 3. *FaceGRAM results*

	Pre-Op				Post-Op			
Patient	HE (mm)	VE (mm)	OE (mm)	SA (degrees)	HE (mm)	VE (mm)	OE (mm)	SA (degrees)
1	19.56	3.67	19.9	100.62	37.42	15.85	40.64	112.95
2	24.87	10.26	26.9	112.42	32.72	17.15	36.94	117.66
3	21.92	2.75	22.1	82.86	26.26	9.77	28.02	110.41
4	32.67	7.5	33.52	102.93	28.07	8.67	29.38	107.16
5	21.93	4.82	22.46	102.4	27.4	10.31	29.28	110.62
6	14.25	0.45	14.25	88.17	25.22	5.9	25.9	103.17
Mean	22.53	4.91	23.19	98.23	29.52	11.28	31.69	110.33
P value					0.07	0.004*	0.014*	0.024*

*Represents statistical significance ($p \leq 0.05$).
HE indicates horizontal excursion; VE, vertical excursion; OE, oblique excursion; SA, smile angle.

symmetry are the hallmark of facial reanimation and rehabilitation.

The masseteric branch of the trigeminal nerve is gaining popularity because it possesses many optimal characteristics including: convenient relationship to the facial nerve, low morbidity of harvest, rapid speed of reinnervation in most cases, and strong motor impulse resulting in strong oral commissure excursion.

In our series of six patients, we employed a technique by which the facial nerve is dissected and divided at the first genu and after unroofing the stylomastoid foramen, transposed from its intratemporal location and brought to the masseteric nerve in a manner to provide a tension free neurorrhaphy.

Releasing the facial nerve at the first genu in a reoperated mastoid for the purposes of translocation to the nerve of the masseter has not been described in previous literature. Most other techniques include release at the stylomastoid foramen with either cable grafting or with selective neurectomy for optimal mobilization before neurorrhaphy (1,2,4,7). Though the merits of selective reinnervation are to localize the lower division for reanimation, we did not find excessive reinnervation in the upper face to an issue. We had no reported eye closure with chewing and only one patient was able to undergo a reduction in upper lid load.

Four of the six patients in our review had previous transmastoid approaches to the skull base for tumor resection. In these cases, the mastoid cavity was obliterated with fat and cement. This provides a unique challenge to the surgeon, as CSF leak and intracranial complications can be much higher in this situation. Despite this, the procedure was able to be successfully completed in all cases with none of these patients in our review experiencing CSF leak or other postoperative complications that might be expected in a reoperated transmastoid skull exposure.

Limitations of this study include the retrospective nature of the review and small number of subjects.

CONCLUSION

The motor branch of the trigeminal nerve is an effective option for facial reanimation via facial nerve translocation with end-to-end neurorrhaphy. The technique described provides a reliable and safe method by which the masseteric branch of the trigeminal nerve and the facial nerve can be brought together in a tension free manner. Variable results in facial tone were noted, however all patients had self-reported and/or objective improvement in resting tone and motion. If followed long enough, these patients will develop some lower division synkinesis requiring chemodenervation to the smile antagonists. No selective neurectomies were performed in these patients to deter later synkinesis and were specifically avoided to evaluate if this technique could return sufficient tone to all branches of the facial nerve. No upper division or ocular synkinesis was reported. Facial reanimation in the reoperated and previously obliterated temporal bones is safe with minimal risk of intracranial complications including CSF leaks or meningitis.

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