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Decompression of Facial Nerve after Temporal Bone Fracture: about 20 Cases

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Abstract

Background: Seven to ten percent of facial nerve paralysis occurs in patients with temporal bone fracture. It has become increasingly common due to the development of human activity. One of the main topics of discussion is facial nerve injury management resulting from temporal bone trauma. The purpose of this study is to report the paralysis of facial nerve after temporal bone fractures.

Aim: In this study, our goal was to record the facial profile of rhinoplasty applicants in Shiraz.

Methods: This retrospective study analyzed 20 cases of traumatic paralysis of facial nerve, which underwent facial nerve decompression.

Results: Recovery rate was correlated to the delay of surgery. 83.3% of patients who underwent decompression surgery within the first 2 weeks after trauma had an excellent therapeutic outcome (HB grading I-II) and the difference was statistically significant (p=0.000).

Conclusion: Facial nerve paralysis surgical management after bone fracture is controversial. The decision must be taken according to the type of paralysis and the radiological electrophysiological and evolutionary data.

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Introduction

Seven to ten percent of facial nerve paralysis occurs in patients with temporal bone fractures (1). It has become increasingly common due to the development of human activity(2).

Facial nerve paralysis associated with temporal bone fractures is classified into immediate palsy, delayed palsy or of unknown onset, depending on the timing of the onset of facial nerve paralysis after the trauma.

This pathology has greatly benefited from advances in imaging and electrophysiological explorations.

One of the main topics of discussion is facial nerve injury management resulting from temporal bone trauma. The main principal questions debated are indications for surgery, the timing and extent of surgical exploration (3). In fact, they depend on clinical, radiological and electrophysiological data.

The aim of this article was to report the indications and the surgical results of facial nerve paralysis after temporal bone fractures.

Methods

This retrospective study analyzed 20 cases of traumatic paralysis of facial nerve at the Department of Ear, Nose and Throat (ENT) at Fattouma Bourguiba University Hospital in Monastir between 2006 and 2018.

In this study all patients who were treated surgically were included. Patients treated

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medically or patients with non-traumatic peripheral facial nerve palsy were excluded.

The interview during the first consultation collected onset of paralysis and the involved side. The degree of paralysis was evaluated according to the Freyss score and the House and Brackmangrading (4). Full audiological evaluation was performed on all patients including air bone conduction pure-tone audiometry, tympanometry, stapedial reflex measurement and brain evoqued response.

A high-resolution temporal bone scan was performed in all cases. The interpretation was made on post processing consoles with multiplanar reformatting. A report was given with four plates in axial and coronal sections. Moreover, electroneuromyography was performed in 4 cases.

Regarding treatment, all patients initially received medical treatment based on intravenous corticosteroid therapy and vasodilators. The decision of the surgical decompression was made in the presence of cases of immediate and complete peripheral facial paralysis and those of delayed onset in the absence of improvement under medical treatment with presence of a fracture line through the facial canal. Follow-up visits consisting of otoscopic examination, audiometric workup, and facial outcome assessment were done on one and three weeks, three and six months, and 1 year after the operation. The House and Brackmann grading was used for evaluation of the facial nerve function. Facial nerve recovery to grade I or II was considered as good recovery. For the analytical study, the patients were divided into two groups according to age (≤45 years or >45 years), type of facial paralysis (immediate onset or delayed onset), and delay of surgery (< 2 weeks, 2 weeks-1 months, >1 month). The outcomes of facial nerve between different groups were compared. $p<0.05$ indicated as a significant difference.

Results

Sixteen patients are male, 3 patients are female with ages ranging from 6 to 60 (mean, 27 years). The pediatric population represented 21% of the cases. One patient had bilateral and 18 patients had unilateral temporal bone fracture, which makes 20 cases of facial paralysis. There were 14 cases of traffic accident, 2 cases of fighting, 2 cases of machine work and 2 cases of domestic accident.

The initial assessment of the accident revealed a head trauma with initial loss of consciousness in 10 cases requiring a stay in the intensive care unit. The initial Glasgow coma scale was less than or equal to 8 in 4 cases. In 7 cases, the assessment was a head trauma without initial loss of consciousness and patients were admitted to the neurosurgery department. The delay between accident and hospitalization in our department was 15 days (1-60 days). The reason for consultation was facial asymmetry in all cases, associated with hearing loss in 11 cases and vertigo in 6 cases.

Facial paralysis was immediate in 9 (45%) cases and delayed in 11(55%) cases with an average time of onset of 75 hours.

Only one case of facial diplegia was identified. A total of 20 paralyses were studied. Twelve cases of facial paralysis was seen on the right (60%) and 8 cases on the left (40%).

Facial motor skills were evaluated according to the classification of Freyss and the House and Brackman grading. The mean initial score for facial paralysis was less than 5/30. Only two patients have a score higher than 5. According to the House and Brackman grading, the paralysis was classified as grade IV in 2 cases (10%), grade V in 11 cases (55%) and grade VI in 7 cases (35%) (Table 1). Temporal bone CT scan recommended clear fracture lines in 19 cases and absent fracture in 1 case. Among the 19 cases with clear fracture lines, there were 11 cases (57.8%) of longitudinal temporal fractures, 7 cases (36.8%) of transverse type and 1 case (5.2%) of mixed type. Geniculate ganglion was the location of fracture in 6 patients (30%). Moreover, the tympanic

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segment was the location of fracture in 8 patients (40%), the geniculate ganglion+tympanic segment (Figure 1) in 3 patients (15%), and the tympanic + mastoid segments in 2 patients (10%).

Table 1. Distribution of facial paralysis by grade and install mode

Types	Grade IV	Grade V	Grade VI	Total
Immediate	2	5	2	9 (45%)
Delayed onset	0	6	5	11(55%)
Total	2 (10%)	11(55%)	7(35%)	20

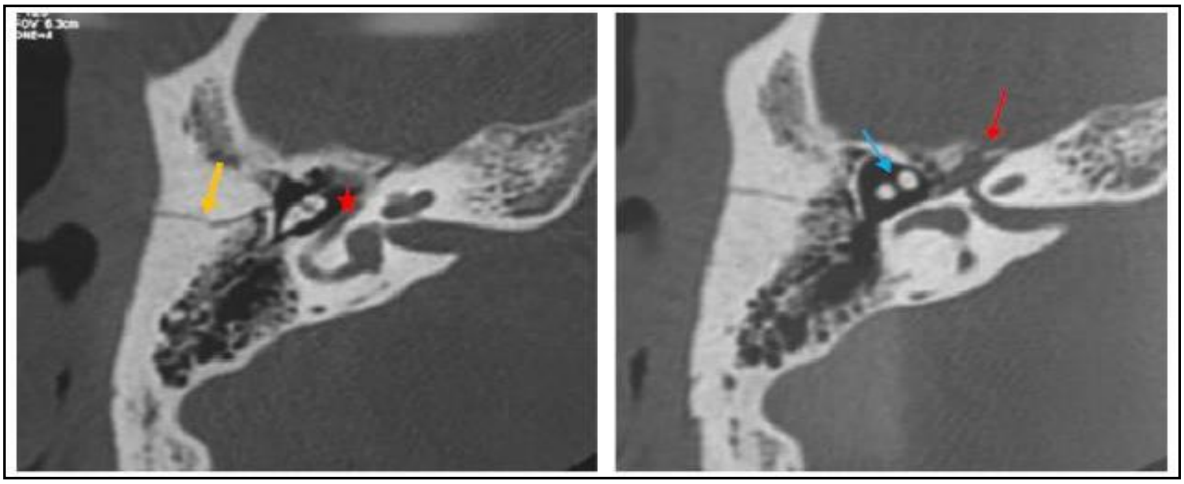

Figure 1. Extra-labyrinthine longitudinal fracture (yellow arrow) of the right temporal bone passing through the geniculate ganglion (red arrow) and the tympanic segment of the facial canal (red star) associated to an uncudo-malleolar dislocation (blue arrow).

The preoperative audiological evaluation revealed normal hearing in 1 (5%) fracture, pure conductive hearing loss in 7 (35%), conductive hearing loss with high frequency neurosensorial hearing loss also in 6 (30%), and pure neurosensorial hearing loss in 6 (30%), two of which were cophotic.

The Electroneuromyography was performed in 4 cases. In 1 case, it showed damage to the facial nerve with signs of active reinnervation. In the 3 others cases, there was severe impairment with signs of denervation.

The intervention timing ranged between 11 and 60 days (mean, 15 days if immediate facial paralysis and 25 days if delayed facial paralysis).

All patients underwent surgical treatment under general anesthesia. The surgery was indicated in the presence of a complete immediate facial paralysis or a delayed onset facial paralysis associated to a total denervation at the Electroneuromyography and a fracture line passing through the facial canal in the CT scan.

All patients underwent facial nerve decompression by the transmastoid extralabyrinthine approach. A fracture line was not always found; only inflammation edema was observed throughout the nerve in one patient (5%). Nerve compression by bone fragments was evident in 6 cases (30%). Three nerve sections were found (15%) (1 complete, 2 partial), a wound limited to the epineurium in one case (5%) and a nerve contusion in 10 cases (50%). In four cases, granulation tissue was found around the facial nerve.

The involvement of the tympanic segment only was the most frequent; it was found in 11 cases (60%). The geniculate ganglion was affected in 5 cases, the mastoid segment in 2 cases, the tympanic segment and the geniculate ganglion in 1 case.

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Associated ossicular lesions were found in6 cases (30%); uncudomalleolar dislocationin 3 cases,incudostapedial dislocation in 2 cases and incus suprastructure fracture in one case.

A total decompression of the facial nerve was carried out in 6 cases, a decompression of the tympanic and mastoid segments in 13 cases and the tympanic segment in 1 case. Additional procedures were opening of the nerve sheath in 3 cases (15%); a nerve suture in the 3 cases of nerve section and ossiculoplasty in 6 cases.

After sugery, The House and Brakman grading (HBG) system was engaged to evaluate the function of facial muscles. The recovery time for functioning started two weeks after surgery. The results of the 20 cases were as follows; seven patients had HBG-II, 8 patients had HBG-III, 3 patients had HBG-IV, 1 patient had HBG-V and only one patient had normal facial function during follow up. Thus, the rate of a good recovery (grade I or II) was 40 % (Figure.2) and the rate of a satisfying result (grade I or II or III) was 80 %. The air-conduction threshold improved but no change was seen in bone conduction. The median follow-up was 24 months

Figure2. The case of facial diplegia: before (A) and after surgery (B).

Table 2. Distribution of post-operative results according to the delay of surgery

Delay of surgery		**<2 weeks**	**2weeks-1month**	**>1 month**	**Total**
Results	**I or II**	5	3	0	8
	III	1	6	1	8
	IV	0	1	2	3
	V	0	0	1	1
Total		**6**	**10**	**4**	**20**

The correlation between the time of surgery after trauma and the recovery rate was analyzed. The delay between the trauma and the surgery was less than two weeks in 6 cases, 2 weeks to 1 month in 10 cases and more than one month in 4 cases. 83.3% of patients who underwent decompression surgery within the first 2weeks after trauma had an excellent therapeutic outcome (HB grading I-II). In contrast, the rates of complete recovery were 30% at 2 weeks to 1 month, and 0 at > 1 month. In the analytical study the difference was statistically significant (p=0.000), suggesting a tendency toward poorer therapeutic outcome with later surgery (Table 2).

Four of 9 cases (44.4%) in the immediate onset group had decent recovery, while 4 of 11 cases (36.3%) in the delayed onset group had good recovery, without significant difference (p=0.18). Seven of 15 cases (46.6%) in the

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younger group (≤ 45 years) had decent recovery of facial nerve in contrast to 1 of 5 cases (20%) in the elder group (> 45 years), without significant difference (p=0.1) (Figure 3).

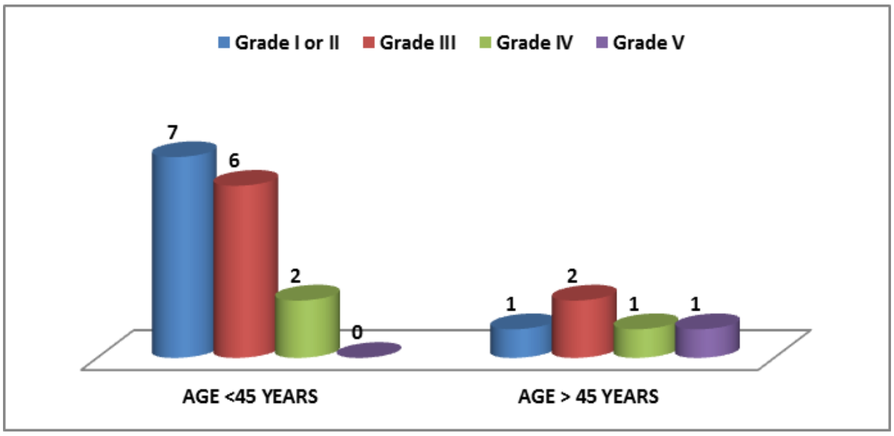

Figure 3. Distribution of the post-operative result according to the two age groups.

Discussion

The second most frequent cause of facial nerve paralysis is due to trauma (4, 5). In one of our cases, facial nerve paralysis occurred in the absence of radiologically demonstrable temporal bone fractures. In these circumstances, a microtrauma, which causes facial nerve edema, can be expected. All patients with traumatic facial nerve palsy, in addition to standard head computed tomography (CT) scan, should undergo a high-resolution CT scan of temporal bone. Actually, the best diagnostic tool for identifying the fracture line at the level of the facial nerve canal and for evaluating any associated lesions within the temporal bone is CT scan, but it cannot visualize the facial nerve itself (4, 6). Direct visibility of the injured facial nerve, and the recognition of neural ischemia or edema (abnormal enhancement after contrast injection) or an intraneural hematoma is detectable with an Magnetic resonance imaging (MRI) (4). The electrophysiological tests, which are facial electromyography (EMG) and electroneuronography (ENoG) can be a useful adjunct tool for determining the need for surgery and for prognosis of a facial nerve paralysis (7-9).

The management of traumatic facial nerve palsy is could be perplexing. The type of injury, sudden or delayed-onset, complete or partial paralysis, localization of the injury, and the electrodiagnostic testing are the main elements of the prognosis (10,11).

The timing of surgery and indications are still a matter of dispute. Exploration of the facial nerve for acute facial paralysis after a fracture of the temporal bone is implied in more than 90% denervation of the facial muscles on ENoG within six days of the onset of the paralysis (12, 13).

In a retrospective study, by Darrouzet and al. (11), stated that important indications for nerve decompression are: CT scan findings, if ENoG shows more than 90% degeneration of nerve fibers within the first 2-3 weeks after paralysis or EMG shows no regeneration signs after 3 weeks.

Several studies (14, 15) revealed that the perfect time for facial nerve decompression surgery for facial nerve paralysis after temporal bone fractures is during the first 2 weeks after trauma in patients with immediate-onset and severe paralysis, suggesting the high efficacy of such surgery. In our study, the rate of complete recovery was 83.3% if surgery was performed within the first two weeks, and these cases

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showed a significantly better prognosis versus those who underwent surgery at 2 weeks to 1 month (p=0.000); which confirms the findings of the previous authors.

The transmastoid method is capable of exposing the mastoid and tympanic segments of the facial nerve, and it consents hearing preservation; we have opted for this surgical method in all our cases. The middle cranial fossa method is used for exposing geniculate ganglion and labyrinthine segment or the internal auditory canal segment injury with good hearing and vestibular function. The transmastoid pathway combined to the middle cranial fossa approach is indicated for decompression of the facial canal over its entire length. When there is complete hearing loss and the injury site is above the geniculate ganglion, the translabyrinthine method can be used (16, 17).

In all approaches, Hato (1) opened the Fallopian canals only at the fracture site and did not perform additional decompression of the facial nerve at normal sites. On the other hand, other authors proposed facial nerve total decompression that combined the middle cranial fossa approach and the transmastoid approach for the treatment of traumatic facial nerve paralysis (17).

In the case of nerve section, most authors agree about using sural auto graft. Early grafting seems to lead to a better outcome (15).

To conclude and as a result of our experience and those of others authors, in case of immediate and severe facial paralysis with an ENoG showing more than 90% degeneration of nerve fibers and a fracture line passing through the facial canal, surgery is performed as soon as the patient's neurological condition allows. Most often, transmastoid approach is used.

In case of delayed onset facial paralysis, a medical treatment with corticosteroids and vasodilators is started. Surgery is indicated in the absence of improvement with degeneration > 90% at EnoG or absence of regeneration at EMG after 3 weeks.

In case of severe facial paralysis in the absence of a visible fracture line on CT scan, electrophysiologic tests, MRI and clinical monitoring are recommended. Surgery may be done later in cases of non-recovery.

The efficacy of surgical interventions varies among literature reports. Xu and al. (14) reported that 83.7% of his patients, achieved recovery to HB grades I to III after surgery. Darrouzet et al. (11) reported that among their 115 patients, 65 received surgical intervention, and 93.8% of them achieved recovery to HB grades I to III. In our study, 80% of patients had at least grade III.

These differing views may be explained by differences in the severity of paralysis between patients receiving conservative therapy and those receiving surgical interventions. Patient outcomes also depend on surgeon skill and surgical approaches(17).

Conclusion

The surgical management of a facial paralysis after temporal bone fracture is still controversial. The indication for surgery, the delay of surgery, the surgical approach, the portion of the nerve to decompress is the main lines discussed. Indeed, the decision must be taken according to the type of paralysis (immediate/delayed onset, complete/ incomplete), and the radiological electrophysiological and evolutionary data.

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Conflict of Interest

The authors declare no conflicts of interest.

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