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Bilateral traumatic facial paralysis associated with unilateral abducens palsy: a case report

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Abstract
Bilateral traumatic facial paralysis is a very rare clinical condition. Abducens palsy, associated with bilateral traumatic paralysis, is even rarer and has not been well described in the literature. In this report, a 24-year-old male, who developed immediate bilateral facial and right abducens paralyses following a motor vehicle accident, is presented. The patient was referred for neurotologic evaluation 22 days after the injury. Electroneurography (ENoG) demonstrated 100 per cent degeneration at the first examination and, correspondingly, electromyography showed no regeneration potentials. Using high-resolution computed tomography (HRCT), a longitudinal fracture on the right and a mixed-type fracture on the left were identified. The patient had good cochlear reserve on both sides. The decision for surgery was based not on ENoG, because of the delayed referral of the patient, but on the HRCT, which showed clear fracture lines on both sides. The middle cranial fossa approach for decompression of the right facial nerve was performed on the 55th day following the trauma, and a combined procedure using the middle cranial fossa and transmastoid approaches was applied for decompression of the left facial nerve on the 75th day following the trauma. On the right, there was dense fibrosis surrounding the geniculate ganglion and the proximal tympanic segment whereas, on the left, bone fragments impinging on the geniculate ganglion, dense fibrosis surrounding the geniculate ganglion, and a less extensive fibrotic tissue surrounding the pyramidal segment were encountered. There were no complications or hearing deterioration. At the one-year follow up, the patient had House-Brackmann (HB) grade 1 recovery on the right, and HB grade 2 recovery on the left side, and the abducens palsy regressed spontaneously. The middle cranial fossa approach and its combinations can be performed safely in bilateral temporal bone fractures as labyrinthine sparing procedures if done on separate occasions.

Key words: Facial Nerve; Abducens Nerve; Pathological Conditions, Signs and Symptoms; Surgical Procedures, Operative; Treatment Outcome

Introduction

Bilateral simultaneous facial paralysis is a rare clinical entity, its incidence being one per 5 000 000 per year.[1] Trauma is only one of many aetiological factors relating to bilateral facial paralysis. Although unilateral involvement of the VIth cranial nerve in the setting of a unilateral temporal bone fracture is not rare, abducens palsy associated with bilateral facial nerve paralysis has not been well described in the literature.

There is controversy concerning indications, timing and choice of approach in the management of traumatic facial nerve paralysis. In this report, a 24-year-old male who developed immediate bilateral facial and right abducens paralyses following a motor vehicle accident is presented, and the current literature is discussed.

Case report

A 24-year-old male was referred to our clinic from a trauma unit with bilateral facial palsy and a right-sided abducens paralysis due to a motorcycle accident. The patient had been admitted to the intensive care unit because of a severe head trauma resulting in a bilateral temporal bone fracture, an anterior skull-base fracture, subarachnoid haemorrhage and pneumocephalus. He also had six right costal bones fractured and a left clavicle fracture. It was noticed by the intensive care unit doctors that the patient had bilateral facial paralysis upon admission. During his stay at the intensive care unit, he underwent bouts of unconsciousness. After spending five days in the intensive care unit, he was transferred to the surgical ward for further treatment.

During his treatment on the surgical ward, the patient was sent to our clinic for neurotologic examination on the 22nd day after the accident. On that day, a complete head and neck examination along with electrophysiological and audiological tests were carried out. The physical examination of the patient revealed total peripheral facial paralysis on both sides, and a right-sided abducens palsy (Figure 1). The head and neck examination was normal. The general condition of the patient was poor, and he was wearing an 'eight strap' for his clavicle fracture. After the examination, the patient stayed on the surgical ward for 10 additional days for his ongoing medical treatment.

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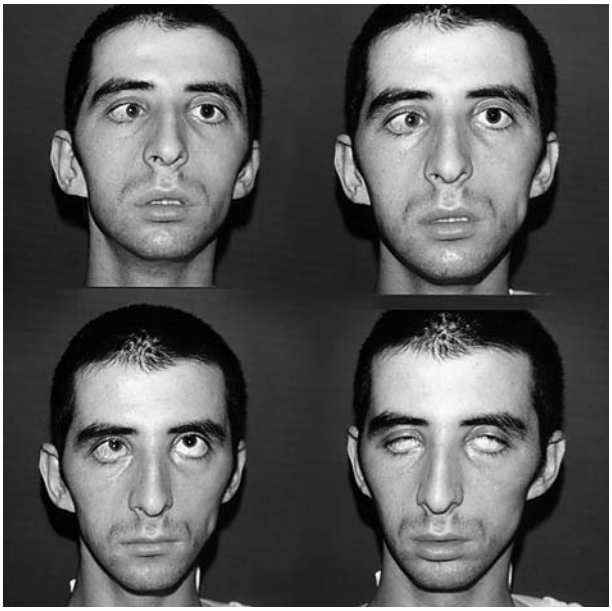

FIG. 1

Pre-operative views of the patient.

The patient underwent full audiological evaluation including air-bone conduction pure-tone audiometry, tympanometry, and stapedial reflex measurement. The pure tone audiogram showed normal bone conduction, with a 20 dB air-bone gap on the right side. On the left, there was a 30 dB air-bone gap and high frequency neurosensorial hearing loss. The acoustic reflex test elicited the absence of stapedial reflexes on both sides.

Electrophysiological tests consisting of electroneurography (ENoG) and spontaneous and voluntary electromyography (EMG) were performed. ENoG demonstrated 100 per cent degeneration at the first examination, i.e. on the 22nd day following the trauma. EMG showed no regeneration potentials at that time, nor at the time of the pre-operative control measurements.

Radiological evaluation of the temporal bone was carried out with high-resolution computed tomography (HRCT), using 1 mm-thick slices of axial and coronal views with a bone algorithm (Figure 2). On the right side, a longitudinal fracture reaching the geniculate ganglion was noted. On the left, a similar longitudinal fracture reaching the geniculate ganglion was observed. However, an additional atypical fracture, running from the posterior part of the petrous bone to the pyramidal segment of the facial nerve, was also present.

The complete blood count and biochemical analyses, including blood glucose, were normal.

Since clear fractures involving the facial canals on both sides were seen on the HRCT, and the EMG did not show any regeneration potentials, surgery was planned. Taking into consideration the patient's poor general status and the ongoing medical treatment for his associated injuries, it was decided to perform facial nerve exploration upon discharge from the emergency unit.

On the 55th day after the accident, a classical middle cranial fossa approach for exploration of the right facial nerve was performed. The classical pre-auriculotemporal vertical skin incision was modified to take the shape of a question mark, with the intent of preserving temporal muscle integrity. A craniotomy, dural elevation, opening of the tegmen tympani, exposure of the vertical crest and internal acoustic meatus followed by exposure of the meatal, labyrinthine and proximal tympanic segments of the facial nerve using hiatus facialis, processus cochleariformis, blue line of the superior semicircular canal (SCC) and other superficial petrosal landmarks, were performed. During the procedure, a fracture line reaching the geniculate ganglion was observed. There was dense fibrosis surrounding the geniculate ganglion and the proximal tympanic segment. The middle ear structures appeared normal. The dense fibrotic tissues along with the anterior portion of the geniculate ganglion were resected. The proximal tympanic segment epineurium, labyrinthine segment periosteum and meatal dura were incised, and the cerebrospinal fluid (CSF) was decompressed. Closure of the surgical field was carried out by classical means. The post-operative course was uneventful: there were no

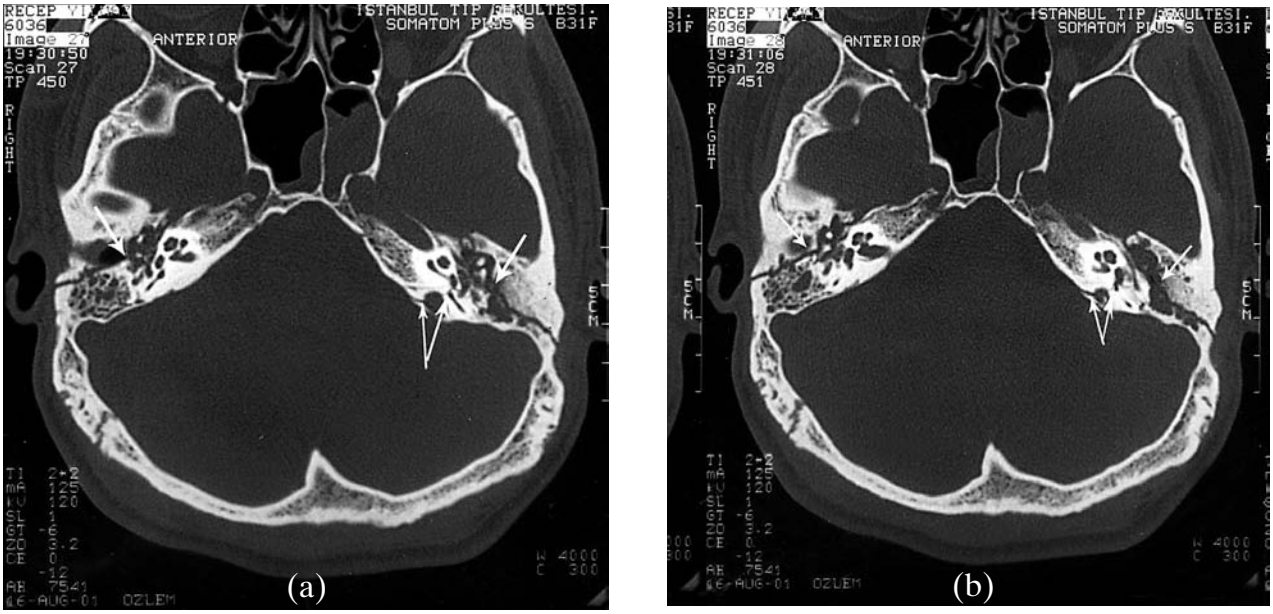

FIG. 2

High-resolution axial computed tomography showing (a) a right-sided longitudinal fracture reaching the geniculate ganglion, and (b) a left-sided similar longitudinal fracture reaching the geniculate ganglion with an additional atypical fracture running from the posterior part of the petrous bone to the pyramidal segment of the facial nerve.

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complications or hearing deterioration and the patient was discharged on the fifth day following the operation.

Twenty days after the first operation, a surgical procedure involving a combination of middle cranial fossa and transmastoid approaches was carried out on the left side. A retroauriculotemporal skin incision was made. After elevation of the temporal muscle flap, a craniotomy was performed using the fracture lines. The rest of the exposure was performed in the same manner as described for the other side. The surgical exploration through the middle cranial fossa approach revealed a fracture line reaching the facial hiatus, bone fragments impinging on the geniculate ganglion and dense fibrosis surrounding the geniculate ganglion. A luxated malleus was seen during the inspection of the tegmen tympani. Bone fragments impinging on the facial nerve, dense fibrotic tissues and the anterior portion of the geniculate ganglion were resected. The proximal tympanic segment epineurium, the labyrinthine segment periosteum and the meatal dura were incised, and the CSF was decompressed. In the transmastoid part of the operation, the other fracture line reaching the pyramidal portion of the facial nerve and less extensive fibrotic tissue surrounding this portion of the nerve were encountered. This fibrotic tissue was removed, and the adjacent epineurium of the involved facial nerve segment was incised. The closure of the surgical field was carried out by classical means. There were no post-operative complications or hearing deterioration, and the patient was discharged on the seventh day following the procedure.

Follow-up visits, consisting of an otoscopic examination, an audiometric work-up and a facial outcome assessment, were made one week, three weeks, three months, six months and one year after the initial operation. The House-Brackmann (H-B) scale was used for evaluation of facial outcomes.

At three months following the first operation, the patient showed good facial movement on the right side, and some facial movement on the left. A pure tone audiogram showed that the pre-operative air-bone gap had disappeared on the right side. On the left, the pre-operative high-frequency hearing loss and the air-bone gap persisted.

At the one-year follow up, the patient exhibited H-B grade 1 recovery on the right and H-B grade 2 recovery on the left side. The abducens palsy had spontaneously regressed. The patient refused further surgical intervention for the left-sided conductive hearing loss that resulted from malleus luxation.

Discussion

The temporal bone is affected in more than one third of basilar fractures.[2,3] Whereas unilateral injury is commonly observed, bilateral temporal bone fractures are unusual.[3–6] Accordingly, traumatic bilateral facial paralyses are rare.[3] Bilateral traumatic facial paralysis associated with abducens palsy is even rarer.[2] A review of the literature revealed the following results: Darrouzet *et al*.,[6] in a recent series of 113 medically or surgically treated traumatic facial paralyses, reported only two cases with bilateral facial paralysis. In a study by Glarner *et al*.,[7] analysing temporal bone fractures in children, of 139 fractures, 117 were unilateral. In that series, two patients suffered from transient abducens palsy. Of the 230 patients with temporal bone fractures studied by Tos,[5] 18 had bilateral fractures.

Bilateral simultaneous facial paralysis is described as facial paralysis involving both sides of the face occurring within four weeks of each other, and is found in 0.3 to two per cent of facial paralysis patients.[8] Among the major causes are: Lyme disease, Guillain-Barré syndrome, Bell's palsy, leukaemia, sarcoidosis, bacterial meningitis, syphilis, leprosy, Moebius syndrome, infectious mononucleosis, and skull fractures. The relative incidence of these aetiologic factors varies among different series.[1,4,8,9]

Traditionally, temporal bone fractures are classified as longitudinal, transverse, and mixed. About 70–80 per cent of temporal bone fractures are longitudinal, 10–30 per cent transverse, and 0–20 per cent mixed.[10–12] The occurrence of facial paralysis depends on the type of temporal bone fracture; the incidence of facial paralysis in longitudinal fractures is 20 per cent, whereas it rises to 50 per cent in transverse fractures.[2] In the case presented here, there was a pure longitudinal fracture on the right and a mixed-type fracture with good cochlear reserve on the left.

The abducens nerve is injured in head trauma relatively often, i.e. in 2.7 per cent of patients with head injuries. The long intracranial transclival route of the abducens nerve and its rigid intracavernous attachment have been proposed as the reasons for its vulnerability to injury.[2] The reversibility of cranial nerve palsies depends on the type of nerve. The recovery of motor nerves in general is more satisfactory than of sensorial nerves. Since the abducens nerve is a motor nerve that innervates a single muscle, a much more satisfactory recovery can be expected.[13] In most instances, abducens palsies recover spontaneously without any surgical intervention, as in the case presented.[2,7]

Exploration of the facial nerve for acute traumatic paralysis is indicated when, within six days of the onset of paralysis, the denervation of the facial muscles is greater than 90 per cent.[11,14–17] Surgery is also indicated if serial ENoGs have not been obtained, but the nerve is 100 per cent degenerated when the patient is first seen and CT shows a clear fracture of the facial canal.[6,14] If the fracture is not seen on CT, six to 12 months is allowed for spontaneous recovery.[6,14,15] The patient presented in this paper had severe associated injuries, delaying his referral to our clinic to the 22nd day following the traumatic event. Therefore, electrophysiological tests could not be performed early. However, a temporal bone CT demonstrated clear fracture lines reaching the facial canal on both sides, necessitating exploration of the injured facial nerve.

According to Fisch and Mattox,[14] immediate paralyses fulfilling surgical criteria are preferably treated with delayed exploration, due to the fact that the patient's general condition is improved, surgical visualization is increased, because of resolution of haematoma of the pneumatic spaces, and sprouting of the regenerating motor fibres has started, making surgical outcomes much more favorable than with an immediate exploration. There are other contradictory views on the preferred timing of surgery in the literature, ranging from immediate exploration to three months after the trauma.[6,15] Due to the poor general condition and the ongoing medical treatment of our patient, facial explorations could be performed only on the 55th and 75th days.

The preferred surgical approach depends on the type of fracture and the presence of a labyrinthine injury. In general, for longitudinal fractures, the middle cranial fossa approach is the preferred technique, since the geniculate ganglion area is the most common site of injury in these fractures.[3,15,18] For mixed and transverse fractures, when there is serviceable hearing, a middle fossa craniotomy combined with a transmastoid exploration is used. When serviceable hearing is absent, the labyrinthine and geniculate areas of the facial nerve can be exposed by a translabyrinthine approach. In the presented case, with good cochlear reserve on both sides, the middle cranial

fossa approach was used for the longitudinal fracture on the right, and a double approach combining the middle cranial fossa and transmastoid approaches was used for the mixed-type fracture on the left. The middle cranial fossa approach and its combinations can be performed safely in bilateral temporal bone fractures as labyrinthine sparing procedures if done on separate occasions.

The H-B facial nerve grading scale was used to assess the facial outcomes in the presented case.[19,20] The right side showed H-B 1 and the left H-B 2 facial recovery at the one-year follow up. There were no complications or hearing deterioration. The relative delay in the timing of surgery did not seem to affect the facial outcome. The minor difference between the final facial outcomes of the two sides can be attributed to the fact that the left side was operated on later than the right. However, we believe that the intraoperative finding on the left being more severe than on the right is the major cause of this difference.

- **This is a case report of a patient with bilateral facial paralysis and unilateral VIth nerve palsy following trauma sustained in a road traffic accident**
- **Both facial nerves were separately decompressed**
- **The controversies surrounding the indication, timing and approach to the traumatised facial nerve are discussed in the light of this case**

Conclusion

Bilateral traumatic facial paralysis associated with abducens nerve palsy is a very rare condition. In such a case, the facial paralysis should be the major concern, because, in most instances, abducens palsies recover spontaneously without any surgical intervention. In an immediate traumatic facial paralysis, after the general condition of the patient improves, diagnostic testing should begin and surgical interventions be made accordingly. The middle cranial fossa approach and its combinations can be performed safely in bilateral temporal bone fractures as labyrinthine sparing procedures if done on separate occasions.

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