Hemihypoglossal–Facial Neurorrhaphy after Mastoid Dissection of the Facial Nerve: Results in 24 Patients and Comparison with the Classic Technique

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OBJECTIVE: Hypoglossal–facial neurorrhaphy has been widely used for reanimation of paralyzed facial muscles after irreversible proximal injury of the facial nerve. However, complete section of the hypoglossal nerve occasionally results in hemiglossal dysfunction and interferes with swallowing and speech. To reduce this morbidity, a modified technique with partial section of the hypoglossal nerve after mastoid dissection of the facial nerve (HFM) has been used. We report our experience with the HFM technique, retrospectively comparing the outcome with results of the classic hypoglossal-facial neurorrhaphy.

METHODS: A retrospective review was performed in 36 patients who underwent hypoglossal-facial neurorrhaphy with the classic (n = 12) or variant technique (n = 24) between 2000 and 2006. Facial outcome was evaluated with the House-Brackmann grading system, and tongue function was evaluated with a new scale proposed to quantify postoperative tongue alteration. The results were compared, and age and time between nerve injury and surgery were correlated with the outcome.

RESULTS: There was no significant difference between the two techniques concerning facial reanimation. A worse outcome of tongue function, however, was associated with the classic technique (Mann-Whitney *U* test; $P < 0.05$). When HFM was used, significant correlations defined by the Spearman test were identified between preoperative delay ($\rho = 0.59$; $P = 0.002$) or age ($\rho = 0.42$; $P = 0.031$) and results of facial reanimation evaluated with the House-Brackmann grading system.

CONCLUSION: HFM is as effective as classic hypoglossal-facial neurorrhaphy for facial reanimation, and it has a much lower morbidity related to tongue function. Better results are obtained in younger patients and with a shorter interval between facial nerve injury and surgery.

KEY WORDS: Facial nerve, Facial paralysis, Hypoglossal-facial anastomosis, Hypoglossal nerve, Nerve transfer, Peripheral nerve

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Classic hypoglossal–facial neurorrhaphy (CHF) has been considered an effective strategy for reanimating the paralyzed face. It is used when a proximal facial nerve segment is unavailable for reconstruction, such as after ablative tumor surgery or trauma involving the cranial base (7, 32). Direct end-to-end coaptation between the hypoglossal and facial nerves is a widely accepted technique that yields good results in the rehabilitation of facial function (7, 32). This procedure, however, demands a total section of the hypoglossal nerve and results in an inevitable loss of hemiglossal function. Although hemitongue paralysis may be transient, some patients show persistent difficulties with speech, mastication, and/or swallowing that interfere with their daily lives (14, 28).

ABBREVIATIONS: CHF, classic hypoglossal-facial neurorrhaphy; **HB**, House-Brackmann; **HFM**, hemihypoglossal–facial neurorrhaphy after mastoid dissection of the facial nerve

Moreover, the occurrence of this morbidity may preclude CHF in patients with bilateral palsy, multiple lower cranial nerve palsies, or a profession for which speech is essential.

To preserve unilateral tongue function, some surgical alternatives have been described in recent years (4, 13, 14, 30, 36). One of these includes a facial nerve dissection in the mastoid bone and its section at the second genu, allowing caudal nerve rerouting and suture with a partially sectioned hypoglossal nerve (4, 13, 14, 36). The remaining intact fibers of the hypoglossal nerve are generally sufficient to preserve tongue function. Given the fact that fewer nerve fibers are transferred to the facial muscles in this technique when compared with CHF, it may be argued that worse results are obtained when a partial hypoglossal nerve transfer is performed. One of the purposes of this study was to evaluate the results of this technique in terms of facial reanimation in 24 patients with proximal facial nerve lesions, comprising the largest series published to date. We compared these results with a series of 12 patients who underwent CHF. We also designed a new scale to quantify the tongue morbidity related to this procedure, which could be useful to compare different procedures that use the hypoglossal nerve as donor.

PATIENTS AND METHODS

We conducted a retrospective follow-up study of 35 patients with irreparable proximal facial nerve injury who underwent hypoglossal-facial neurorrhaphy between February 2000 and July 2006. Patients from three centers were included: two in São Paulo, Brazil (Peripheral Nerve Surgery Unit of the Department of Neurosurgery, São Paulo University Medical School, and Hospital Santa Marcelina), and one in Buenos Aires, Argentina (Department of Neurosurgery, Hospital de Clínicas, University of Buenos Aires School of Medicine). During the study period, restitution of nerve function was performed by means of the CHF technique in 12 patients and by hemihypoglossal–facial neurorrhaphy after mastoid dissection of the facial nerve (HFM) in 24 patients. Surgery was performed if there was no clinical or electrical evidence of facial nerve function 9 months after the injury or as soon as possible if we had information about irreversible nerve damage during a previous surgery.

A standard dissection, as previously described, was used to expose the hypoglossal and facial nerves (7, 32). *Figure 1* illustrates the primary steps of CHF after dissection of the nerves. The surgical technique used in HFM was very similar to that previously described by Atlas and Lowinger (4) and by Sawamura and Abe (36). With the patient under general anesthesia and in the supine position on the operating table, the head was turned to the contralateral side. A linear postauricular incision was made, starting 4 cm proximal to the tip of the mastoid and extending 6 to 8 cm obliquely down the neck, up to 2 cm behind the angle of the mandible. After opening the incision and the subcutaneous tissue, the fascia and platysma muscle were divided along the same line. The sternocleidomastoid muscle was identified, and its anterior border was retracted laterally. The tip of the mastoid process was exposed by removing the muscle attachments and the periosteum with a periosteal elevator. The styloid process was digitally identified but not exposed, and the dissection, under loupe magnification, was directed to identify the facial nerve.

The facial nerve was isolated near its origin at the stylomastoid foramen and exposed up to its penetration into the parotid gland. In some cases, the nerve was isolated after identification of the digastric branch, which was dissected distally to proximally. Subsequently, the hypoglossal nerve was dissected at the lowest portion of the cervical incision, inferior and medial to the posterior belly of the digastric muscle (*Fig. 2*). The nerve was found near and superior to the carotid artery bifurcation and identified by its pulsation. A nerve stimulator (Stimuplex, Dig RC; B. Braun Medical, Inc., Melsungen, Germany) was used to confirm the normal function of the hypoglossal nerve. With the aid of the operating microscope, a proximal dissection of the facial nerve was then performed by drilling the mastoid bone with a high-speed drill and a diamond burr. A limited mastoidectomy, in a rectangular shape not exceeding 2 to 3 cm in width, was performed (*Fig. 3*). At the end of the drilling, a thin wall of bone was left over the nerve and removed with a microdissector. This approach opened the facial canal, exposing the facial nerve up to the external genu. The nerve was then sectioned as proximally as possible, dissected from the mastoid bone, and moved caudally toward the hypoglossal nerve (*Fig. 4*). The point where the mobilized facial nerve stumps reached the hypoglossal nerve defined where the hypoglossal nerve should be sectioned. Half of the axial section of the hypoglossal nerve was transected, and the facial nerve was coapted without tension directly to the proximal hypoglossal stump using a 10–0 nylon interrupted suture and a standard microsurgical technique (*Fig. 5*). After the

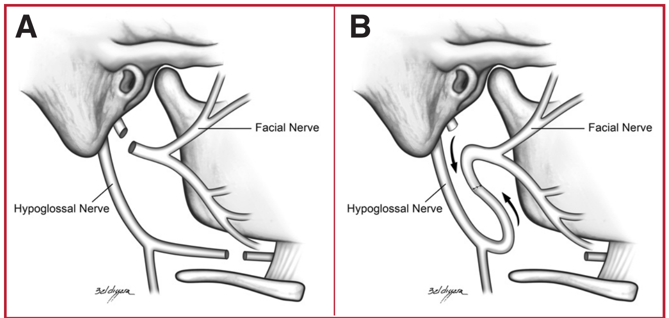

FIGURE 1. *Schematic drawings illustrating the classic hypoglossal–facial neurorrhaphy (lateral view).* **A**, *section of hypoglossal and facial nerves.* **B**, *the hypoglossal nerve is moved cranially toward the facial nerve (*Adapted from*, Darrouzet V, Guerin J, Bébéar J: New technique of side-to-end hypoglossal-facial nerve attachment with translocation of the infratemporal facial nerve.* ***J Neurosurg*** *90:27–34, 1999 [14]).*

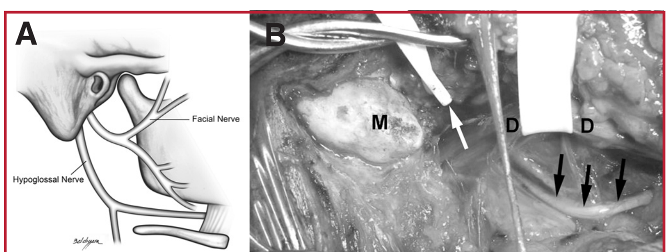

FIGURE 2. *Initial surgical exposure.* **A**, *schematic drawing showing the topographic disposition of the hypoglossal and facial nerves (*Adapted from*, Darrouzet V, Guerin J, Bébéar J: New technique of side-to-end hypoglossal–facial nerve attachment with translocation of the infratemporal facial nerve.* ***J Neurosurg*** *90:27–34, 1999 [14]).* **B**, *intraoperative view showing the mastoid tip (*M*) after removal of the muscle attachments and the periosteum. The digastric muscle (*D*) has been superiorly retracted. The hypoglossal nerve is exposed (*black arrows*), and the initial portion of the facial nerve is identified (*white arrow*).*

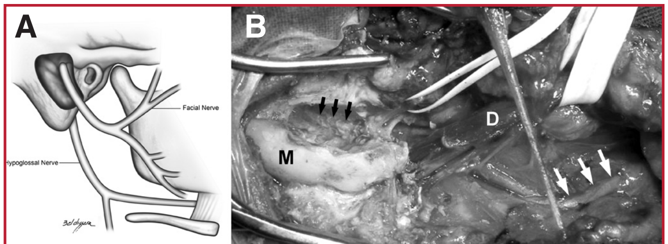

FIGURE 3. *Exposure of the mastoid segment of the right facial nerve.* **A**, *schematic drawing showing facial nerve exposure after partial mastoidectomy (*Adapted from, *Darrouzet V, Guerin J, Bébéar J: New technique of side-to-end hypoglossal–facial nerve attachment with translocation of the infratemporal facial nerve.* ***J Neurosurg*** *90:27–34, 1999 [14]).* **B**, *surgical exposure after drilling of the facial canal. The digastric muscle (*D*) is superiorly retracted. The mastoid segment of the facial nerve (*black arrows*) is skeletonized and exposed at the mastoid bone (*M*). Note the limited bone removal.* White arrows, *hypoglossal nerve.*

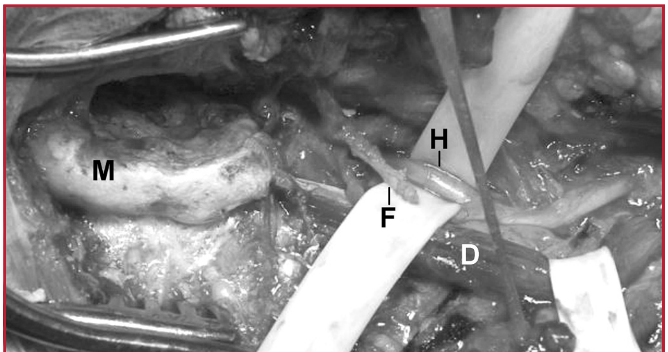

FIGURE 4. *Photograph obtained during surgery showing the digastric muscle (*D*) inferiorly retracted. The right facial nerve (*F*) is transected and moved caudally toward the hypoglossal nerve. Note the position of the mobilized facial nerve along the longitudinal axis of the hypoglossal nerve (*H*) and the caliber disproportion between the two nerves.* M, *mastoid bone.*

correct alignment of the two stumps was secured, the mastoid cavity was obliterated with a muscle fragment and fibrin sealant.

Patients in both surgical groups received the same standard postoperative care. Topical artificial tears were used to lubricate the eye, and the exposed cornea was protected. Tarsorrhaphy was indicated if there was some evidence of persistent conjunctival irritation. Motor reeducation and strengthening exercises were initiated 3 weeks after surgery for all patients.

Recovery from facial palsy was quantified with the House–Brackmann (HB) grading system in sequential outpatient visits, and facial and hypoglossal nerve function was reported after the final follow-up visit (23). A scale was created to assess tongue function on the basis of the degree of atrophy of the hemitongue and lingual tip deviation (*Table 1*). This classification is based on four degrees of hemitongue atrophy (severe, mild, discrete, and normal), which correlate well with the degree of tongue deviation. Atrophy was quantified as a percentage of the total area of the hemitongue and classified as severe, mild, or discrete when the atrophy was 50% or more, between 25 and 50%, and less than 25%, respectively. We measured the angle between the midline and the main axis of the deviated tongue; deviation was classified as

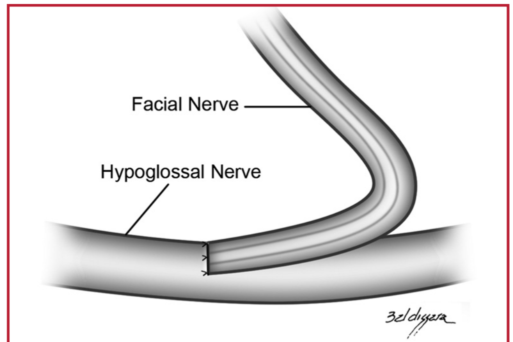

FIGURE 5. *Schematic drawing illustrating the hemihypoglossal–facial neurorrhaphy (lateral view). Observe the loop of facial nerve that provides a proper anatomic alignment between the distal stump of the facial nerve and half of the sectioned hypoglossal nerve (*Adapted from, *Darrouzet V, Guerin J, Bébéar J: New technique of side-to-end hypoglossal–facial nerve attachment with translocation of the infratemporal facial nerve.* ***J Neurosurg*** *90:27–34, 1999 [14]).*

Grade 4 if its angle was more than 30 degrees and as Grade 3 if it was less than 30 degrees (*Fig. 6*). Grades 1 and 2 included patients who had no tongue deviation.

Statistical analysis was performed with the SPSS statistical software program (version 14.0 for Windows; SPSS, Inc., Chicago, IL). After applying the normality test (Kolmogorov-Smirnov), the Spearman rank correlation coefficient was used to determine the correlations between age, time between nerve lesion and surgery, and the result, as evaluated by the HB grading system, of the modified hypoglossal-facial neurorrhaphy. A comparison of surgical results from the two techniques of hypoglossal-facial neurorrhaphy was made with the Mann-Whitney U test. Differences were considered significant at a P value of less than 0.05.

RESULTS

CHF

All patients had no previous mastoid surgery or coexisting morbidity. CHF was performed in 12 patients (eight women, four men) whose ages ranged from 23 to 69 years (mean, 45.4 yr). The mechanisms of nerve injury were resections of vestibular schwannomas in 11 patients and cranial base injury in 1 patient. Preoperative grading in all patients was HB Grade VI, indicating a severe facial nerve injury. Surgery was

TABLE 1. **Scale describing the grade of tongue dysfunction after hypoglossal-facial neurorrhaphy**

Grade	Description
1	Normal
2	Discrete hemiatrophy, no deviation
3	Mild hemiatrophy, tongue deviation <30 degrees
4	Severe hemiatrophy, tongue deviation >30 degrees

FIGURE 6. *Photograph showing the measurement of tongue deviation after hypoglossal-facial neurorrhaphy. The deviation angle is defined as the angle formed by the midline and a drawn line that divides the tongue into two halves.*

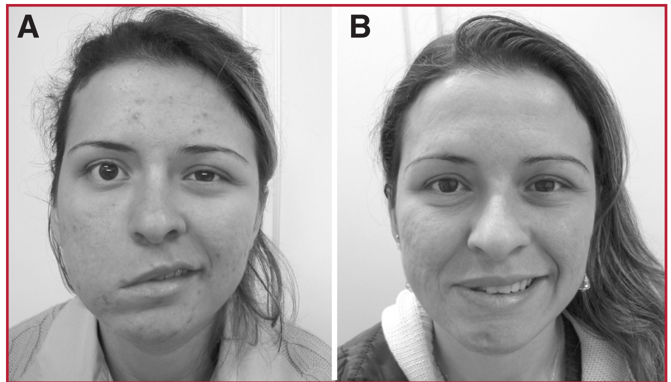

FIGURE 7. *Photographs showing a 28-year-old patient with right facial palsy after vestibular schwannoma excision who underwent hemihypoglossal-facial neurorrhaphy after mastoid dissection of the facial nerve; the photographs were taken while she was smiling.* **A**, *preoperative photograph demonstrating a severe facial palsy.* **B**, *postoperative view at 9 months showing that facial symmetry is almost completely preserved.*

performed at a mean of 5.7 months after injury (range, 2–11 mo). The average follow-up period was 19.8 months (range, 12–36 mo). Postoperative grading improved in all patients; nine patients achieved Grade III, and the remaining three patients were classified as Grade IV. All patients experienced some difficulty in swallowing and speech immediately after surgery. These symptoms persisted in 41% of patients at the final follow-up evalution. We analyzed data to grade tongue function in eight patients; all of them demonstrated moderate (Grade III in 25% of patients) or severe (Grade IV in 75% of patients) tongue dysfunction.

HFM

The series of 24 patients who underwent HFM was comprised of 13 women and 11 men, ranging in age from 22 to 63 years (mean, 42.3 yr). Facial nerve injury during cerebellopontine angle tumor surgery was the most common cause found in almost all patients (95.8%). Only one patient had a facial paralysis secondary to cranial base trauma. All patients had a uniform clinical picture and complained of severe facial paralysis (Grade VI). Time between the facial nerve injury and the hypoglossal–facial neurorrhaphy ranged from 1 to 25 months (mean, 7.1 mo). The average follow-up period was 18.5 months (range, 8–38 mo). At the final follow-up visit, 17 patients attained a Grade III, six patients were classified as Grade IV, and one patient achieved Grade V (*Figs. 7* and *8*). A positive correlation was found between age and results of facial reanimation ($\rho = 0.43$, $P = 0.033$). There was also a significant correlation between preoperative time and the outcome evaluated by HB after surgical facial nerve repair ($\rho = 0.53$, $P = 0.008$).

A tensionless suture was achieved in all patients. There were no major postoperative complications. One patient developed a superficial wound infection on postoperative Day 10 that resolved after a 2-week course of orally administered antibiotics. One patient complained of numbness in the ipsilateral tongue in the immediate postoperative period; this resolved 1 month after the surgery. Most patients (70%) developed no tongue dysfunction. Six patients (26%) showed discrete hemiatrophy (Grade II), and only one patient had a mild hemiatrophy with an angle of tongue deviation of 25 degrees, classified as a Grade III tongue dysfunction.

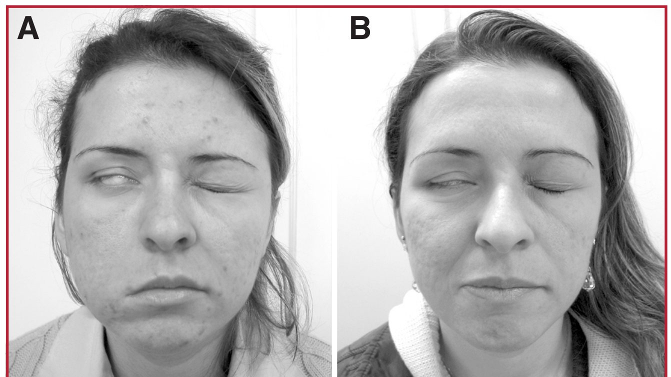

FIGURE 8. *Photographs showing a 28-year-old patient with right facial palsy after vestibular schwannoma excision who underwent hemihypoglossal-facial neurorrhaphy after mastoid dissection of the facial nerve.* **A**, *preoperative view demonstrating severe facial palsy.* **B**, *photograph taken 9 months after surgery. Eye closure is almost complete without hemitongue dysfunction.*

Comparison of the Two Methods

Figure 9 shows the distribution of patients according to HB grade after facial reinnervation, and *Figure 10* shows the distribution of patients according to the tongue dysfunction classification. No statistical differences were noted between the patients treated with CHF and the variant surgical method concerning HB evaluation. However, significantly better results were obtained in tongue function with the HFM technique (Mann-Whitney U test, $P < 0.05$). All patients from the two groups

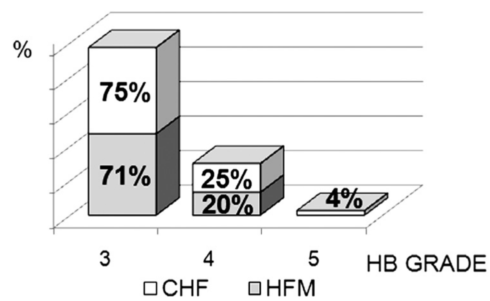

FIGURE 9. *Graph showing the distribution of results of facial reanimation according to the House-Brackmann (HB) classification.* CHF, *classic hypoglossal-facial neurorrhaphy;* HFM, *hemihypoglossal-facial neurorrhaphy after mastoid dissection of the facial nerve.*

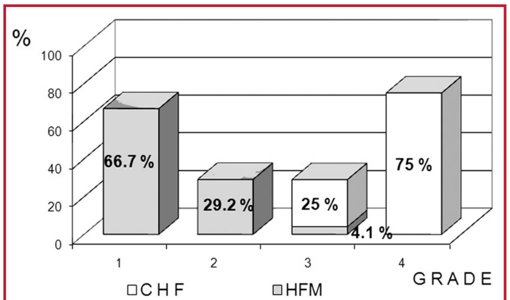

FIGURE 10. *Graph demonstrating the distribution of results of facial reanimation according to tongue dysfunction classification.* CHF, *classic hypoglossal-facial neurorrhaphy;* HFM, *hemihypoglossal-facial neurorrhaphy after mastoid dissection of the facial nerve.*

showed some degree of synkinesis that did not compromise facial movements.

DISCUSSION

Hypoglossal–facial neurorrhaphy is a widely used surgical technique for restoration of facial nerve function when its proximal stump is not available. The standard technique includes a complete transection of the hypoglossal nerve and its cranial dislocation so that it can be sutured to the facial nerve in an end-to-end fashion (10, 32). With an appropriate rehabilitation program, a satisfactory functional outcome can usually be achieved, but the sacrifice of the hypoglossal nerve unavoidably results in paralysis and atrophy of the ipsilateral tongue (36). Disabilities resulting from hemiglossal paralysis may interfere with chewing, swallowing, and speech (4, 10, 12, 22, 28). Although unilateral deficits may be transient and result in minimal functional impairment, some patients remain with permanent deficits that may be disabling for daily life activities.

Several alternative techniques have been proposed to avoid tongue denervation after CHF. In one of these, after complete division of the hypoglossal nerve, the ansa cervicalis is distally sectioned and coapted with the distal stump of the hypoglossal nerve. Unfortunately, this procedure generally results in poor reanimation of the tongue because of the insufficient number of axons contained in that hypoglossal branch (7, 10, 32, 42).

Another surgical strategy is to split the hypoglossal nerve longitudinally (2, 12). After partially transecting the hypoglossal nerve, half is routed cranially and connected in an end-to-end fashion with the proximal stump of the facial nerve after its section near the cranial base origin at the stylomastoid foramen (2). Good results in terms of facial reanimation were obtained with this technique, but mild to moderate glossal atrophy was described in all of the patients treated with it, hypothetically because the hypoglossal nerve is not a polyfascicular nerve and the longitudinal incision may transect many interweaving axons (10, 36, 42). Moreover, according to Magliulo et al. (28), fibrosis involving the exposed nerve after being split might be a complication of this technique.

More recently, partial section without longitudinal splitting of the hypoglossal nerve has been used as a technique of choice to avoid significant complications related to hemitongue paralysis. In this variant, the hypoglossal nerve is transversally sectioned in an extension of 30 to 50% of its cross sectional area, enabling good hemitongue function by the remaining intact axons (14, 31). Data obtained by morphometric analyses of human nerves, in addition to results from experimental studies evaluating regeneration after partial hypoglossal neurectomy, suggest that half of the hypoglossal nerve may be adequate to provide a good functional muscle reinnervation after hypoglossal-facial neurorrhaphy (3, 25, 27, 41). Many technical variants have been described to connect the partially sectioned hypoglossal nerve to the facial nerve (4, 16, 30, 36). The interposition of a free nerve graft between the hemihypoglossal nerve and the facial nerve stump was proposed by May et al. (30), but this method has some disadvantages, including donor site morbidity and occurrence of two suture lines, which may act as obstacles to the regenerating axon sprouts (14, 16, 22, 28, 30).

To provide sufficient length of the facial nerve to allow its mobilization toward the hypoglossal nerve, in 1997 Sawamura and Abe (36), followed by Atlas and Lowinger (4) and by Darrouzet et al. (13), introduced a technique that included an intratemporal dissection of the facial nerve, which was transected, reflected inferiorly to the neck, and sutured directly to a partially sectioned hypoglossal nerve (4, 13, 36). This procedure provides enough extension of the facial nerve to perform a tensionless suture without the need of an interposed nerve graft (3, 6).

A recently described variant of this method (15), less advisable in our opinion, consists of an end-to-side coaptation between the hypoglossal and facial nerves instead of a partial section of the former. An effective axonal transfer with this technique should be much less likely, and the technique endangers the final result in terms of facial reanimation. Only two cases have been described in the original article, and further investigation should be made in this direction before the procedure can be recommended.

Age has been considered a significant factor that influences the final outcome after CHF (20, 28, 29, 32), and this relationship was also observed with the HFM technique in our study. Some controversy still remains regarding the impact of preoperative time on the results of the CHF. Although the time between facial nerve injury and its repair has been identified as an important predictor of the final outcome in experimental and clinical studies (10, 11, 13, 17, 21, 32, 35), some reports find no correlation between time delay and final results. Good outcomes have been described even 2 years after the facial nerve lesion, an observation also supported by the results of experimental studies (20, 24, 26, 34, 36, 37). Some explanations have been proposed to support this fact, including the shorter distance between the facial nerve and muscles, and the maintenance of the trophic influence on the muscle fibers of a partially but clinically imperceptible injured facial nerve. Additionally, there are histological and physiological differences between facial and limb muscles that may explain the relative tolerance of the facial muscles to long-term denervation (38, 39). Moreover, axonal sprouting from the facial nerve of the nonaffected side may also explain the maintenance of facial muscle integrity during denervation, especially in muscles that cross the midline. This phenomenon has been clinically proven after electrophysiological investigation in patients who underwent CHF and in patients with complete facial paralysis after surgery or trauma (18, 40).

For some authors, a relative delay in the surgical timing of a facial reanimation by the hypoglossal nerve is preferable to an immediate repair, to prevent synkinesis (2, 20, 22). Some degree of synkinesis has been identified in almost all patients who have undergone hypoglossal–facial nerve transfer (2, 10, 20, 22, 30), and, if severe, it may be a disabling condition that compromises the final outcome. Synkinesis after hypoglossal-facial neurorrhaphy has been attributed to misdirection of regenerating axons, which results in random muscle reinnervation (9). Some authors suggest that these complications often occur when hypoglossal-facial neurorrhaphy is performed early after injury, resulting in excessive muscle innervation (1, 5, 8, 14, 22). This has been explained by the fact that the axons contained in the donor nerve outnumber those in the receptor nerve, an observation that was supported by morphometric evaluations of human hypoglossal nerves, where the axonal count exceeds by approximately 40% the number of axons in the facial nerve (3, 27, 41). Furthermore, the calibers of myelinated axons in the hypoglossal nerve are larger than those in the facial nerve (3). On the basis of these observations, we speculate that the use of a partially sectioned hypoglossal nerve, providing a sufficient but not excessive number of axons, could prevent the occurrence of severe synkinesis and mass movement. Regretfully, we used the HB grading system, which is based on subjective criteria to classify the degree of facial muscle function and synkinesis, and our hypothesis still awaits testing in future investigations with the use of an effective method of synkinesis evaluation. Because no severe synkinesis occurred in our series, a delay in facial reanimation when performing HFM is not recommended.

Tongue dysfunction after hypoglossal-facial nerve transfer has been historically evaluated on the basis of subjective criteria, and an accurate assessment has not yet been used. We have developed a scale to evaluate tongue dysfunction on the basis of the grade of postoperative atrophy and deviation of the tongue. According to our evaluation, a clear and significant discrepancy was noted between the two assessed techniques, showing a superiority of HFM compared with CHF in terms of preserving tongue function. Moreover, we believe that the use of a quantitative scale, as done in our series, would be a useful tool to compare different techniques in hypoglossal–facial neurorrhaphy and should be used in further prospective studies, particularly to clarify the role of ansa cervicalis–hypoglossal neurorrhaphy in tongue reinnervation and the degree of tongue dysfunction in longitudinal hypoglossal nerve transection.

So far, few reports with a limited number of patients have been published with regard to the use of HFM, and information on the effectiveness and complications of this surgical technique is scarce (4, 13, 19, 33, 36). This study represents the largest reported clinical experience with the HFM. Our results correlate well to those described by other authors using the same surgical technique, and they are quite satisfactory when compared with the results achieved with CHF in the literature and in our own cases (13, 26, 35). Consequently, HFM has been routinely adopted for us as the treatment of choice for facial paralysis after proximal injury of the facial nerve because significant tongue dysfunction is a rare occurrence. However, besides its superiority in the preservation of tongue function when compared with CHF, there are some important facts to be considered. Facial nerve dissection demands an accurate anatomic knowledge of temporal bone anatomy, and mastoid mobilization of the facial nerve is a time-consuming procedure because dissection should be carefully performed to avoid nerve injury. On the other hand, facial nerve anatomy and its dissection at the mastoid bone should be well known to surgeons who perform hypoglossal–facial nerve transfer. Particularly with long time lapses between the injury and facial nerve surgery, identification of an atrophic facial nerve distal to the stylomastoid foramen may be difficult, and a mastoidectomy may be necessary before performing the extracranial facial nerve dissection. Because of the absence of significant complications, such as cerebrospinal fluid leakage, in this large series, the HFM may be considered a safe procedure because a limited mastoidectomy with cavity obliteration is used. Furthermore, because it is superior in preventing hemitongue dysfunction, this technique should be a strongly supported option even in rare cases with a risk of multiple lower cranial nerve deficits and in neurofibromatosis Type II. We believe that this technique should be routinely used to reanimate the face, replacing the CHF as the "gold standard" when managing a proximal facial nerve injury.

CONCLUSION

This large series suggests that HFM is an effective technique that provides satisfactory results in reanimating the facial muscles with a low risk of tongue dysfunction and without major complications. Furthermore, our experience suggests that better functional results are obtained in younger patients and when the nerve transfer is performed early after facial nerve injury.

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COMMENTS

In this article, Martins et al. compared the results of surgery to reinnervate the facial nerve using two different surgical techniques, namely, classic hypoglossal to facial anastomosis and facial nerve anastomosis to the hypoglossal nerve after rerouting the facial nerve from the mastoid bone and to a partially sectioned hypoglossal nerve. The results were nearly the same for facial function after the second technique (75% House-Brackmann [HB] Grade 3 recovery in the first group versus 68% HB Grade 3 recovery in the second group, with one patient showing no recovery), but no tongue atrophy occurred in the second group. Although the results of facial function were not statistically different between the two groups, the results may become worse in the second group in comparing a larger series. The study was retrospective, so the results must be interpreted cautiously.

When facial nerve function does not recover after 9 or more months of waiting, the preferred method of reinnervation is a facial (cisternal segment) to facial (mastoid or peripheral segment) anastomosis, or nerve grafting procedure. Despite the complexity of the operation, HB Grade 3 recovery is achieved in most patients, without any risk to hypoglossal nerve function. This procedure should be considered strongly, especially if the patient already has any speech or swallowing problems. When the proximal stump of the facial nerve is not available, a hypoglossal to facial anastomosis is performed. In such patients, I use a technique that was described previously (1) wherein the hypoglossal nerve is split longitudinally for a short distance (about 1 cm) and anastomosed to the facial nerve transected at the stylomastoid foramen. Recently, I have preferred to do this with electromyographic monitoring of the tongue muscles, and I have not observed any tongue atrophy in our patients, with HB Grade 3 recovery in all of them. This technique may avoid the need to drill the facial nerve in the mastoid segment.

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1. Cusimano MD, Sekhar L: Partial hypoglossal to facial nerve anastomosis for reinnervation of the paralyzed face in patients with lower cranial nerve palsies: Technical note. **Neurosurgery** 35:532–534, 1994.

In this article, Martins et al. present their experience with hemihypoglossal–facial neurorrhaphy and compare it with the results of classic hypoglossal–facial neurorrhaphy. Hemihypoglossal–facial neurorrhaphy, which was applied in 24 patients, has the advantage of only partial sectioning of the hypoglossal nerve and thus the complications related to loss of hemiglossal function are obviated.

Although the technique is not new, it is presented with great accuracy, and all crucial steps are highlighted. The authors are highly experienced in the field and present the largest series of hemihypoglossal–facial neurorrhaphies published to date. The comparison with the classic technique showed that the rate of facial nerve functional recovery was similar in both groups, but the rate of hypoglossal nerve-related complications was statistically lower with the newer technique. Although the classic hypoglossal–facial neurorrhaphy in our experience does not lead to such high numbers of persisting swallowing or speech problems, we certainly appreciate the concept presented by Martins et al. that a given neurosurgical procedure should not lead per se to additional problems or complications.

Martins et al. designed a scale for assessing tongue function that is a positive step toward introducing objective measures for neurological deficits. The scale is based on the degree of atrophy of the hemitongue and lingual tip deviation. However, the actual problems of patients with hemitongue paralysis are difficulties with speech, mastication, and/or swallowing. A scale that does not take into account these parameters and their influence on daily life might not have wide applicability. In this regard, it would be interesting to analyze the correlation between a given degree of atrophy or deviation and the aforementioned functions.

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Martins et al. provided the results of the largest series with this technique in the literature to date and for the first time compared it with the "gold standard" technique for facial reanimation after irreversible proximal injury of the facial nerve. They found no statistically significant difference in facial nerve function as evaluated by the HB scale between classic hypoglossal–facial neurorrhaphy and hemihypoglossal–facial neurorrhaphy after mastoid dissection of the facial nerve. Importantly, the patients who underwent the latter procedure had a significantly decreased loss of tongue function, which is the primary complication associated with the classic technique. The scale created by Martins et al. to evaluate tongue dysfunction after facial reanimation techniques is simple and appropriate, and it can be used in the future to compare techniques.

Martins et al. provided a good review of many different facial reanimation techniques and discussed the advantages and disadvantages of each. The use of microscopic dissection and cranial nerve monitoring during surgery when the facial nerve is at risk has decreased the incidence of complete facial nerve paralysis. However, when paralysis does occur, facial reanimation procedures are effective. In particular, hemihypoglossal–facial neurorrhaphy after mastoid dissection of the facial nerve maximizes facial nerve function while limiting all other morbidity. Therefore, although this technique has yet to be compared with other techniques, it seems to be superior to the classic technique of reanimation in the hands of surgeons who are able to undertake the more complex procedure.

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In this article, Martins et al. compared two surgical techniques for hypoglossal–facial neurorrhaphy in the treatment of facial nerve paralysis owing to an irreversible proximal injury of the facial nerve. This is an original article that is well written, and it shows that a new surgical technique, which is less invasive and radical than the classic method, provides the same results on the face but less morbidity on the tongue.

We agree that these results are of interest to surgeons performing this type of surgery because this technique yields the same results on the face but is less traumatic on the tongue. Thus, the results are more beneficial for the patient.

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