The patterns of maxillofacial fractures in traumatic head injury patients in Songklanagarind hospital: a retrospective study.

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Abstract

Background: Maxillofacial injury was usually found in low to middle countries moreover it commonly associated with brain injury, the major etiological factors are traffic collision, violence, and fall from height. The incidence and etiology was important to developed treatment moreover to improve patient care in the future. The aim of this study was to analyze the incidence of the pattern of maxillofacial fracture in a patient with a traumatic head injury and to measure the incidence of the cause of injury, age, and gender distribution **Methods:** This is a retrospective study in Songklanagarind hospital. We evaluate all patients who presented with a concomitant maxillofacial and traumatic head injury in Songklanagarind hospital between 2007 and 2016. **Results:** 859 patients consisting of 73.3% male and 22.7% female. The mean age was 39.5 years. The severity of the traumatic head injury was mild traumatic head injury 70.15%. Moreover the alcohol consumption was significantly related to a mild and severe traumatic head injury ($P < 0.05$). The most frequent was maxilla bone. 33.9% of patients were undergone the operation. **Conclusion:** In this retrospective study, the maxilla bone fracture was the most frequent site involved. The patients with mild traumatic head injury are related to the coronoid process of mandible, Le Fort fracture type II and type III, moderate traumatic head injury is only related to the coronoid process of mandible and severe traumatic head injury are related to Le Fort fracture type II and III. **Keyword:** traumatic head injury, maxillofacial fracture

Background

Maxillofacial injuries frequently occur among patients with acute traumatic head injuries. The major etiological factors are traffic collision, violence and fall.¹⁻⁴ Regarding the etiology, patients in Amsterdam mostly suffered from frontal sinus fracture¹, with mandibular fracture being the most common in tertiary trauma centers.^{3,5,6} Maxillofacial fractures are often associated with multiple injuries to the cranium, especially following high energy trauma.

Understanding of the demographic patterns of maxillofacial injuries will assist health care providers as they plan and manage the treatment of traumatic maxillofacial injuries. Such epidemiological information can also be used to guide future findings and prevention.

The aims of this retrospective study were meant to evaluate the patterns of maxillofacial fractures in patients with traumatic head injuries, as well as to identify the prevalence of cause of injury, age and gender distribution.

Methods

The study was approved by the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC number 59-293-10-4), we evaluated all patients who presented with concomitant maxillofacial and traumatic head injuries in Songklanagarind hospital; between January, 2007 and October, 2016. Data collected included: history, physical examination and radiographic evaluation. Data was collected from the medical records division by using search terms from ICD-10 version 2015.

Patients aged over 17 years old with traumatic head injuries were diagnosed and referred for consultation to a neurosurgeon for evaluation. Therefore, all of the neurological data were based on CT results, performed by neurosurgeons. Exclusion criteria were any head injury with non-skull related injury, such as spine, and patients who were classified as a low risk of mild TBI and medial of orbital wall fracture.

Information concerning age, gender, socioeconomic activity, cause of injury, pattern of maxillofacial injury, severity of traumatic head injury and hospitalization periods were obtained. The causes of injury were summarized as follows: motorcycle accidents, car accidents, falls, assaults, sport-related injuries and others. Maxillofacial bone fractures were

classified as: zygomatic fracture (zygomatic arch, zygomatic complex), mandibular fracture (condyle, coronoid process, ramus, angle, body, parasymphysis and symphysis), Le Fort fracture (I, II, III), frontal bone fracture, maxillary bone fracture, nasal bone and orbital bone fracture. Clinical judgment of neurological injury was dependent on Glasgow coma score (GCS) at admission into the Emergency department. Traumatic head injury was defined as: Mild (GCS 14-15), Moderate (GCS 9-13) and Severe (GCS 3-8) traumatic head injury. For each mild traumatic head injury, we included only moderate and high risk of mild traumatic head injury. Moderate risk of mild traumatic head injury were vomiting > 2 episodes, age > 65, depressed skull fracture, basilar fracture (Raccoon eyes, battle sign, CSF rhinorrhea or otorrhea) or GSC drop < 15 at 2 hour and high risk of mild traumatic head injury were GCS scores of 13 or 14, or a GCS score of 15 with acute radiographic abnormalities.

Statistics

Data were recorded in Epidata version 3.1 program and analyzed using the IBM SPSS Statistics version 23.0 (IBM Co., Armonk, NY, USA). For parametric data Student t-test and non-parametric data chi-square tests were performed.

Results

Demographic patterns of the patients

The study population consisted of 859 patients. There were 664 males and 195 females, with a mean age of 39.5 years (SD = 16.8). The youngest patient was 18 years old, whilst the oldest was 91 years of age. The majority of the patients (n = 506, 59%) were between the ages of 18–40 years. (Figure 1)

As shown in Table 1, the most common cause of injury was motorcycle accident, accounting for 65.9% (n = 566), followed by car accident 10.9% (n = 94), fall 8.1% (n = 70), assault 6.8% (n = 58), sport related injury 0.8% (n = 7) and others, such as suicide pedestrian injury, blast injury and gunshot injury 7.5% (n = 64).

The severity of most traumatic head injuries was mainly mild traumatic head injury 70.1% (n = 602), followed by severe traumatic head injury 19% (n = 163) and lastly moderate traumatic head injury 10.9% (n = 94); as shown in Figure 2.

Alcohol consumption

In concerns to alcohol consumption, the data of 178 patients (20.7%) were missing. Of the remaining 681 patients, 380 (44.2%) had consumed alcohol before injury. As shown in Table 2, alcohol consumption was significantly related to both mild and severe traumatic head injuries ($P < 0.05$).

Overview of maxillofacial fractures and locations

Regarding the fracture type, maxilla bone, orbital bone and zygomatic arch were the anatomical sites most fractured, representing 429 (49.9%), 329 (38.3%) and 298 (34.7%) of the injuries, respectively. Table 3 and Figure 3 shows the description of maxillofacial fractures in this study.

Maxillofacial fracture analysis

Patients with mild traumatic head injury were significantly associated with fracture of coronoid process of the mandible, Le fort fracture type II and type III ($P < 0.05$). Whereas, patients with moderate traumatic head injury were

significantly associated with fracture of coronoid process of the mandible only ($P < 0.05$), and patients with severe traumatic head injury were significantly associated with Le fort fracture type II and III, respectively. (Table 4)

Hospitalization period and treatment

Patients were most commonly hospitalized for only 1 day (10.6%), with the average period being 12.2 days. 43.8% of patients were hospitalized for more than 10 days, usually for long-term observation, and to receive either pre- or postoperative treatment.

Among the 859 patients, 291 (33.9%) patients underwent operations, and were significantly related to mild traumatic head injury and severe traumatic head injuries (Table 2). Six (2.1%) patients experienced postoperative complications. Postoperative infection was the most common; two cases, followed by defect and malocclusion.

Discussion

In this study, we assessed the epidemiology of concomitant maxillofacial and traumatic head injuries from patients who visited the emergency department at Songklanagarind hospital within the last 10 years. These were then retrospectively analyzed based on the patients' medical records and radiological imaging. Our hospital is a level I trauma center in the south of Thailand, and receives referrals from all provinces in the south of Thailand.

The etiological factors for maxillofacial injuries are; traffic accidents, assaults, falls and sport related injuries. The main cause in the western world is traffic related, involving male patients most of the time.^{2,9-11} Maxillofacial fractures are thought to have an association with the presence of simultaneous brain injury.¹² The causes of an maxillofacial fracture depends on a variety of contributing factors, including environmental, cultural and socioeconomic factors.⁷

This study describes the epidemiology of 859 patients with concomitant maxillofacial and traumatic head injuries. The male to female ratio was 3.4:1. This can be explained by the fact that men have more exposure to public behaviors, such as drinking, driving, and assault more so than women. On the other hand, in countries with more social freedom for women, for example; Greenland, Finland and Austria, the sexual ratio remains 2.1:1.¹³

Traffic accidents remain the most frequent cause in many developing countries, including India. About 50% of fractures were reported due to traffic accidents, and 13% were from assault.¹⁴ The results of our study indicate that the most frequent cause of maxillofacial fractures were traffic accidents. The reports of previous studies, performed by different authors, also showed that maxillofacial fractures are most commonly caused by trauma, such as motor vehicle accidents, assaults and falls.^{7,14} Traffic accidents are the leading cause of maxillofacial fractures. The reasons for this high frequency are difficult to postulate, but may be due to inadequate road safety awareness, unsuitable road conditions, violation of speed limits, failure to wear seat belts or helmets, entry into opposing traffic lanes, violation of the right, and consumption of alcohol or other intoxicating agents. In our study, fall related facial injuries were the second most common cause of maxillofacial fractures, this finding is similar to a previous study.¹⁶

According to the severity of traumatic head injuries, mild traumatic head injuries was described as the most common, followed by severe and lastly moderate traumatic head injury. Additionally, traffic accidents were identified as the most common cause¹⁵ in patients with mild traumatic head injury concomitant with maxillofacial fracture 29%, and 14% were associated with severe traumatic head injury; as shown in Table 5.

Maxilla, zygomatic and orbital bone fractures were the main fractures, accounting for 80% of all fracture sites. Assault was also the commonest cause of maxillofacial fracture in countries, such as Jordan (16%), Canada (41%)¹⁸, Turkey (19.4%) and developing countries like Nigeria (13%)¹⁹. Our study revealed, assault as the third commonest cause of maxillofacial injury. Fractures that occurred most frequently, following assault, are the nasal bones, the mandible, the zygoma and the mid face.¹² This finding is in contrast to our findings; in which, assault related injuries resulted in fractures of the maxilla, then nasal followed by orbital bone fractures. Maxilla bone fractures were the most common (40%), which resulted from traffic accidents; as shown in Table 6.

Intoxication was documented in 45% of patients, usually associated with alcohol. The involvement of substances, other than alcohol, was probably under-reported as physicians may have been unaware, or simply failed to document it in the medical records. A further, prospective study could ensure complete documentation on substance use. Alcohol consumption was a reason for maxillofacial fractures, leading to violence and careless driving, in addition to that intoxicated patients are usually difficult to examine and small fractures in intoxicated patients can easily be misdiagnosed.⁵ Prevention, such as the obligatory wearing of a helmet and seat belts, better enforcement of the law regarding “drinking and driving”, educating people about the dangers of all-terrain injuries and providing proper safety guidelines, before the purchase of a vehicle, have been shown to significantly reduce the number of road traffic accidents.

In our study, the most common hospitalization period was 1 day (10.6%), the average period was 12.2 days, which is in contrast to another study wherein the hospitalization period was 3 days (19%).¹ The operation rate was 34%, and incidence of complications after maxillofacial bone fracture surgery is reported to be about 6%. Complications included; infection, malocclusion and defect were observed. Some studies reported that ophthalmologic complications account for almost half of all complications.^{20,21}

This study was retrospective, and focused on all traumatic head injuries with maxillofacial fracture patients whom visited our hospital. In so saying, as it uses data from one hospital the generalizability may be reduced. Therefore, further epidemiological studies that integrate all data from nearby hospitals are required.

Conclusion

The results of this retrospective study provide important data for the design of future planning for injury prevention. In this retrospective study of 859 cases, of the patients in Songklanagarind hospital; between 2007 and 2016, the most common cause found was from traffic accidents. The second most common cause was a fall from height, followed by assault. The most common of the severity of traumatic head injuries was mild traumatic head injury, and most fractures occurred in the age range of 18-40 years of age, with maxilla bone fracture being the most frequent site involved. Patients with mild traumatic head injury were associated to coronoid process of the mandible, Le fort fracture type II and type III, moderate traumatic head injury were only associated to coronoid process of the mandible; whereas, severe traumatic head injury were associated to Le fort fracture type II and III. Citizen awareness programs should be initiated coupled with legislation on preventive measures enforced and followed by every citizen.

Declarations

Ethics approval and consent to participate

The study was approved by the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC number 59-293-10-4).

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

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Tables

Table 1	Demographic characteristics
	Frequency (%)
Age (years)	
18-40	506(59)
>40	353(41)
Gender	
Male	664 (73.3)
Female	195 (22.7)
Male to female ratio	3.4
Occupation	
Student (high school, college, university)	109 (12.7)
Employee	341 (39.7)
Self-employed/business owner	162 (18.9)
Government officer	102 (11.9)
State enterprise employee	6 (0.7)
Unemployed	139 (16.2)
Alcohol consumption	
Yes	380 (44.2)
No	301 (35)
Unknown	178 (20.7)
Cause of injury	
Motorcycle	566 (65.9)
Car accident	94 (10.9)
Fall	70 (8.1)
Assault	58 (6.8)
Sport related injury	7 (0.8)
Others (Suicide, pedestrian injury, blast injury, gunshot injury)	64 (7.5)
Severity of traumatic head injury	
Mild traumatic head injury	602 (70.1)
Moderate traumatic head injury	94 (10.9)
Severe traumatic head injury	163 (19)
Hospitalization period	Mean 12.2 days (Min = 0 days, Max = 164 days)
<i>Min: minimum, Max: maximum</i>	

Table 2		Correlation of alcohol consumption with severity of traumatic head injuries		
		Traumatic Head Injury		
		Mild	Moderate	Severe
1. Alcohol consumption				
	Yes	268 31.2% **	43 5.0%	69 8.0% **
	No	232 27%	34 4.0%	35 4.1%
2. Operation		217 25.3% **	39 4.5%	35 4.1% **
** Statistical significant, $P < 0.05$				

Table 3		Description of maxillofacial fractures
		Number of the patients
Zygomatic fracture		
	Zygomatic arch	298 (34.7%)
	Zygomatic complex	124 (14.4%)
Mandibular fracture		
	Condyle	39 (4.5%)
	Coronoid process	4 (0.5%)
	Ramus	27 (3.1%)
	Angle	8 (0.9%)
	Body	26 (3%)
	Parasymphysis	13 (1.5%)
	Symphysis	7 (0.8%)
Le Fort fracture		
	Type I	36 (4.2%)
	Type II	59 (6.9%)
	Type III	60 (7%)
Frontal sinus fracture		160 (18.6%)
Maxilla bone/ sinus fracture		429 (49.9%)
Nasal bone fracture		172 (20%)
Orbital wall fracture		329 (38.3%)

Table 4	Correlation of severity of traumatic head injury with maxillofacial fracture area																
Severity	Maxillofacial fracture area (n, %)																
of	Zygomatic				Mandibular fracture					Le Fort fracture			FT	MX	NS	OB	Total
traumatic	fracture																
head	ZA	ZMC	MC	MCO	MR	MAN	MB	MP	MS	LF I	LF II	LF III					
injury																	
Mild	199	89	27	1	18	7	16	7	5	24	30	31	106	293	118	229	1200
	23.2%	10.4%	3.1%	0.1%**	21%	0.8%	1.9%	0.8%	0.6%	2.8%	3.5%**	3.6%**	12%	34%	13.7%	26.7%	
Moderate	37	11	3	2	4	0	3	2	0	7	9	8	19	50	21	33	236
	4.3%	1.3%	0.3%	0.2%**	0.5%	0	0.3%	0.2%	0	0.8%	1.0%	0.9%	2.2%	5.8%	2.4%	3.8%	
Severe	62	24	9	1	5	1	7	4	2	5	20	21	35	86	33	67	481
	7.2%	2.8%	1.0%	0.1%	0.6%	0.1%	0.8%	0.5%	0.2%	0.6%	2.3%**	2.4%**	4.1%	10%	3.8%	7.8%	
** Statistical significant, P<0.05																	
ZA: Zygomatic arch, ZMC: Zygomatic complex, MC: Mandibular Condyle, MCO: Mandibular coronoid process, MR: Mandibular ramus, MAN: Mandibular angle, MB: Mandibular body, MP: Mandibular parasymphysis, MS: Mandibular symphysis, LF I: Le fort type I, LF II: Le fort type II, LF III: Le fort type III, FT: Frontal sinus, MX: Maxilla bone, NS: Nasal bone, OB: Orbital bone																	

Table 5		Correlation of cause of injury with severity of traumatic head injury		
Cause	Traumatic Head Injury (n, %)			
	Mild	Moderate	Severe	
Motorcycle accident	387, 20.8%	61, 7.1%	118, 13.7%	
Car accident	66, 7.7%	10, 1.2%	18, 2.1%	
Fall	55, 6.4%	7, 0.8%	8, 0.9%	
Assault	46, 5.4%	5, 0.6%	7, 0.8%	
Sport	5, 0.6%	1, 0.1%	1, 0.1%	
Others	43, 5%	10, 1.2%	11, 1.3%	
<i>P</i> > 0.05				

Table 6		Correlation of cause of injury with patterns of maxillofacial fractures				
Pattern of maxillofacial fracture	Cause of Injury					
	Motorcycle accident	Car accident	Fall	Assault	Sport-related	Others
Zygomatic fracture						
Zygomatic arch	213, 24.8%	32, 3.7%	22, 2.6%	14, 1.6%	2, 0.2%	15, 1.7%
Zygomatic complex	104, 12.1%	13, 1.5%	2, 0.2%	1, 0.1%	0	4, 0.5%
Mandibular fracture						
Condyle	25, 2.9%	2, 0.2%	6, 0.7%	4, 0.5%	0	2, 0.2%
Coronoid process	2, 0.2%	0	1, 0.1%	0	0	0.1%
Ramus	13, 1.5%	1, 0.1%	2, 0.2%	0	0	1, 0.1%
Angle	1, 0.1%	1, 0.1%	0	1, 0.1%	0	10, 1.2%
Body	20, 2.3%	1, 0.1%	2, 0.2%	0.1%	0	6, 0.7%
Parasymphysis	3, 1.0%	1, 0.1%	2, 0.2%	0	0	2, 0.2%
Symphysis	5, 0.6%	0	0	1, 0.1%	0	2, 0.2%
Le Fort fracture						
Type I	28, 3.3%	3, 0.3%	2, 0.2%	0	1, 0.1%	2, 0.2%
Type II	44, 5.1%	9, 1%	3, 0.3%	1, 0.1%	0	2, 0.2%
Type III	44, 5.1%	11, 1.3%	0	3, 0.3%	0	2, 0.2%
Frontal sinus fracture	103, 12%	20, 2.3%	15, 1.7%	9, 1%	3, 0.3%	10, 1.2%
Maxilla bone/ sinus fracture	294, 34.2%	46, 5.4%	25, 2.9%	29, 3.4%	2, 0.2%	33, 3.8%
Nasal bone fracture	96, 11.2%	29, 3.4%	15, 1.7%	18, 2.1%	1, 0.1%	13, 1.5%
Orbital wall fracture	22.3, 26%	39, 4.5%	30, 3.5%	15, 1.7%	2, 0.2%	20, 2.3%
<i>P</i> > 0.05						

Figures

Figure 2

Age distribution of patients concomitant maxillofacial and traumatic head injuries

Figure 4

Severity of traumatic head injuries

Figure 5

Description of the incidence of maxillofacial fracture in traumatic head injury patients