

Etiology and Pattern of Maxillofacial Fractures in Medellín, Colombia: a Retrospective Analysis of 2680 Patients

Patrón Etiológico de Fracturas Maxilofaciales en Medellín, Colombia:
un Análisis Retrospectivo de 2680 Pacientes

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ABSTRACT: Maxillofacial injuries can cause significant long-term functional, esthetic, and psychological complication. Besides, these injuries may pose a substantial economic consequence for the patients as the treatment may involve a complex procedure. The purpose of the current retrospective study was to investigate the pattern of maxillofacial fractures in Medellín, Colombia over a 13-year period (1998–2010). A retrospective study of 2680 subjects with 4893 maxillofacial fractures admitted at the Oral and Maxillofacial Surgery Department of the San Vicente de Paul University Hospital in Medellín, Colombia, is presented. The patients were evaluated by age, gender, etiology, type of injury, treatment modalities and hospitalization time. The Chi-Square test was used to compare the counts of categorical response between two independent variables. The study population consisted of 2193 males and 487 females with a mean age of 26.5 (SD: 13.5) years. The age group 21-30 years accounted for the largest subgroup in both sexes. The most common cause of the fractures was traffic related followed by interpersonal violence. There were mainly mandibular, maxilla alveolar process and zygomatic bone fractures in both males and females, accounting for approximately 92% of all fractures. The main fracture site of the mandible was the mandibular condyle. The results of the present study reveal that road traffic accidents remain among the main reasons of maxillofacial fractures. Measures on prevention of road traffic crashes and policies that strengthen social investment should be strongly emphasized in order to reduce the occurrence of these injuries.

KEY WORDS: Maxillofacial fracture, retrospective study, road traffic accidents.

INTRODUCTION

The maxillofacial region occupies the most prominent position in the human body and rendering it vulnerable to injuries quite commonly (Adeyemo *et al.*, 2005). The incidence of maxillofacial fractures varies widely between different countries (Al Ahmed *et al.*, 2004). The main causes worldwide are traffic accidents, assaults, fall and sport, whereas in low-income countries maxillofacial injuries are more often the result of interpersonal violence in the form of fights, assaults and gunshots (Lee *et al.*, 2010).

Medellin, the second largest city in Colombia, with a population of nearly 2.5 million has suffered a severe epidemic of violence during past three decades. The most frequent expression of violence was verbal,

followed by yelling and heavy pranks, unarmed physical aggression and, representing the lowest proportion, fraud or deception. The highest proportions of violence over the lifespan were unarmed robbery and unarmed threats, followed by armed threats and sexual violence (Duque *et al.*, 2011). On the other hand; road traffic injuries are a leading public health in Medellín. They are ranked as the second leading cause of morbidity and mortality from external causes (Rodriguez *et al.*, 2003). Official sources for all motor vehicle crashes for 1995 reported 52.527 injured in Colombia (Fund for the Prevention of Road Injury, 1995).

Maxillofacial injuries involve soft and hard tissues injuries of face extending from frontal bone superiorly

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to mandible inferiorly and vary from soft tissue lacerations to complex fractures of maxillofacial skeleton (Allareddy *et al.*, 2011). The pattern of these injuries depends on the mechanism of injury, magnitude and direction of impact force and anatomical site (Allareddy *et al.*, 2011; Sawazaki *et al.*, 2010).

Various studies have been carried out in various countries of world to study the epidemiology and demographics of the maxillofacial injuries but the studies from South America are very few. Additionally, to our knowledge there are not reports detailing the causes and incidence of maxillofacial trauma in Colombia. Understanding maxillofacial trauma helps to evaluate the conduct patterns of people in different countries and helps to establish valuable actions through which injuries can be prevented and treated. This article presents the age, sex, etiology, type, and site of fracture for 2680 patients treated for maxillofacial fractures from January 1998 to December 2010 in the main public hospital in Medellín.

MATERIAL AND METHOD.

This was a retrospective study which reviewed data from 2680 patients sustaining maxillofacial fractures and who were attended between 1998 and 2010 at the Oral and Maxillofacial Surgery Department of the San Vicente de Paul University Hospital in Medellín, Colombia. This hospital is a central referral emergency hospital in the area and all kinds of emergency patients are referred to this hospital.

On admission the patients gave their consent to use the data obtained during the examination and treatment for further scientific projects. The data was collected from charts of patients admitted to the University Hospital. Charts that did not have complete information about the trauma were excluded, and subjects who had either died before treatment or had been referred to other facilities were excluded as well. Information relevant to the study was obtained from the patient directly; when this was not possible, collateral history was obtained from either the police or relatives attending to the patients. History of the injury, medical and drug history were noted, while clinical and radiographic examinations were carried out. The patients were evaluated by age, gender, etiology, type of injury, treatment modalities and hospitalization time. Causes were grouped into five categories: road traffic collisions, interpersonal violence (fights, assaults

and gunshots), falls, animal impact and other causes. The fractures were classified as mandible fractures (condyle, coronoid process, ramus, body, angle, parasymphysis, symphysis and alveolar process fractures), zygomatic complex fractures, maxillary fractures according to the system of Le Fort (1901) and alveolar process fractures of the maxilla. The treatments were divided into closed reduction (maxillomandibular fixation) and open reduction (open reduction and stable rigid fixation). Besides, craniofacial suspension wiring was used. In the same way, Killey classification was handled to rate the fractures that were treated conservatively (Banks 1991). The period between first consultation and surgery were also analyzed.

According to a previous work (Naveen *et al.*, 2012), the patients were grouped into 7 age categories: from 0 to 10, from 11 to 20, from 21 to 30, from 31 to 40, from 41 to 50, from 50 to 60 and over 60 years.

Data collected were analyzed using the statistical package for social sciences (SPSS) for Windows version 19. Data was summarized in form of proportions and frequency tables for categorical variables. Means, median and standard deviation were used to summarize continuous variables. The Chi-Square test was used to compare the counts of categorical response between two independent variables. The statistical significance was fixed at 0.05.

RESULTS

In this study, 4893 fractures in 2680 patients were included. The total number of patients receiving a surgical treatment increased from the period 1999-2006 to 2007, beginning to decrease since then (Fig. 1). Of the patients, 81.8% were males and 18.2% were females ($p < 0.001$). The patients' age ranged between 1 month and 85 years, with a mean of 26,5 and a median of 24. Among the patients 38.5% were between 21 and 30 years. The mean and the median were, respectively, 27 and 25 in males and 23 and 21 in females ($p < 0.05$). The majority of fractures in males (85%) and females (84.8%) occurred before 40 years. The occurrence decrease with age after that, and the risk was proportionally related to age. A total of 1294 subjects (48.4%) presented a single fracture, 746 (28%) presented two fractures, and 640 patients presented more than two fractures, with an average of 1.94 (± 1.27) fractures per patient.

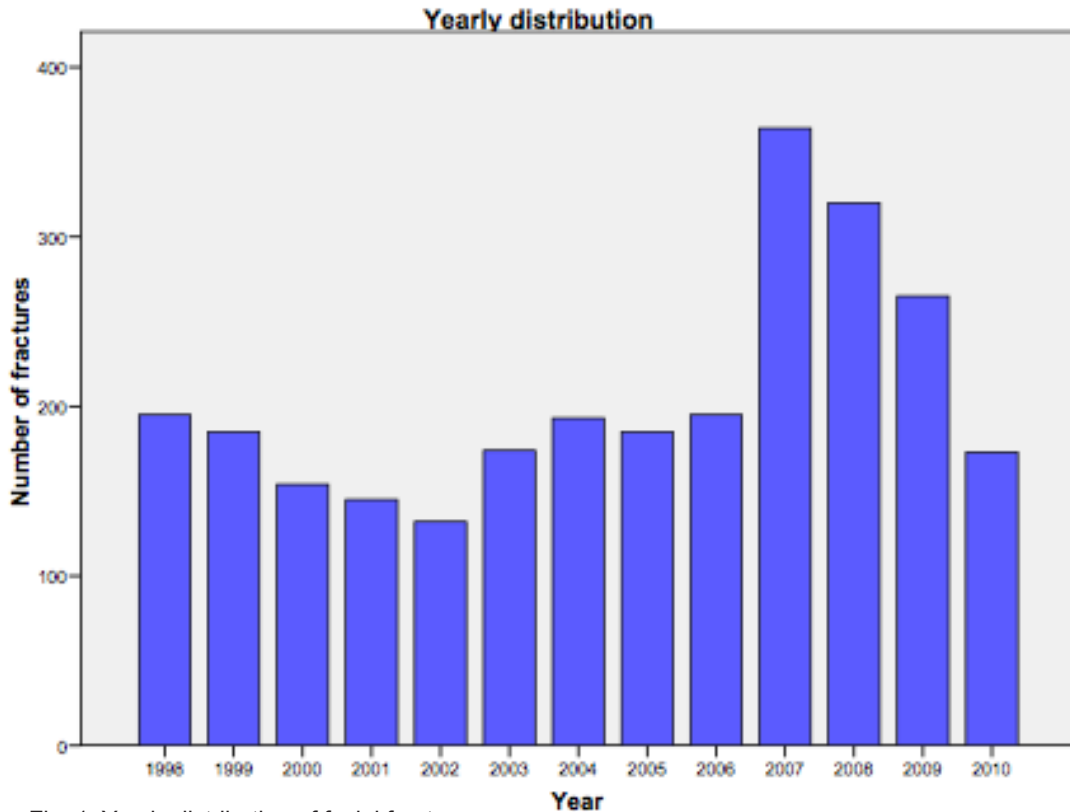


Fig. 1. Yearly distribution of facial fractures.

Regarding fracture type, mandibular, maxillary alveolar process and zygomatic bone fractures, in both males and females, were the anatomical sites most fractured, representing 3597 (55%), 923 (19%) and 913 (18%) of the injuries, respectively. The main fracture site of the mandible was the mandibular condyle (542; 12%), followed by mandibular alveolar process (492;10%) and fracture of the parasymphysis (474; 9.6% subjects). In fractures of the upper 2/3 of the face, maxillary alveolar process and zygomatic bone fractures were most common. Table I shows the frequency of maxillofacial fractures observed in this study. A statistically significant association was seen between some types of fractures and males, as seen in Table II. Table III depicts the frequency of etiologic factors associated with maxillofacial fractures. The most frequent cause of injury was road traffic collision (55.8%), followed by interpersonal violence (24.9%); a significant statistical association was seen between both etiologic factors and the anatomical sites most fractured (Table IV). When comparing males to females, road traffic collisions and violence related fractures, proved to be significant higher in males ($p < 0.0001$).

The age groups were used to establish an

association between the number of fractures and etiologic factors (Table V), and the treatment modality (Table VI). Regarding the number of fractures by age group, a statistically significant association was seen between the age group involving 21 and 30 years and the etiologic factors, except for falls; it is important to note that falls were the main cause of injury in the age group involving 0 and 10 years (Table V).

Of the 2680 maxillofacial fractures, 35.6% were treated using open reduction and 33.7% using closed reduction; 21% were treated non-operatively and in these cases, the treatment of choice was analgesics, a liquid-to-soft diet and observation. Moreover, craniofacial suspension wiring was used in 260 subjects (9.7%). Concerning the treatment modality, there was statistically significant association, which means that the treatments were influenced by the age of the patient (21-30 years) (Table VI).

Table VII summarizes the period between first consultation and surgery for the 2680 patients sustaining maxillofacial fractures; 821 (30.6%) patients had their surgery on the same day after the clinical evaluation.

Table I. Patterns of maxillofacial fractures.

Type of fracture	Patients	%
Mandible	2674	55
Condyle	542	12
Alveolar Process	492	10
Parasymphysis	474	9.6
Body	429	8.7
Angle	375	7.6
Ramus	162	3.2
Symphysis	124	2.4
Coronoid process	76	1.5
Maxilla	1306	27
Alveolar Process	923	19
Le Fort I	221	4.5
Le Fort II	102	2
Le Fort III	46	1
Le Fort IV	17	0.5
Zygomatic	913	18

Table II. Association between some types of fractures and sex.

Type of fracture	Male	Female	p value
Mandibular Alveolar Process	418	74	0.04
Ramus	145	17	0.05
Maxilla Alveolar Process	730	193	0.007
Le Fort I	206	15	0.0001
Zygomatic	785	128	0.02

Table III. Frequency of etiologic factors associated with maxillofacial fractures.

Etiologic factor	Patients	%
Road traffic accident	1497	55.8
Interpersonal violence	667	24.9
Falls	311	11.6
Animal impact an others	205	7.7
Total	2680	100

Table IV. Association between Road traffic accident and Interpersonal violence with the anatomical sites most fractured.

Etiologic factor	Mandibular	Maxilla alvedar process	Zygomatic
Road traffic accident	1469*	628*	533*
Interpersonal violence	847**	115**	179**

*p=0.001 **p=0.01

Table V. Association between the number of fractures and etiologic factors by age.

Age	Road traffic collisions	Interpersonal violence	Fall	Animal, others
0-10	119	27	127*	11
11-20	378	149	42	31
21-30	548*	259*	52	56
31-40	220	126	40	41
41-50	143	78	29	28
51-60	54	23	13	25
>60	35	5	8	13
Total	1497	667	311	205

*p=0.001

Table VI. Association between treatment modality and age.

Age	Open Reduction	Close reduction	non-operatively	Craniofacial suspension wiring
0-10	43	24	74	56
11-20	207	248	93	47
21-30	378	388	151	88
31-40	174	152	94	35
41-50	101	67	70	19
51-60	38	18	47	12
>60	14	7	32	3
Total	955	904	561	260

Table VII. Period between first consultation and surgery for the 2680 patients sustaining maxillofacial fractures.

Day	Patients	%
1	821	38.7
2-7	805	37.9
8-15	385	18.1
>16	669	5.3
Total	2680	100

DISCUSSION

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 (Brasileiro & Passeri, 2006). The present study shows that the most common cause of maxillofacial fractures was road traffic accidents, which is consistent with other studies in developing countries (Adeyemo *et al.*, 2005; Malara *et al.*, 2006). In Colombia, traffic and safety laws are not implemented strictly; consequently road traffic accident is responsible for almost 56% of maxillofacial fractures in the present study. A peculiar characteristic found in Medellín, is the high number of motorcyclists that move in the traffic, a fact that could explain the high number of occurrence of road traffic accidents. The main types of victims in Colombian urban traffic are pedestrians and motorcyclists; the men are more frequently subjected to these injuries (Rodriguez *et al.*, 2003), confirming our results. Furthermore, these findings corroborate data observed in Poland and Australia (Malara *et al.*, 2006; Wood & Freer, 2001). In Colombia, after 2007, the enforcement of traffic rules has decreased the number of traffic accidents and this fact could explain the reduction of this kind of trauma. Similarly, the traffic accidents mortality in Spain has decreased by 14.5% due to the implementation of the driving license points system (Izquierdo *et al.*, 2011). In Colombia, the target priorities for an intervention program are urban roadways and young men, given that the majority of the vehicle crash injuries in the country involve young drivers in the cities (Posada *et al.*, 2007).

As was shown in the present investigation, interpersonal violence is the second leading cause of maxillofacial fractures in developing countries (Adeyemo *et al.*, 2005; Al Ahmend *et al.*, 2004). Fractures that occur most frequently following interpersonal violence are the mandible, maxillary alveolar process followed by the zygomatic bone, which is in accordance with previous reports (Adeyemo *et al.*, 2005; Naveen *et al.*, 2012). Collaboration among national governments and health-related nongovernmental and multilateral organizations can establish the importance of formally addressing violence through public health approaches. Though legal and criminal justice approaches provide a deterrent, experience in high-income countries suggests that a proactive public health approach can reduce the negative health, social, and economic consequences of interpersonal

violence (Rosenberg *et al.*, 2006). In the study published by Chrcanovic *et al.*, (2004) road traffic accidents and violence were the main etiologic factors of maxillofacial trauma. Our data are in line with the literature worldwide.

In agreement with other investigations (Naveen *et al.*, 2012; Subhasraj *et al.*, 2007), the majority of patients in the present study were young adult in their third decade (21-30 years); this information may be attributed to the fact that people in this period of life are more active regarding high speed transportation, fights and violent activities. Proper education to these groups may reduce their involvement in such accidents. The present study showed that falls were the main cause of injury in the age group involving 0 and 10 years. This is in conformity with the findings of Singh *et al.* (2011). Pediatric maxillofacial fractures are not common and demonstrate different clinical features when compared with adults. They also need different treatments due to the differences in their facial bones and skulls (Singh *et al.*, 2011).

As would be expected, there was a male preponderance, 81.8% of the cases being men and 18.2% women, in the ratio of 7:1. This can be explained because the majority of such casualties result from traffic accidents, assaults and violence, where men are more often involved (Naveen *et al.*, 2012; Malara *et al.*, 2006).

The frequency of mandible fracture in our group population was 55%. The mandibular fracture is the most prevalent maxillofacial injury in many countries (Adeyemo *et al.*, 2005; AL Ahmend *et al.*, 2004). Injuries leading to mandibular fractures are influenced by various factors such as the severity and anatomical sites of impacting force, whether the mouth was opened or closed at the time of injury, the presence or absence of teeth and the cross sectional area of bone. In other instances, especially following road traffic accidents, fractures may occur at sites of impact irrespective of the thickness of the bone or the presence of muscles Anyanechi & Saheeb, 2011).

It is known that the most common mandibular fracture location is the condyle. Our findings are similar to other studies in this regard (AL Ahmend *et al.*, 2004; Brasileiro & Passeri, 2006). Sawazaki *et al.* (2010) showed that the most common cause of

condylar fractures was road traffic accidents, which is in line with our results. These findings are in contrast with those of a study, which presented the body mandibular region as the most common location (Ellis *et al.*, 1985).

The results of this study revealed that the maxillary alveolar process and the zygomatic bone fractures were the most common fractures of the upper 2/3 of the face. The prevalence of maxillary alveolar process fractures varies according to the type of study, country where the study was conducted, and even different regions in a single country (Adeyemo *et al.*, 2005). Maxillary alveolar process fractures are frequently overlooked in surveys that review maxillofacial injury (Gassner *et al.*, 2003, 2004). Only the analysis of a large number of injuries reveals the risk of suffering from alveolar process fracture. Gassner *et al.* (2003) in a large series of 9.543 patients with 21.067 maxillofacial injuries reported an incidence of 49.9% of alveolar process fractures among their patients. On the other hand, Naveen *et al.* (2012) and van den Bergh *et al.* (2012) indicated that the majority of the upper 2/3 face fractures were zygomatic bone fractures, confirming our results. Our study also showed that midface fracture was frequent among road traffic accidents followed by interpersonal violence; these findings are similar to previous reports (Naveen *et al.*, 2012; van den Bergh *et al.*, 2012).

There are many treatment regimens in maxillofacial fractures, but the selection may change according to the type and location of the fracture, patient characteristics, and the surgeon's experience

and preference. Each patient and fracture has particular properties; therefore, standardization is not possible (Ozkaya *et al.*, 2009). In this study, most cases were treated using open reduction (35.6%) and closed reduction (33.7%). Although, open reduction and internal fixation remains the "gold standard" of treatment of maxillofacial fractures (van Sickels, 2005), closed reduction has been commonly used (Naveen *et al.*, 2012; Ozkaya *et al.*, 2009). Undisplaced fractures were managed conservatively.

The ideal time to treat maxillofacial fractures depends on the location of the trauma and the age of the patient (Maliska *et al.*, 2009). In the present study, the treatment was accomplished on the same day of the first consultation in 38.7% of the patients, or two to seven days after it (37.9%). These data are in accordance with previous studies 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 (Maliska *et al.*, 2009).

The results of the present study confirm that road traffic accidents remain among the main reasons of maxillofacial fractures following the traumas resulting from assaults and interpersonal violence. Therefore, an awareness campaign to educate the public, especially the drivers, about the importance of restraints and protective measures in motor vehicles should be started. Additionally, the government ought to develop policies that strengthen social investment as a strategy to decrease violence and increase economic growth.

DUQUE, F. L.; AGUDELO-SUAREZ, A. A. & ARDILA, C. M. Patrón etiológico de fracturas maxilofaciales en Medellín, Colombia: un Análisis retrospectivo de 2680 pacientes. *Int. J. Odontostomat.*, 7(1):159-166, 2013.

RESUMEN: Las lesiones maxilofaciales pueden causar complicaciones funcionales, estéticas y psicológicas significativas a largo plazo. Además, pueden representar una consecuencia económica sustancial para los pacientes, y su tratamiento puede implicar un procedimiento complejo. El propósito de este estudio retrospectivo fue investigar el patrón de las fracturas maxilofaciales en Medellín, Colombia en un período de 13 años (1998-2010). Se estudiaron 2.680 pacientes con 4.893 fracturas maxilofaciales, quienes ingresaron al Departamento de Cirugía Oral y Maxilofacial del Hospital Universitario San Vicente de Paúl en Medellín, Colombia. Los pacientes fueron evaluados clasificados según edad, sexo, etiología de la fractura, tipo de lesión, tratamiento y tiempo de hospitalización. Se utilizó la prueba de chi-cuadrado para comparar los conteos de respuestas categóricas entre dos variables independientes. La muestra se conformó por 2.193 hombres y 487 mujeres, con una edad promedio de 26,5 años (DE 13,5). El grupo entre 21-30 años fue el más numeroso. La causa más común de fracturas fue el accidente de tránsito, seguido por la violencia interpersonal. En ambos sexos se observaron, principalmente, fracturas de la mandíbula, proceso alveolar maxilar y hueso cigomático; aproximadamente el 92% de todas las fracturas. En la mandíbula, el sitio principal de fractura fue el cóndilo mandibular. Los resultados revelan que los accidentes de tránsito aun son la principal causa de fractura maxilofacial. Se debe enfatizar en medidas de prevención de los accidentes de tránsito, junto a políticas que fortalezcan la inversión social con el fin de reducir la aparición de estas lesiones.

PALABRAS CLAVE: Fractura maxilofacial, estudio retrospectivo, accidentes de tránsito.

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