

# Epidemiology and complications of facial fractures: a 5-year retrospective study<sup>1</sup>

## Epidemiología y complicaciones de las fracturas faciales: un estudio retrospectivo de 5 años<sup>1</sup>

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### ABSTRACT

**Introduction:** regional epidemiological studies involving facial trauma are needed to develop more efficient ways of providing health care services. The time elapsed from the occurrence of facial trauma to its definitive treatment can affect clinical outcomes in terms of interventions, resolution, and complications. The aim of this study was to verify if there is a relationship between the different fracture types, their treatments or time intervals for clinical resolution and the onset of complications. **Methods:** a retrospective study was conducted by means of the clinical records of the Eugenio Espejo Hospital in Quito, verifying the epidemiological data on the clinical evolution of facial trauma patients between 2012 and 2016, and registering data such as age, gender, fracture type, time elapsed until its definitive treatment, and onset of complications. Clinical records lacking these data were excluded. **Results:** most cases occurred outside Quito (64%). There was no relationship between harmful habits, fracture displacement, type of access or fixation, or presence of comorbidities and the onset of complications. The odds ratio (95% confidence interval) for complications was OR = 0.301(0.170-0.536), so there is a 70% increased chance of developing some complications if treatment is performed one week after trauma occurs. **Conclusion:** reducing facial fractures before a week can decrease the onset of complications and sequelae.

**Keywords:** facial bones, fractures, complications, sequelae, lesions, surgery

### RESUMEN

**Introducción:** los estudios epidemiológicos regionales que involucren trauma facial son importantes para ayudar a desarrollar formas más eficientes de brindar cuidados en salud. El tiempo transcurrido desde que ocurre un traumatismo facial hasta su tratamiento definitivo puede afectar los resultados clínicos en términos de intervenciones, resolución y complicaciones. El objetivo del presente estudio consistió en verificar si existe una relación entre los diferentes tipos de fracturas, sus tratamientos y los intervalos de tiempo para su resolución clínica con la aparición de complicaciones. **Metodología:** se realizó un estudio retrospectivo con las historias clínicas del hospital Eugenio Espejo de Quito, verificando los datos epidemiológicos de la evolución clínica de pacientes con trauma facial entre el 2012 y 2016. Para ello se tomaron datos como edad, sexo, tipo de fractura, tiempo transcurrido hasta su tratamiento definitivo y aparición de complicaciones. Se descartaron las historias que no tuvieron todos los datos para este trabajo. **Resultados:** la mayoría de los casos ocurrió fuera de Quito (64%). Se observó que no existe relación entre hábitos nocivos, desplazamiento de fractura, tipo de abordaje o de fijación y presencia de comorbilidades con la aparición de complicaciones. El resultado de razones de probabilidad (intervalo de confianza) para las complicaciones fue de OR=0.301(0.170-0.536); por lo tanto, existe un 70% más de probabilidad de presentar alguna complicación si el tratamiento se realiza después de una semana de ocurrido el trauma. **Conclusión:** la reducción de las fracturas faciales antes de una semana puede disminuir la ocurrencia de complicaciones y secuelas.

**Palabras clave:** huesos faciales, fracturas, complicaciones, secuelas, lesiones, cirugía

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## INTRODUCTION

Facial fractures are very common clinical situations in emergency rooms. Lesions of the maxillofacial complex are significant public health problems, not only for costs but also because of the functional and aesthetic problems that patients can suffer. The clinical characteristics of trauma and treatment methods vary according to social issues, geopolitical variations, and technological advances.<sup>1-7</sup>

Regional epidemiological studies involving maxillofacial trauma can help develop more efficient ways to provide health care services and to assess and improve quality, in addition to create strategies for prevention, financing and access to treatment in the public sector.<sup>1</sup>

The treatment of facial fractures has experienced huge improvements in the last decades thanks to the introduction of better devices that are more functional in the reduction, fixation, and immobilization of fractures. However, some debate remains about fracture types, kind of access, treatment delays and their relationship with complications and sequelae.<sup>2</sup> The time interval from fracture to final resolution is a controversial aspect that will still be discussed in terms of its impact on complication rates and hospitalization time; in the meantime, there is no conclusive evidence that delays in treatment of facial fractures, especially of the jaw, have an influence on these results.<sup>2-5</sup> Some authors argue that the time elapsed between fracture and fixation/immobilization of the jaw does not affect the rate of complications. The schemes that adhere to global patterns for the treatment of jaw fractures considered “non-urgent” should take the cost-benefit of treatment delay into account, as it should be reasonable for the patient’s comfort and quality of life.<sup>3</sup>

These problems still have a major impact on the quality of life of citizens in countries like Ecuador with a human development index (HDI) of 0.739, considered high according the United Nations Development Programme.<sup>6</sup>

This epidemiological retrospective study aims to evaluate the clinical characteristics and factors associated with trauma of the facial bones of patients treated at the Eugenio Espejo Hospital in Quito, Ecuador, and to analyze whether these factors may be associated with a greater risk for postoperative complications.

## METHODS

The clinical records of patients of the Maxillofacial Surgery Service at the Eugenio Espejo Hospital in the city of Quito, Ecuador, filed between 2012 and 2016 were longitudinally and retrospectively analyzed. This project was approved by the Ethics Committee for Human Research of the Universidade de S o Paulo’s School of Dentistry (CEP-FOUSP) and accepted on June 23, 2017 with number 2.135.157.

## COLLECTION OF DATA FROM CLINICAL RECORDS

Demographic variables such as sex, age, origin, and education level were collected, as well as other variables like systemic diseases, tobacco smoking, alcoholism, and the use of other drugs. Data related to trauma etiology, fracture type, diagnostic, clinical characteristics, date of accident, first treatment in both the hospital and the maxillofacial surgery service (MFS), definitive treatment of fracture and discharge from MFS and hospital were tabulated. When

available, cranioencephalic trauma (CET) data were also collected, as well as type of anesthesia (local or general), type of fracture reduction (open or closed) and whether it was rigid or semi-rigid. Data on fracture type and the presence of complications were also collected, as well as treatment for their clinical correction, like reoperation, medication, etc.

## INCLUSION CRITERIA

This study included all clinical records detailing the data listed above or describing additional needed information in relation to facial bones only.

## EXCLUSION CRITERIA

Clinical records older than 5 years, with no diagnosis of facial fractures or entirely focused on CET were excluded, as well as those lacking full data on the fractures. Absence of X-ray images, CT scans or X-ray reports were not exclusion factors, but if available, they were used to verify the diagnosis in clinical records.

Once all data were collected, fractures were grouped according to face region, considering the upper, middle and lower third and panfacial fractures; for the upper third, we included Le Fort III fractures, as well as those affecting the frontal, ethmoid and parietal bones, including the orbital fractures involving the frontal or temporal bone. For the middle region we included Le Fort I and II fractures and those For the middle region we included Le Fort I and II fractures and those involving: zygomatic bone, orbital floor and the upper jaw—occasionally associated with the lower jaw—. As for the lower third,

we mainly included the jaw and fractures in some other bones, mainly the alveolar ridge of the upper jaw. Panfacial fractures were considered if they involved the three regions of the face. To verify the association among categorical variables like harmful habits, the presence of systemic comorbidities, the presence of fracture displacement, and association with surgical access (open or closed), the data were subdivided like this: with complications (WC) and with no complications (NC).

## DATA ANALYSIS

The data were tabulated in Excel 2016® spreadsheets (Microsoft® Windows 10.0) and presented in a descriptive manner (mean, median, standard deviation, maximum and minimum values, standard error, and frequencies). Data from the continuous variables, like interval (in days) elapsed since the accident and the clinical management, considering subgroups WC and NC, were subjected to the Shapiro-Wilks normality test. The Mann-Whitney test and Fisher's exact test were used to verify the differences between the frequency of a given variable and the outcome WC. Odds ratios (OR) were calculated for both outcomes, WC and NC, considering an interval between clinical actions longer and shorter than 7 days (one week). A 95% confidence interval and a statistical significance level of  $p < 0.05$  were used. Statistical testing was performed on Sigma Plot for Windows, version 11.0 (Systat Software Inc., Germany).

## RESULTS

For this data collection, 847 medical histories were reviewed in the period January 1,

2012 - December 5, 2016; 282 histories lacking basic information were excluded, for a final sample of 565 records. Most accidents happened in men aged 21 to 30 years (87.14%), with primary to secondary education. The main cause of fractures was traffic accidents (48.14%), mainly with motorcycles, followed by physical assaults (29.55%); falls are more frequent in children and the elderly. The three cities with the most accidents were Quito (35.75%), Esmeraldas (8.67%) and Santo Domingo (6.9%). 36.28% of all patients injured during

accidents live in Quito, while those injured for other causes live in provinces like Los R os, Manab , Guayas, or Cotopaxi.

Of the 215 fractures in the lower region, 195 (90%) involved the jaw only, 56 were bilateral, 185 were displaced, and 164 had no associated CET. Most fractures occurred in the upper third by 54.48% (n = 267), and general anesthesia was used in most cases (86.73%), with an extraoral access (65.54%) and rigid fixation (93.81%) (Table 1).

**Table 1.** Distribution of the sample according to face regions and fracture characteristics

	Upper 1/3	Middle 1/3	Lower 1/3	Panfacial	Total
	n (%)	n (%)	n (%)	n (%)	
Unilateral	246 (56.03)	36 (8.20)	153 (34.85)	4 (0.91)	439 (77.69)
Bilateral	33 (26.19)	26 (20.63)	62 (49.20)	5 (3.96)	126 (22.30)
Total	279 (49.38)	62 (10.97)	215 (38.05)	9 (1.59)	565 (100)
Displaced	275(50.0)	61 (11.09)	205 (37.27)	9 (1.63)	550 (97.34)
Non-displaced	4 (26.66)	1 (6.66)	10 (66.66)	0 (0)	15 (2.65)
Total	279 (49.38)	62 (10.97)	215 (38.05)	9 (1.59)	565 (100)
<b>Association with other body fractures</b>					
Yes	44 (57.14)	5 (6.49)	26 (33.76)	2 (2.59)	77 (13.62)
No	235 (48.15)	57 (11.68)	189 (38.72)	7 (1.43)	488 (86.38)
Total	279 (49.38)	62 (10.97)	215 (38.05)	9 (1.59)	565 (100)
<b>Association with cranioencephalic trauma (CET)</b>					
Yes					
Grade I	51 (56.66)	11 (12.22)	25 (27.77)	3 (3.33)	90 (15.92)
Grade II	17 (73.91)	2 (8.690)	3 (13.04)	1 (4.34)	23 (4.070)
Grade III	19 (67.85)	3 (10.71)	4 (14.28)	2 (7.14)	28 (4.950)
No	192 (45.28)	46 (10.84)	183 (43.16)	3 (0.70)	424 (75.04)
Total	279 (49.38)	62 (10.97)	215 (38.05)	9 (1.59)	565 (100.0)

Of all clinical records (n = 565), only 11.15% (n = 62) had a history of comorbidities, with 28.8% being hypertension, diabetes, heart disease, hypothyroidism or a combination of these; the remainder 71.42% correspond to depression, gastric ulcer, rheumatic fever, and acquired immunodeficiency syndrome

(AIDS), either alone or associated with other diseases.

Regarding harmful habits, 383 (67.78%) patients said they had none. Of the remaining 32% with harmful habits, 106 (50%) stated they were alcoholic only, 15 (2.6%) tobacco

smokers, 4 (1.8%) were drug-dependent (with the exclusion of tobacco), and the remaining 45.47% had a combination of several harmful habits.

Of the total clinical records (n = 565), 136 patients (24%) had complications, with the most common being plaque exposure (n = 31), followed by eye complications such as diplopia, eyelid ptosis, entropion, and subconjunctival hemorrhages (n = 30). Neurosensorial complications (n=16) included hypoesthesia, dysesthesia, paresthesia, paresis, and facial nerve paralysis. Other complications included stuffy nose, amnesia, oroantral communications, hearing loss, and hyposmia.

Of the 136 cases with complications, 32 (23.5%) were subjected to reoperation (new

surgery), while 53 (38.9%) were treated with local measures such as antibiotics, analgesics, and local administration of corticosteroids, 17 (12.5%) were referred to specialties like Neurology, Ophthalmology, Otolaryngology, and the remaining 25% were given local physiotherapy. Of the 195 cases of jaw fractures, 37 (18.9%) had complications like plaque exposure, trismus, and malocclusion, 12 of which needed a new surgery (6.15%).

Concerning the time interval (in days) between the day of accident and the first MFS appointment, and from this first appointment to fracture treatment and patient discharge, the fractures of the upper third were the ones with the longest time interval (Table 2).

**Table 2.** Distribution of the sample according to face region and time interval (in days) between day of accident and clinical actions

Upper 1/3	n	Media±SD (days)	Median	Standard error	Max	Min	25%	75%
Accident/MFS admission	279	19.70±40.55	3	2.428	305	0	1	20.5
MFS admission/treatment	279	6.104±6.36	5	0.381	43	0	1.25	9
Treatment/discharge	279	8.11±29.47	2	1.765	375	0	2	4
Accident and discharge	279	33.91±49.56	15	2.97	390	1	11	35.75
Middle 1/3	n	Media±SD (days)	Median	Standard error	Max	Min	25%	75%
Accident/MFS admission	62	15.29±28.36	3	3.602	154	0	1	18
MFS admission /treatment	62	7.161±11.57	5	1.469	83	0	2	7
Treatment/discharge	62	4.21±5.84	2	0.742	36	0	2	4
Accident and discharge	62	26.66±29.64	14.5	3.76	164	1	14	20.75
Lower 1/3	n	Media±SD (days)	Median	Standard error	Max	Min	25%	75%
Accident/ MFS admission	215	8.87±14.40	3	0.982	95	0	1	10
MFS admission /treatment	215	7.763±11.44	5	0.78	81	0	1	9
Treatment/discharge	215	5.265±12.21	2	0.833	129	0	1	3
Accident and discharge	215	21.89±20.86	14	8.50	129	1	8.50	27.50
Panfacial	n	Media±SD (days)	Median	Standard error	Max	Min	25%	75%
Accident/MFS admission	9	8.89±9.35	7	3.116	31	1	1.75	11
MFS admission/treatment	9	5.889±4.81	5	1.602	15	0	1.75	9.25
Treatment/discharge	9	3.444±1.42	3	0.475	6	2	2	4.25
Accident and discharge	9	18.22±6.86	18	2.28	33	11	15	19

SD = Standard Deviation

The time interval between day of accident and definitive treatment longer than one week significantly affected complications (OR 0.301; 95%CI 0.170-0.536,  $p < 0.001$ ). Intervals longer than one week between: the accident and admission to MFS; admission and definitive treatment; treatment and patient discharge, or day of accident and patient

discharge did not significantly affect the onset of complications (Table 3). Regardless of fracture region, and considering the groups with (WC) and without complications (NC), there was no significant difference between the average number of days elapsed from day of accident and admission to MFS ( $p = 0.27$ ) and between admission to MFS and treatment ( $p = 0.20$ ).

**Table 3.** Frequency of fractures with (WC) and with no complications (NC) between clinical actions and intervals shorter than or longer than one week

Accidents and clinical actions	Complications	< Weak n (%)	> Week n (%)	OR* (Confidence Interval 95%)	P
Accident/MFS	Yes (WC)	89 (23.86%)	47 (30.92%)	0.700	0.953
	No (NC)	284 (76.13%)	105 (69.08%)	(0.461-1.064)	
MFS/Treatment	Yes (WC)	93 (23.01)	43 (26.7%)	0.821	0.414
	No (NC)	311(76.98%)	118 (73.29%)	(0.540-1.248)	
Accident/Treatment	Yes (WC)	15 (10.7%)	121 (28.47%)	0.301	<0.001
	No (NC)	125 (89.3%)	304 (71.52%)	(0.170-0.536)	
Treatment/Discharge	Yes (WC)	116 (26.32%)	20 (27.02%)	0.835	0.623
	No (NC)	375 (76.21%)	54 (72.97%)	(0.480 -1.453)	
Accident/ Discharge	Yes (WC)	184 (76.03%)	245 (75.85%)	1.010	0.961
	No (NC)	58 (23.96%)	78 (24.14%)	0.684-1492	

\* OR: Odds Ratio calculated by  $\chi^2$  - significant when  $p < 0.05$

The average number of days between day of accident and discharge of patients with no complications was  $25.7 \pm 1.45$ , and  $36.47 \pm 4.95$  for patients with complications. There was no significant difference ( $p = 0.25$ ) between the interval of days elapsed from accident to discharge in the

group with complications (WC). To verify if there was a difference in the interval of days between both groups, a higher interval median was used in the upper third fractures as cut-off limit to filter the data. Table 4 shows these time interval differences.

**Table 4.** Differences in time interval (days) between day of accident and clinical actions regarding subgroups with (WC) and with no complications (NC)

	Time interval (days) (media $\pm$ SD)	P value
Accident/Admission to MFS	With complications	17.11 $\pm$ 41.18
	No complications	14.22 $\pm$ 28.01
Admission to MFS/Treatment	With complications	6.91 $\pm$ 7.00
	No complications	6.82 $\pm$ 9.82
Treatment/Discharge	With complications	12.43 $\pm$ 41.02
	No complications	4.65 $\pm$ 10.08
Accident/Discharge	With complications	36.47 $\pm$ 57.66
	No complications	25.70 $\pm$ 30.10

Mann-Whitney Test - significant when  $p < 0.05$

Variables like harmful habits, fracture displacement, surgical access, fixation type, presence of comorbidities, and type of

anesthesia showed no significant difference in the onset of complications (Table 5).

**Table 5.** Differences between the frequencies of independent variables and the onset of complications

Variables		With complications (n)	P-value
Harmful habits	Present	45	0.49
	Absent	91	
Displacement	Present	134	0.41
	Absent	1	
Access	Extraoral	61	0.07
	Intraoral	44	
	Both	30	
Fixation type	Stable functionality (rigid)	130	0.19
	Semi-rigid	5	
	Both	1	
Comorbidities	Present	10	0.22
	Absent	126	
Type of anesthesia	General	125	0.07
	Local	11	

Fisher's exact test - significant when  $p < 0.05$

There was no association between history of harmful habits, fracture displacement, type of access, type of fracture fixation, presence of comorbidities and the risk of complications. The odd ratios for the onset of complications are greater when the time between trauma and definitive fracture treatment is longer than one week.

## DISCUSSION

Establishing the epidemiological profile of facial fractures treated at the Maxillofacial Surgery Service of the Eugenio Espejo Hospital in Quito helped quantify and clarify, for the first time in Ecuador, the various complexity levels of facial trauma. This study showed that the epidemiological indices of this type of trauma were very similar to those in other dental services around the world.<sup>8-10</sup> The main cause of fractures in this hospital was car accidents, followed by

physical assault. Some studies<sup>24,30</sup> differ with these results, as physical assaults appear at the top followed by car accidents, but this tends to happen in places where traffic laws are stricter and more respected. The cases in the present study generally involved males aged 25 years in average, with low education levels.<sup>32-33-34</sup> Also, the face region most affected was the upper third, mainly in the zygomatic-orbital complex (56.03%). As most patients were young, the presence of systemic comorbidities was very low, with high-blood pressure being the most prevalent. Most fractures were one-sided and with displacement. 87% of cases were not associated with other body fractures, and 75% were not associated with CET.

Most accidents did not happen in Quito (64%) and most patients were not residents of Quito (63.7%) either. The distance they had to travel in some cases ranged from 112 to 428 km, which may have affected the

delay in the definitive treatment of fractures. In many cases, perhaps what was being treated were the sequelae rather than the fractures. In these cases, we can infer that the intervention for the definitive treatment of fractures was more complicated and with greater risks of unsatisfactory results.

We conducted two analyses to confirm if time intervals between the clinical actions could influence the onset of complications. The first analysis considered a variation in the average days between clinical actions in the WC and NC subgroups, finding out no significant differences, as other authors have also reported.<sup>3,18,19</sup> But by analyzing the number of complicated cases subdivided into clinical action groups using an interval shorter and longer than one week, we found out that patients subjected to definitive treatment at later times have 70% chance of complications. This differs from some studies, 11 but confirms the findings of others that used shorter time intervals (72h).<sup>2,16</sup> This aspect should be of relevance for the health care initiatives seeking to improve public service and should be taken as a guideline for the creation of new basic, second- and third-level care services in this specialty.

Most complications in this study were not serious, but they do increase hospital costs, as many complications required a new surgery. Most complications were associated with plaque exposure, followed by eye and sensorineural disorders, while other studies<sup>4,17</sup> suggest that malocclusion, hyposensitivity and infection were more common. It is true that most studies focus on the jaw only, but this pioneering study in Ecuador tried to include all types of fractures in order to conduct a broader analysis of our profile and then focus on different fracture types.

While other studies suggest that alcohol and tobacco use are risk factors for the onset of complications in jaw fractures,<sup>13,18</sup> we did not find this association when considering all types of fractures, perhaps due to the great time variabilities among the clinical actions in each case.

Katsarelis et al<sup>13</sup> claim that it is challenging to argue that surgical treatments should be urgent, particularly as permanent innovations in emergency care allow surgeons to delay treatments when necessary to avoid negative results. However, the authors propose a list of emergency care protocols in maxillofacial trauma surgery in order to optimize the use of surgery rooms in England hospitals for the surgical treatment of jaw fractures, at least up to 24 hours of admission to the service.<sup>13</sup>

In a retrospective study,<sup>14</sup> possible causal factors for reoperation were assessed in patients treated for jaw fractures with an initial internal fixation, compared with a group of uncomplicated patients. Substance abuse, age, dental condition, fracture site, degree of fragmentation, fracture exposure, and time elapsed between day of trauma and initial treatment were found to be factors significantly influencing the need for reoperation.<sup>14</sup> In the present study, the type of access and fixation did not influence the rate of complications.

In a different study, in relation to complications following jaw fracture treatment, the same group of researchers reported that non-union (50%), soft tissue infection associated to the loosening of screws or exposure of plaques (35%), osteomyelitis (10%), and delayed healing (5%) were the most frequent complications.<sup>15</sup>

Hermund et al (2008)<sup>2</sup> showed the advantages of early surgical treatment of



fractures: minimized risk of infection and substantial reduction of inflammation, which facilitates the surgical intervention and decreases inpatient time. On the other hand, emergency surgery is more likely to be performed by less experienced staff outside regular hospital hours, which may result in increased risk of complications.

We note that even in surgery and maxillofacial trauma services in developed countries with much higher HDIs (0.94 to 0.98), like the United States, England and other European countries, there is an interest to minimize the risks of complications and their impact in both hospital costs and the quality of life of individuals.<sup>3,5,12,19</sup> Many authors demonstrate that more investment and better management are important variables for health care quality and the service provided in this specialty. Obviously, risk of death or health emergencies should be assisted or treated with priority and as soon as possible to reduce the chance of postoperative complications.

The limitations of retrospective studies are well known and include selection biases and inaccuracies in clinical records.<sup>20-23</sup> While we tried to control selection bias by carefully defining the inclusion and exclusion criteria, incomplete clinical records are a challenge, and more than 30% were excluded from this study, since obviously unreported data could not be included.

Given the importance of epidemiological studies for the modernization of public health policies, we recommend conducting

further prospective studies. The use of medical records for data collection, with standardized, relevant, complete, easy-to-fill information, as well as long-term follow ups, can help determine the existence of independent factors that to a greater or lesser extent influence the rates of complications, including data such as the experience of either intern or practitioner, seniority, first and subsequent appointments, or types of synthesis plates used.

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## CONFLICT OF INTEREST

The authors state that they have no conflict of interest.

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