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Results and complications of facial reanimation following cerebellopontine angle surgery

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Abstract The present study was undertaken to evaluate the results of a group of patients following treatment for cerebellopontine angle lesions who developed postoperative facial palsy and underwent facial nerve repair in order to reanimate the muscles of facial expression. A retrospective study was performed on 23 patients treated between 1988 and 1997 at the 2nd and 4th ENT chairs of University "La Sapienza" of Rome for facial palsy following cerebellopontine angle surgery. Tumors included acoustic neuromas (*n* = 3). Seventeen patients underwent hypoglossal-facial anastomoses [10 with end-to-end anastomoses, 4 with May's interposition "jump-nerve" grafts and 3 with partial (30%) use of the hypoglossal nerve plus a facial cross-over]. The remaining patients were operated on using a cable graft with the sural nerve (*n* = 2) and the great auricular nerve (*n* = 4). Postoperative facial function was determined by the House-Brackmann 6-scale classification The hypoglossal-facial anastomoses resulted in long-term grade III or IV findings. Cable grafts improved facial function from grade VI to grade III. None of the patients operated on with the modfied VII-XII anastomosis developed swallowing disturbances. The ten patients having traditional hypoglossal-facial anastomoses showed different degrees of tongue disability and retention of residue in the oral cavity. Surgical recovery of postoperative facial palsy can be obtained with various techniques according to the availability of the proximal facial nerve stump at the brain stem. Since a traditional hypoglossal-facial anastomosis procedure can be a source of a separate disability for the patient, techniques are preferred that leave the hypoglossal nerve mostly intact and uncompromised.

Keywords Cerebellopontine angle surgery · Facial palsy · Hypoglossal-facial anastomosis · Cable nerve grafts

Introduction

Although the development of microsurgical techniques and monitoring have signicantly improved the chances of preserving the facial nerve anatomically and functionally [5, 8, 13], cerebellopontine angle surgery can still result in a postoperative facial deficit owing to unavoidable facial nerve resection because of the histologic characteristic of a lesion or the lack of functional recovery from nerve trauma at the time of surgery. Several techniques have now been proposed to repair actual facial nerve loss. Each has specific indications, contraindications and complications [1-3, 7, 9-12, 14-16], but the quality of the reanimated face has been a matter of controversy. A surgical technique to obtain optimal cosmetic results, such as a natural smile without synkinesis, is yet to be available [15].

The present study was undertaken to evaluate the results of facial function in a group of patients suffering from cerebellopontine angle pathologies who developed postoperative facial paralisis and underwent facial nerve repair in order to reanimate the muscles of facial expression.

Materials and methods

A retrospective study was performed on 23 patients treated between 1989 at the 2nd and 4th ENT Chairs of University La Sapienza of Rome. All had complete facial palsies following cerebellopontine angle surgery and had House-Brackmann [6] grade VI paralyses. No other cranial nerve deficits were found. The group consisted of 11 women and 12 men ranging in age from 36 to 66 years (mean age, 43.1 years).

Thirteen patients had previously been operated on in other hospitals for skull-base surgery and were referred to our institution for surgical rehabilitation of postoperative palsies. The majority of the patients (*n* = 15) developed facial palsy after resection of an

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Table 1 Interval period between the onset of the facial palsy and the surgical rehabilitation

Case number	Interval period (months)
1	13
2	11
3	2
4	1
5	23
6	18
7	3
8	14
9	16
10	8
11	2
12	11
13	31
14	26
15	1
16	14
17	15

acoustic neuroma. Other pathologies were facial nerve neuromas ($n = 3$) and meningiomas ($n = 3$) and cerebellopontine angle epidermoid cysts ($n = 2$).

Facial nerve repair was done intraoperatively in six patients when the facial nerve was found to be intimately involved with a lesion requiring the nerve to be sacrified. Two patients underwent cable grafts with the sural nerve, while the great auricular nerve was used as a graft in the other four patients.

In 17 cases, a hypoglossal-facial anastomosis [3] was performed with different techniques owing to loss of the proximal stump of the facial nerve. An end-to-end facial nerve-hypoglossal nerve anastomosis was used in 10 patients. An interpositional jump technique [9] was performed in 4 patients. In the remaining 3 an anastomosis of a split hypoglossal nerve to the facial nerve was combined with a facial cross-over technique [16].

The interval period between the onset of the postoperative facial palsy and nerve repair is summarized in Table 1. Facial function was analyzed postoperatively at 2, 6, 9 , 12 and 24 months using the facial nerve grading system of House-Brackmann [6]. The outcomes of the hypoglossal-facial nerve anastomoses were grouped according to the classification system proposed by May et al. [9]. In these patients, further evaluations determined postoperative morbidity in terms of speech, mastication and swallowing difficulties. Each patient was recalled and assessed using tongue echography and cine barium swallows.

Results

The results of postoperative facial function were recorded after 2 years of follow-up. Of the six patients who underwent intraoperative cable grafts of the sectioned facial nerve, four had grade III postoperative facial function (Table 2). The other patients had grade IV nerve function. The first evidence for reinnervation was documented between 2.5 and 7 months after surgery. The findings stabilized in four patients after 1 year. In the remaining patients there was further improvement that was evident at the 2-year follow-up. The data for recovered facial function after hypoglossal-facial anastomosis are summarized in Table 3.

Table 2 Postoperative facial function outcomes after cable grafts

Case number	Surgical approach	Cable graft	Grade
1	Retrosigmoid	Great auricular nerve	IV
2	Retrosigmoid	Sural nerve	III
3	Translabyrinthine	Great auricular nerve	IV
4	Translabyrinthine	Great auricular nerve	III
5	Translabyrinthine	Great auricular nerve	III
6	Translabyrinthine	Sural nerve	III

Table 3 Postoperative facial function outcomesafetr hypoglossal-facial nerve anastomoses

Case number	Surgical technique	House-Brackmann grade	May grade
1	XII-VII	III	I
2	XII-VII	IV	II
3	XII-VII	III	III
4	XII-VII	V	V
5	XII-VII	IV	III
6	XII-VII	III	II
7	XII-VII	IV	IV
8	XII-VII	IV	III
9	XII-VII	III	II
10	XII-VII	IV	III
11	XII-VII jump graft	III	I
12	XII-VII jump graft	V	V
13	XII-VII jump graft	IV	III
14	XII-VII jump graft	IV	III
15	XII-VII and facial cross-over	III	II
16	XII-VII and facial cross-over	III	II
17	XII-VII and facial cross-over	II	I

Table 4 Postoperative swallowing outcomes following end-to-end hypoglossal-facial anastomoses (swallowing dysfunction: + slight, ++ moderate, +++ severe)

Case number	Tongue atrophy	Swallowing dysfunction
1	Slight	++
2	Severe	+
3	Moderate	++
4	Moderate	++
5	Moderate	++
6	Moderate	+
7	Severe	++
8	Slight	+
9	Severe	++
10	Moderate	+++

The end-to-end hypoglossal-facial anastomosis achieved grades III-IV of the House-Brackmann system in nine patients. In these patients May's classification showed that seven had excellent or good outcomes (grades II-III), while the other three patients had grade I, grade IV and grade V outcomes, respectively. The patients operated on using May's jump graft tended to have poorer results in terms of muscle tone, while the cross-over grafts had better results.

The initial sign of reinnervation in the patients operated on using the various techniques of XII-VII anastomosis varied between 4 and 9 months and was linked to the variability of the interval period between the onset of the facial palsy and the surgery for facial rehabilitation. None of the patients complained of oropharyngeal dysfunction who had undergone the modified techniques of hypoglossal-facial anastomosis. In contrast, the end-to-end technique impaired deglutition because of the various degrees of atrophy of the hemitongue (Table 4). Six patients who experienced moderate swallowing difficulties were found to have retention of residue in the oral cavity. In three patients this change was slight, while one patient had a disturbance in swallowing owing to his hypoglossal nerve deficit. This patient required several sessions of retraining to reduce the effect of this complication.

Discussion

Although the advances of intraoperative facial nerve monitoring and the refinements of microsurgical techniques have significantly reduced the incidence of postoperative facial palsy during cerebellopontine angle surgery [5, 8, 13], its management can be controversial.

There is consensus that any available central stump of the facial nerve should be managed with an intracranial-extracranial nerve graft or an intracranial-intratemporal nerve graft [7]. This entails grafting immediately after disruption of the facial nerve. Experience detailed in the literature shows that this strategy affords acceptable outcomes with final results that commonly vary between House-Brackmann grades III and IV. After the first year of follow-up, these findings may be worse due to the development of delayed synkinesis. Our data are similar to what has been reported elsewhere [7, 10,15], indicating that facial reanimation does not commonly result in the return of normal or near-normal facial function. Obviously, the clinical implication is that better postoperative facial function can be obtained only by preserving its anatomic and functional integrity.

The hypoglossal-facial anastomosis is an appealing option for patients with loss of the proximal stump of the facial nerve, but no clear consensus exists with regard to an optimal strategy about the timing and type of operating technique for avoiding additional disabilities, such as swallowing or speech dysfunction [6, 9]. These latter disabilities represent the major complication of this rehabilitative approach. Many patients operated on with end-to-end anastomoses between the facial and hypoglossal nerves have experienced this complication. Cine barium swallows and tongue echography in our study documented retention of residue in the oral cavity in a significant number of our patients. This potential morbidity has led to the development of modified techniques to preserve glossal function. In 1991, May et al. [9] proposed interposing a cable nerve graft between a proximal partially severed end of the hypoglossal nerve and the distal stump of the facial nerve. Favorable results were reported in 21 out of 24 procedures. Cusimano and Sekhar [4] and Arai et al. [1] preferred to anastomose a split hypoglossal nerve to the facial nerve. More recently, Sawamura and Hiroshi [14] and Atlas and Lowinger [2] separately devised a similar technique to perform an end-to-side anastomosis using a skeletonized intratemporal segment of the facial nerve, which is transected and mobilized towards the hypoglossal nerve. These procedures have successfully overcome the risk of swallowing dysfunction.

Our experience with May's technique [9] has taught us that the interposition of a cable graft between the the hypoglossal and facial nerves required more operating time but, at least in our hands, the results were less favorable. The nature of our findings may be due to the need to perform double anastomoses. Splitting of the hypoglossal nerve presents a potential increase in fibrosis around the nerve not totally covered by an epineurium. Thus, our current method of choice is to bridge the gap between the facial and hypoglossal nerves according to the technique of Sawamura and Hiroshi [14] and Atlas and Lowinger [2].

In our series, we found satisfactory restored facial function similar to that reported in the literature. Facial tone recovered within 4 to 9 months with the reappearance of a nasolabial fold. Facial symmetry at rest as well as closure of the eye were achieved by all of our patients. Oral continence improved, but the inferior lip showed no movements or uncoordinated and weak contractions. An analogous phenomenon occurred in the frontal region of the forehead. Indeed, cosmetic results were influenced by such factors as the age of the patients, timing of surgery and, above all, the ability of the patients to create voluntary facial movements through the dynamic positioning of the tongue against teeth or the palate. Our outcomes seemed to confirm the trend of better results in younger patients, especially when surgery was not postponed. However, our limited experience prevents definitive conclusions to be made. In contrast, the importance of training to coordinate the tongue and facial movements must be emphasized. More "natural" cosmetic results occurred in the patients who carefully followed a physiotherapy program. Despite all these enhancements, the facial movements produced were unfortunately only partially symmetric. This is the real limitation of the hypoglossal-facial anastomosis.

Combining the hypoglossal-facial anastomosis with a facial nerve cross-over is an alternative approach to reanimate a paralyzed face obtaining dynamic symmetry [16]. This has been developed to overcome the failings of both techniques. In fact, a sole facial cross-over does not provide sufficient muscular tone and has had disappointing results.

Our findings were encouraging with a near-normal facial function in one patient. However, this approach is technically difficult and requires longer operating times. Moreover, it is a staged operation. At the first stage the hypoglossal-facial anastomosis is performed, with facial coaptation of the branches of the contralateral facial nerve done later with interposition cable grafts (three or four in order to reanimate the frontal, eye, buccal and mandibular areas of the face). After 9 months (time necessary for the growth of the facial axons into the grafts), these latter branches are coapted with the related branches of the paralyzed facial nerve. Patients undergoing this technique have to accept the fact that there will be additional time before recovery is complete. In this context, this procedure is best reserved for selected motivated patients.

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