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Hypoglossal–facial nerve side-to-end anastomosis for preservation of hypoglossal function: results of delayed treatment with a new technique

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This report describes a new surgical technique to improve the results of conventional hypoglossal–facial nerve anastomosis that does not necessitate the use of nerve grafts or hemihypoglossal nerve splitting.

Using this technique, the mastoid process is partially resected to open the stylomastoid foramen and the descending portion of the facial nerve in the mastoid cavity is exposed by drilling to the level of the external genu and then sectioning its most proximal portion. The hypoglossal nerve beneath the internal jugular vein is exposed at the level of the axis and dissected as proximally as possible. One-half of the hypoglossal nerve is transected: use of less than one-half of the hypoglossal nerve is adequate for approximation to the distal stump of the atrophic facial nerve. The nerve endings, the proximally cut end of the hypoglossal nerve, and the distal stump of the facial nerve are approximated and anastomosed without tension. This technique was used in four patients with long-standing facial paralysis (greater than 24 months), and it provided satisfactory facial reanimation, with no evidence of hemitongue atrophy or dysfunction.

Because it completely preserves glossal function, the hemihypoglossal–facial nerve anastomosis described here constitutes a successful approach in patients with long-standing facial paralysis who do not wish to have tongue function compromised.

KEY WORDS • facial palsy • facial nerve • hypoglossal nerve • nerve anastomosis • nerve reconstruction • surgical technique

IN choosing an approach to reanimate the paralyzed face, it is axiomatic that restoration of facial nerve continuity is the procedure of choice whenever possible and assuming it can be performed within 24 months from the date of injury.[8] When the central stump of the facial nerve is unavailable, and the mimetic muscles are still viable, hypoglossal–facial anastomosis has been the favored technique.[1–5,7–9]

Classic hypoglossal–facial nerve anastomosis, however, sacrifices the hypoglossal nerve, inevitably causing hemitongue atrophy. Normal tongue function can be an aid in masticating, swallowing, and speaking, especially when facial function is less than normal.[7,8] To avoid or reduce hemiglossal dysfunction, some modified techniques of this operation have recently been developed.[1–5,8,9]

In 1991, May, et al.,[8] described a hypoglossal–facial nerve interpositional jump graft in which hypoglossal nerve deficit occurred in only three of 20 patients. Cusimano and Sekhar in 1994[4] and Arai, et al., in 1995[1] reported a similar technique to anastomose a split hypoglossal nerve to the facial nerve, which preserved hypoglossal function with mild or moderate hemiglossal atrophy.

These partial hypoglossal–facial nerve anastomoses resulted in good facial reanimation provided that the procedure was performed early after the onset of facial palsy.[1,5] In patients with long-standing facial paralysis of more than 24 months, hypoglossal–facial nerve anastomosis is not generally performed and is often unsuccessful if attempted beyond the 24-month period.[7,8] These patients, who have less chance of recovering facial reanimation, often refuse to accept additional hypoglossal paralysis.

We describe our experience with a technique for direct hypoglossal–ipsilateral facial nerve side-to-end anastomosis, which does not use nerve grafting or hemihypoglossal nerve splitting in patients with long-standing facial paralysis.

Clinical Material and Methods

Patient Population

Four patients who experienced facial paralysis of more than 24 months' duration underwent direct hypoglossal–facial nerve anastomosis for treatment of unilateral facial paralysis (Table 1).

The patients in Cases 1, 2, and 3 underwent resection of a vestibular schwannoma, and the patient in Case 4 had undergone radical resection of a medulloblastoma involving the medulla oblongata. The facial nerve of the patient in Case 1 was known to have been resected. The patients in Cases 2 and 4 had suffered complete facial palsy after the first surgery with no improvement: House–Brackmann

TABLE 1

Clinical summary of four patients treated by direct hypoglossal–facial nerve anastomosis for preservation of hypoglossal nerve function

Case No.	Age (yrs), Sex	Preop Grade*	Duration of Facial Palsy	Site of Nerve Transection	Recovery Grade†	Tongue Atrophy
1	63, M	VI	37 mos	cistern	poor	none
2	28, F	VI	33 mos	cistern	good	none
3	31, M	V	45 mos	cistern	good	none
		VI	20 mos	cistern		
4	9, M	VI	25 mos	pons	good	none

* According to the facial nerve grading system of House and Brackmann.

† According to the classification of facial nerve function after hypoglossal–facial nerve anastomosis described by Pitty and Tator.

Grade VI.[6] The third patient underwent partial removal of a tumor and had severe right facial palsy postoperatively. Forty-five months later, this patient underwent total removal of the recurrent tumor, resulting in transection of the facial nerve (Table 1).

These previous surgeries had rendered all four patients deaf on the affected side. Before hypoglossal–facial nerve anastomosis, all patients suffered from total paralysis of the unilateral facial nerve, which itself exhibited clear asymmetry; tone loss; and a complete lack of motion, synkinesis, and hemifacial spasm. In Case 1, the patient's mimetic muscles on the affected side were atrophic or nearly absent, but in the other patients these muscles were still viable.

Facial nerve function was evaluated preoperatively using the facial nerve grading system of House and Brackmann[6] and postoperatively using the classification system of facial nerve function after hypoglossal–facial nerve anastomosis by Pitty and Tator[9] and by May, et al.[8]

Surgical Technique

A craniocervical lazy S-shaped incision, approximately 8 cm in length, was made along the anterior edge of the sternocleidomastoid muscle. The sternocleidomastoid muscle was partially detached from the mastoid process and retracted posteriorly to expose the anterior one-third of the mastoid process.

With the aid of an operating microscope, the facial nerve was carefully exposed in the cranial base and dissected free to mobilize its distal portion in the parotid gland. The mastoid process was partially resected to open the stylomastoid foramen. The styloid process was fractured and retracted anteriorly along with attached muscles. Once the facial nerve, which was surrounded by thick connective tissue, was identified at the stylomastoid foramen, further dissection was performed on the mastoid cavity with a diamond burr, following the facial canal to the external genu of the descending portion of the facial nerve. The soft tissue, including vessels in the facial canal and the nerve sheath, was left intact to preserve vascular supply to the facial nerve through the parotid gland. By sectioning the chorda tympani nerve, the facial nerve was mobilized.

After obtaining a length of facial nerve sufficient to perform a tensionless anastomosis, the most proximal portion

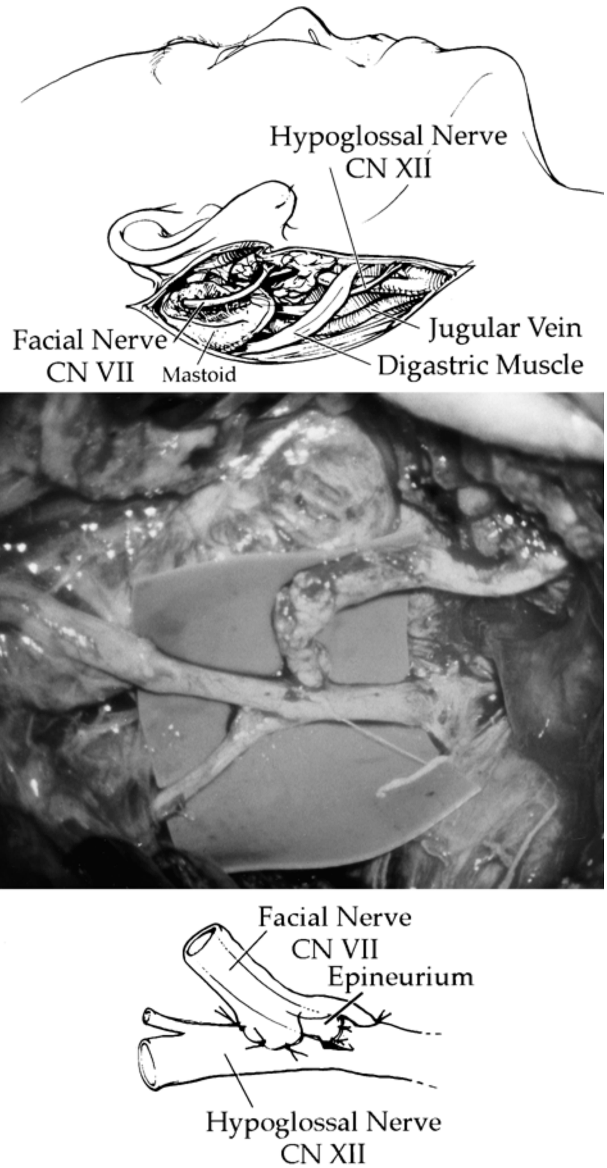

FIG. 1. *Upper:* Illustration showing a skin incision and overview of hypoglossal and facial nerve exposures. The descending portion of the facial nerve has been skeletonized. *Center:* Intraoperative photograph showing tensionless attachment of the facial nerve to the hypoglossal nerve at the level between the atlas and the axis. Note this was taken before anastomosis: the facial nerve was placed on the hypoglossal nerve without any support. Mastoidectomy and exposure of the facial canal provided sufficient length of distal facial nerve. *Lower:* Illustration showing the partial hypoglossal–facial nerve anastomosis adding several stay sutures on the nerve sheath.

was sectioned. To expose nerve tissue for anastomosis, the distal stump of the facial nerve was trimmed by cutting its thick nerve sheath of tough connective tissue and feeding vessels (Fig. 1). The facial nerve tissue was always atrophic and very small in diameter. Some bleeding occurred from the cut end when the feeding artery was preserved.

FIG. 2. The patient in Case 3 experienced long-standing right facial paralysis preoperatively for more than 5 years. Photographs taken 20 months after hypoglossal–facial nerve anastomosis demonstrating facial expressions at rest *(upper left)*, voluntary movement of the right mouth angle *(upper right)*, and eye closure *(lower left)*. There was no tongue atrophy and straight tongue protrusion was possible *(lower right)*.

The posterior belly of the digastric muscle was retracted inferoposteriorly. The hypoglossal nerve behind the internal jugular vein was exposed at the level of the axis and dissected as proximally as possible, compressing the jugular vein dorsally. One-half to two-fifths of the hypoglossal nerve was transected rostrally at the level between the atlas and the axis to the most proximal branch of the descendens hypoglossi. Because at this level the hypoglossal nerve was large in diameter, less than one-half of the nerve was necessary for approximation to the atrophic facial nerve (Fig. 1).

The nerve endings, the proximal cut end of the hypoglossal nerve, and the distal stump of the facial nerve were approximated without any tension. The epineurium of the cut ends of the hypoglossal and facial nerves were sutured with four to five 10–0 monofilament nylon sutures. Connective tissue surrounding the facial nerve was then sutured to the hypoglossal epineurium to reduce tension further on this neural tissue anastomosis (Fig. 1).

Results

Postoperative recovery of facial movement was good in Cases 2, 3, and 4 and poor in Case 1, as evaluated by the classification system of Pitty and Tator,[9] which grades facial nerve function after hypoglossal–facial nerve anastomosis (Table 1). According to the classification system of May, et al.,[8] for results of facial reanimation techniques Cases 1, 2, 3, and 4 were graded as fair, good, excellent, and good recovery, respectively.

With the exception of the patient in Case 1, all patients recovered facial muscle tone and some voluntary movement and exhibited complete restoration of facial symmetry at rest. All patients regained complete voluntary eye closing ability. Minimal facial muscle mass movement and recovery of the frontalis muscle were observed in Cases 2 and 3.

The process of recovery, beginning at between 8 and 12 months after surgery, was extremely slow and almost imperceptible. No patient experienced hemitongue atrophy or hemiglossal dysfunction (Fig. 2). Each patient was able to extend the tongue straight and had no eating, swallowing, or speaking deficits attributable to hypoglossal nerve section.

Discussion

Proper evaluation of the postoperative recovery of a severely injured, but not totally resected, facial nerve often requires observation over the course of 1 year or longer. Consequently, surgery to reanimate the face may be delayed. In patients with long-standing facial paralysis, hypoglossal–facial nerve anastomosis is not usually attempted because it so often proves unsuccessful.[1,7,8] In particular, patients with persistent facial palsy generally choose not to accept the additional sequelae of loss of hypoglossal nerve function. One treatment goal in our technique is to bypass the posttreatment hypoglossal nerve dysfunction completely. In this regard, our results were successful. We believe that no hemitongue atrophy was encountered in our patients because we only partially sectioned the hypoglossal nerve proximal to the descending hypoglossal branch at the level between the axis and the atlas, where the nerve is obviously thicker than at its more distal position. However, our results are not conclusive because of the limited number of patients in our series.

Certain modifications to the technique of hypoglossal–facial anastomosis that are pertinent to eliminating tongue atrophy have been previously reported. Anastomosis of the descending hypoglossal branch to the distal stump of the hypoglossal nerve trunk is of little or no help in improving tongue dexterity.[2,3,9] One-half of the hypoglossal nerve can be cut and used for anastomosis. Recovery of facial function using one-half of the hypoglossal nerve is reportedly equivalent to that expected in routine hypoglossal–facial anastomosis.[1,4,5,8]

Arai, et al.,[1] reported successful facial reanimation in eight patients who underwent direct split hypoglossal–facial nerve anastomosis. They found, however, mild to moderate hypoglossal atrophy on the operated side in all patients. Their technique involves a deep exposure of hypoglossal nerve to the plane of the digastric muscle and superficial exposure to the carotid vessels. Because the hypoglossal nerve is not polyfascicular and thus cannot be split into different fascicles, a long split along its distal portion proves harmful and appears to cause hemiatrophy of the tongue. Axons in the hypoglossal nerve thread their way through neural tubules in a random, interweaving fashion; therefore, splitting the nerve invariably results in the transection of axons at multiple points.[8]

Cusimano and Sekhar[4] have described a similar technique involving partial hypoglossal–facial nerve anastomosis: the facial nerve is sectioned either at the stylomastoid foramen or in its mastoidal segment, the split hypoglossal nerve is dissected longitudinally over a distance of 2 to 3 mm, and the cut nerve ends are anastomosed. They report connecting the facial nerve to a short split hypoglossal nerve without performing a partial mastoidectomy. However, their technique as applied to our procedure seems practically impossible. At the level of the axis or lower, the split hypoglossal nerve may need to be as long as 20 mm to connect directly to the extracranial facial nerve without tension, even if the facial nerve is sectioned at the stylomastoid foramen. As Cusimano and Sekhar note, if it is not possible to obtain a tensionless anastomosis, an interpositional nerve graft must be used. A direct hypoglossal–facial nerve anastomosis without using a graft or splitting the nerve requires exposure of the descending portion of the facial nerve in the mastoid cavity.

May, et al.,[8] reported the placement of an interpositional nerve graft, 5 to 7 cm long, between the facial and hypoglossal nerves with excellent results. Hypoglossal nerve deficit occurred in only three of their 20 patients. We believe, however, that to restore facial function, a direct hypoglossal–facial nerve anastomosis is superior to the use of an interpositional nerve graft.

A partial hypoglossal–facial nerve anastomosis results in sufficient facial reanimation if the procedure is performed early after the onset of facial palsy.[1,4,7,8] In our series, good recovery of facial movement was accomplished in three patients with long-standing facial paralysis. Although two of the three patients had been classified as a Grade VI (complete facial palsy) for more than 2 years, the facial nerve had not been completely transected during surgery for tumor removal; thus, the continuity of the facial nerve had been preserved and the mimetic muscles were not severely atrophic. A low number of remaining facial nerve fibers might have preserved the facial musculature and myoneural junctions. It would appear that there is no clear-cut period of delay beyond which hypoglossal–facial nerve anastomosis becomes ineffective.[9] In conclusion, the hemihypoglossal–facial nerve side-to-end anastomosis described here constitutes a successful treatment for patients with long-standing facial paralysis who do not want compromised tongue function.

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