Turkish Neurosurgery 2006, Vol: 16, No: 4, 158-162

Hypoglossal-Facial Nerve Anastomosis for Facial Nerve Palsy Following Surgery for Vestibular Schwannoma: Retrospective Analysis of 13 Patients

Halil AK
Galip Zihni SANUS
Mustafa Onur ULU
Necmettin TANRIOVER
Cihan İŞLER
Taner TANRIVERDİ
Ali Metin KAFADAR

Department of Neurosurgery,
Cerrahpaşa Medical Faculty,
İstanbul University,
İstanbul, Turkey

ABSTRACT

OBJECTIVE: Hypoglossal-facial nerve anastomosis for the purpose of reanimating the muscles of facial expression is a well known procedure with variable published results. In this retrospective clinical study, we aimed to evaluate the results of our series of patients who underwent hypoglossal-facial nerve anastomosis operation for facial palsy following vestibular schwannoma surgery and discuss the current and alternative surgical techniques.

METHODS: We retrospectively evaluated the records of 13 patients operated at the Cerrahpasa Medical Faculty Neurosurgery Clinic between 1991 and 2005 for vestibular schwannoma who had postoperative facial nerve palsy and in whom hypoglossal-facial nerve anastomosis was done. There were 9 female and 4 male patients with a mean age of 44.5 (Range 29-59) The preoperative facial nerve function of all patients was evaluated with the House-Brackmann (HB) grading for the facial nerve. Loss of integrity of CN VII was detected intraoperatively during the first operation for tumor resection by the operating surgeons in all cases and postoperatively all patients had complete facial palsies with HB grades of VI. All the patients were re-operated within 6 months following tumor resection. The mean time interval between the operations was found to be 2.2 months. The postoperative facial function was analysed at 3 months intervals by using HB grading.

RESULTS: In the majority of the cases (9 cases) the first signs of reinnervation were detected between 3 and 6 months after surgery. The recovery HB grades were III in 7 patients, IV in 3 patients and V in 2 patients. In one patient, the operative result was a failure with a recovery HB grade of VI. Among all patients, eight had severe hemitongue atrophy and hemiglossal functional loss in the postoperative follow up period. In the remaining patients the hemitongue atrophy was found to be moderate.

CONCLUSION: Facial nerve reanimation should be performed in every patient suffering from facial nerve paralysis as a complication of VS surgery. Despite some of its disadvantages, the hypoglossal nerve transposition and end-to-end anastomosis directly to the facial nerve appears to be an effective and reliable technique with constant and satisfying results.

KEY WORDS: Facial nerve, Facial paralysis, Hypoglossal nerve, Nerve anastomosis, Vestibular schwannoma

Correspondence Address
Mustafa Onur ULU
İ.Ü. Cerrahpaşa Tıp Fakültesi
Nöroşirürji Anabilim Dalı,
Cerrahpaşa, İstanbul, 34301, Turkey
Phone: +90 212 4143000 (21007)
Fax : +90 212 4143427
E-mail : dronurulu@gmail.com

INTRODUCTION

In current neurosurgical practice, vestibular schwannomas (VS) are considered to be one of the most difficult intracranial tumors to remove without producing additional neurological deficit (18, 22). Despite the advances in intraoperative cranial nerve monitoring and neurosurgical techniques, postoperative nerve dysfunction is still an important issue with paralysis of the facial nerve (CN VII) being the most common (21, 24). Paralysis of CN VII causes significant functional and aesthetic compromise. Functional concerns primarily center on adequate protection of the eye, with a risk of keratitis. In addition, loss of oral competence, swallowing, mastication, and speech difficulties may arise. Furthermore, especially younger patients may experience enormous psychological distress about their physical appearance.

Direct repair of the nerve by end-to-end anastomosis is considered the suggested technique yielding best results (14, 19). However, in many cases, the nerve's proximal stump cannot be identified due to postoperative changes and fibrosis. In such cases, nerve reanimation can be achieved by nerve substitution techniques. Among these, the hypoglossal-facial (XII - VII) anastomosis appears to be the most popular procedure and a standard for facial reanimation (1, 2, 6, 7, 8, 15, 16, 17, 19, 20, 23, 25).

In this retrospective clinical study, we aimed to evaluate the results of a group of patients following surgery for VS, who experienced postoperative facial palsy and underwent facial nerve repair in order to reanimate the muscles of facial expression.

MATERIALS AND METHODS

This retrospective study includes 13 patients who had facial palsy following VS resection operated at the Cerrahpasa Medical Faculty Neurosurgery Clinic between 1991 and 2005 for facial nerve reanimation. There were 9 female and 4 male patients with a mean age of 44.5 (Range 29-59) . All of the patients were previously operated in our clinic for VS and none had Neurofibromatosis Type II. The preoperative CN VII function was evaluated with House-Brackmann (HB) grading for the facial nerve (10). During the first operation for tumor resection, loss of integrity of CN VII was detected intraoperatively by the operating surgeon in all cases and postoperatively all patients had complete facial palsies with HB grades of VI. All patients were operated within 6 months following tumor resection. The mean time interval between the operations was found to be 2.2 months. A classical end-to-end XII - VII anastomosis was used in all the patients. The postoperative facial function was analysed at 3-month intervals using HB grading. The demographic features, recovery HB grades, the time interval between the operations, follow up periods and the extent of tongue atrophy of the cases are summarized in Table I.

Table I. Description and outcome of 13 patients operated for facial reanimation. All of the patients had preoperative HB grades of VI.
Abbreviations: HB:House-Brackmann grade, VS: Vestibular Schwannoma

Case #	Age/Sex	Pathology	Interval between operations (months)	Follow up (years)	Recovery HB	Tongue Atrophy
1	52 / F	Left VS	2	2.2	III	Moderate
2	59 / F	Right VS	3	4.5	IV	Severe
3	51 / M	Right VS	1.5	2.2	III	Severe
4	29 / F	Right VS	3	3	IV	Severe
5	53 / M	Left VS	6	1.5	V	Moderate
6	7 / F	Right VS	3	4.2	IV	Severe
7	43 / F	Right VS	2	5	III	Moderate
8	32 / F	Right VS	1	1.5	III	Severe
9	56 / M	Left VS	1	4	III	Moderate
10	47 / F	Left VS	2	2	III	Severe
11	31 / F	Left VS	1.5	3.6	V	Severe
12	34 / M	Right VS	2	2	VI	Severe
13	45 / F	Right VS	1	1.5	III	Moderate

Surgical Technique of Hypoglossal-Facial Anostomosis

With the patient in the lateral decubitus position, an S shaped incision was made along the anterior edge of the sternocleidomastoid muscle (SCM). The SCM was partially detached from the mastoid process and drawn back posteriorly to expose the anterior one third of the mastoid process. The CN VII was identified as it exits the stylomastoid foramen and sharply transected through its exit point. If the CN VII could not be identified distal to its exit, it was localized in the mastoid bone canal by partial mastoidectomy. The hypoglossal nerve (CN XII) was isolated in the neck passing lateral to the carotid artery and medial to the internal jugular vein. It was then tracked distally to obtain the maximum length for anostomosis. The proximal cut end of CN XII and the distal stump of CN VII were approximated without any tension and sutured with 10-0 monofilament nylon sutures (See Figures 1 - 4).

RESULTS

There were no intraoperative complications related to the anastomosis procedures. The first signs of reinnervation were detected 3 to 6 months after surgery ın the majority of the cases (9 cases). In the remaining cases with reinnervation, the evidence of improvement was detected within 9 months. The recovery HB grades were III in 7 patients, IV in 3 patients and V in 2 patients. In one patient, the operative result was a failure with a recovery HB grade of VI. Among all patients, eight had severe hemitongue atrophy and hemiglossal functional loss

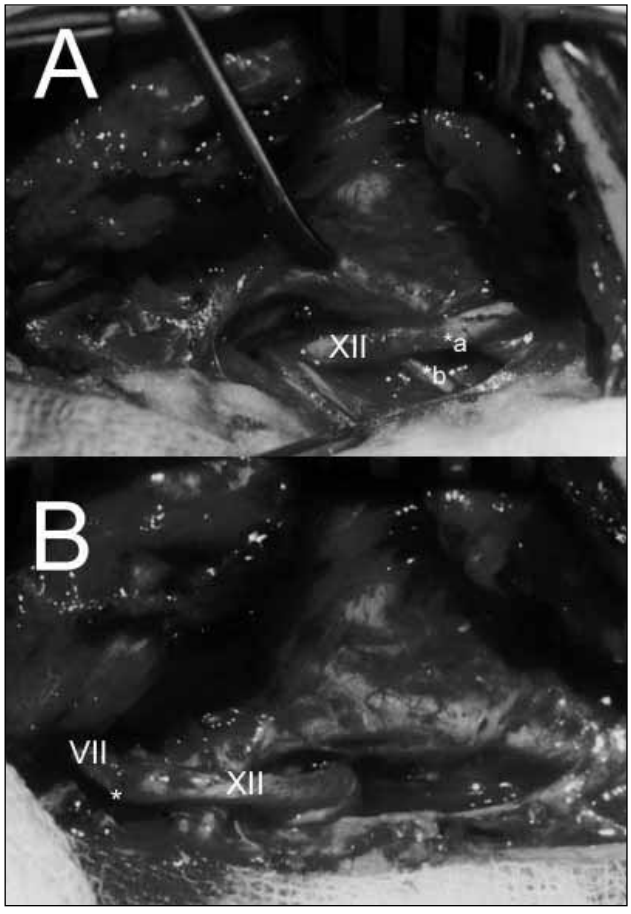

Figure 1: (case no:3)
(A) The hypoglossal nerve was isolated in the neck passing lateral to the carotid artery and medial to the internal jugular vein (*a: lingual branch, *b: descending hypoglossal branch).
(B) Hypoglossal-Facial anastomosis (*shows the anastomosis line)

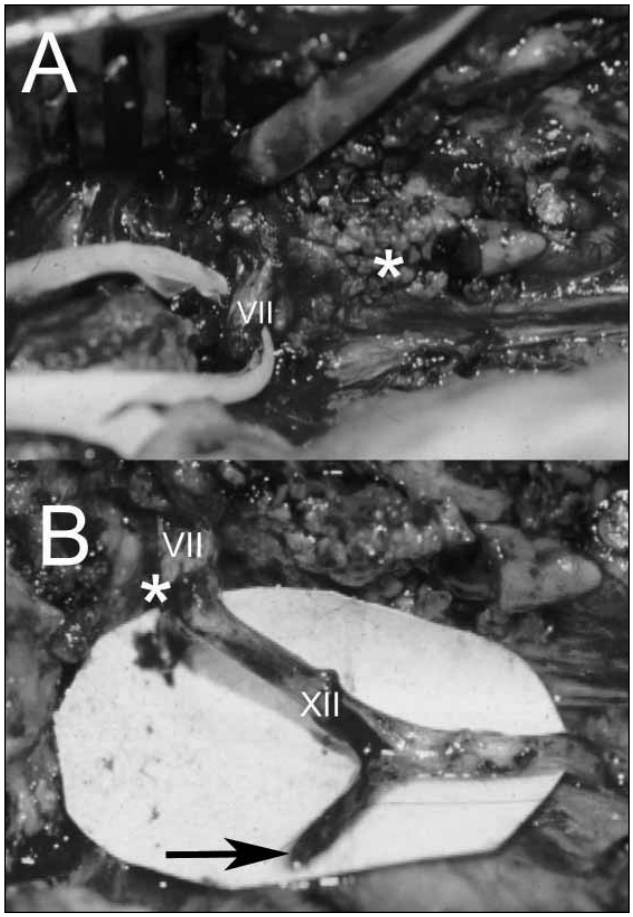

Figure 2: (case no:8)
(A) The 7th nerve is prepared and hung by rubber wires (*:parotid gland).
(B) Hypoglossal-Facial anastomosis (*shows the anastomosis line). For better approximation, the descending hypoglossal nerve has been sacrificed (arrow).

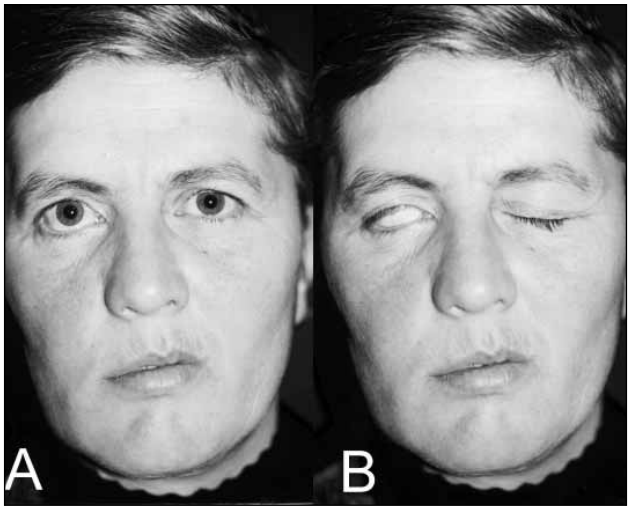

Figure 3: (case no: 7)
(A,B) Preoperative photos of the patient with facial paralysis following vestibular schwannoma surgery

Figure 4: (case no: 7)
(a - d) Postoperative 12th month control photos of the patient showing the functions of the facial muscles with complete closure of the right eye.

in the postoperative follow up period. In the remaining patients, the hemitongue atrophy was found to be moderate.

DISCUSSION

The use of CN XII for reinnervating CN VII has first been proposed by Korte and Bernhadt in 1903 (11). Since then, many different surgical techniques have been suggested and different cranial nerves such as the accessory, glossopharyngeus and trigeminus have been proposed for this purpose (18, 19). Among these nerves, the neuronal compatibility achieved with CN XII has been found to be better than the others (1, 5, 6, 19, 23).

CN XII transposition and end-to-end anastomosis directly to CN VII is a popular, effective and reliable technique with constant and satisfying results (1, 16, 19). However, complete transection of CN XII inevitably results in unilateral paralysis and hemitongue atrophy, which interferes with mastication, speech, and swallowing, particularly when the facial mimic function is less than normal (16, 23). This loss of function must be weighed against the expected gain in facial tone and symmetry and movement.

The other techniques developed have aimed particularly at reducing and preserving the glossal function. In 1991, May et al described a modified technique where CN XII CN VII were anastomosed end-to-side by using a nerve graft (17). The technique was carried out with sectioning half of the thickness of CN XII and an end-to-side anastomosis was achieved by interposing the greater auricular nerve. The drawback of this technique was the requirement of additional nerve suturing and the axonal regrowth was thought to be deficient by some authors quantitatively and qualitatively (2, 20, 23). More recently, other techniques of hemi-hypoglosso-facial anastomosis have been suggested (3, 6, 20). These techniques have described rerouting and suturing of the intratemporal part of CN VII with CN XII was described. These techniques reduce the sequel of hemi-lingual atrophy and problems with articulation and mastication. However since there are fewer nerve cells employed for the movement of the facial muscles, the functional outcome of these techniques is reported to be less satisfactory than with the classical end-to-end anastomosis technique (8, 15, 20). We used the classical technique in our series and did not observe

significant postoperative complaints except for hemitongue atrophy which was severe in eight and moderate in the remaining cases. The potential problems of the sacrifice of CN XII were preoperatively discussed with the patient and his/her relatives.

There is significant confusion and controversy regarding the timing of the anastomosis procedure in the literature, but the most popular concept advocates early surgical intervention and suggests that the delay in performing the anastomosis should be as short as possible, preferably less than one year (4, 6, 13, 17, 20). In cases where the paralysis lasts more than two years, other surgical techniques such as muscle transfers and neuromuscular pedicle grafts must be considered due to the progressive atrophy of the facial musculature (9, 12, 20). In the present study, all patients were operated within 6 months following the first operation and the mean time interval between the operations was found to be 2.2 months. This was found to be directly proportional to the functional outcome as the recovery HB grades of the patients operated earlier were significantly better than the recovery HB grades of patients operated later on.

In conclusion, CN VII reanimation should be performed in every patient suffering from facial nerve paralysis as a complication of VS surgery. Despite some of its disadvantages, CN XII transposition and end-to-end anastomosis directly to CN VII appears to be an effective and reliable technique with constant and satisfying results. However one should not forget that the outcome is influenced by several factors including the extent of the injury, the experience of the surgeon, the psychological condition of the patient and the timing of the operation. The advantages and disadvantages of the alternative surgical methods should be discussed with the patient and the final decision should be made afterwards.

REFERENCES

1. Arai H, Sato K, Yanai A. Hemihypoglossal-facial nerve anastomosis in treating unilateral facial palsy after acoustic neurinoma resection. J Neurosurg 1995; 82:51-4.
2. Asaoka K, Sawamura Y, Nagashima M, Fukushima T. Surgical anatomy for direct hypoglossal-facial nerve side-to-end anastomosis. J Neurosurg 1999; 91(2):268-75.
3. Atlas MD, Lowinger DSG. A new technique for hypoglossal-facial nerve repair. Laryngoscope 1997; 107:984-91.
4. Bernat I, Vitte E, Lamas G, Soudant J, Willer JC, Tankere F. Related timing for peripheral and central plasticity in hypoglossal-facial nerve anastomosis. Muscle Nerve. 2006; 33(3):334-41.
5. Chen Y, Hsu C, Liu TC, Yanagihara N, Murakami S. Histological rearrangement in the facial nerve and central nuclei following immediate and delayed hypoglossal-facial nerve anastomosis. Acta Otolaryngol 2000; 120: 551-56.
6. Darrouzet V, Guerin J, Bebear JP. New technique of side-to-end hypoglossalfacial nerve attachment with translocation of the infratemporal facial nerve. J Neurosurg 1999; 90:27-34.
7. Donzelli R, Motta G, Cavallo LM, Maiuri F, De Divitiis E. One-stage removal of residual intracanalicular acoustic neuroma and hemihypoglossal-intratemporal facial nerve anastomosis. Neurosurgery 2003; 53(6):1444-7.
8. Ferraresi S, Garozzo D, Migliorini V, Buffatti P. End-to-side intrapetrous hypoglossal-facial anastomosis for reanimation of the face. J Neurosurg 2006; 104(3):457-60.
9. Harrison DH. The treatment of unilateral and bilateral facial palsy using free muscle transfers. Clin Plastic Surg 2002; 29:539-49.
10. House JW, Brackmann DE. Facial nerve grading system. Otolaryngol Head and Surg 1985; 93:146-7.
11. Korte W, Bernhardt M. Ein Fall von Nervenpfropfung des Nervus facialis auf den Nervus hypoglossus. Dtsche Med Wchschr 1903; 29:293-95.
12. Kozak J, Voska P, Tichy M. Contemporary state of surgical treatment of facial nerve paresis. Preliminary experience with new procedures. Acta Chir Plast 1997; 39(4):125-31.
13. Kunihiro T, Kanzaki J, O-Uchi T. Hypoglossal-facial nerve anastomosis. Clinical observation. Acta Otolaryngol 1991; 487 (Suppl):80-4.
14. Lee KK, Terzis JK. Management of acute extratemporal facial nerve palsy. Clin Plast Surg. 1984 Jan;11(1):203-10.
15. Magliulo G, D'Amico R, Forino M. Results and complications of facial reanimation following cerebellopontine angle surgery. Eur Arch Otorhinolaryngol 2001; Jan;258(1):45-8.
16. Manni JJ, Beurskens CH, van de Velde C, Stokroos RJ. Reanimation of the paralyzed face by indirect hypoglossal-facial nerve anastomosis. Am J Surg. 2001 Sep;182(3):268-73.
17. May M, Sobol SM, Mester SJ. Hypoglossal-facial nerve inter-positional-jump graft for facial reanimation without tongue atrophy. Otolaryngol Head Neck Surg 1991; 104:818-25.
18. Mingrino S, Zuccarello M. Anastomosis of the facial nerve with accessory or hypoglossal nerves in Samii M, Janetta PJ (eds) : The Cranial nerves. Berlin: Springer-Verlag, 1981:512-14.
19. itty LF, Tator CM. Hypoglossal-facial nerve anastomosis for facial nerve palsy following surgery for cerebellopontine angle tumors. J Neurosurg 1992; 77:724-31.
20. Rebol J, Milojkovic V, Didanovic V. Side-to-end hypoglossal-facial anastomosis via transposition of the intratemporal facial nerve. Acta Neurochir (Wien) 2006; 148(6):653-7.
21. Samii M, Turel KE, Penkert G. Management of seventh and eighth nerve involvement by cerebellopontine angle tumors. J Neurosurg 1985; 32:242-72.
22. Sampath P, Holliday MJ, Brem H, Niparko JK, Long DM. Facial nerve injury in acoustic neuroma (vestibular schwannoma) surgery: etiology and prevention. J Neurosurg 1998; 5:51-4.
23. Sawamura Y, Abe H. Hypoglossal-facial nerve side-to-end anastomosis for preservation of hypoglossal function: results of delayed treatment with a new technique. J Neurosurg 1997; 86:203-6.
24. Sterkers JM, Morrison GAJ, Sterkers O, et al. Preservation of facial, cochlear, and other nerve functions in acoustic neuroma treatment. Otolaryngol Head Neck Surg 1995; 110:146-55.
25. Yamamoto Y, Sasaki S, Sekido M, Yokoyama T, Tsutsumida A, Furukawa H, Sawamura Y, Sugihara T. Alternative approach using the combined technique of nerve crossover and cross-nerve grafting for reanimation of facial palsy. Microsurgery 2003; 23(3):251-6.

Acknowledgements: The authors are indebted to Mrs. Hande Ulu for her help in data collection process