Original Article

The Relationship between Mid-face Fractures and Brain Injuries

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ABSTRACT

Statement of Problem: Although advances in technology have led to improvements in man's life in different aspects, statistics show that the incidence of fractures is increasing in different regions of the body. Recent studies show that midface fractures are strongly associated with patient's death. The exact relationship between different types of facial fractures and brain injuries is still controversial.

Purpose: To evaluate individuals with midface fractures from different causes and determine if there is any relationship between various midface fractures and brain injuries.

Materials and Methods: In this descriptive cross-sectional retrospective study, we assessed the hospital charts of all the patients with midface fractures at the trauma center of Poursina hospital. The complete medical record of each patient was reviewed. The etiologic and demographic data, the type of midface fracture and brain injury, and Glasgow coma scale (GCS) were assessed. The data were analyzed by, the Chi-square, and the Fisher's exact tests. The statistical package SPSS was used for all the analyses.

Results: Of all the patients 47% had brain injury. The Important significant correlations were as follows: Le Fort III with Brain Contusion (p =0.0001), nasal orbital ethmoid fractures with subdural hematoma (p =0.0001), frontal fracture with subdural hematoma (p =0.0001). Zygomatic complex fracture with Brain Contusion (p =0.009). Nasal fracture correlated with Brain Contusion (p =0.0001). The zygomatic complex fracture was the most prevalent fracture.

Conclusion: Different midface fracture patterns have the risk of brain injury simultaneously. So midface fractures need more attention. According to the results, more attention is needed to be paid to driving rules specially the use of helmet and seat belt.

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Introduction

Although advances in technology have led to improvements in man's life in different aspects, statistics show that the incidence of fractures is increasing in different regions of the body. Facial fractures and concomitant injury have been the focus of numerous investigations over the past 4 decades. Historically, the facial architecture has been perceived to be a cushion against impact, protecting the neurocranium from severe injury. However, some recent investigations have suggested that the face may actually transmit forces directly to the neurocranium, resulting in more serious brain injury.

Midface fracture patients at risk for accompanying brain injuries should be discovered before deterioration takes place [1]. Midface includes

developmental sutures that make it prone to the fracture. The closeness of the midface bones to the cranium would suggest that there are chances of cranial injuries occurring simultaneously. Dangerous results of these fractures are related injuries of the other parts of body such as brain that might be life threatening. Many of these injuries are preventable by true and proper diagnosis [2].

The incidence of neurologic injury associated with facial fractures has been reported to be as high as 76% [3]. But according to recent studies, the exact relationships between different types of facial fractures and brain injuries have not been firmly established in literatures yet [4].

Therefore, in our study, we retrospectively evaluated patients with traumatic midface injuries from different mechanisms and tried to determine if there is any relationship between various midface fractures and brain injuries.

Materials and Method

This was a descriptive cross-sectional retrospective study. We assessed hospital charts of all the patients with midface fractures at the trauma center of Poursina hospital in the north of Iran. This required a review of 306 patients suffering from midface fractures.

The complete medical record of each patient was reviewed, and the etiologic and demographic data, the type of midface fracture and brain injury, and Glasgow Coma Scale (GCS) were collected.

Midface fractures were divided into Zygomatic fixation, Nasal fixation, Nasal Orbital Ethmoid complex fixation, Le Fort I, II, III and Frontal fixation. Each fracture was assessed separately in each patient. Fractures were diagnosed by oral and maxillofacial surgeons.

Brain injuries include epidural hematoma, subdural hematoma, pneumocephalus, intracranial hemorrhage and brain contusion. Neurologic injuries were diagnosed by a neurosurgeon. The types of midface fracture were then correlated to the type of brain injury and Glasgow Coma Scale (GCS).

The medical records were also examined for GCS, reported by Teasdale and Jennett [5]. GCS is used as a method of neurologic evaluation in head injury patients, denoting the severity of injury. The summation of 3 categories (best motor response, best verbal response, and best eye opening response) gives a total score ranging from 3 to 15, suggesting the patient prognosis.

Statistical analyses included descriptive analysis, Chi-square test, and the Fisher's exact test. P values less than 0.05 were considered statistically significant. The statistical package SPSS was used for all the analyses (SPSS. Inc, Chicago, IL) [6].

Results

In our study, zygomatic complex fracture was the most common midface fracture. The patients consisted of 74% male and 26% female. 47% of them had brain injury, most of which being brain contusion. The prevalence of different midface fracture and brain injuries are summarized in Figures 1, 2a , b.

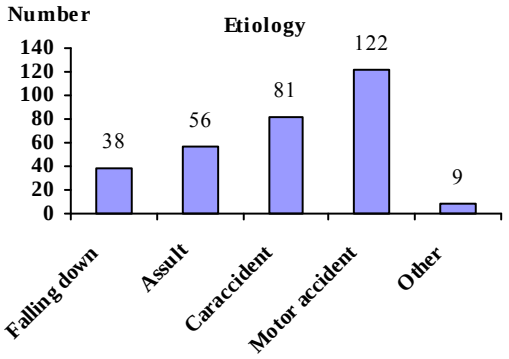

Figure 1 Etiologies of midface fractures

Motor vehicle accidents were the most common cause of injury (122) followed by car accident (81), assault (56), falling down (38) and others (9). The significant results were as follows: Le Fort II with Subdural Hematoma (p =0.001),b contusion (p =0.049), Intra-cranial Hemorrhage (p =0.001). Le Fort III correlated with Subdural Hematoma (p =0.001) and Brain Contusion (p =0.0001).There was a relationship between Nasal Orbital Ethmoid complex fracture with Subdural Hematoma (p=0.0001), Epidural Hematoma (p =0.003), Brain contusion (p =0.0001), and Intracranial Hemorrhage (p =0.002).

Also, Frontal Fracture with Subdural Hematoma (p=0.0001), Brain contusion (p=0.0001), Intracranial Hemorrhage (p =0.024) correlated with each other. And finally Zygomatic complex fracture correlated with Brain Contusion (p =0.009) and Nasal fracture

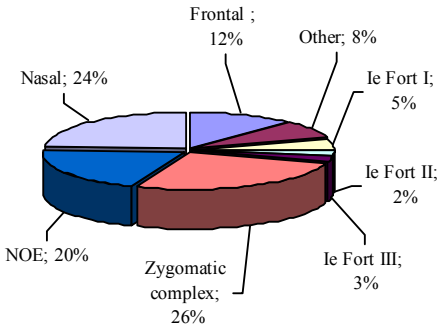

Figure 2a The prevalence of Midface fracture

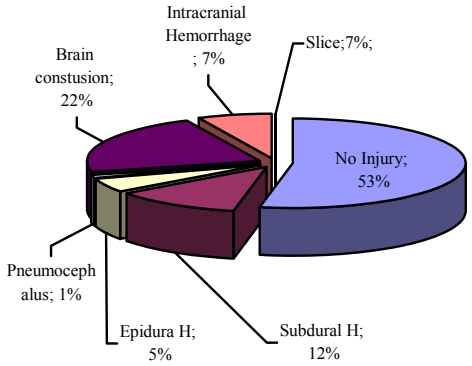

Figure 2b The prevalence of brain injuries

correlated with Subdural Hematoma (p =0.01) and Brain Contusion (p =0.0001).

The presence of Le Fort II and Le Fort III causedthe mean GCS of the patients to drop to scale 5, which is dramatically dangerous and Frontal Fracture caused the GCS of patients decrease to scale 9. So, there was a relationship between Le Fort II, Le Fort III and Frontal fractures with GCS (p =0.01).

Discussion

It has been proposed that the face protects the brain from injury the way an airbag protects the chest in a motor vehicle crash. Whether or not cranial injuries can be correlated with facial fractures is an important question with clinical implications. Multiple origins and potentially significant confounding variables make accurate assessment of the association between traumatic head injury and facial fractures difficult [1].

In a study by Haug et al [7], it was found that approximately one third of the patients with facial fractures had some form of neurologic injury. There is, however, a general lack of literature, specifically with regard to maxillofacial surgery pertaining to associated injuries in general, and head injuries in particular [7-9]. The relationship between midface fractures and brain injuries is one of the most critical subjects in the field of trauma. Several studies describing a large series of facial fractures have been reported [10-13]. Although at first it was thought that this incidence was high, a thorough review of literature indicated that the frequency of neurologic injury associated with facial fracture was as high as 76% [13-17]. Those studies, however, described neurologic injury in general terms rather than a specific injury.

The adjacent position of the brain and face would attract the scientist's mind to determine if the midface can act as shock absorber for brain [7] or the reverse, it directs the force to the brain? Totally, midface absorbs some parts of trauma force but, as the results of this study showed, some patterns of midface fractures can coincide with some brain injuries. The objective of this study was to determine midface fractures that can increase the risk of special brain injury.

In neurologic injuries, various studies show concussion to be associated more frequently with facial fractures [7, 11, 18, 19, 21]. In intracranial injury, cerebral contusion was seen more frequently [8]. In a case-control study, Keenan et al [11] found more concussion (9%) than intracranial injury (4%). Our study group also had concussion (47.27%) associated more frequently with facial fractures. In intracranial injury, cerebral contusion predominated (26.36%). Davidoff et al [19], however, found facial fractures to be highly associated with traumatic brain injury.

Lee et al [20] reported that facial fractures are associated with a lower risk of traumatic brain injury. They theorized that the facial bones act as a protective cushion for the brain to explain why injuries that crush the facial bones frequently cause no apparent brain damage. Chang et al [22] realized that in the central craniofacial fractures, the maxilla is not only important for functional, physiologic, and esthetic reasons, but with other bones of the central area. It forms a structure capable of absorbing considerable impact energy, thus protecting the brain from direct trauma. They concluded that there should be a direct correlation between the severity of maxillary fracture

(in the central craniofacial) and that of the initial head injury.

Recent studies have shown that midface fractures are strongly associated with patient's death [23]. Recently, Keenan et al [11] found that there is no evidence that facial fracture would prevent traumatic brain injury. They found that risk of intracranial injury in those with facial injuries increased almost 10-fold, and the risk for all brain injuries, including concussion, was doubled. The forces from trauma can rupture brain arteries and cause hemorrhage which can be more dangerous than the fracture itself. Especially, when the brain injuries are silent and asymptomatic in traumatic patients, neglect can be life threatening.

As the results show, the nasal-orbit-ethmoid fracture has the most relationship with brain injuries in our study and except with Pneumocephalus, it has a statistically significant relationships with other injuries. This finding emphasizes the importance of this area's correct examinations.

According to our findings, Naso-Orbital-Ethmoid (NOE) complex fractures were the most correlated fracture with the brain injuries we measured, and except with Pneumocephalus, they were significantly related with all brain injuries. Among midface fractures, Le Fort II and Frontal fractures increase the risk of intracranial hemorrhage.

Among the midface fractures, frontal and Le Fort II fractures increase the risk of intracranial hemorrhage and has to be examined from this aspect too.

Totally, all of the midface fractures in our study had a relationship with a brain injury at least. So, it can be claimed that midface fractures increase the risk of brain injuries. According to the results, it seems that the lower the trauma force is, the lower the brain injury risk will be. Of course, more studies are needed to come to an exact conclusion

Males are more susceptible for midface fracture than females due to their more active presence in the society in our context.

Most of our patients were in the age range of 16-30 that is similar with the results of Tanaka et al [24].

The midface fracture pattern and etiology are quite different in different countries. Previous studies have indicated that car accidents are the first cause of midface fractures in US and Europe. However, recent studies have shown that the main cause is Assault. Today's, meanwhile, in the developing countries car accidents are still the main etiology [25]. Our study shows in Iran motorcycle accidents are the main cause of midface fracture. This difference in accident rate can be due to negligence of driving rules, so attention to driving rules specially the use of helmet is needed.

Diagnosis of lesions with midface fracture on the proper time can prevent irreversible effects and even death in patients. Therefore, midface fractured patients must be studied from different aspects.

Some of these brain injuries are due to brain movement inside the skull which can hurt and we cannot find the exact number of them. So, some of these injuries indirectly results from midface fractures.

Another interesting finding is the relationship between the gender and Le Fort III NOE Frontal fractures, Brain Contusion, and Intracranial Hemorrhage. Of course, this finding needs to be more investigated and evaluated in more studies.

Glasgow coma score is a scale which indicates the prognosis of traumatic patients. This scale is simple and fast in the scoring of traumatic patients in emergencies. GCS ranges from 3 to 15. Lower scores indicate worse prognosis. According to the studies, mortality of the patients with GCS 3 to 4 is about 90% [5]. Totally, all the evaluated fractures in the study had a relationships with the brain injury, so like similar assessments, it can be stated that midface fractures increase the risk of brain injury [26].

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