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Penetrating injury of the cheek requiring skull base exploration

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Abstract

We report a case of a very unusual penetrating injury of the middle third of the face. The patient was involved in a road traffic accident, and the indicator control lever became impaled in his right cheek. There was contralateral orbital damage resulting in loss of sight. The cribriform plate was breached and a pneumoencephalocele ensued.

We discuss the modern management of such injuries including injury assessment. We emphasize the importance of crash scene information gathering and analysis of injury mechanisms. Facial injury zonal classification and imaging are reviewed in the context of the case. We discuss the reasons that led us to treat this patient via the subcranial approach.

Key words: Facial Injuries; Skull Base; Accidents, Traffic

Case report

A 21-year-old male, wearing a three point seatbelt, was the driver of a 1994 Chevrolet S-10 pick-up truck that was involved in a frontal collision with a tree. The driver claimed to have lost control of his vehicle, driven off the road and crashed into the tree. The patient was found by a passer-by and taken to the nearest accident and emergency department.

He was alert and orientated. He complained of pain from his cheek and loss of vision in his left eye. There was no medical history of note. Physical examination found the patient to have a foreign body, which appeared to be the control lever of his vehicle's indicator, impaling his right cheek (Figure 1). He had no evidence of airway compromise and was haemodynamically stable. There was no active bleeding of significance. He had a fixed and dilated left pupil. There were no other abnormal neurological findings. His left globe was irregular, suggestive of global rupture. There were minor soft tissue injuries to his knee, left hand, neck and abdominal wall.

On scene crash investigators reported evidence of a moderate speed crash with rollover and frontal impact. Driving conditions were good. There were no tyre markings on the road indicating sudden evasive manoeuvres or sudden braking.

An emergency computed tomography (CT) scan of his brain, skull base and facial skeleton including orbits, was obtained. This showed the foreign body penetrating the patient's midface and anterior skull base (Figures 2 and 3). The foreign body was seen to be composed of metal and plastic components. It passed through the anterior wall of the right maxillary sinus in a superomedial direction penetrating the left orbital floor and roof. The CT scan showed displacement of the left globe and possible transection of the left optic nerve. There were comminuted fractures of the right maxillary sinus, the left orbit, the cribriform plate and the ethmoid. There was evidence of frontotemporal pneumocephalus. There was some artefact due to the metallic content of the foreign body, that also had a signal luscency halo around it corresponding to the plastic components.

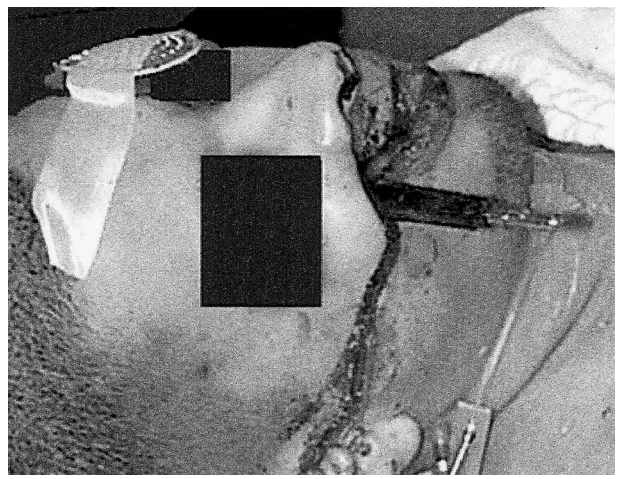

Fig. 1
Turn signal control lever impaling patient's right cheek.

It was decided to take the patient to the operating theatre for an urgent surgical exploration to remove the foreign body and repair the skullbase. For reasons discussed below the extended subcranial approach to the skull base was used.

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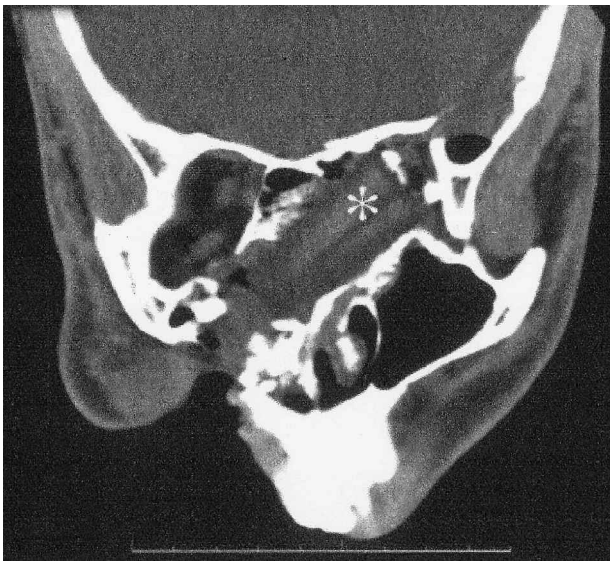

FIG. 2

Coronal plane CT scan demonstrating foreign body (*) penetrating the right cheek traversing the midline and disrupting the contralateral orbit and anterior cranial fossa.

A bicoronal incision was performed. The scalp was degloved to below the orbital rims and to the nasion, the supraorbital nerves having been preserved. A left frontal craniotomy was performed and this extended to the right side. The orbital visor was exposed at the anterior skull base and a subcranial extension performed. This was carried along the level of the supraorbital nerve on the left, down just anterior to the planum sphenoidale, across the level of the crista galli on the right and just medial to the superior orbital nerve on the right. This was also carried down to the nasion. This piece of bone was then removed giving excellent exposure to the foreign body and the anterior skull base. The foreign body was removed from the cheek whilst under direct vision. Multiple fragments of orbit and anterior skull base bone were found. The cone of the orbit was penetrated by bone and the optic nerve damaged. These bony fragments were removed and optic nerve decompression achieved by establishment of a subcranial cavity communicating with the nose thus allowing free drainage. There were extensive ethmoid fractures and the cribriform plate was shattered. Fragments were removed from the overlying dura and dural lacerations repaired. A pericranial flap was used to cover the anterior skull base defect, inner table bone from the craniotomy, fat and fibrin glue were used to reconstruct the anterior skull base. The subcranial bone was replaced and plated back into position with microplates. The incision was closed in multiple layers with interrupted sutures.

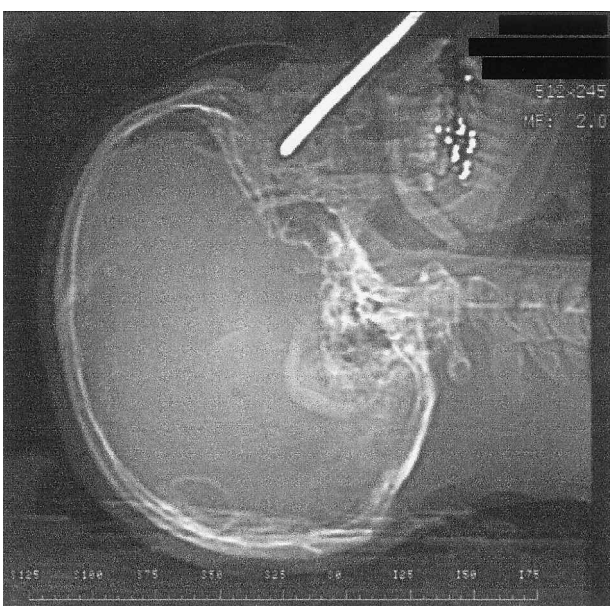

FIG. 3

Sagittal CT reconstruction demonstrating the foreign body.

The patient was nursed in the neurosurgical intensive care unit and extubated the next day. The lumbar drain was removed on the seventh post-operative day with no cerebrospinal fluid leakage. The patient made an uneventful recovery and was discharged.

The patient remained blind in one eye. The patient also suffered from recurrent episodes of acute infective maxillary sinusitis starting three months after his accident. Since CT scans showed osteomeatal complex distortion and resultant obstruction, most likely due to the cheek injury. Functional endoscopic sinus surgery was performed and at a further one year follow-up he was symptom free.

Discussion

Penetrating injuries of the face are unusual; the cause of these injuries varies with the society surveyed. In a series from urban USA, the commonest cause was assaults either with guns or knives.[1] Motor vehicle accidents more frequently cause blunt rather than penetrating trauma to the face, but all facial injuries have reduced in incidence with seat belt use.[2] Penetrating facial injury with a dashboard control lever, as in this case has not been reported. Its interest lies in the likely mechanism of injury, and the public health message this conveys. A multidisciplinary team that included doctors and crash engineers carried out a detailed crash analysis of this accident. Their conclusion was that the patient sustained such an injury only as a result of falling asleep at the wheel. This causes forward slumping of the body, which does not activate seatbelt tensioners that restrain the occupant. Instead, at impact the patient was probably vulnerably positioned next to the steering wheel and indicator levers. It is important to warn drivers of the risks of falling asleep at the wheel, and that car safety devices may fail to protect them in such situations. This applies regardless of the vehicle in question.

Facial injuries may be complicated by damage to structures that may cause immediately life-threatening risk to the airway, cardiovascular compromise or neurological injury. The case described here illustrates well the risks of midface trauma; there was breach of the skull base and orbital damage.

Classification systems have been developed for penetrating facial injuries,[1,3,4] however these have not been generally accepted. This is possibly due to their lack of applicability to all causes of penetrating facial injury and the disparate patterns of injury that have emerged from the few published series. The authors believe the Ben Taub classification system,[1] does have merit, if qualified by a description of the injury cause (Figure 4). We recommend the adoption of this scheme to aid communication, audit and research about penetrating facial injuries. As larger series are reported with more standardized data collection, more definite patterns may then be apparent.

With major organs at risk, resuscitation is the first stage of managing these patients. With high velocity injuries the airway is particularly at risk and proactive airway manage-

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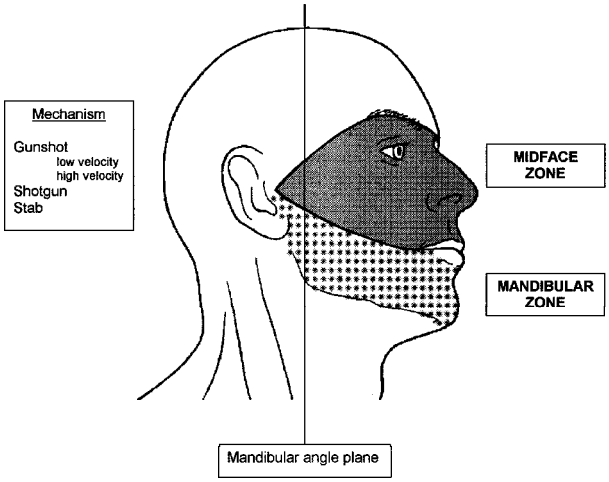

FIG. 4

The Ben Taub classification of penetrating injuries of the face. (after Chen *et al.*[1]). (Injuries above the brow are treated as head injuries due to the very high incidence of intracranial damage with penetrating trauma in this area).

ment is recommended.[1] Vascular damage[1] is common, especially with injuries posterior to the mandibular angle plane[4] (Figure 4), and arteriography may be employed diagnostically and therapeutically (embolization).[5] Further treatment is directed towards prevention of deterioration and long-term complications. There was a 37 per cent complication rate after penetrating facial injuries in the Ben Taub series.[1] Further assessment including imaging (particularly CT scanning[6]) and the involvement of other specialists, may prove necessary.

Surgical exploration is indicated where there is a retained foreign body, vascular dmage, threatened or actual visual deficit.

There are a variety of approaches to the anterior skull base each with their proponents.

The commonly used transfacial/transfrontal approach involves a facial Weber-Fergusson incision and a bicoronal incision to allow a frontal craniotomy.

The subcranial approach is performed via a bicoronal incision. The bicoronal flap is extended to the supra-orbital ridge and the nasoglabellar complex is removed for access and a frontal craniotomy is performed. In contrast to the transfacial/transfrontal approach, the subcranial approach avoids facial incision, allows simultaneous treatment of facial fractures and intracranial injury, establishes a subcranial cavity that drains into the nose (thus reducing the risks of orbital apex syndrome and long-term sinus complications), minimizes frontal lobe retraction and allows wide access to the orbits, sinuses and anterior skull base.[7–9]

Treatment of this kind of penetrating injury was an unusual but fitting application for the subcranial approach.

In summary, this case report discusses some of the issues that surround the modern treatment of complex penetrating facial injury. It also illustrates the importance of injury mechanism analysis for acute management and for the practice of preventative medicine.

References

1 Chen AY, Stewart MG, Raup G. Penetrating injuries of the face. *Otolaryngol Head Neck Surg* 1996;**115**:464–70
2 Nakhgevany KB, LiBassi M, Esposito B. Facial trauma in motor vehicle accidents: etiological factors. *Am J Emerg Med* 1994;**12**:160–3
3 Dolin J, Scalea T, Manor L, Sclafani S, Trooskin S. The management of gunshot wounds of the face. *J Trauma* 1992;**33**:508–15
4 Gussak GS, Jurkovich GJ. Penetrating facial trauma: a management plan. *Southern Med J* 1988;**82**:297–302
5 Sclafani AP, Sclafani SJA. Angiography and transcatheter arterial embolisation of vascular injuries of the face and neck. *Laryngoscope* 1996;**106**:168–73
6 Rhea JT, Rao PM, Novelline RA. Helical CT and three-dimensional CT of facial and orbital injury. *Radiol Clin North Am* 1999;**37**:489–513
7 Raveh J, Vuilleman T. The surgical one-step management of combined cranio-maxillo-facial and frontobasal fractures – advantages of the subcranial approach in 374 cases. *J Cranio Max Fac Surg* 1988;**16**:160–72
8 Raveh J, Laedrach K, Vuilleman T, Zingg M. Management of combined frontonaso-orbital/skullbase fractures and telecanthus in 355 cases. *Arch Otolaryngol Head Neck Surg* 1992;**118**:605–14
9 Moore CE, Ross DA, Marentette LJ. Subcranial approach to tumours of the anterior cranial base; analysis of current and traditional surgical techniques. *Otolaryngol Head Neck Surg* 1999;**120**:387–90

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