Int. J. Oral Maxillofac. Surg. 2004; 33: 389–395
doi:10.1016/j.ijom.2003.10.011, available online at http://www.sciencedirect.com

International Journal of
Oral & Maxillofacial Surgery

Evidence Based Therapy
Trauma

Maxillofacial fractures masking traumatic intracranial hemorrhages

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M. Hohlrieder, J. Hinterhoelzl, H. Ulmer, W. Hackl, E. Schmutzhard, R. Gassner:Maxillofacial fractures masking traumatic intracranial hemorrhages. Int. J. Oral Maxillofac. Surg. 2004; 33: 389–395.

Abstract. Maxillofacial trauma may mask intracranial injuries prompting intensive care treatment. The purpose of this study was to identify whether craniofacial fracture patterns predispose patients with maxillofacial fractures to different types of intracranial hemorrhages.

Within 7 years, 6649 patients with craniomaxillofacial injuries were admitted for treatment. The charts of the patients were analyzed according to age, sex, cause and mechanism of injury, type and location of facial injury, and intracranial trauma; 2195 sustained maxillofacial fractures. Statistical analyses were followed by logistic regression analyses for the four main types of intracranial hemorrhage to determine the impact of the different maxillofacial fractures.

Intracranial hemorrhages in 212 patients (9.7%) occurred as epidural (2.5%), subdural (4.3%), subarachnoid (5.3%), and intracerebral hemorrhages (6.3%). Le Fort, orbit, nose, zygoma, and maxillary fractures increased the risk for accompanying intracranial hemorrhage by two- to fourfold ($P < 0.05$). Basal skull fractures caused a multiplication of the risk up to 17-fold, while fractures of the cranial vault were associated with a risk up to 14-fold.

Nearly 10% of patients with craniomaxillofacial fractures sustain intracranial hemorrhages requiring frequently immediate neurosurgical intervention. Those patients, suffering from central midface fractures and skull base fractures, are prone to highly significant elevated risks of intracranial hemorrhage.

Key words: craniofacial trauma; maxillofacial fractures; intracranial hemorrhage; skull base fractures; risk factors; injury mechanisms.

Accepted for publication 7 October 2003

Maxillofacial fractures may disguise in patients with accompanying traumatic intracranial injuries. The leading cause for morbidity and mortality in head trauma patients is a traumatic intracranial hematoma. A review of the literature indicates that the frequency of neurologic injury associated with facial fractures is as high as 76%[4,9,13,16]. While most patients with minor head injury demonstrate immediate recovery, a proportion deteriorates and necessitates intervention for intracranial hematoma[1,12,25]. Yet, the relationship between intracranial hemorrhage and craniofacial fracture has not been firmly established within a large population. A timely detection may lead to improve results[21,24], because proper and prompt treatment of an intracranial hematoma is crucial in boosting the outcome of head injury[20,23,24].

In that regard, maxillofacial fracture patients at risk for accompanying intracranial hemorrhages should be discovered before deterioration takes place. Moreover, physicians/healthcare providers outside of hospitals with CT scanners need directions about which patients require costly and time consuming transfers for a CT scan. While CT scanning is also an expensive high technology investigation, data supporting a more selective use could lead to reductions in healthcare costs. In this connection, a highly sensitive clinical decision rule for the use of CT in patients with minor head injury has been published recently[22]. Today, CT scanning is routinely performed in patients with impaired consciousness or neurological signs[22]. But head injury patients are often screened for skull fractures by plain radiography only. The purpose of this study was to identify fracture patterns predisposing patients with craniofacial fractures for different types of intracranial hemorrhages. Such data could support a more efficient use of computed tomography to detect intracranial hemorrhages in maxillofacial fracture patients.

Patients and methods

Between 1991 and 1997, a 7-year period, 6649 patients with cranio- and maxillofacial injuries were treated at the University Hospital Innsbruck, Austria, which serves a population of more than 500,000 people. Of them, 2195, 1627 male (74.1%) and 568 females (25.9%), sustained maxillofacial fractures. Patients were considered to have a skull fracture on the basis of a plain radiograph or a CT scan evaluated by a radiologist. In patients with impaired consciousness, neurological signs or clinical signs of a basal skull fracture, an initial CT scan was performed. The patients' charts were reviewed and analyzed according to age, sex, cause of injury, mechanism of injury, type and location of the facial injury, associated injuries, and neurologic injuries.

Fractures of the Le Fort categories were counted in the zygomatic or nasal complex group as these bones were involved. Epidural and subdural hematoma were classified as frontal, parietal, temporal, and occipital. Additional locations of intracerebral hematoma were brainstem, cerebellum, and basal ganglia area, hemorrhagic contusions also included. The category ''concussion'' was defined by either a transient state of witnessed unresponsiveness or a patient's report of temporary loss of awareness and/or posttraumatic amnesia.

Statistical analyses completed included descriptive analysis, the chi-square test, and the Fisher's exact test. This was followed by logistic regression analysis for the four main types of intracranial hemorrhage (epidural, subdural, subarachnoid, and intracerebral) to determine the impact of the different fractures at different ages in male and female patients. Odds ratios and their 95% confidence intervals (CI) were calculated to represent the risk of the predictors. The following independent variables were considered in logistic regression analysis: age, sex, fractures of the orbit, zygoma, mandible, maxilla, nose, Le Fort I, II, III fractures, basal skull fractures, cranial vault fractures, and cervical spine injuries. Selection was based on clinical relevance and simple comparisons (chi-square test).

Results

Age, sex, cause, and mechanism of injury

Altogether, 1627 male (74.1%) and 568 female patients with facial fractures were included (Table 1). They ranged from 1 to 98 years of age, with the peak incidence in the 21- to 30-year age group (26.6%); 62% were between 11 and 40 years. Whereas traffic accidents (18.1%) were comparatively rare, more than one third of the patients (36.1%) were injured due to sports accidents. Males dominated in all categories of accidents; in industrial accidents (124m, 8f) and accidents due to assault (265m, 29f) the difference was significant ($P < 0.001$). Patients suffering from industrial accidents were 41.7 years old

Table 1. Description, type, and location of facial fractures

Patients	2195	
Male	1627 (74.1%)	
Female	568 (25.9%)	
Age range	1–98	
Mean age	34.9	
Median	30	
SD	19.1	
Sports accidents	793 (36.1%)	
Traffic accidents	397 (18.1%)	
Assault	294 (13.4%)	
Industrial accidents	132 (6.0%)	
Other accidents	579 (26.4%)	
Falls	918 (41.8%)	
Hits, pushes, kicks	437 (19.9%)	
Collisions	213 (9.7%)	
Other mechanisms	627 (28.6%)	
Total	**Number (%)**	
Orbit and floor of the orbit	995 (45.3)	
Zygoma and zygomatic arch	974 (44.4)	
Mandible	699 (31.9)	
Nose	285 (13.0)	
Maxilla	236 (10.8)	
Le Fort II	86 (3.9)	
Le Fort I	72 (3.3)	
Le Fort III	64 (2.9)	
Detail	**Side**	**Number (%)**
Floor of the orbit	Left	530 (24.2)
Zygoma	Left	497 (22.6)
Zygoma	Right	438 (20.0)
Floor of the orbit	Right	435 (19.8)
Mandible	Left	238 (10.8)
Mandible	Right	236 (10.8)
Mandibular collum	Left	188 (8.6)
Mandibular collum	Right	175 (8.0)
Zygomatic arch	Left	129 (5.9)
Zygomatic arch	Right	101 (4.6)
Maxilla	Left	94 (4.3)
Maxilla	Right	92 (4.2)
Orbit	Left	87 (4.0)
Orbit	Right	75 (3.4)
Maxillary alveolus	Right	71 (3.2)
Maxillary alveolus	Left	61 (2.8)
Mandibular symphysis		52 (2.4)
Mandibular alveolus	Right	39 (1.8)
Mandibular condyle	Left	37 (1.7)
Mandibular condyle	Right	36 (1.6)
Mandibular alveolus	Left	35 (1.6)

in average, while the mean age among the other types of accidents was between 29 and 32 years. Falls were the most frequent mechanism of injury (41.8%). Despite the absolute dominance of males in falls (605m, 313f), females were injured more frequently by falls ($P < 0.001$). Patients injured by hits, pushes, or kicks (388m, 49f) were mostly male ($P < 0.001$). On admission, 1959 patients (89.2%) were alert, the remaining 236 patients showed impaired levels of consciousness.

Type and location of maxillofacial trauma

Table 1 shows the clearly defined locations of the maxillofacial fractures. For statistical analysis the fractures were registered into eight groups. This classification shows 2195 patients with 3646 fractures. The site most frequently fractured was the orbital complex (45.33%), followed by the zygomatic complex (44.37%). The detailed analysis reveals the exact sites of the fractures: the floor of the orbit and the zygomatic bone. Patients did not differ significantly by sex in any of the locations.

Associated injuries

Associated extra-facial injuries (Table 2) were sustained in 711 patients (32.4%) simultaneously with maxillofacial fractures. Most commonly, concussions occurred (538, 24.5%), while all other injuries were seen in less than 10% each. Cranial nerve injuries (212, 9.7%) most frequently affected the N. trigeminus (101, 4.6%). Brain edema and brain contusions were morphologically diagnosed based on CT scanning or magnetic resonance imaging (MRI).

Table 2. Associated injuries

Total	711 (32.4%) patients (1977 incidents)
Concussion	538 (24.5%)
Intracranial hemorrhage	212 (9.7%)
Cranial nerve injury	183 (8.3%)
Brain contusion	179 (8.2%)
Basal skull fractures	163 (7.4%)
Brain edema	141 (6.4%)
Cranial vault fractures	141 (6.4%)
Open brain injury	114 (5.2%)
Extremities injury	109 (5.0%)
Thoracic injury	80 (3.6%)
Cervical spine injury	49 (2.2%)
Other spine injury	47 (2.1%)
Abdominal injury	21 (1.0%)

Intracranial hemorrhages

Intracranial bleeding ranked second among associated extra-facial injuries shown in Table 2. A total of 212 patients (9.7%), 169 males and 43 females, suffered from epidural (55, 2.5%), subdural (95, 4.3%), subarachnoid (116, 5.3%), or intracerebral hemorrhages (139, 6.3%). In comparison to all maxillofacial trauma patients, these are 10.4% of the male and 7.6% of the female patients (statistically not different). The mean age was 36.9 years. Although sports accidents embodied the most frequent cause of injury in general, traffic accidents (76, 35.8%) were most frequent among patients with intracranial hemorrhages. Of these patients, 185 (87.3%, $P < 0.001$) suffered from a concussion; 129 (60.8%) showed cerebral edema. Additionally, open brain injuries were found in 92 (43.4%) patients of this group. CT or MRI showed cerebral contusion areas in 165 (77.8%) victims. On admission, 54 (25.5%) of the patients with intracranial hemorrhages were alert, meaning that 2.8% of the alert patients turned out to be bleeding patients.

Epidural hematoma (26 frontal, 23 temporal, 13 parietal, 4 occipital) were found in 55 (2.5%) patients. Eighteen (32.7%) of them resulted from sports accidents. Traffic accidents (13, 23.6%) were less important as a cause of injury. CT or MRI showed cerebral contusions in 33 (60.0%, $P < 0.001$) and brain edema in 30 patients (54.5%, $P < 0.001$). Concussions were noted in 49 (89.1%, $P < 0.001$) patients. Logistic regression analysis (Table 3) revealed basal skull fractures having the strongest impact on the incidence of epidural hematoma. Cranial vault fractures increased the risk seven times. Among the facial fractures the orbital fractures were those having a significant influence.

Subdural hematoma (64 frontal, 55 parietal, 48 temporal, 36 occipital) occurred in 95 (4.3%) patients. Among the causes of injury, traffic accidents ranked first (37, 38.9%, $P < 0.001$), followed by sports accidents (21, 22.1%). Both, cerebral contusions (75, 78.9%) and brain edema (66, 69.5%) showed significant associations with subdural hematoma ($P < 0.001$). Accompanying thoracic injuries (11, 11.6%) were also found to be significantly associated with subdural bleedings ($P < 0.001$). Of these patients, 93.7% (89, $P < 0.001$) suffered from concussions. Logistic regression analysis (Table 4) identified cranial vault fractures as the most important risk factor among the predictors. Of the facial fractures, nose and

Table 3. Relation of epidural hematoma and orbital, cranial, and basal fractures

Predictor	EDH		Odds ratio	Odds ratio 95% CI	Significance
	Yes	No			
Age	31.9 ± 15.9	35.0 ± 19.2	0.9833	0.9661–1.0008	0.0609
Sex					
Female	11/568 (1.9%)	557/568 (98.1%)	0.6754	0.3100–1.4715	0.3233
Male	44/1627 (2.7%)	1583/1627 (97.3%)			
Periorbital fracture					
Yes	37/995 (3.7%)	958/995 (96.3%)	2.0018	1.0449–3.8351	0.0364
No	18/1200 (1.5%)	1182/1200 (98.5%)			
Cranial vault fracture					
Yes	34/141 (24.1%)	107/141 (75.9%)	7.3768	3.6046–15.0965	<0.0001
No	21/2054 (1.0%)	2033/2054 (99.0%)			
Basal skull fracture					
Yes	40/163 (24.5%)	123/163 (75.5%)	16.8305	8.0899–35.0151	<0.0001
No	15/2032 (0.7%)	2017/2032 (99.3%)			

Table 4. Relation of subdural hematoma and nasal, zygomatic, basal, and cranial fractures

Predictor	SDH Yes	SDH No	Odds ratio	Odds ratio 95% CI	Significance
Age	37.2 ± 20.4	34.8 ± 19.1	1.0026	0.9900–1.0153	0.6902
Sex					
Female	21/568 (3.7%)	547/568 (96.3%)	0.7513	0.4240–1.3312	0.3272
Male	74/1627 (4.5%)	1553/1627 (95.5%)			
Nose fracture					
Yes	21/285 (7.4%)	264/285 (92.6%)	1.8927	1.0437–3.4324	0.0357
No	74/1910 (3.9%)	1836/1910 (96.1%)			
Zygoma fracture					
Yes	56/974 (5.7%)	918/974 (94.3%)	1.9264	1.1780–3.1500	0.0090
No	39/1221 (3.2%)	1182/1221 (96.8%)			
Basal skull fracture					
Yes	50/163 (30.7%)	113/163 (69.3%)	5.8598	3.3663–10.2004	<0.0001
No	45/2032 (2.2%)	1987/2032 (97.8%)			
Cranial vault fracture					
Yes	54/141 (38.3%)	87/141 (61.7%)	13.6997	7.9509–23.6052	<0.0001
No	41/2054 (2.0%)	2013/2054 (98.0%)			

zygoma fractures showed significant association and were consequently considered in logistic regression analysis. Basal skull fractures increased the risk of subdural hematoma fivefold.

Among 116 (5.3%) patients suffering from traumatic subarachnoid bleeding, traffic accidents (45, 38.8%) were the most frequent cause of injury ($P < 0.001$), sports accidents (33, 28.4%) ranked second. Cerebral contusions (96, 82.8%) and brain edema (81, 69.8%) were found to be significantly related to subarachnoid bleeding ($P < 0.001$), as well as thoracic injuries (11, 9.5%, $P < 0.005$) and abdominal traumas (5, 4.3%, $P < 0.005$). Nine out of 10 (104, 89.7%, $P < 0.001$) suffered from concussions. Most significant predictors in logistic regression analysis (Table 5) were basal skull and cranial vault fractures causing approximately nine- and sixfold risks, respectively, for traumatic subarachnoid hemorrhages. Le Fort II fractures showed the highest odds ratio among facial fractures. Further cervical spine injuries, nose and orbit fractures were considered in logistic regression analysis.

Intracerebral hematoma were most frequent (139, 6.3%) in this study showing the following distribution: 101 frontal, 61 temporal, 58 parietal, 28 occipital, 17 basal ganglia area, 23 brainstem, and

Table 5. Relation of subarachnoid hemorrhage and cervical spine injuries, orbital, nasal, Le Fort II, cranial, and basal fractures

Predictor	SAH Yes	SAH No	Odds ratio	Odds ratio 95% CI	Significance
Age	39.4 ± 19.5	34.6 ± 19.1	1.0122	1.0009–1.0236	0.0335
Sex					
Female	25/568 (4.4%)	543/568 (95.6%)	0.8411	0.4978–1.4213	0.5180
Male	91/1627 (5.6%)	1536/1627 (94.4%)			
Periorbital fracture					
Yes	71/995 (7.1%)	924/995 (92.9%)	1.6485	1.0407–2.6111	0.0332
No	45/1200 (3.8%)	1155/1200 (96.3%)			
Nose fracture					
Yes	32/285 (11.2%)	253/285 (88.8%)	2.3694	1.4162–3.9642	0.0010
No	84/1910 (4.4%)	1826/1910 (95.6%)			
Cervical spine injury					
Yes	13/49 (26.5%)	36/49 (73.5%)	3.6549	1.6155–8.2690	0.0019
No	103/2146 (4.8%)	2043/2146 (95.2%)			
Le Fort II injury					
Yes	20/86 (23.3%)	66/86 (76.7%)	4.0373	2.0200–8.0690	0.0001
No	96/2109 (4.6%)	2013/2109 (95.4%)			
Cranial vault fracture					
Yes	52/141 (36.9%)	89/141 (63.1%)	5.7204	3.3775–9.6884	<0.0001
No	64/2054 (3.1%)	1990/2054 (96.9%)			
Basal skull fracture					
Yes	62/163 (38.0%)	101/163 (62.0%)	8.7893	5.3437–14.4567	<0.0001
No	54/2032 (2.7%)	1978/2032 (97.3%)			

Table 6. Relation of intracerebral hematoma and cervical spine injuries, orbital, maxillary, Le Fort II, III, cranial, and basal fractures

Predictor	ICH		Odds ratio	Odds ratio 95% CI	Significance
	Yes	No			
Age	38.2 ± 20.3	34.7 ± 19.0	1.0102	0.9989–1.0215	0.0759
Sex					
Female	31/568 (5.5%)	537/568 (94.5%)	0.7425	0.4460–1.2362	0.2523
Male	108/1627 (6.6%)	1519/1627 (93.4%)			
Periorbital fracture					
Yes	85/995 (8.5%)	910/995 (91.5%)	1.9935	1.2538–3.1696	0.0035
No	54/1200 (4.5%)	1146/1200 (95.5%)			
Maxillary fracture					
Yes	25/285 (8.8%)	260/285 (91.2%)	2.0318	1.1019–3.7467	0.0232
No	114/1910 (6.0%)	1796/1910 (94.0%)			
Cervical spine injury					
Yes	13/49 (26.5%)	36/49 (73.5%)	2.6101	1.0718–6.3562	0.0346
No	126/2146 (5.9%)	2020/2146 (94.1%)			
Le Fort II injury					
Yes	23/86 (26.7%)	63/86 (73.3%)	2.8505	1.3392–6.0672	0.0066
No	116/2109 (5.5%)	1993/2109 (94.5%)			
Le Fort III					
Yes	25/64 (39.1%)	39/64 (60.9%)	3.1195	1.4232–6.8377	0.0045
No	114/2131 (5.3%)	2017/2131 (94.7%)			
Cranial vault fracture					
Yes	71/141 (50.4%)	70/141 (49.6%)	8.9059	5.4067–14.6697	<0.0001
No	68/2054 (3.3%)	1986/2054 (96.7%)			
Basal skull fracture					
Yes	80/163 (49.1%)	83/163 (50.9%)	12.1497	7.4652–19.7739	<0.0001
No	59/2032 (2.9%)	1973/2032 (97.1%)			

5 cerebellum. All of the intracerebral hematoma patients showed signs of cerebral contusions in CT/MRI, while brain edema was found in 92 (66.2%) victims. Fifty-six (40.3%) sustained their injury in a traffic accident ($P < 0.001$), 38 (27.3%) had a sports-related accident. Statistical analysis revealed significant relations to thoracic injuries (13, 9.4%, $P < 0.005$), abdominal trauma (5, 3.6%, $P < 0.01$), and injuries of the extremities (17, 12.2%, $P < 0.001$). A total of 120 patients (86.3%, $P < 0.001$) were affected by concussions. Again, basal skull and cranial vault fractures were the strongest predictors for intracerebral hemorrhage in logistic regression analysis (Table 6). Le Fort II and III fractures were most important among maxillofacial fractures. Orbit and maxillary fractures as well as cervical spine injuries caused a two- to threefold increase of the risk.

Discussion

Head trauma presenting with facial injuries may pose maxillofacial fractures, but also affect skull, brain, and its meninges. High velocity impacts breaking facial bones may result in ruptures of intracranial vessels, leading to hemorrhages in different compartments. These accompanying injuries can be more life-threatening than facial injuries themselves. Hence, the presence of intracranial hemorrhage is associated with poorer survival rate[3,4,13,26].

The high proportion of males (74.1%) in our study was hardly surprising. During the period from March 1984 to January 1990, at the MetroHealth Medical Center of Cleveland, 79% of the patients treated with facial fractures were male[10]. This is only one example for the well-known phenomenon of the male preponderance in facial trauma. Yet, our study revealed no statistically significant difference for females and males sustaining intracranial bleedings. As to the mechanism of injury there was a significant sex-specific difference. While females were more frequently injured by falls, men clearly dominated in hits, pushes, and kicks. These last findings can be flawed because men may describe their injury as caused by another person, while women are more likely to conceal interpersonal violence.

Showing a peak incidence in the third decade of life, the age distribution of this sample is similar to those of other studies on facial fractures[9,11,14,15]. Nevertheless, our mean age (34.88) is distinctively higher than in other publications on this topic[14,16].

The high proportion of sports-related injuries (36.1%) is quite unusual; in most comparable studies[9,11,14,15], assaults and motor vehicle accidents were the predominant cause of injury. Nearly 50% of these sports accidents were skiing-related which is not surprising: the location of the hospital is in the midst of the Alps, where skiing is one of the favorite holiday and leisure-time activities throughout most of the year. The high percentage also supports reports of other authors[5,6,8,13,17] that sports-related injuries become increasingly more common. Still, the leading causes for craniofacial fractures combined with intracerebral hematoma are traffic accidents.

The most frequently affected bones were the floor of the orbit and the zygoma, confirming the data of previous surveys of our clinic[6,7]. In contrast, maxilla, orbit, and nasal bones were most frequently fractured in a survey of epidemiologic features of maxillofacial injuries among motorcyclists[5]. We saw nose fractures in only 13.0% due to the fact that facial injuries resulting in isolated nasal fractures were treated by the ENT service and, therefore, not registered in this database.

Among associated trauma (32.4%) concussions ranked first (24.5%). Comparable to these percentages, incidences of closed head injuries reported by DAVIDOFF et al.[2] and HAUG et al.[11] accounted for 55 and 17.5%, respectively.

A skull fracture and an impaired conscious level are both indicators of an elevated risk of acute traumatic intracranial hematoma at all ages[8,18,23]. On admission, 236 of the fracture patients (10.8%) showed an impaired level of consciousness. Intracranial hemorrhages indeed occurred with a frequency of 9.7% in fracture patients, confirming the reduced conscious level to be a powerful risk factor. Nevertheless, on admission 54 (25.5%) of the patients with intracranial hemorrhages were alert, meaning that 2.8% of the alert patients turned out to be bleeding patients.

Among intracerebral hematoma patients, the male predominance (79.7%) was even stronger than in the whole sample (74.1%). Sports accidents altogether were responsible for the largest part of maxillofacial fractures, while traffic accidents were the predominant cause in patients with intracranial hemorrhage (35.8%). Epidural hematoma was the only type of bleeding most frequently occurring after sports accidents.

Although Austrians wear seat belts, traffic accidents are still a frequent cause of severe head trauma. This confirms observations that motor vehicle accidents are responsible for more cases of polytrauma than any other mechanism of injury[9]. HAUG et al.[11] found motor vehicle accidents associated with a disproportional higher rate of severe intracranial injury, as well as higher brain injury index and lower Glasgow Coma Score.

Differential diagnosis between hemorrhagic contusions and intracerebral hematoma is often very difficult. Therefore, both of them were counted as ''intracerebral hematoma''. This summation is partly responsible for the leading incidence of intracerebral hematoma (6.3%). Epidural hematoma seldomly accompanied facial fractures (2.5%). Previous reports[11,14] also found epidural hematoma to have the lowest incidence among intracranial hemorrhages. Except subarachnoid hemorrhages, all hematoma were preferably located in the frontal lobes. This is consistent with findings of HAUG et al.[9] who additionally reported that the frontal bone is most frequently fractured in patients with maxillofacial fractures.

In logistic regression analysis the subarachnoid hemorrhage showed a significant dependence on age. All other types of bleeding were independent of age and sex. Altogether basal skull and cranial vault fractures were the strongest predictors for intracranial hemorrhages. Their presence increased the risk of any hemorrhage by 5- to 17-fold. Mandibular fractures were not significantly associated with one of the different types of hemorrhages. Our data support reports that midface fractures rather than mandibular fractures are more frequently associated with closed head injury and death from neurologic injury[11,19]. GOPALAKRISHNA et al.[5] also found the anatomic composition of the maxilla, nose, and zygoma (thickness of bone and hollow interiors) to make them more susceptible to fracture compared with the mandible.

In summary, we show that Le Fort II and III, orbit, nose, zygoma, and maxillary fractures significantly increase the risk of intracranial hemorrhage by two to four times. Basal skull fractures caused a multiplication of the risk up to 17-fold, while fractures of the cranial vault were associated with a risk up to 14-fold of sustaining an accompanying intracranial hemorrhage. These findings reaffirm the evidence of other studies that the presence or absence of a skull fracture is crucial in the assessment of head trauma patients[4,18,22,23]. A suspected open or depressed skull fracture or any sign of a basal skull fracture indicates a high risk of accompanying acute intracranial hematoma, both in children and adults[8,22]. Additionally, we identified several maxillofacial fractures as significant risk factors for intracranial bleeding. Because immediate neurosurgical intervention is frequently required, patients with the above-mentioned fractures should undergo sustained radiological diagnostics and observance without delay.

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