Turkish Neurosurgery 2007, Vol: 17, No: 1, 7-12

Late Decompression in Patients With Acute Facial Nerve Paralysis After Temporal Bone Fracture

Galip Zihni SANUŞ
Necmettin TANRIÖVER
Taner TANRIVERDİ
Mustafa UZAN
Ziya AKAR

Istanbul University, Cerrahpasa Medical Faculty, Department of Neurosurgery, Istanbul, Turkey

Received : 29.01.2007
Accepted : 15.02.2007

Correspondence address
Taner TANRIVERDİ
P.K: 5, Cerrahpasa
34301, Istanbul/Turkey
Phone: +90 212 414 34 27
Fax : +90 212 414 34 27
E-mail : tanerato2000@yahoo.com

ABSTRACT

OBJECTIVE: The aim of this paper was to address the management of acute facial nerve paralysis after temporal bone fracture and the outcomes of late decompression.

METHODS: The study design was a retrospective review of eight patients who underwent late decompression of acute facial nerve paralysis due to temporal bone fracture involving the geniculate region. Pre-operative electrophysiological testing showed total degeneration of the facial nerve in all patients. The mean operation period was 70.1 ± 54.8 days after the trauma. A pure middle fossa approach and combined approach included middle cranial fossa and transmastoid approaches and were used in six and two patients, respectively. Evaluation of the facial nerve function was graded according to the House-Brackmann grading scale.

RESULTS: The mean follow up period was 5.7 ± 3.2 years, ranging from 3 months to 10 years. Six patients showed 3 score of House-Brackmann recovery of facial nerve function in long-term follow-up and the last 2 patients still need time for their final House-Brackmann evaluation.

CONCLUSIONS: Surgery should be performed if serial electroneurography and electromyography demonstrate more than 90% degeneration and total denervation potentials, respectively, of nerve fibers. Based on the outcomes observed, late facial nerve decompression may have still beneficial effects in patients who could not be operated on early.

KEY WORDS: Acute facial nerve paralysis, Decompression surgery, Temporal bone fracture.

INTRODUCTION

Temporal bone fracture (TBF) following head trauma is a well-known cause of facial nerve paralysis (FNP) and nearly 22% of all skull fractures are TBF [3]. It has been estimated that 25 to 70% of TBF are associated with FNP and transverse fracture of the petrous portion of the temporal bone is more commonly associated with FNP although longitudinal fracture is more common [4, 12]. Acute paralysis is more commonly encountered than delayed ones, however; the best management of acute FNP after TBF is still a matter of controversy and a common consensus is yet to be defined. Furthermore, management of TBF associated with FNP has been discussed extensively in the ENT literature but is often underscored in the neurosurgical literature. We therefore report on the outcomes after late facial nerve decompression surgery in 8 patients with acute FNP secondary to TBF following head injury in this paper.

MATERIALS AND METHODS

Demographic data

Between April 1996 and July 2006, six patients underwent middle cranial fossa (MCF) and two patients underwent combined (MCF plus transmastoid) approaches due to acute FNP associated with TBF at the Neurosurgical Department of Cerrahpasa Medical Faculty, Istanbul University. The mean time of operation after the trauma was 70.1 ± 54.8 days, ranging from 21 to 160 days. The patients included 7 males and 1 female, with a mean age of 27.8 ± 10.1 years and FNP was due to traffic accidents in 4, occupational accidents in 3 and to the earthquake that occurred in 1999 in Turkey in 1 patient. FNP occurred on the left side in 4 and on the right side in 4 cases. The clinical history revealed an acute FNP in all patients and both electrical tests and radiological imaging were available in all the cases (Table 1). Three patients (patient no. 2, 4, and 8 in the Tables 1 and 2) were referred to our unit from different hospitals in Istanbul after treatment for critical surgical and medical conditions. All cases received a full course of corticosteroids. In the present series, the relative delay in the time of surgery was due either to especially late referral or to unstable neurological status (Table 2). Patient 2 was operated in another center due to depressed frontal bone fracture and Patients 7 and 8 had otorrhea on the affected side at the time of admission.

Electrophysiological testing

Electrophysiological testing consisting of electromyography (EMG) and electroneurography (ENoG) was used depending on the period between the onset of FNP and admission. Patients admitted before 3 weeks from the onset of FNP were evaluated by both ENoG and EMG while patients admitted after 3 weeks (patient no. 2, 4, and 8 in Table 1) were evaluated by EMG only. ENoG showed 100% degeneration of the facial nerve at the time of surgery and correspondingly EMG displayed total denervation potentials (Table I).

Hearing function

All patients in this series had no serviceable hearing (SH) on the affected side. SH practically means that the patient is able to hear while he/she is speaking on the phone on the affected side [10].

Radiological evaluation

High resolution computerized tomography (HRCT) was the method of radiological examination and was performed in all cases (Figure 1). Axial and coronal sections showed a transverse petrosal fracture in 6, a mixed fracture in 1 and a longitudinal fracture in 1 case. Radiological examination revealed the involvement of the perigeniculate ganglion in all cases (Table II). Magnetic resonance imaging (MRI) was not routinely performed in this series but performed only in cases in which MRI was indicated and it played a complementary role in the diagnosis of concomitant intracranial complications. Patient 1 had a Le-Fort III fracture in addition to TBF.

Table I: Summary of demographic data of the patients incluted in this study.

No	Age (years)	Gender	Etiology	Side	HRCT	SH	Pre-op ENoG	Pre-op EMG	Pre-op HB
1	36	M	TA	L	Trans	No	100%	TD	VI
2	18	M	OA	L	Trans	No	-	TD	VI
3	22	M	OA	R	Trans	No	100%	TD	VI
4	28	F	EQ	L	Trans	No	-	TD	VI
5	47	M	TA	R	Trans	No	100%	TD	VI
6	23	M	TA	R	Long	No	100%	TD	VI
7	17	M	OA	L	Mised	No	100%	TD	VI
8	32	M	TA	R	Trans	No	-	TD	VI

ENoG: Electroneurography; EMG: Electromyography; EQ: Earthquake; HB: House-Brackman Scale; HRCT: High-resolution computed tomography; L: Left; Long: Lonfitudinal; OA: Occupational accident, R: Right; SH: Serviceable hearing; TA: Traffic accident; TD: Total Denervation; Trans: Transverse.

Table II: Surgical findings and outcome of the patients.

No	Time of surgery (days after trauma)	Site of FNI	Type of FNI	Follow-up (years)	Post-op HB
1	56	GG	E	10	III
2	120	GG	BI	8	III
3	21	GG	E	8	III
4	120	GG	E	7	III
5	28	GG	E	6	III
6	21	GG	BI	5	III
7	35	GG	E	9 months	IV
8	160	GG	E	3 months	VI

BI: Bone impingement; E: Edema; GG: Geniculate ganglion; HB: House-Brackmann scale; FNI: Facial nerve injury.

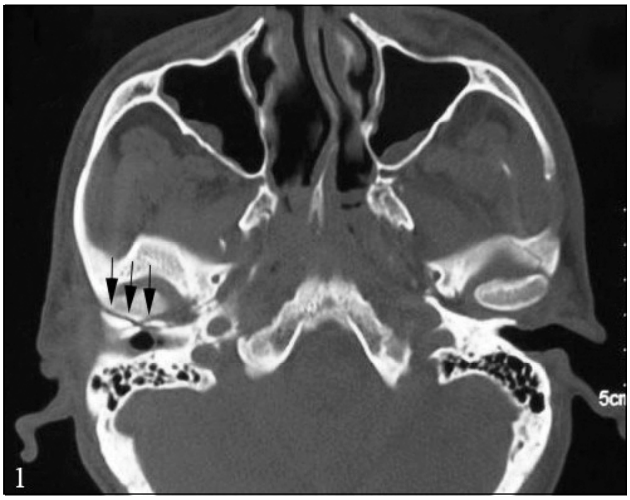

Figure 1: Preoperative axial HRCT view of the patient no. 8 demonstrating the transverse petrous bone fracture on the right side (white arrow).

Surgery

EnoG in patients admitted 3 weeks before and EMG in patients admitted 3 weeks after the onset of FNP showed total degeneration and total denervation, respectively, at the time of surgery and all therefore underwent surgical decompression of the facial nerve. The MCF approach was used in 6 patients with a transverse petrous bone fracture. Using this approach, a complete decompression of the proximal tympanic, labyrinthine and meatal segments of the facial nerve was performed and excision of the impinged bone fragments and fibrotic tissue were undertaken. A combined approach including the MCF and transmastoid was performed in 2 patients, one with longitudinal and one with mixed TBF. In addition to the MCF decompression obtained using this approach, the rest of the intratemporal facial nerve segments were also decompressed by considering the fracture line. The distal tympanic and mastoidal segments of the facial nerve were decompressed and total decompression of the facial nerve was achieved. The integrity of the facial nerve preservation was one of the main intraoperative findings in all patients (Figure 2 and 3). The House-Brackmann (HB) scale was used for evaluation of the restoration of the facial nerve function [11].

RESULTS

The postoperative period of all patients was uneventful and no surgical complications were observed. The geniculate or perigeniculate region

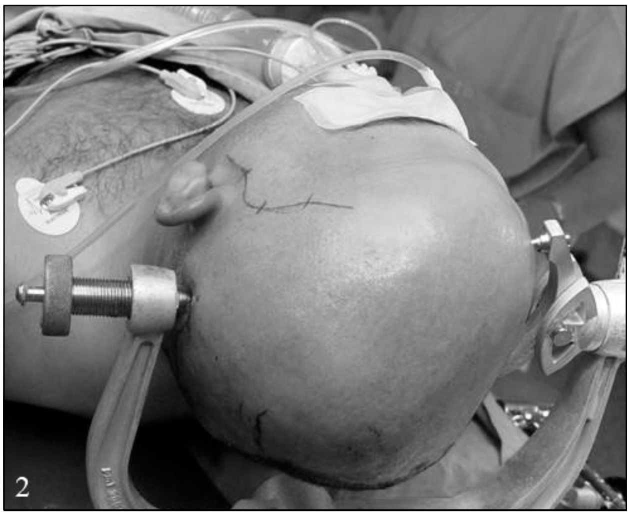

Figure 2: Operation position of a patient for MCF approach.

Figure 3: An intra-operative view. The area in the black circle depicts the perigeniculate area which had been opened. The black arrow in the circle points the internal acoustic meatus that has not been opened yet. On the left, the mandibular division of the trigeminal nerve (V3) is seen. The fracture line is denoted by black oblique arrows traversing on the tegmen tympani. Inlet on the left in Figure 3 shows the cadaver dissection of the same area. The circle indicates the perigeniculate area which had been opened and the 2 white arrows indicate the internal acoustic meatus containing the 7th and 8th nerve complex.

was the most affected part of the facial nerve and edema was the most commonly encountered type of injury. (Table II) summarizes the surgical findings of 8 patients. Pre-operatively all patients showed an HB scale of VI (total paralysis) (Figure 4A and B). The mean follow-up was 5.7 ± 3.2 years, ranging

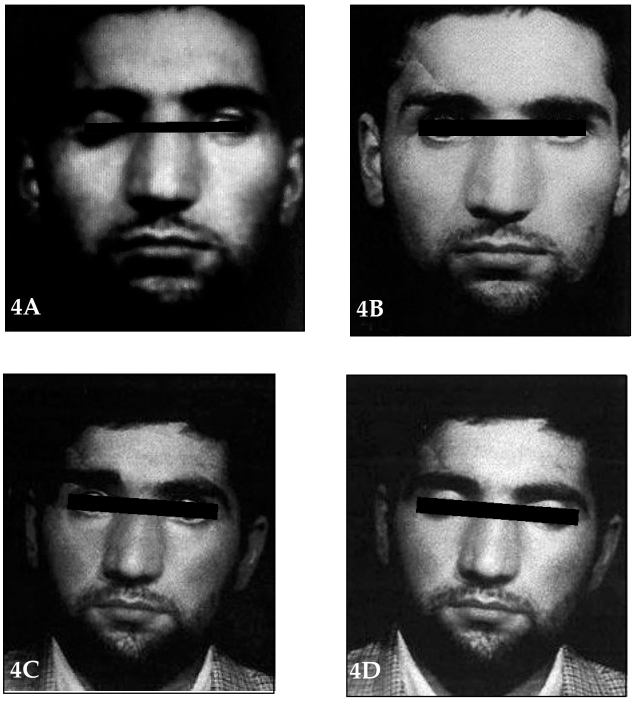

Figure 4: Pre- (**A** and **B**) and post-operative (**C**and **D**) views of the patient 2.

from 3 months to 10 years. Six patients showed at least III scale recovery in facial nerve function [(HB III-moderate dysfunction)] in the long-term follow-up (Table II) (Figures 4C, 4D and 5A through 5B). All patients were routinely referred to physical therapy during the postoperative period. Patients referred for physical therapy were often treated with electrical stimulation of the facial muscles and facial movement exercises to be completed with maximal effort.

Figure 5: Figure 5 (**A** through **D**). Post-operative views of patient 4 who was injured during the 1999 earthquake in Turkey.

DISCUSSION

With the guidance of recommendations of other authors [6, 7, 9, 12, 15, 16] we utilized both ENoG and EMG, depending on the period between the onset of FNP and admission, to select the treatment of acute FNP associated with TBF. It has been well documented that surgery is indicated when a patient with acute FNP shows more than 90 % degeneration of the nerve fibers on ENoG within 6 days after the onset of palsy and clear-cut surgery is also mandatory if EMG obtained after 3 weeks following FNP shows total denervation potentials [9]. Darrouzet et al. [7] stated that EMG is much of greater value with traumatic FNP because patients are almost always referred to specialized units in the third week after the trauma, when classical stimulation testing is becoming conclusive. The surgical indication depends mainly on the electrophysiological tests. In the present series, 5 patients could be evaluated within the first 3 weeks and the decision was based on both ENoG and EMG findings, which showed 100 % degeneration and total denervation, respectively, at the time of surgery. Three patients were referred to our unit 3 weeks after the trauma from different hospitals after the their medical and neurological condition was stabilized. The indication of surgery for these 3 patients was made depending on EMG findings. Thus, surgery should be indicated when the diagnostic yields of ENoG and EMG are at their peak together with TBF on HRCT.

The timing of surgery is still a matter of debate. Fisch [8] advocates immediate exploration only in patients with delayed FNP if ENoG shows more than 90% degeneration while delayed exploration (3 to 4 weeks) should be performed in patients with acute FNP if they meet the surgical criteria. Patients with acute FNP after trauma generally have other system injuries and the surgery should be delayed until the patient's neurological condition is in stable. According to Chang and Cass [5], decompression surgery provides beneficial effects if performed within 14 days of injury and delayed surgery should be done if the facial nerve function does not show any recovery to ascertain acute or delayed FNP in an unconscious patient. Lieberherr et al. [13] operated on patients with acute FNP, with more than 90 % nerve degeneration on ENoG, 1 to 3 months following the trauma and found that 53-100% of the facial nerve function returned to normal. McKennan and Chole [14] found different degrees of recovery of the facial nerve function according to the HB scale in patients who were operated either early or late following the trauma. Quaranta et al. [15] included 13 patients with acute FNI in their series after TBF found that good recovery is also seen in patients who underwent decompression surgery even 3 months after trauma. In a recent study that included acute FNP associated with TBF after head trauma, Ulug and Ulubil [16] found that the patients who were operated on relatively late had better facial recovery. In this series, the mean operation time was 70.1 days, ranging from 21 to 160 days. The delay in surgery was mainly due to the late first evaluation and the late referral since we had to wait until the patients' conditions became stable. However, late decompression was not associated with a bad outcome and all six patients' facial nerve function recovered at least 3 HB scale. Overall, we prefer to decompress the facial nerve as soon as the patient's general condition permits and the patients included in this study were operated on later as they had multiple associated lesions or were referred to our unit late.

The choice of the approach in traumatic FNP greatly depends on the presence of serviceable hearing following trauma. According to Fisch [9], the facial nerve is injured distal to the geniculum in the majority of the cases with longitudinal fracture. It has been traditionally suggested that a MCF combined with transmastoid approach should be used for mixed and longitudinal fractures [1, 2, 7, 8].

We used the MCF approach and combined it with transmastoid exploration in 2 such affected patients and total decompression of the facial nerve was achieved. A pure MCF approach was performed in the remaining 6 patients. We believe that the MCF approach is unique and adequate in that it allows for direct exposure of the IAM, the cisternal, meatal, labyrinthine and tympanic segments of the facial nerve and the perigeniculate area. Thus, we advocate using the MCF approach as a surgical technique if the geniculate ganglion region of the facial nerve requires exploration.

Long-term outcomes were available in 6 patients in this series and all 6 showed 3 HB scale recovery. Thus, functional recovery is possible in patients with acute FNP who were operated even 4 months after the onset of paralysis.

CONCLUSION

Surgery should be considered for patients with acute FNP due to TBF secondary to head trauma if ENoG shows more than 90% degeneration within the first 3 weeks of the onset of FNP. If the patients are admitted more than 3 weeks after the onset of palsy, surgery should be considered when EMG shows total denervation potentials. MCF approach allows the management of most cases of FNP in TBF involving the geniculate ganglion. Early decompression of the facial nerve in case of acute paralysis has beneficial effects, but facial nerve decompression even 4 months after the onset of FNP can still have a beneficial effect, depending on the ENoG or EMG, in patients who could not be operated on early.

Acknowledgements

The authors want to thank Civan Islak and Naci Kocer, Professors, Department of Radiology and Division of Neuroradiology, Istanbul University, Cerrahpasa Medical Faculty, for their help in providing the images and to thank Nurten Adatepe, Associate Professor, Department of Neurology and Division of Neurophysiology, Istanbul University, Cerrahpasa Medical Faculty and Turgut Adatepe, M.D., SEP Neurophysiology Laboratory, Istanbul, for their help in performing serial ENoG and EMG and constant support to this work. In addition, we want to thank Fusun Kobas Tanriverdi for her great help in arranging the high-quality figures.

REFERENCES

1. Angeli SI, Chiossone E. Surgical treatment of the facial nerve in facial paralysis. Otolaryngol Clin North Am 1997; 30: 683-700
2. Arbag H, Uyar Y, Ulku CH, et al. The surgical treatment of facial paralysis due to temporal bone fractures and results. Turk Arch Otolaryngol 2002; 40: 17-22
3. Cannon CR, Jahrsdoefer RA. Temporal bone fractures: review of 90 cases. Arch Otolaryngol 1983; 109: 285-288
4. Chan EH, Tan HM, Tan TY. Facial palsy from temporal bone lesions. Ann Acad Med Singapore 2005; 34: 322-329
5. Chang CY, Cass SP. Management of facial nerve injury due to temporal bone trauma. Am J Otol 1999; 20: 96-114
6. Coker NJ, Kendall KA, Jenkins HA, et al. Traumatic intratemporal facial nerve injury: management rationale for preservation of function. Otolaryngol Head Neck Surg 1984; 97: 262-269
7. Darrouzet V, Duclos JY, Liguoro D, et al. Management of facial paralysis resulting from temporal bone fractures: our experience in 115 cases. Otolaryngol Head Neck Surg 2001; 125: 77-84
8. Fisch U. Facial paralysis in fractures of the petrous bone. Laryngoscope 1974; 84: 2141-2154
9. Fisch U. Management of intratemporal facial nerve injuries. J Laryngol Otol 1980; 94: 129-134
10. Gardner G, Robertson JH. Hearing preservation in unilateral acoustic neuroma surgery. Ann Otol Rhinol Laryngol 1988; 97: 55-66
11. House JW, Brackmann DE. Facial nerve grading system. Otolaryngol Head Neck Surg 1985; 93: 146-147
12. Lambert PR, Brackmann DE. Facial paralysis in longitudinal temporal bone fractures: a review of 26 cases. Laryngoscope 1984; 94: 1022-1026
13. Lieberherr U, Schwarzenbach D, Fisch U. Management of severe facial nerve paralysis in the temporal bone-a review of 82 cases. In: Castro D, ed. Proceedings of the Sixth International Symposium on the facial nerve, 1990. Amsterdam: Kugler and Ghedini Publications, 1990; 285-289
14. McKennan KX, Chole RA. Facial paralysis in temporal bone trauma. Am J Otol 1992; 13: 167-172
15. Quaranta A, Campobasso G, Piazza F, et al. Facial nerve paralysis in temporal bone fractures: outcomes after late decompression surgery. Acta Otolaryngol 2001; 121: 652-655.
16. Ulug T, Ulubil SA. Management of facial paralysis in temporal bone fractures: a prospective study analyzing 11 operated fractures. Am J Otol 2005; 26: 230-238