Immediate Hypoglossal-Facial Anastomosis in Patients With Facial Interruption

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Abstract: Hypoglossal-facial anastomosis provides excellent motor supply to the mimetic muscles of the face when there is no chance of recovery of the damaged facial nerve. However, to achieve optimal results, the timing of facial nerve surgery based on electrophysiological testing and clinical evaluation requires close follow-up of the patient. Functional results after delayed surgery are not predictable and depend on the number of surviving fibers, type of injury, severity of damage, degree of infiltration of inflammatory cells, and local fibrosis. Facial hypertonia, synkinesis, and involuntary mass movement are the major problems of delayed reanimation of the facial nerve. Surgery in the vicinity of the facial nerve always aims to preserve neural integrity. However, immediate facial nerve grafting is sometimes required. We present our experience with 4 patients having normal facial function prior to surgery. The facial nerve was severed due to tumor infiltration and instantaneously reconstructed with the hypoglossal nerve. Two patients had House-Brackmann grade-II 10 days and 28 months after surgery, respectively, and another 2 patients had House-Brackmann grade-III facial paralysis 2 weeks and 6 months after surgery, respectively.

Key Words: 7–12 anastomosis, facial function, facial paralysis

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When the patient wakes up with facial paralysis following surgery, the treatment plan is based either on medication with close clinical and electrophysiological follow-up, or on an instant reanimation surgery. The main issue is the reliability of the anatomical integrity of the facial nerve after the primary approach. It is not predictable to determine the time interval in which the facial nerve will achieve its function by medication. Close electrophysiological and clinical monitoring of the patient is necessary to optimize the timing of the intervention to enhance the facial rehabilitation. The chance of facial recovery is higher with earlier reconstruction.[1] Hypoglossal-facial nerve grafting provides a powerful alternative axonal supply when there is no spontaneous recovery of facial dysfunction within a certain time.[2]

Cellular and molecular changes occur in response to injury to the facial nerve. Axonal atrophy and myelin disruption initiate neural inflammation.[3] One of the main obstacles for secondary surgical repair of the facial nerve is scar formation around the nerve and fibrous tissue transformation inside the neural tube. Inflammatory response causes migration of inflammatory cells and growth of granulation tissue. Felix et al[4] presented the long-term findings of facial nerve biopsies in 12 patients in whom repair of the facial nerve after temporal bone trauma required end-to-end anastomosis or cable grafting. They demonstrated demyelization, areas of Schwann cell proliferation representing traumatic neuroma and regenerating myelinated fibers blocked by endoneural fibrosis.[4]

Hypoglossal nerve transfer has been well described particularly in those who have no recovery in almost a year after primary surgery. However, little is known regarding the functional results of immediate reconstruction of the injured facial nerve with hypoglossal nerve transfer. The aim of this study was to present the functional results in 4 patients (1 glomus jugulare, 2 facial Schwannomas in the temporal and parotid areas, and 1 temporal bone carcinoma) with functioning facial nerve. The facial nerves were transected to remove the tumor and immediately reconstructed through facial-hypoglossal anastomosis with extensive backward mobilization of the twelfth nerve to the main facial trunk. Postoperative functional results have been presented.

CLINICAL REPORTS

All the procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation and the Helsinki Declaration of 1975, revised in 2008. Written permissions were obtained from all the subjects.

Patient I. A 51-year-old man presented with a right-sided hearing loss and chronic ear discharge. He had undergone 2 previous surgeries due to chronic otitis media without cholesteatoma. In the second intervention, the surgeon suspected irregular granulation tissue in the posterior ear canal skin and obtained a sample for biopsy which revealed squamous epithelial carcinoma. The magnetic resonance imaging (MRI) was unremarkable. However, temporal bone tomography showed bony destruction at the posterior-superior aspect of the bony wall of the external auditory canal and there was an irregular cavity extending underneath of the mastoid cortex (Fig. 1A). The patient underwent subtotal temporal bone resection including the parotid, facial nerve, ossicles, cochlea, lateral aspect of the sigmoid sinus, and the jugular bulb. The main stump of the facial nerve and the hypoglossal were instantaneously sutured and the cavity was reconstructed with a pectoralis major flap (Fig. 1B). The patient received combined radiotherapy and chemotherapy, postoperatively. Tomography of the temporal bone after surgery was unremarkable (Fig. 1C). Two years later, the patient is free of tumor with House-Brackmann grade-II facial paralysis (Fig. 1D). He has no facial asymmetry of the nasolabial fold at rest and no synkinesis during motion.

Patient II. A 36-year-old Asian man had undergone temporal bone MRI and tomography due to hearing loss and swelling in the parotid region, and recent deep facial pain around the left ear, which revealed a mass deep in the temporal bone at the level of hypotympanium and mastoid apex (Fig. 2A). The mass was observed to extend from the enlarged stylomastoid foramen to the deep layer of

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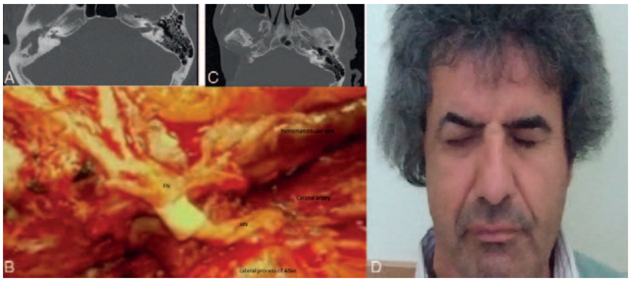

FIGURE 1. (A) Destruction of the posterior bony wall is observed on the axial section of the temporal bone tomography of the right ear. (B) After resection of the temporal bone and the mastoid portion of the facial nerve, the parotid gland was removed and all the branches of the facial nerve were exposed. Jugular foramen was opened; jugular vein was ligated and resected. The hypoglossal nerve was transposed toward the main stump of the facial nerve. After anastomosis with 10/0 nylon suture, the sutured site was wrapped with the pericardium patch (Tutoplast; Innovative Ophthalmic Products Inc, Costa Mesa, CA). (FN, facial nerve; HN, hypoglossal nerve). (C) Postoperative temporal bone tomography of the patient following temporal bone resection, parotidectomy, 7 to 12 anastomosis and pectoralis flap reconstruction. (D) Facial appearance of the patient 2 years after 7 to 12 neural anastomosis.

the left parotid (Fig. 2B). The patient had subtotal petrosectomy with resection of the parotid and facial nerve since the nerve showed continuity with the mass and the surgeon was unable to save it. The facial nerve was simultaneously reconstructed with end-to-end hypoglossal nerve anastomosis. The pathology result revealed facial Schwannoma. Postoperative tomography revealed a reconstructed cavity with abdominal fat tissue (Fig. 2C). Six months later, the patient had House-Brackmann grade-III (Fig. 2D). There was no noticeable synkinesis during facial motion.

Patient III. A 45-year-old man had temporal bone MRI and tomography due to facial pain around the left ear which revealed a mass deep in the temporal bone at the level of hypotympanum and mastoid apex (Fig. 3A and B). The patient underwent subtotal petrosectomy. The facial nerve was resected since the fibers around the mass were extremely thin and the electrophysiological response was lost during dissection. The facial nerve was simultaneously

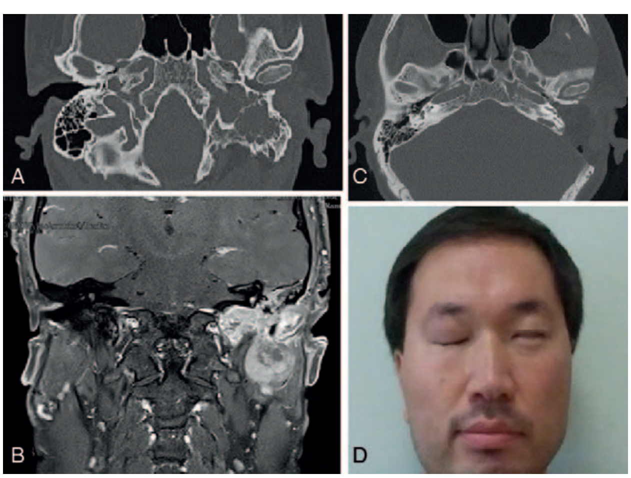

FIGURE 2. (A) Temporal bone tomography of the left ear demonstrating a mass in the mastoid portion of the temporal bone. (B) T1-weighted magnetic resonance imaging with contrast enhancement on coronal view demonstrates mastoid a mass extending deep into the parotid through the enlarged stylomastoid foramen. (C) Postoperative tomography revealed the reconstructed cavity with abdominal fat tissue. (D) Facial appearance of the patient 6 months later. Complete palpebral occlusion was achieved without involuntary mass movement.

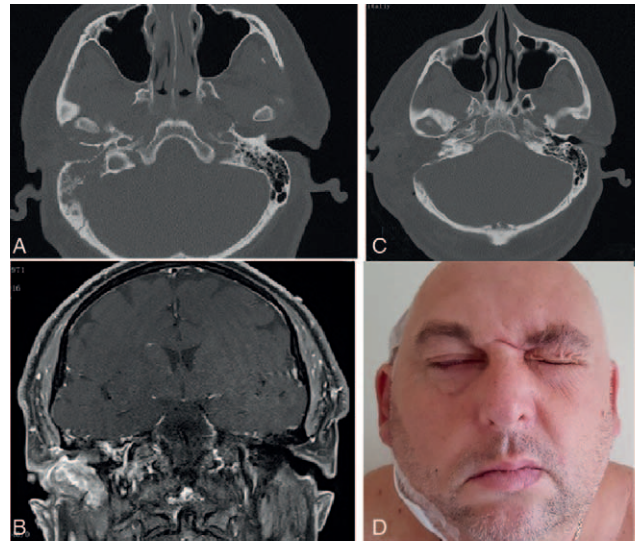

FIGURE 3. (A) Temporal bone tomography of the right ear displaying a destructive mass in the mastoid portion of the temporal bone. (B) T1-weighted magnetic resonance imaging with contrast enhancement on coronal view demonstrates mass on the left temporal bone filling the mastoid with enlargement of the stylomastoid foramen. (C) Early postoperative tomography revealed reconstructed cavity with abdominal fat tissue. (D) Facial appearance of the patient 2 weeks later. Complete palpebral occlusion was achieved without involuntary mass movement.

reconstructed with the hypoglossal nerve. The cavity was obliterated with abdominal fat tissue (Fig. 3C). The pathology report revealed facial Schwannoma. The patient had House-Brackmann type-III at 2 weeks after surgery (Fig. 3D).

Patient IV. A 36-year-old woman presented with a right-sided hearing loss, pulsating tinnitus, and a history of ear bleeding. Otoscopy demonstrated purulent discharge and a reddish mass filling the auditory canal. Temporal bone tomography demonstrated a huge vascular lesion filling the middle and the external ear with subdural extension (Fig. 4A). The mass was observed to surround the horizontal portion of the carotid artery with erosion of the posterior bony wall and the petrous apex (type-D1 glomus jugulare). She did not undergo radiotherapy due to presence of purulent discharge from the middle ear. Subtotal petrosectomy was planned. The tumor was observed to infiltrate the facial nerve. End-to-end hypoglossal-facial anastomosis was completed after resection of the facial nerve at the mastoid level during tumor dissection. The

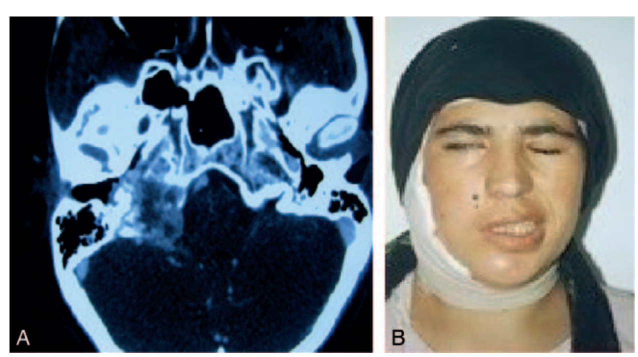

FIGURE 4. (A) Temporal bone tomography showing a mass in the right mastoid portion of the temporal bone surrounding the horizontal portion of the carotid artery with erosion of the posterior bony wall and petrous apex. (B) Facial appearance of the patient 2 weeks later. Complete palpebral occlusion was achieved without involuntary mass movement.

patient had House-Brackmann type-II facial paralysis at10 days after surgery (Fig. 4B). She received radiotherapy later.

DISCUSSION

The best surgical strategy is to avoid interruption of the facial nerve at all costs when manipulating around the nerve. However, despite improvement in microsurgical techniques and the use of intraoperative electrophysiological nerve monitoring, this is a difficult task to achieve. There will be a number of patients in whom the facial nerve cannot be saved. Various types of neural reconstructions have been utilized, and there is no currently superior technique to restore the normal facial function. Primary anastomosis is the preferred procedure if there is an adequate length of neural ends. Malik et al[5] compared 3 different methods for reanimation of the paralyzed face. They found that end-to-end facial anastomosis had superior outcome compared with cable grafting or 7 to 12 anastomosis.[5] However, when this is not possible, interneural grafting or 7 to 12 anastomosis is indicated to ensure facial nerve integrity without any tension. Masseter nerve transfer is an alternative method for reanimation of the injured facial nerve, which does not cause donor site morbidity. Different studies have demonstrated a less favorable outcome.[6] However, this is a valid option.

The timing of facial nerve repair has some conflicting aspects. Barr reported higher axon counts for nerves that were repaired earlier (earlier than 20 days) than nerves repaired late (later than 60 days). However, no statistically significant difference was determined between these groups in electrophysiological testing.[7] Chen et al[8] carried out histological studies on guinea pigs and reported that immediate anastomosis provided better neural regeneration of the facial nerve. In general, facial function begins to return in approximately 6 months.[9] The best facial function that can be reasonably expected after secondary 7 to 12 anastomosis is HB grade III and IV if the facial nerve is grafted within the first year after the onset. It is clear that the length of facial paralysis may have an impact on the final outcome. A decreased regenerative potential is expected in prolonged facial nerve lesions. Kunihiro et al[10] reported that the overall results were better in patients undergoing facial nerve repair within 3 months after injury compared with those who did so after 1 year or longer. Gavron and Clemis[11] reviewed their patients with secondary 7 to 12 anastomosis and reported better results in younger patients and in repairs completed shortly after injury.

Hemi-hypoglossal-facial anastomosis avoids unilateral complete tongue paralysis.[12] Loss of function and hemiglossal atrophy are less severe, but eventually, inevitable.[13] The length of the facial nerve was insufficient in all 4 patients since mobilization of intratemporal portions of the facial nerve was not possible due to tumor involvement. Therefore, primary end-to-end reanimation was processed with extensive backward mobilization of the hypoglossal nerve to prevent tension. On the other hand, reports indicate that end-to-end anastomosis does not always present a tongue problem. Schaitkin et al[14] reviewed a multi-institutional survey of patient perceptions of facial reanimation success by mailing questionnaires to 809 randomly selected patients. They reported that 40% of the patients were satisfied with swallowing, tongue movement, and chewing. Conley reported that immediately grafted patients at the time of the original procedure appeared to be more satisfied with the result, and that the use of a split nerve or a descending hypoglossal branch did not achieve the expected facial reanimation.[15]

Palpebral occlusion was achieved in all patients without a need for additional intervention for eye protection. Patient satisfaction with swallowing and facial movement was good and none of them requested additional therapy. There was no facial contraction. Facial hypertonia and involuntary mass movement, which are more commonly seen in secondary hypoglossal-facial anastomosis, were not severe, most probably due to the immediate reanimation of the facial nerve. In conclusion, when the remaining main trunk of the facial nerve is too short due to facial nerve defect in the primary surgery, immediate hypoglossal-facial end-to-end anastomosis with extensive backward mobilization of the donor nerve provides good results.

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