

Analysis of 185 maxillofacial fractures in the state of Santa Catarina, Brazil

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Abstract: A retrospective study was performed to assess maxillofacial fractures in patients treated at a public hospital from 2002 to 2006. The data collected included age, gender, etiology, type of injury, treatment modalities and period of treatment. Causes were grouped into seven categories: road traffic collisions, sports accidents, occupational accidents, gunshot fractures, falls, violence and other causes. The analyses involved descriptive statistics, the Chi-squared Test and the Fisher Exact Test. Records from 132 patients sustaining 185 maxillofacial fractures were evaluated. The mandible (54.6%) was the most commonly fractured bone in the facial skeleton, followed by the zygoma (27.6%). The mean age of the patients was 37.7 years, and the male:female ratio was 4.3:1. Most fractures occurred in adults with ages ranging from 18 to 39 years. A significant statistical relation was found between the age and the etiology of the trauma ($p < 0.05$), and between the number of fractured sites and the age of the patient ($p < 0.05$). Considering the age groups, accidents were the most frequent cause of maxillofacial fractures in the age group between 18 to 39 years, and interpersonal violence was the most frequent cause of maxillofacial fractures in the age group between 40 to 59 years. Treatment was performed on the same day as the diagnosis in 44.7% of the patients. Open surgery with internal stable fixation was indicated for most of the patients. Facial fractures occurred primarily among men under 30 years of age, and the most common sites of fractures in the face were the mandible and the zygomatic complex. Traffic road collisions were the main etiologic factor associated with maxillofacial trauma.

Descriptors: Trauma; Facial injuries; Mandible; Maxilla; Zygoma.

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Introduction

The patterns of the maxillofacial trauma in South America are poorly studied. Only seven reports in the related literature have focused on this subject¹⁻⁷ and only three of them provide a general trend of maxillofacial fractures.^{2,3,7} Understanding maxillofacial trauma helps to assess the behavior patterns of people in different countries and helps to establish effective measures through which injuries can be prevented and treated.

The epidemiology of facial fractures varies in type, severity, and cause depending on the population studied.⁸ Maxillofacial fractures affect a significant portion of trauma patients.⁹ They can occur isolated or in combination with other serious injuries, including cranial, spinal, upper and lower body injuries.²

The state of Santa Catarina has 5.8 million inhabitants, representing 3.1% of the Brazilian population.¹⁰ This is the first epidemiological study about facial fractures in Santa Catarina. The purpose of this retrospective study was to analyze the maxillofacial fractures treated during a five year period (2002 - 2006) in the University Hospital of Florianópolis (the state capital), with special attention to the association between age and diversity, incidence, fractures pattern, clinical management and treatment modality. Additionally, the present study compares the results with similar studies in Brazil and throughout the world.

Material and Methods

This was a retrospective study which reviewed the data from 132 patients sustaining maxillofacial fractures and who were attended between 2002 and 2006 at the Oral and Maxillofacial Surgery Department, Federal University of Santa Catarina, Florianópolis, SC, Brazil. The data was collected from charts of patients admitted to the University Hospital or treated as outpatients in the oral surgery clinics. Charts that did not have complete information about the trauma were excluded.

The patients were evaluated by age, gender, etiology, type of injury, treatment modalities and period of treatment. Causes were grouped into seven categories: road traffic collisions, sports accidents,

occupational accidents, gunshot fractures, falls, violence and other causes. The fractures were classified as mandible fractures (condyle, coronoid process, ramus, body, parasymphysis, symphysis, and comminuted), zygomatic complex fractures, maxillary fractures according to the system of Le Fort,¹¹ orbital floor fractures and isolated nasal bone fractures. The treatments were divided into closed reduction (maxillomandibular fixation) and open reduction (open reduction and stable rigid fixation). The period between trauma and first consultation and between first consultation and surgery were also analyzed.

Data analysis involved a descriptive analysis, which was made for each variable. The Chi-Square test was used to compare the counts of categorical response between two independent variables. If the expected values were less than 5 in the contingency table, Fisher's exact test was used. An association between the variables was considered significant when the p-value was less than 0.05 ($p \leq 0.05$).

Results

A total of 132 patients sustaining 185 maxillofacial fractures were studied. One hundred and seven (81.1%) were men and 25 (18.9%) were women. Mandibular fractures were more frequent than other injuries, representing 54.6% of all maxillofacial fractures. The body and condyle were the anatomical sites most fractured, representing 37 (20%) and 24 (13%) of the injuries, respectively. The zygoma was the second most frequent bone fractured (27.6%). Table 1 shows the frequency of maxillofacial fractures observed in this study.

Table 2 shows the frequency of etiologic factors associated with maxillofacial fractures. The most frequent cause of injury was road traffic collision (48.4%), followed by violence (36.4%). Although traffic accidents were responsible for almost fifty percent of the maxillofacial fractures reported, no significant statistical correlation was seen between the etiologic factor and the facial bone fractured (Table 3).

The patients were divided in age groups, as listed in Table 4: from 11 to 17 years, from 18 to 39 years, from 40 to 59 years and above 60 years. The age of the patients ranged between 11 and 77 years, with

Table 1 - Patterns of maxillofacial fractures.

Type of fracture	Patients	%
Mandible	101	54.6
Angle	9	4.9
Comminuted	3	1.6
Condyle	24	13.0
Body	37	20.0
Parasymphysis	9	4.9
Symphysis	9	4.9
Ramus	9	4.9
Coronoid process	1	0.5
Zygoma	51	27.6
Nasal bones	8	4.3
Maxilla	14	7.6
Le Fort I	4	2.2
Le Fort II	2	1.1
Le Fort III	6	3.3
Comminuted	2	1.1
Dento-alveolar	7	3.8
Orbital floor	4	2.2

Table 2 - Causes of maxillofacial injuries.

Etiology	Patients	%
Traffic*	64	48.4
Work	1	0.8
Others	1	0.8
Gunshot	5	3.8
Falls	13	9.8
Violence	48	36.4

*Includes car, motorcycle and bike accidents.

Table 3 - Distribution of cases of maxillofacial fractures according to etiology and type of fracture.

Etiology	Type of fracture			Total
	Mandible	Zygoma	Others	
Traffic	43 (48.3%)	25 (28.1%)	21 (23.6%)	89
Violence	42 (57.5%)	23 (31.5%)	8 (11.0%)	73
Others	16 (69.6%)	3 (13.0%)	4 (17.4%)	23
Total	101	51	33	185

Chi-square test ($p > 0.05$).

Table 4 - Distribution of cases of maxillofacial fractures according to etiology and age.

Etiology	Age				Total
	11 to 17	18 to 39*	40 to 59	60+	
Accident	5 (7.7%)	50 (76.9%)	8 (12.3%)	2 (3.1%)	65
Violence	1 (2.1%)	27 (56.3%)	18 (37.5%)	2 (4.2%)	48
Others	1 (5.3%)	10 (52.6%)	8 (42.1%)	0 (0.0%)	19
Total	7	87	34	4	132

*Fisher exact test ($p < 0.05$).

a mean age of 37.7 years. Eighty percent of the patients which sustained maxillofacial fractures were between the third and fourth decade of life. Table 4 shows a statistically significant association between age and cause of maxillofacial fracture. Accidents were more prevalent in the age group between 18 and 39 years. In the group between 40 and 59 years, interpersonal violence was the most common cause of fracture.

The age groups were used to establish a correlation between the number of sites fractured in each patient, the treatment modality and if one gender had a greater incidence of maxillofacial fractures

than the other. The results are shown in Tables 5, 6 and 7. Regarding the number of fractured sites in the maxillofacial skeleton, a statistically significant correlation was seen between the number of fractured sites and the age of the patients (Table 5).

Patients treated by open reduction and internal stable fixation received plates and screws. Regarding the treatment modality, there was no statistically significant correlation, which means that the treatment was not influenced by the age of the patient (Table 6).

The male:female ratio was 4.3:1. No significant statistical difference was found between the age and

Table 5 - Distribution of cases of maxillofacial fractures according to number of maxillofacial fractures and age.

Sites fractured	Age				Total
	11 to 17	18 to 39*	40 to 59	60+	
1	4 (4.3%)	57 (61.3%)	30 (32.3%)	2 (2.2%)	93
2 to 5	3 (7.7%)	30 (76.9%)	4 (10.3%)	2 (5.1%)	39
Total	7	87	34	4	132

*Fisher exact test (p < 0.05).

Table 6 - Distribution of cases of maxillofacial fractures according to treatment modality and age.

Treatment modality	Age				Total
	11 to 17	18 to 39	40 to 59	60+	
Open surgery	2 (2.6%)	47 (61.0%)	24 (31.1%)	4 (5.2%)	77
Closed treatment	5 (10.2%)	33 (67.3%)	8 (16.3%)	3 (6.1%)	49
Open/Closed	3 (5.1%)	46 (78.0%)	9 (15.3%)	1 (1.7%)	59
Total	10	126	41	8	185

Fisher exact test (p > 0.05).

Table 7 - Distribution of cases of maxillofacial fractures according to gender and age.

Gender	Age				Total
	11 to 17	18 to 39	40 to 59	60+	
Female	3 (12.0%)	12 (48.0%)	9 (36.0%)	1 (4.0%)	25
Male	4 (3.7%)	75 (70.1%)	25 (23.4%)	3 (2.8%)	107
Total	7	87	34	4	132

Fisher exact test (p > 0.05).

the gender of the patients. The age group between 18 and 39 years, for both male and female patients, presented the highest incidence of maxillofacial fractures (Table 7). The mandible fracture was the most frequent maxillofacial injury for both man and woman. No correlation was seen between the diagnosis and gender of the patients, as seen in Table 8.

The majority of patients first sought consultation from the first to the seventh day after trauma, and 44.7% of the patients evaluated had their surgery on the same day. Table 9 summarizes the period between fracture and hospital consultation, the period between first consultation and surgery and the period of hospitalization for the 132 patients sustaining maxillofacial fractures.

Discussion

Epidemiological studies are necessary to determine the requirements of any population to improve the quality of life and health of the citizens

Table 8 - Distribution of cases of maxillofacial fractures according to gender and diagnosis.

Gender	Diagnosis			Total
	Mandible	Zygoma	Others	
Female	15 (50.0%)	8 (26.7%)	7 (23.3%)	30
Male	86 (55.5%)	43 (27.7%)	26 (16.8%)	155
Total	101	51	33	185

Chi-square test (p > 0.05).

of any country. The epidemiology of maxillofacial trauma can provide information about how people are injured and know how the geographic area, the socioeconomic status, the traffic and social behavior can influence this type of trauma.² Furthermore, monitoring trends in the occurrence of maxillofacial trauma allows adjustments to be made in the training and continuing professional development in a timely fashion.¹²

Comparing the data of this study with that of

Table 9 - Time interval between trauma and surgery.

	Patients	%
Period between fracture and hospital consultation (days)		
0	38	28.8
1 to 7	45	34.1
8 to 13	14	10.6
15 to 20	25	18.9
21+	10	7.6
Period between first consultation and surgery (days)		
0	59	44.7
1 to 3	26	20.0
4 to 7	22	16.7
8 to 12	20	15.2
13+	5	3.8
Hospitalization stay (days)		
0 to 2	61	46.2
3 to 5	51	38.6
6 to 10	14	10.6
11+	6	4.5

others published about Brazilian maxillofacial fractures shows that the mandible is the bone most frequently fractured. Brasileiro, Passeri² (2006) reported an incidence of 44.2%, Chrcanovic *et al.*³ (2004) reported an incidence of 39.97%. The frequency of mandible fracture in our group population was 54.6%. The mandibular fracture is the most prevalent maxillofacial injury in many countries.^{13,14,15} These findings are in contrast with those of a study published in Austria,¹⁶ which presented the middle third of the face as the most injured site of the face, and those of Palma *et al.*⁷ (1995), which reported an incidence of 21.9% of mandibular fractures in the population studied. The main etiologic factors in these two studies were activities of daily life and falls respectively, which explain the difference in the distribution of maxillofacial fractures.

Our study and the other two from Brazil^{2,3} reported accidents as the most common etiologic factor associated with maxillofacial injuries. Accidents were the main etiologic factor for the group between 18 and 39 years. This age group is usually involved in dangerous activities and drive without

care. This same age group sustained more fractures of the facial skeleton. This data was statistically significant, and shows that young adults are involved with more severe traumas. The age group between 40 and 59 years was more prone to robbery, which explains the high incidence of interpersonal violence in this group. In the study published by Chrcanovic³ (2004), car accidents and violence were the main etiologic factors of maxillofacial trauma. Brasileiro, Passeri² (2006) reported a similar cause of facial fractures. Our data also revealed a higher incidence of car accidents (48.4%) followed by interpersonal violence (36.36%). These data are in line with the literature worldwide. In Turkey, traffic accidents represent 38% of the causes of facial fractures.¹⁷ In contrast, Gassner *et al.*¹⁶ (2003) reported in Austria that activities of daily life and sports represented more than 50% of the cases. The association between the etiology of facial fractures and the type of fracture presents significant results if the nature of the impact is taken into consideration. Although the etiology was not depicted, Mattos *et al.*¹⁸ (2006) reported that the main cause of globe loss in the age between 08 and 13 years was trauma. Oji reported a peak incidence of trauma in the age of 10 years and falls as the most frequent etiologic factor.¹⁹ The sample studied did not present a significant correlation between the etiology and type of fracture because the nature of impact could not be obtained from the charts.

The man:woman ratio was 4.3:1 in our study. This pattern is dominant and is comparable with other studies worldwide, as reported in Canada,²⁰ the United Arab Emirates,²¹ Singapore²² and Turkey.²³ In Brazil, our results are similar to those reported by Chrcanovic *et al.*³ (2004) and Brasileiro, Passeri² (2006). Lower ratios were found in Nigeria¹⁹ and Greece,²⁴ but Pakistan²⁵ reported a ratio of 32:1.

The ideal time to treat maxillofacial fractures depends on the location of the trauma and the age of the patient. Nasal bone fractures usually repair during the following 15 days after trauma, while mandible fractures can be manipulated with elastics until 45 days after trauma. Although the patients sought treatment late after trauma (34.1%), the treatment

was accomplished on the same day of the first consultation in 44.7% of the patients. These data are in accordance with the literature about treatment of maxillofacial fractures, in which traumatized facial bones should be treated on the day of trauma or five to seven days after it, in order to wait soft tissue swelling to regress. Since the initial descriptions by Michelet and others of internal fixation with small plates and screws for facial fractures, surgeons have developed variations on traditional surgical approaches that have been adjusted to appropriately fit specific clinical situations.²⁶ Noncomminuted parasymphiseal and body fractures of the mandible were treated through an intraoral approach using miniplate fixation along the ideal lines of osteosynthesis. Mandibular angle fractures were treated intraorally by placing a single miniplate. Comminuted fractures and fractures involving substantial bone loss were treated with reconstruction plates in association with intermaxillary fixation (IMF). All condylar fractures were treated using IMF. Orbitozygomatic fractures were exposed using incisions in the gingivobuccal sulcus, subtarsal approaches to the lower eyelid and through a lateral extension of the supratarsal fold in the frontozygomatic suture. The zygomatic complex fractures were also treated by the use of a hook to reduce the fracture, without the use of plates to fixate the bones. Although Qudah, Bataineh²⁷ (2002) have reported that the use of internal fixation is not universal because of the cost, all patients in the presented study were treated with internal rigid fixation when open reduction was the treatment of choice. Wire osteosyntheses was not used in this group of patients. It is interesting to note that no statistical relation was found between the modality of treatment and the age group studied, indicating the use of internal stable fixation in-

dependently of the age of the patients, and that patients could receive surgery under local or general anesthesia independently of age.

The length of the hospital stay varies according to the surgical procedure performed, the type of trauma, whether it is localized or not (i.e., whether in the maxillofacial complex or in other areas of the body), and the overall health status of the patient. The majority of patients had their fractures treated under general anesthesia and stayed at hospital for postoperative follow-up up to 48 hours. This means that maxillofacial trauma usually is not life-threatening, and treatment can be performed in an elective way.

Conclusions

1. There seemed to be no major differences in the patterns of maxillofacial fractures when compared with studies from other parts of the world.
2. Facial fractures occur primarily among men under 30 years of age in the population studied.
3. Overall, the most common sites of fracture in the face are the mandible and the zygomatic complex.
4. The body of the mandible is the site most commonly fractured.
5. Traffic accidents are still the main etiologic factor associated with maxillofacial trauma in Brazil.
6. The implementation of programs to reduce road traffic accidents and interpersonal violence are necessary to reduce the incidence of maxillofacial trauma.
7. Internal stable fixation is a standard treatment for maxillofacial fractures.
8. Young adults are more severely injured and are more frequently involved in accidents.

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