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A ten-year analysis of the traumatic maxillofacial and brain injury patient in Amsterdam: Incidence and aetiology

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ABSTRACT

In the literature it is questioned if the presence of maxillofacial trauma is associated with the presence of brain injury. The aim of this study is to present a 10-year retrospective study of the incidence and aetiology of maxillofacial trauma associated with brain injury that required both oral and maxillofacial and neurosurgical intervention during the same hospital stay. Forty-seven patients from a population of 579 trauma patients undergoing maxillofacial surgery were identified. The main cause of injury was road traffic collision, followed by falls. Interpersonal violence correlated less well with traumatic brain injury. Most of the patients were males, aged 20–39 years. Frontal sinus fractures were the most common maxillofacial fractures (21.9%) associated with neurosurgical input, followed by mandibular fractures and zygomatic complex fractures. In the general maxillofacial trauma population, frontal sinus fractures were only found in 2.2% of the cases.

At presentation to the Emergency Department the majority of the patients were diagnosed with severe traumatic brain injury and a Marshall CT class 2. Intracranial pressure monitoring was the most common neurosurgical intervention, followed by reconstruction of a bone defect and haematoma evacuation.

Although it is a small population, our data suggest that maxillofacial trauma does have an association with traumatic brain injury that requires neurosurgical intervention (8.1%). In comparison with the overall maxillofacial trauma population, our results demonstrate that frontal sinus fractures are more commonly diagnosed in association with brain injury, most likely owing to the location of the impact of the trauma. In these cases the frontal sinus seems not specifically to act as a barrier to protect the brain.

This report provides useful data concerning the joint management of oral and maxillofacial surgeons and neurosurgeons for the treatment of cranio-maxillofacial trauma and brain injury patients in Amsterdam.

1. Introduction

Maxillofacial injury comprises a substantial proportion of all trauma cases. The major aetiological factors in these cases are interpersonal violence and road traffic collisions, with a male preponderance and a peak incidence between 20 and 30 years of age (Fasola et al., 2003; Forouzanfar et al., 2013; Katarzyna and Piotr, 2010; Lee, 2009; Lee and Antoun, 2009; Naveen Shankar et al., 2011; Salentijn et al., 2013a,b; Van Beek and Merkx, 1999; Van den Bergh et al., 2011). According to several authors, maxillofacial fractures are often associated with multiple injuries to the cranium, especially following high energy trauma.

Traumatic brain injury (TBI) is defined as evidence of loss of consciousness and/or post-traumatic amnesia in a patient with a non-penetrating head injury (Davidoff et al., 1988). The Glasgow Coma Scale (GCS) is used to describe the level of consciousness in patients with traumatic brain injury (TBI). GCS measures a TBI patient's best eye, motor, and verbal responses, and classifies TBI in

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clinical practice as mild (14–15), moderate (9–13), or severe (3–8) (Mena et al., 2011).

Comminution of the craniofacial skeleton in high energy trauma can cause damage to the frontal lobes and neurovascular structures located between the face and the anterior and middle cranial fossae, with significant potential for morbidity or mortality (Giuliani et al., 1997; Katarzyna and Piotr, 2010).

Davidoff et al. found facial fractures to be strongly associated with traumatic brain injury (Davidoff et al., 1988), whereas Haug et al. found a 76% incidence of neurologic injury associated with facial fractures (Haug et al., 1992). Haug et al. stressed that in case of a trauma to the midface, energy will be directly transmitted to the cranium, causing damage to the brain (Haug et al., 1994). Furthermore Keenan et al. found that the risk of intracranial haemorrhage was increased in patients with maxillofacial fractures compared with patients without maxillofacial fractures due to trauma (Keenan et al., 1999). Regarding aetiology, road traffic collisions are thought to have a significantly higher incidence of concomitant closed head injury, compared with interpersonal violence, due to the high energy often associated. In contrast to this theory, many authors have the opinion that no association exists between maxillofacial trauma and brain injury. Lee et al. reported that facial fractures are not associated with an increased risk of traumatic brain injury, theorising that the facial bones act as a protective cushion for the brain (Lee et al., 1987). This view was shared by Chang et al., who stated that the maxilla and the surrounding midfacial bones act as an absorption barrier against high impact energy caused by trauma, thus protecting the brain from damage (Chang et al., 1994). Due to these mechanisms fewer brain injuries are expected to occur. The association between maxillofacial trauma and brain injury is still a matter of current debate.

Treatment of patients with maxillofacial fractures, accompanied by traumatic brain injury remains a challenging problem, due to conflicting priorities for treatment – early repair favours good outcome in OMFS, but TBI requires optimisation of ICP and ventilation. Management of these injuries requires a multidisciplinary team approach (Katzen et al., 2003), to improve outcomes (Gassner et al., 2003). Good awareness and close cooperation between oral and maxillofacial surgeons and neurosurgeons are required to facilitate rapid diagnosis and appropriate treatment (Katzen et al., 2003).

According to Pappachan and Alexander there is a paucity of evidence regarding the correlation between maxillofacial trauma and head injury (Pappachan and Alexander, 2006).

The aim of this study was to investigate the association of maxillofacial trauma and traumatic brain injury requiring neurosurgical intervention.

2. Material and methods

Hospital and outpatient records from January 2000 to January 2010 were reviewed and analysed to identify trauma patients undergoing maxillofacial surgery who also had traumatic brain injury (TBI) that required neurosurgical intervention.

The diagnosis of TBI was based on evaluation and consultation by the Department of Neurosurgery/Neurology in our hospital. Indications for neurosurgical intervention were aesthetic appearance, open skull fractures with dural lesions, intracranial haemorrhage (e.g. subdural, epidural and intracerebral haematoma), and combinations thereof. Patients were included if they had been treated surgically for their maxillofacial skull and brain injuries by the oral and maxillofacial surgeons and the neurosurgeons during the same hospital stay. Exclusion criteria were neurosurgical interventions of non-skull related injuries (e.g. spine injuries/vertebral injuries).

The patients were identified using the hospital database. Data collected included gender, age, cause of the trauma, radiographical examination, type of maxillofacial fractures, neurological injury (GCS), neurological deficits and treatment modalities. Clinical judgement of the neurological injury was dependent on the level of consciousness and based on the GCS score at admission of the Emergency Department of our hospital. TBI was defined as mild (GCS 14–15), moderate (GCS 9–13) and severe (3–8).

If available, for each included patient the initial CT-scan acquired was assessed and scored according to the Marshall CT classification (Marshall et al., 1992). The Marshall CT classification describes the pathological changes on the initial CT-scan after TBI and could help in the prognostication of neurological outcome (Table 1a). In our study, we used a modified classification for the initial CT-scan, leaving out the surgically evacuated mass lesion (Table 1b).

The maxillofacial and cranial bone fractures were classified as zygomatic complex fractures, mandibular fractures, orbital wall fractures, nasoethmoid fractures, Le Fort fractures, panfacial-fractures and multi-trauma fractures.

Neurosurgical intervention consisted of a combination of different treatment modalities that were subdivided into early stage surgery (treatment within 48 h after presentation of the emergency department) or late stage surgery (treatment after 48 h after presentation of the emergency department).

Statistics

Data were processed using the Statistical Package for Social Sciences (SPSS) version 17.0. For parametric data Student *t*-test and non-parametric data chi-square tests were performed.

3. Results

3.1. Trauma cause according to gender

Over a period of 10 years 579 patients with maxillofacial fractures were treated surgically. Table 2 demonstrates the frequency of all treated maxillofacial trauma patients, as well as those with a neurosurgical treatment indication, according to the cause for the male and female population. Sport related accidents, suicide attempts and other causes were classified into one subgroup (other/miscellaneous).

Within the overall maxillofacial trauma population, the main cause of maxillofacial fracture was road traffic collision related (37.5%), followed by interpersonal violence (21.9%). Forty-seven patients (8.1%) fulfilled the inclusion criteria for the present study. The male–female ratio was 8.4:1. In contrast, in patients with

Table 1a
Marshall CT classification.

Class	Definition
I: Diffuse injury (no visible pathology)	No visible intracranial pathology seen on CT-scan
II: Diffuse injury	Cisterns are present with midline shift of 0–5 mm and/or: lesion densities present; no high- or mixed-density lesion >25 cc; may include bone fragments and foreign bodies
III: Diffuse injury (swelling)	Cisterns compressed or absent with midline shift 0–5 mm, no high- or mixed-density lesion >25 cc
IV: Diffuse injury (shift)	Midline shift >5 mm, no high- or mixed-density lesion >25 cc
V: Evacuated mass lesion	Any lesion surgically evacuated
IV: Non-evacuated mass lesion	High- or mixed-density lesion >25 cc, not surgically evacuated

CT: computed tomography.