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Multicenter epidemiological study of maxillofacial trauma: a one-year retrospective-descriptive assessment of 1356 cases in a Colombian metropolitan region.

Estudio epidemiológico multicéntrico de trauma maxilofacial: evaluación retrospectiva-descriptiva de un año, de 1356 casos en una región metropolitana de Colombia.

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Abstract: Background: This retrospective study was conducted to identify the epidemiological profile and treatment modalities linked to the maxillofacial trauma (MFT) managed in the Maxillofacial Surgery Departments of seven hospital centers in Antioquia, Colombia. Material and Methods: Clinical records with specific attention to sociodemographic characteristics, mechanisms of injury, type of MFT, location of injuries, and treatment modalities of MFT were collected from January to December 2017. Descriptive analyses using Pearson's chi-square tests were performed. Results: A total of 1356 records were retrieved.Males were significantly more affected, with a male-to-female ratio of 3.85:1. The most susceptible age group involved was young adults (18 to 40 years). A low percentage of alcohol (9.3%) and drugs consumption (2.5%) was recorded. Most common causes of MFT were road traffic accidents (RTA), falls, and interpersonal violence (IPV). Most injuries involved both soft and hard tissues followed by hard tissues and isolated open soft tissue injuries. Among fractures, the middle third was the most commonly affected site and the utmost method of treatment was open reduction and internal fixation. Conclusion: Within the limitations of the evidence available, this study has demonstrated that the gender, age stratum, and etiological factors, such as RTA, falls, and IPV, but no alcohol and/or psychoactive substances consumption, may have a significant influence on the prevalence, patterns, and treatment modalities of MFT in this sample population.

Keywords: *epidemiology; etiology; maxillofacial injuries; jaw fractures; therapeutics; young adult.*

Resumen: Antecedentes: Este estudio retrospectivo se realizó para identificar el perfil epidemiológico y las modalidades de tratamiento vinculados al Trauma Maxilofacial (TMF) atendido en los Servicios de Cirugía Maxilofacial de siete centros hospitalarios de Antioquia, Colombia. Objetivo: Material y Métodos: Se recopilaron historias clínicas con atención específica a las características

sociodemográficas, mecanismos de lesión, tipo de TMF, ubicación de las lesiones y modalidades de tratamiento de TMF de enero a diciembre de 2017. Análisis descriptivos utilizando el chi-cuadrado de Pearson fueron realizados. **Resultados:** Se recuperaron un total de 1356 registros. Los hombres se vieron significativamente más afectados, con una relación hombre-mujer de 3,85:1. El grupo de edad más susceptible involucrado fue el de los adultos jóvenes (18 a 40 años). Se registró un bajo porcentaje de consumo de alcohol (9,3%) y drogas (2,5%). Las causas más comunes de TMF fueron los accidentes de tránsito (ADT), las caídas y la violencia interpersonal (VIP). La mayoría de las lesiones involucraron tejidos blandos y duros, seguidas de tejidos duros y lesiones abiertas aisladas de tejidos blandos. Entre las fracturas, el tercio medio fue el sitio afectado con mayor frecuencia y el método de tratamiento más utilizado fue la reducción abierta y la fijación interna. **Conclusion:** Dentro de las limitaciones de la evidencia disponible, este estudio ha demostrado que el género, el estrato etario y los factores etiológicos, como ADT, caídas y VIP , pero no el consumo de alcohol y/o sustancias psicoactivas, pueden tener una influencia significativa en la la prevalencia, los patrones y las modalidades de tratamiento de TMF en esta poblaión muestral.

Palabras Clave: *epidemiología; etiología; traumatismos maxilofaciales; fracturas maxilomandibulares; terapéutica; adulto joven.*

INTRODUCTION.

The maxillofacial (MF) region comprises soft and hard tissues of the face extending from the frontal bone superiorly to the mandible inferiorly.[1] This region is very prone to injuries because of the prominence of the face[2] and the lesions may cause cranial and facial bone fractures, as well as nerve, dental, soft tissue, ear, nose, eyes, and other associated structures injuries.[3] Additionally, MF trauma (MFT) might also bear emotional, functional, and cosmetic repercussions[4] and unfavorable fina-ncial effects on the health system, becoming one of the major health problems worldwide.[5]

Although some studies have concluded that MFT occurs in approximately 5 to 33% of patients experiencing severe injuries,[6,7] the epidemiological features of MFT are extremely variable, so that the incidence and etiology differ from one country to another and even within the same country, due to factors such as cultural and lifestyle differences, risk variables, and socioeconomic status of the population investigated.[8]

Exhaustive knowledge and understanding of the etiology, frequency, and severity of MFT is fundamental for the development of health services, planning of health actions, as well as for the establishing of effective treatments and prevention measures.[9-11]

Although many studies about incidence and etiology of MFT have been performed worldwide, periodic update of trauma data is important for refining treatment algorithms and for prevention and improvement in its management.[12] Therefore, this study aimed to identify the epidemiological profile and treatment modalities linked to the MFT managed in the Maxillofacial Surgery Departments of seven hospital centers in the Metropolitan Area of the Aburrá Valley in Antioquia, Colombia.

MATERIALS AND METHODS.

Study design and inclusion/exclusion criteria

This retrospective study was carried out following the ethical guidelines of the Helsinki Declaration and was approved by the Institutional Ethics Committee for Human Studies of the University of Antioquia in Medellín, Colombia (Concept Number 15-2016). The study sample consisted of clinical data abs-tracted from the clinical records of 1356 patients with MFT evaluated from January to December 2017 in the Maxillofacial Surgery Departments of the CES-Prado Clinic, General Hospital, North Clinic, Las Vegas Clinic, San Vicente Foundation University Hospital,

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Leon XIII Clinic, and SOMA Clinic, all located in the Metropolitan Area of the Aburrá Valley in Antioquia, Colombia. The inclusion criterion was a complete clinical record of first-time MFT cases treated within the review period. Conversely, the exclusion criteria applied were patients who have incomplete details or history, only minor superficial soft tissue injuries, repeated admissions by MFT, presence of pathological disorders of the MF region such as cysts, tumors, MF infections, and bone-related lesions of the jaws which may predispose to facial fractures, as well as those cases that were not treated in the Maxillofacial Surgery Departments of the included centers.

Clinical data collection

The data obtained were gathered in a Google Docs standardized tool located on an internet ser-ver with the exclusive domain of the study's authors.

The socio-demographic variables documented included gender, age at the time of the injury, as well as alcohol and/or psychoactive substances consumption before the incident (found through information from the patient and/or physical exam). Based on the criteria of a similar study performed in Brazil,[4] the age range was stratified according to the stage of the life cycle as follows: children (≤10 years), adolescents (11 to 17 years), young adults (18 to 40 years), middle-aged (41 to 65 years) and elderlies (>65 years).

The mechanisms of injury were classified into road traffic accident (RTA), falls, interpersonal violence (IPV), work-related injuries, sport-related injuries, animal injuries, and "others" which comprised less frequent types of accidents such as domestic accidents, self-inflicted injuries, explosive accidents, blunt objects fall, and iatrogenic surgical trauma. In turn, clinical variables related to the injuries comprised the type of MFT, including isolated facial open soft-tissue injuries on the facial region, hard-tissue injuries (dental and MF bone fractures), and combined MF injuries (soft- and hard-tissue injuries). Diagnosed fractures were determined by computed tomography scans at admission to hospitals.

They were initially classified according to the affected MF region as isolated dental, upper third, middle third, lower third, and more than one third fractures.

Afterward, the type of MF fracture was classified according to the anatomical site of MF bones considering the main type of fracture, so that when a specific fracture was part of a major type of fracture, it was classified only as the major type.

Consequently, upper third fractures were categorized as supra-orbital rim, frontal sinus, and multiple fractures; middle third fractures were divided into maxillary (including Le Fort types I, II and III, palatine bone, and maxillary sinus), orbital, zygomatic complex (including the zygomatic bone and the zygomatic arch), nasal, alveolar process and multiple fractures (including two or more iso-lated fractures and naso-orbital-ethmoid complex fractures); lower third or mandibular fractures included symphysis/parasymphysis, body, angle, ramus/coronoid, condyle, alveolar process, and multiple mandibular fractures, and fractures invol-ving more than one-third were stratified as lower-middle, middle-upper, and panfacial fractures.

Subsequently, the treatment modality for MF bone fractures was stratified based on methods previously described[13,14] as follows: observation/conservative management (soft diet and monitoring of results), closed reduction (CR), open reduction and internal fixation (ORIF), and combined surgical treatment (*i.e.*, open and closed reduction).

Statistical methods

The data collected were entered and analyzed in the Statistical Package for Social Sciences (SPSS 26.0®, IBM, Armonk, NY) using descriptive statistics of frequency distributions and per-centages. Gi

ven the categorical nature of the variables under study, all comparisons were tested using the Pearson's chi-square (χ^2) probability test. p-values <0.05 were considered as statistically significant.

RESULTS.

Demographics, mechanisms, and type of MF injuries

Table 1 shows the comparison between socio-demographic parameters and mechanisms of MFT.

For the period of 12 months evaluated in the

different centers, a total of 1356 cases of MF injuries met the eligibility criteria and were included in the study.

Of these cases, 79.4% were male patients (age range: 0-95 years, mean 33.4 ± 18.4 years) whereas 20.6% were female (age range: 0-99 years, mean 33.5 ± 24.7 years), yielding a male-to-female ratio of 3.85:1. The most susceptible age group involved was young adults (52.1%), followed by middle-aged individuals (21.5%), children (10.4%), elderlies (8.0%), and adolescents (7.9%).

A history of preceding alcohol consumption was present in 9.3% of the patients, being significantly greater in young adult males ($p<0.05$, χ^2; data not shown). Otherwise, psychoactive substance use was only noted in 2.5% of the cases, being significantly more frequent in young adults ($p= 0.001$, data not shown) with no differences by gender ($p>0.05$, data not shown).

Descriptive analysis of the results showed that RTA was the most frequent causative factor, accounting for 50.2% of the cases. The second most frequent causative factor was falls, with 21.5% of the cases and IPV accounted for 16.5% of the patients. In contrast, the lower frequencies were noted for sport-related injuries (4.8%), animal injuries (2.4%), work-related injuries (1.8%), and other grouped causes (2.8%).

As also can be seen from Table 1, significant variations in the mechanisms of MFT regarding gender and age stratum ($p<0.001$, χ^2) were detected. Overall, it was noticeable that whereas in all categories males outnumbered females, the proportion of males was significantly higher in falls, IPV, and work-related injuries (all $p<0.05$), but no significant differences in gender were found among RTA, sport-related injuries, animal injuries, and other grouped causes (all $p>0.05$).

It was also noticeable that the population from 18 to 40 years of age (young adults) was significantly more affected by RTA, IPV, sport-related injuries, and other grouped causes, whereas children (≤10 years) suffered significantly more falls, and middle-aged individuals (41 to 65 years) were significantly involved in more animal injuries when comparing with the other age groups (all $p<0.001$).

Alternatively, none of the patients with work-related, sport-related, and animal injuries were reported under alcohol or psychoactive substances influence during the incidents, which led to a significantly lower frequency of cases with alcoholic or drug intoxication when considering all the types of causative factors ($p<0.05$), data not shown.

Summary statistics of socio-demographic parameters and mechanisms of injury with reference to the type of MFT are presented in Table 2. Most injuries (48.5%) involved both facial soft and hard tissues (*i.e.*, combined facial injuries), followed by facial hard tissue injuries (43.4%) and only 8.1% of the patients had isolated facial open soft tissue injuries without facial hard tissue fractures. Intragroup comparisons showed that although there was a significantly greater proportion of males affected by open soft-tissue injuries ($p<0.001$), no significant differences regarding gender could be detected when comparing with the other types of MFT ($p>0.05$).

At the same time, children (≤10 years) suffered significantly more Isolated open soft-tissue injuries ($p<0.001$) and young adults (18 to 40 years) were significantly more involved in hard tissue and combined maxillofacial injuries ($p<0.05$). Conversely, no significant differences ($p>0.05$) in relation to the alcohol or psychoactive substances consumption were observed with reference to the type MFT groups.

Regarding mechanisms of injury, whilst no statistically significant differences ($p>0.05$) were observed for combined maxillofacial injuries subgroup, it was noteworthy that falls contributed significantly ($p<0.001$) to the proportion isolated open soft-tissue injuries, whereas a significantly greater number RTA was responsible of hard-tissue injuries ($p=0.002$).

Fracture patterns and mechanisms of MFT

The details of the anatomical location of the MF fractures are listed in Table 3. A total of 1246 fractures were recorded with the middle third of the

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face being the most commonly affected site (49.9%), followed by fractures involving more than one facial third (21.0%), lower third (20.5%), isolated dental fractures (5.7%), and upper third fractures (2.9%).

As it is shown in Table 3, when associating anatomical fracture location with its etiology, significant variations were noted. It appears that work-related injuries, animal injuries or other grouped causes have no significant influence on the anatomical distribution of the lesions (p>0.05). On the contrary, the proportion of RTA was significantly higher in patients with fractures involving more than one facial third and in cases with middle third fractures (p<0.05). In turn, the proportion of falls was significantly higher in patients with isolated dental fractures than in cases with fractures of other anatomical locations (p<0.001).

In contrast, the proportion of cases related to IPV was significantly more frequent in lower third fractures when compared with other anatomical locations (p<0.001).

Furthermore, although sport-related injuries were more frequently related to middle third fractures, only a marginal difference (p= 0.048) with respect to the anatomical locations of the MF fractures could be noted.

Table 1. Comparison of mechanisms of maxillofacial trauma with reference socio-demographic characteristics of the patients.

Variable	Mechanism of maxillofacial trauma.[a]							
	Total of cases (n = 1356)	RTA[b] (n = 681)	Falls (n = 291)	IPV (n = 224)	Work injuries (n = 25)	Sport injuries (n = 65)	Animal injuries[c] (n = 32)	Others[d] (n = 38)
Gender								
Male	1076 (79.4)	549 (80.6)	198 (68.0)	200 (89.3)	24 (96.0)	53 (81.5)	22 (68.8)	30 (78.9)
Female	280 (20.6)	132 (19.4)	93 (32.0)	24 (10.7)	1 (4.0)	12 (18.5)	10 (31.2)	8 (21.1)
	p-value[e]	0.247	<0.001	<0.001	0.038	0.655	0.134	0.950
Age stratum (years)								
≤10	141 (10.4)	21 (3.1)	82 (28.2)	7 (3.1)	- - -	10 (15.4)	9 (28.1)	12 (31.6)
11-17	107 (7.9)	56 (8.2)	17 (5.8)	13 (5.8)	- - -	15 (23.1)	6 (18.8)	- - -
18-40	707 (52.1)	427 (62.7)	73 (25.1)	142 (63.4)	14 (56.0)	31 (47.7)	7 (21.9)	13 (34.2)
41-65	292 (21.5)	132 (19.4)	64 (22.0)	58 (25.9)	11 (44.0)	8 (12.3)	10 (31.3)	9 (23.7)
>65	109 (8.0)	45 (6.6)	55 (18.9)	4 (1.8)	- - -	1 (1.5)	- - -	4 (10.5)
	p-value[e]	<0.001	<0.001	<0.001	0.100	<0.001	<0.001	<0.001
Alcohol Consumption								
Yes	126 (9.3)	70 (10.3)	26 (8.9)	27 (12.1)	- - -	- - -	- - -	3 (7.9)
No	1230 (90.7)	611 (89.7)	265(91.1)	197 (87.9)	25 (100.0)	65 (100.0)	32 (100.0)	35 (92.1)
	p-value[e]	0.209	0.813	0.119	0.106	0.008	0.067	0.763
Psychoactive substances consumption								
Yes	34 (2.5)	17 (2.5)	5 (1.7)	8 (3.6)	- - -	- - -	- - -	4 (10.5)
No	1322 (97.5)	664 (97.5)	286 (98.3)	216 (96.4)	25 (100.0)	65 (100.0)	32 (100.0)	34 (89.5)
	p-value[e]	0.979	0.331	0.265	0.418	0.185	0.359	0.001

a: Values are given as n (%) of cases according to the mechanism of maxillofacial trauma. **b**: Including cases of pedestrians (n = 160), motorcycle passengers (n = 85), motorcycle drivers (n = 407), car passengers (n = 23) and car drivers (n = 6). **c**: Including cases due to dog bites (n = 11) and animal kicks (n = 11) by horses, donkeys, and cows. **d**: Including cases due to domestic accidents (n = 19), self-inflicted injuries (n = 6), explosive accidents (n = 1), blunt objects fall (n = 8), iatrogenic surgical trauma (n = 1) and unknown etiology (n = 3). **e**: Two-sided Pearson's chi-square test (χ^2).

Table 2. Bivariate comparisons of socio-demographic parameters and mechanisms of injury according the type of maxillofacial trauma.

Parameter		Type of maxillofacial trauma[a]		
		Isolated open soft-tissue injuries (n = 110)	Hard-tissue injuries (n = 588)	Combined maxillofacial injuries (n = 658)
Gender	Male	63 (57.3)	480 (81.6)	533 (81.0)
	Female	47 (42.7)	108 (18.4)	125 (19.0)
	p-value[b]	<0.001	0.069	0.145
Age stratum	Children	53 (48.2)	25 (4.3)	63 (9.6)
	Adolescents	7 (6.4)	45 (7.7)	55 (8.4)
	Young adults	27 (24.5)	313 (53.2)	367 (55.8)
	Middle-aged	15 (13.6)	144 (24.5)	133 (20.2)
	Elderlies	8 (7.3)	61 (10.4)	40 (6.1)
	p-value[b]	<0.001	<0.001	0.021
Alcohol consumption	Yes	12 (10.9)	53 (9.0)	61 (9.3)
	No	98 (89.1)	535 (91.0)	597 (90.7)
	p-value[b]	0.542	0.757	0.979
Psychoactive substances consumption	Yes	1 (0.9)	15 (2.6)	18 (2.7)
	No	109 (99.1)	573 (97.4)	640 (97.3)
	p-value[b]	0.263	0.928	0.602
Mechanisms of injury	RTA[c]	16 (14.5)	314 (53.4)	351 (53.3)
	Falls	44 (40.0)	126 (21.4)	121 (18.4)
	IPV	21 (19.1)	99 (16.8)	104 (15.8)
	Work-related injuries	4 (3.6)	7 (1.2)	14 (2.1)
	Sport-related injuries	4 (3.6)	26 (4.4)	35 (5.3)
	Animal injuries[d]	12 (10.9)	3 (0.5)	17 (2.6)
	Others[e]	9 (8.2)	13 (2.2)	16 (2.4)
	p-value[b]	<0.001	0.002	0.099

a: Values are given as n (%) of cases according to the type of maxillofacial trauma. b: Two-sided Pearson's chi-square test ($\chi 2$). c: Including cases of pedestrians (n = 160), motorcycle passengers (n = 85), motorcycle drivers (n = 407), car passengers (n = 23) and car drivers (n = 6). d: Including cases due to dog bites (n = 11) and animal kicks (n = 11) by horses, donkeys and cows. e: Including cases due to domestic accidents (n = 19), self-inflicted injuries (n = 6), explosive accidents (n = 1), blunt objects fall (n = 8), iatrogenic surgical trauma (n = 1) and unknown etiology (n = 3).

Table 3. Mechanism of maxillofacial trauma with reference to the anatomical region of the maxillofacial fractures.

Mechanism of maxillofacial trauma	Anatomical location of the maxillofacial fractures[a]					
	Isolated dental fractures (n = 71)	Lower third fractures (n = 255)	Middle third fractures (n = 622)	Upper third fractures (n = 36)	More than one third (n = 262)	*p*-value[e]
RTA[b]	32 (45.1)	109 (42.7)	334 (53.7)	19 (52.8)	171 (65.3)	<0.001
Falls	27 (38.0)	44 (17.3)	136 (21.9)	4 (11.1)	36 (13.7)	<0.001
IPV	3 (4.2)	67 (26.3)	93 (15.0)	7 (19.4)	33 (12.6)	<0.001
Work-related injuries	--	9 (3.5)	7 (1.1)	1 (2.8)	4 (1.5)	0.099
Sport-related injuries	7 (9.9)	15 (5.9)	27 (4.3)	4 (11.1)	8 (3.1)	0.048
Animal injuries[c]	--	6 (2.4)	8 (1.3)	--	6 (2.3)	0.418
Others[d]	2 (2.8)	5 (2.0)	17 (2.7)	1 (2.8)	4 (1.5)	0.836

a:Values are given as n (%) of cases according to the anatomical location of the maxillofacial fractures. **b:** Including cases of pedestrians (n = 153), motorcycle passengers (n = 84), motorcycle drivers (n = 401), car passengers (n = 22) and car drivers (n = 5). **c:** Including cases due to dog bites (n = 9) and animal kicks (n = 11) by horses, donkeys and cows. **d:** Including cases due to domestic accidents (n = 11), self-inflicted injuries (n = 5), explosive accidents (n = 1), blunt objects fall (n = 8), iatrogenic surgical trauma (n = 1) and unknown etiology (n = 3). **e:** Two-sided Pearson's chi-square test (χ^2).

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Table 4. Treatment modalities in relation to the anatomical sites of maxillofacial bone fractures.

Region/anatomical site	Treatment modality[a]					
	Total of cases (n = 1175)	Observation and/or conservative management (n = 372)	Closed reduction (n = 105)	Open reduction and internal fixation (n = 577)	Combined surgical treatment (n = 121)	*p*-value[b]
Upper third						
Supraorbital rim	18 (50.0)	16 (59.3)	---	2 (22.2)	---	0.058
Frontal sinus	12 (33.3)	9 (33.3)	---	3 (33.3)	---	1.000
Multiple fractures	6 (16.7)	2 (7.4)	---	4 (44.5)	---	0.010
Middle third						
Maxilla	39 (6.3)	28 (12.0)	1 (1.6)	10 (3.3)	---	<0.001
Orbit	73 (11.7)	51 (21.9)	---	22 (7.4)	---	<0.001
Zygomatic complex	52 (8.4)	32 (13.7)	3 (4.7)	16 (5.4)	1 (3.8)	0.002
Nasal bones	72 (11.6)	34 (14.6)	27 (42.2)	11 (3.7)	--	<0.001
Alveolar process	42 (6.8)	9 (3.9)	26 (40.6)	7 (2.3)	--	<0.001
Multiple fractures	344 (55.3)	79 (33.9)	7 (10.9)	233 (77.9)	25 (96.2)	<0.001
Lower third						
Symphysis/parasymphysis	8 (3.1)	2 (4.8)	1 (3.6)	4 (2.9)	1 (2.1)	0.901
Body	5 (2.0)	1 (2.4)	---	3 (2.2)	1 (2.1)	0.887
Angle	17 (6.7)	3 (7.1)	2 (7.1)	12 (8.8)	---	0.220
Ramus/coronoid	3 (1.2)	3 (7.1)	--	---	---	0.002
Condyle	37 (14.5)	9 (21.4)	12 (42.9)	16 (11.7)	---	<0.001
Alveolar process	17 (6.7)	8 (19.0)	4 (14.3)	4 (2.9)	1 (2.1)	0.001
Multiple fractures	168 (65.9)	16 (38.1)	9 (32.1)	98 (71.5)	45 (93.8)	<0.001
More than one-third						
Lower-middle	126 (48.1)	16 (22.5)	9 (69.2)	66 (50.0)	35 (76.1)	<0.001
Middle-upper	119 (45.4)	52 (73.2)	4 (30.8)	55 (41.7)	8 (17.4)	<0.001
Panfacial fractures	17 (6.5)	3 (4.3)	--	11 (8.3)	3 (6.5)	0.524

a: Values are given as n (%) of cases according to the treatment modality category. **b:** Two-sided Pearson's chi-square test (χ^2).

Treatment modalities according to the type of MF fracture

Information about the method of treatment gathered from the operating notes is displayed in Table 4.

Among 1175 patients with MF bony fractures, the treatment provided included ORIF (49.1%), followed by observation/conservative management (31.7%), combined surgical treatment (10.3%), and CR (8.9%).

Upper third fractures included mainly isolated fractures of supraorbital rim (50%) and frontal sinus walls (33.3%), whilst multiple fractures of this facial third accounted for only 16.7% of the total.

Although ORIF was significantly more indicated in cases of multiple fractures of this facial third ($p<0.05$), no differences regarding the treatment modality in cases of supraorbital rim and frontal sinus wall fractures were found ($p>0.05$). In the midface, more than half of the patients (55.3%) suffered multiple fractures.

This was followed by isolated fractures of the orbit (11.7%), nasal bones (11.6%), zygomatic complex (8.4%), alveolar process (6.8%), and maxilla (6.3%). For this anatomical location, a significantly major number of fractures of maxilla, orbit, zygo-

matic complex, and nasal bones were managed conservatively with support medication for pain, soft diet, a short course of systemic steroids/vitamin B com-plex and monitoring of results, whereas CR and ORIF were mainly applied in cases of alveolar process and multiple maxillary fractures, respectively (all *p*-values <0.01). As for the lower third, most of the patients (65.9%) experienced multiple mandibular fractures. Moreover, these were followed by isolated condyle fractures (14.5%), angle fractures (6.7%), alveolar process fractures (6.7%), and less frequently isolated symphyseal/parasymphyseal fractures (3.1%), body fractures (2.0%) and ramus/coronoid fractures (1.2%).

Although, there were no significant differences in the treatment methods for symphysis/parasymphysis, body, and angle fractures, (all *p*>0.05), observation/conservative management was significantly more employed in the treatment of ramus/coronoid and alveolar process fractures; and ORIF was the main therapeutic choice in cases of condyle and multiple mandibular fractures (*p*-values <0.001). Additionally, the most frequent facial third fracture combination was lower-middle (48.1%), followed by middle-upper third fracture combination (45.4%), and just a small number of cases of panfacial fractures (6.5%).

Furthermore, the treatment with ORIF was significantly more common in cases of lower-middle and middle-upper third fracture combination (*p*-<0.001), but no statistical differences were found in the treatment modalities for panfacial fractures (*p*>0.05).

DISCUSSION.

MFT not only may cause serious injuries to the victims but also impose a significant human and social burden in terms of morbidity, mortality, facial disfigurement, loss of function, and financial expenses associated with these injuries.[15] Thus, knowledge regarding epidemiological features of MFT is essential for both maxillofacial surgeons and health systems, as it leads to the introduction of preventive measures[10] aiming at reducing the incidence of the lesions.[4]

Due to these facts, this retrospective multicenter study was designed to assess the pattern of MFT and various epidemiological factors, including the patient's demographic profile, mechanisms of injury, type of MFT, and treatment modalities in a representative sample of patients from a Colombian metropolitan region.

The differences and conflicts in studies regarding the association of sociodemographic variables with MFT globally are very wide. In this study, the proportion of males affected by MFT was higher than females, which concurs with previously published results.[2,4,8,9,11,13,15-17] Since women are still segregated of the labor market in Colombia,[18] this fact has been attributed to the greater involvement of males in outdoor activities and their greater exposure to violent interactions,[11] while females are restricted to the domestic sphere, and if they do work, it is mainly office work or another stereotypically female profession.[15]

It is important to emphasize, however, that the male-to-female ratio herein observed is comparable with that quoted in reports from Europe, North America, and Brazil, whereas investigations from Asia and Africa reported much higher ratios,[10] so that the cultural, religious, and socioeconomic values of populations might also influence the frequency of MFT in females.[8] The pattern of age distribution of patients revealed that individuals of all ages were affected, ranging from 0 to 99 years. Nevertheless, the young adult patients (18 to 40 years old) were the most predominant from both genders, which is in line with previous findings.[4,11,17] It has been acknowledged that, since young adults usually have greater physical skills and mobility,[4] the frequent occurrence of MFT at this stage of the life cycle can be attributed to the fact that this age group of individuals is more energetic, performs exercises, dangerous sports, and use transportation means at high speeds,[19] and consequently is more vulnerable to risky situations.[4]

Likewise, the frequency of alcohol/psychoactive substances consumption was significantly greater in this age group; hence these habits may be important contributing factors to the high rate of MFT within this population group. It is important to point here

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that the greater affectation of young people is very worrying, since it may possibly generate sequels that could compromise their performance of work activities.[11]

Conversely, in the current study only 8.0% of MFT occurred in elderlies (>65 years), mainly related to falls. Although it is difficult to compare this result with the data published worldwide, as a different definition of the elderly has been used through the studies, this finding parallels those of the European population[20] where falls was the most frequently causative factor observed in this age group. In this sense, it has been accepted that aging is associated with a gradual reduction in several biological functions and sensory deficits that may increase the risk of falls.[4] Compelling evidence suggests that alcohol and/or drugs consumption increase MFT likelihood.[12,16,21] Proposed reasons include the fact that intoxication reduces the cognitive ability to assess risks, reduces the ability to make rational decisions, and reduces the physical ability to escape or defend oneself.[16]

In this study, the low percentage of alcohol and drugs consumption within the study population may be due, on one hand, to that the contribution of these substances was probably under-reported as clinicians may have been unaware or failed to document it in the medical records, so that the rate may be higher;[22] but on the other hand, to that enforcement of legislation about the sale and consumption of alcohol/psychoactive substances in Colombia may have also played a significant role in reducing intoxication-related injuries due not only to the effectiveness of sobriety checkpoints for reducing alcohol consumption, but also to the tighter controls on abuse and distribution channels of psychoactive substances.

The mechanism of injury is another important epidemiological factor that directly affects the incidence, clinical presentation, and treatment modalities of MFT.[17] In this study, it was found that the commonest mode of injury was RTA, which is consistent with the results of many studies and reviews.[8-10,14,16,17,21,23-25]

This has been attributed to several reasons, among them unsuitable road conditions, poor maintenance of vehicles, inadequate implementation of traffic rules and safety norms, recklessness and negligence of drivers and pedestrians, as well as the ignorance of traffic roles.[21,24] Additionally, in agreeance with previous stu-dies,[3,11,13,15,17,26] the present findings confirm that younger adults are more prone to MFT due to RTA. Given the careless and fast driving attitude, the lack of use of safety belts/helmets in this age group and also the interest in adventures among the youth, this population subgroup is more prone to MFT.[25,26] Hence, it would be important to reinforce the existing laws targeting male young adults as a priority in public health programs[3] in order to prevent and/or reduce the frequency of RTA involving this population.

Another important causative factor in this study was falls, which was the second most common injury mechanism, mainly in the children (≤10 years) group. Similarly, several authors[2,23,27] have also reported falls as the second most common cause for MFT in their studies. In agreement to the former, it has been acknowledged that most falls occur in children because they are active and more prone to accidents and injuries, specialty when they are playing without the surveillance of their parents/guardians.[17,23,26]

It is important to point out that the rate of falls may have been overestimated as some patients may not always report an IPV event as the true cause of their injury, thus reporting a fall injury instead.[28] Although IPV has had a profound negative impact on Colombian society,[29] in this study IPV, including intra-familial and gender-based violence, fights and assaults, blunt trauma, firearms and stab wounds, was listed third in the etiology of MFT. This finding contrasts with previous studies undertaken in many developed nations,[12,17,30] where the primary cause of MFT was IPV.

This variation may be due to the different geo-graphic regions, socio-economic status, and samples sizes of the populations in which the studies were conducted. In addition, it was noticed that the escalation in IPV-related MFT involved mainly young

adult males. This finding may be the result of factors such as socioeconomic inequalities, unemployment, social violence, uncontrolled immigration, and/or political violence.[9,23] Accordingly, there would a strong need for assignment of national health priority to the development of preventive programs intended to support government/non-government agencies, communities, and individuals to plan proactively to avoid the increase of IPV.

The extremely low percentages of work-related injuries, sport-related injuries, animal injuries, and other grouped causes could be explained by more efficient safety laws and regulations. Although there were several significant variations regarding age and gender within these causative groups, the males were also much more involved. Given that in Colombia unemployment rates remain higher among women and, especially, among younger groups,[18] they are usually more devoted to housework than outdoor activities and it is possible to argue that they are little exposed to such factors.[23]

On the contrast, males tend to have higher-risk jobs, are more likely to be involved in sports, and are more susceptible to MFT due to their high rate of commuting.[8] Additionally, higher exposure of young adults to sports, behavioral (increased thrill-seeking, willingness to take risks), and physical (increased muscle mass, greater force of impact) factors may also have contributed to the observed rates in sport- and work-related injuries as well as in other grouped causes.[8,31] In addition, most of animal injuries occurred in middle-aged individuals because of farm animal kicks, so it would be possible to infer a major exposure of these individuals related to living in a rural areas[32,33] where those animals are used for agricultural, domestic, and recreational purposes.

Patients with MFT can have injuries with varied degrees of complexity and severity. In the present study, combined MF and hard tissue injuries were the most predominant injury type recorded. Although this result coincides, at least partially, with those of earlier studies,[13,34] also differs from those of others[4,8,16] in which soft tissue injury was the most frequent injury documented.

Besides that those cases of open soft tissue injuries treated in plastic surgery units were not included, it is also possible that differences in results may lie in inclusion criteria, causative factors analyzed, and sample size, since while most of the published evidence has been focused only on hard tissue injuries, few others have reported either hard/soft tissue or soft tissue injuries only.[35]

Given that RTA contributed significantly to the rates of hard tissue and combined MF injuries in comparison with open soft-tissue injuries in which falls occurred frequently, the severity of those injuries may be a function of the force of impact.[34] On the other hand, whilst no differences regarding gender among the patients affected by hard tissue and combined MF injuries were observed, males, mainly under the age of ten years, were significantly more affected by isolated open soft-tissue injuries. As it is possible that not all children victims of violence have reported abuse, this specific pattern of injury might be revealing a modality childhood maltreatment that occurs silently and frequently in Colombia as it has previously described.[36,37]

Few studies have analyzed the occurrence of MF fractures according to the anatomical location. In this study the middle third of the face was most commonly fractured than other areas, which is in concurrence with data previously reported,[2,38] but in contrast to studies which have reported the mandible as the most commonly fractured site.[39,40]

In addition, alike in this study, RTA has been the leading cause for middle third fractures reported by similar studies.[2,41] Although the reasons for this high frequency are difficult to establish, it has been suggested that this pattern may be related to the direction of force from the colliding objects or projecting parts of the vehicles involved in the accidents[34] along inadequate road safety awareness. In contrast, in the current study the proportion of falls was significantly higher in patients with isolated dental fractures than that observed in other anatomical locations.

This finding concurs with previous reports of isolated dental trauma involving a high frequency of

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crown fractures following falls.[42] This fact is usually due the impaction of the lower jaw against the upper teeth.[43] Also, in this study there was a significantly greater proportion of lower third fractures related to IPV incidents, which coincides with data from relevant studies.[43-45] This is probably due to that facial injury from acts of violence frequently results from a kick to the face, with the aggressor commonly targeting its prominent point,[46] so that mandible's prominence made it a favorable site for fracture,[8] being at the same time more vulnerable due to its mobility and less bony support.[38] Also, in these cases, the presence of impacted third molars may represent points of weakness related with the risk of angle fractures.[45]

On the other hand, the highest frequency of sports-related middle third fractures in this study parallels previous results[9] and suggests that the risk of sports-related MF fractures is considerably higher in contact sports that are both popular and lacking in facial protection.[46] The selection of an appropriate treatment approach is a very important step in the management of MFT),[14] must be considered on a case by case basis, and depends upon a variety of factors including the nature of the injury, lesions/comorbidities as-sociated, skills of the surgeon, availability of facilities and instruments, and willingness to pay for the treatment.[15] Overall, in this study the most frequently performed treatment modality was ORIF, followed by observation/ conservative management, combined surgical treatment, and CR.

This finding is in consonance with previous observations[17,22,26,30] and could represent a reflection of the complexity of MFT, since the greater the energy associated with the cause of trauma, the greater the trauma complexity and the greater the probability of surgical treatment.[11,48] Nevertheless, comparing the present results obtained in other studies, there is a difference in treatment modalities, as several studies have also reported that conservative treatment[8,15,49] or CR[35,40] were used more frequently. This discrepancy in the provided treatments may be due to different frequencies of non-displaced fractures or soft tissue injuries, preference for conservative approaches at the study's institutions, refusal of surgical treatment by the patient, lack of equipment and materials for rigid fixation, and healthcare costs. Despite of the former, though maxillofacial surgeons prefer ORIF not only because it offers the advantages of stability and precise anatomical reduction of fragments, early recovery, more rapid return of function, and improvement of patient's comfort,[8,26] but also because it can prevent some undesirable concerns such as body weight reduction, poor oral hygiene, speech difficulties, and periodontal disease associated with the CR approach,[17] treatment choices may be driven by the site and number of fractured bones.[14]

Accordingly, in the present results observation/ conservative management was more frequently chosen in cases of isolated fractures of maxilla, orbit, zygomatic complex, nasal bones, mandibular alveolar process, and ramus/coronoid fractures, while CR were mainly applied in cases of maxillary alveolar process fractures and ORIF was the main therapeutic choice in cases of multiple fractures of the middle and lower facial thirds, mandibular condyle, as well as in cases of lower-middle and middle-upper third fracture combination.

Finally, the results of this study must be interpreted within the context of some limitations. First, the retrospective design could have influenced the study results due to inaccurate original examination, lack of detailed information, and information obtained based on assessment and documentation by various professionals. Second, although the Maxillofacial Surgery Departments included are reference centers for 125 municipalities in Antioquia, the findings are representative only of the region studied and therefore may not be generalized to other regions of Colombia. Third, several open soft tissue injuries, as well as nasal bone and upper-facial third fractures were excluded from this study as other medical specialties achieved the management of these fractures according to the hospitals' policies, which could have led to a sub-registry of cases from our sample.

CONCLUSION.

Within the limitations of the evidence available, this study has demonstrated that the gender, age stratum, and etiological factors such as RTA, falls, and IPV, but no alcohol and/or psychoactive substances consumption, may have a significant influence on the prevalence, patterns, and treatment modalities of MFT in this sample population.

Conflict of interests: The authors declare that they have no financial affiliation or involvement with any commercial organization with direct financial interest in the subject or materials discussed in this manuscript.

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