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A retrospective study of zygomatico-orbital complex and/or zygomatic arch fractures over a 71-month period

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Abstract – *Background/Aim*: The aim of this retrospective study was to evaluate the epidemiology, treatment, and complications of zygomatico-orbital complex (ZOC) and/or zygomatic arch (ZA) fractures either associated with other facial fractures or not over a 71-month period. *Material and methods*: This survey was performed in three hospitals of Ribeirao Preto in Sao Paulo, Brazil, from August 2002 to July 2008. The records of 1575 patients with facial trauma were reviewed. There were 140 cases of ZOC and ZA fractures either associated with other facial fractures or not. Data regarding gender, age, race, addictions, day of trauma, etiology, signs and symptoms, oral hygiene condition, day of initial evaluation, hospital admission, day of surgery, surgery approach, pattern of fractures, treatment performed, post-operative antibiotic therapy, day of hospital discharge, and post-operative complications were collected. The data were subjected to descriptive statistical analyses. *Results*: The most frequent fractures affected Caucasian men and occurred during the fourth decade of life. The most frequent etiology was traffic accident, and symptoms and signs included pain and edema. Type I fractures were the main injury observed, and the treatment of choice was always rigid internal fixation. Post-operative antibiotic therapy was solely employed when there was an indication. Complications were observed in 13.1% of the cases. *Conclusions*: The treatment protocol yielded suitable post-operative results and also showed success rates comparable to published data around the world.

The zygomatic complex and its multiple joints comprise the most prominent area of the face. This condition often subjects these bones to traumatic forces from several sources, which can lead to various types of fractures (1, 2). The zygoma is a robust bone that is seldom fractured (3), and the most affected areas are sutures (2), where associated fractures occur more frequently (1).

The zygomatico-orbital complex (ZOC) and/or zygomatic arch (ZA) are the second most affected maxillofacial area (3) and the most common mid-face fractures (2). There were several studies that show that and comparisons between the different epidemiological datasets were difficult (4) because of socioeconomic, policy, educational and governmental differences (1, 3). On the other hand, this comparison should help professionals to improve several aspects of facial trauma treatment (3).

Analysis of the epidemiology and treatment of ZOC and ZA fractures is essential to assess detailed data analyses of these types of injuries. Indeed, it reflects the incidence, etiology, patient gender, patient age, oral health, time between injury and treatment, the most common fracture patterns, different kinds of treatment, complications and long-term follow-up of zygomatic complex trauma (3, 5). Although, a number of ZOC and ZA studies concerning the development of a treatment protocol already exist, there is no consensus, and several controversial issues still remain about this subject (6).

Nevertheless, few reports on ZOC and ZA fracture epidemiology in Brazilian patients can be found in the international literature (3, 7, 8). An epidemiological report including a large series of Brazilian subjects would be relevant because it could suggest novel ways of avoiding and treating maxillofacial trauma, it could reveal improvements in treatment results, and it could motivate changes in traffic laws.

The aim of this descriptive and analytical retrospective study was to evaluate the epidemiology, treatment, and complications associated with ZOC and/or ZA fractures either associated or not with other facial fractures when the application of rigid internal fixation (RIF) is the treatment of choice. This survey was performed in three hospitals in Ribeirao Preto, Sao Paulo, Brazil, from August 2002 to July 2008.

Material and methods

One thousand five hundred and seventy-five records of patients who presented facial trauma were evaluated at the hospitals Santa Casa de Misericordia, Sao Francisco, and Beneficencia Portuguesa, in Ribeirao Preto, Sao

Paulo, Brazil, from August 2002 to July 2008. Written informed consent was obtained from all subjects, and the local Ethics Committee for Human Research approved the protocol of the study.

The inclusion criteria were to select all records that sustained ZOC and ZA fractures. Records that did not provide complete information were excluded from this study. There were 141 records that described cases of ZOC and ZA fractures either associated or not with other facial fractures. The evaluation included data regarding gender, age, race, addictions, day of trauma, etiology, signs and symptoms, oral hygiene, dates of initial evaluation, hospital admission, surgery and hospital discharge, surgery approach, fracture pattern according to Jackson's classification in 1989 (9), treatment performed, fixation systems applied, and complication rate. The Jackson's classification (9) proposed a non-displaced or minimally displaced orbito-zigomatic fractures (OZM) as a type I fractures. Type II is a segmental fracture of the infraorbital rim. When there is a displaced fracture of the zygomatic body, usually with isolated fragment at the anterior orbital rim and/or at the zygomatic maxillary buttress, it is classified as type III fracture. The type IV fractures are classified as a fragmented orbito-zygomatic fracture and are usually associated with defects of the orbital walls.

All surgical procedures were carried out by the same oral and maxillofacial surgeon. Plain radiographs (water and submentovertex views) and (in more complex cases) facial computed tomography (CT) were used for radiographic analysis. Immediate preoperative and post-operative radiographs were both required for all subjects' evaluations and were also used for long-term follow-up.

The fixation of the ZOC and/or ZA fractures was performed using 1.5- and 2.0-mm titanium RIF systems, which were purchased from a national commercial company (MDT Industria e Comercio de Implantes Ortopedicos, Rio Claro, São Paulo, Brazil).

Antibiotic therapy was always applied during intra-operative period. Also, in some patients this therapy was necessary during the post-operative period. This was used solely when there were associated facial fractures or associated traumas in non-maxillofacial areas, large swelling and hematoma volume, and/or when the subject had a systemic disease. We never used antibiotic prophylaxis as a part of the treatment of ZOC and/or ZA fractures.

Post-operative clinical appointments were scheduled weekly up to 1 month post-surgery for all subjects, and thereafter, an appointment was requested every month until 1 year post-operation. However, this evaluation schedule was not adhered to in all cases as several subjects did not attend their clinical assessment.

The ZOC fracture treatment protocol was according to Ellis and Kittidumkerng in 1996 (6). The Carroll Girard screw technique was not used in any of the cases; however, in some cases orbital reconstruction was required.

A standard series of approaches have been used extensively for approaching the fractures. The surgical approaches applied to ZOC were maxillary vestibular approach to reach the zygomatic maxillary buttress, maxillar sinus wall, and ZA. The fracture of isolated ZA was accessed using a temporal approach (Gillies or Al-Kayat and Branley method). The upper eyelid approach was used to access the frontozygomatic suture. Lower eyelid approaches (subciliary) were applied to reach the infraorbital rim and orbital walls, and the coronal approach was used just when there was a severe ZOC and ZA displacement.

Results

The files of 1575 patients with facial trauma were evaluated. The most prevalent facial fractures were mandibular, followed by nasal and ZOC and/or ZA fractures.

One hundred and forty ZOC and ZA fractures were found. These affected 113 men (80.7%) and 27 women (19.3%).

The most affected age group was 31–40 years (27.8% – 39 patients), followed by 21–30 (25% – 35 patients), 41–50 (15.7% – 22 patients), 11–20 (12.9% – 18 patients), 51–60 (9.3% – 13 patients), 61–70 (5% – seven patients), 71–80 (2.9% – four patients), 0–10, and 81–90 (0.7% – one patient) (Fig. 1). The mean age was 36 years, and 3 and 82 years were the youngest and oldest ages affected, respectively.

More than half the subjects evaluated were Caucasian (70%), followed by mixed-race (20.7%) and Afro-Brazilian (9.3%).

Data collected regarding the time between the trauma and the day of initial evaluation showed that 64 (45.7%) patients were evaluated on the day of the trauma, 37 (26.4%) were evaluated within 3 days or more, 29 (20.7%) 1 day after the trauma, and 10 (7.2%) 2 days after the trauma. Data regarding the time between the evaluation and the day of the surgery showed that 79 (64.8%) patients underwent surgery within 3 or more days, 23 (18.8%) within 1 day, and 20 (16.4%) underwent surgery within 2 days. There were 54 (44.3%) subjects who underwent surgery 3 or more days after hospital admission, 37 (30.3%) subjects underwent surgery 1 day after, 16 (13.1%) underwent surgery 2 days after, and 15 (12.3%) subjects underwent surgery on the same day of hospital admission.

Ninety-four (77%) patients were discharged 1 day after surgery, 9 (7.4%) were discharged 2 days after, 3 (2.5%) were discharged after 3 or more days, and 16 (13.1%) were discharged on the same day of the surgical treatment. Seventy (57.4%) patients were discharged 3 days or more after admission as an inpatient, 34 (27.9%) were discharged after 2 days, 7 (5.7%) were discharged 1 day after admission as an inpatient and 11 (9%) patients were discharged on the day of hospital admission. One hundred and ten (90.2%) patients underwent the surgery 3 days or more after trauma, 6 (4.9%) underwent the surgery 2 days after trauma, and 6 (4.9%) underwent surgery only 1 day after trauma.

We found in this retrospective study that 86 subjects (61.4%) presented at least one social risk factor. Addictions, including smoking and alcohol abuse, were found in 24 subjects (17.1%). Thirty-four subjects (24.3%) used only alcohol, 16 subjects (11.4%) were only smokers, and

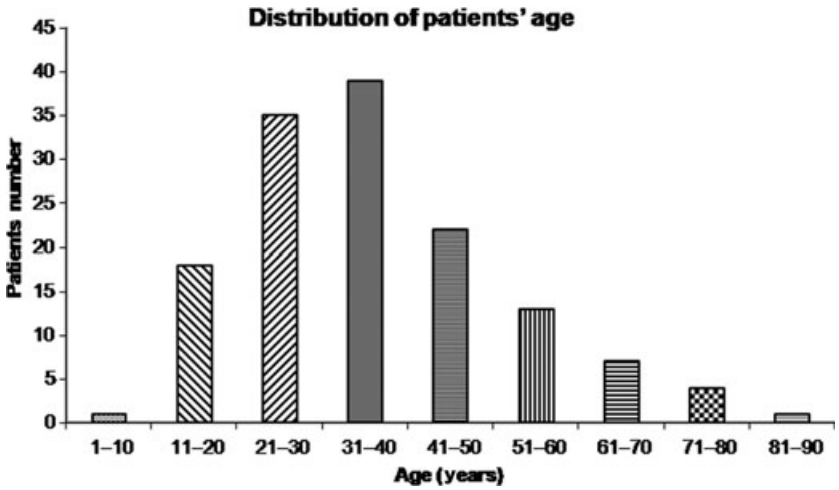

Fig. 1. Distribution of patients' ages.

alcohol abuse and illegal drug use were observed in 12 subjects (8.6%). These data are presented in Fig. 2.

The distribution of trauma etiologies is presented in Fig. 3. The etiology most frequently observed in this retrospective study was traffic accidents, which comprised roughly 55% of the cases (77 patients). Motorcycle accidents accounted for 23.6% of these cases (33 patients), bicycle accidents 17.1% (24 patients), motor vehicle accidents 7.2% (10 patients), and 7.2% (10 patients) suffered vehicle–pedestrian collisions. Altercations were the second most prevalent etiology, accounting for 22.1% of the cases (31 patients), followed by falls (8.6%, 12 patients), sports accidents (6.4%, nine patients), other etiologies (5.7%, eight patients) and work accidents (2.1%, three patients).

When the analysis focused only on the motorcycle accidents, we observed that 21 of 33 patients reported wearing an open helmet (63.6%), one reported not wearing a helmet (3%), and 11 patients reported wearing a closed helmet (33.4%) during the accident.

Moreover, in the vehicle accident cases, 80% (eight patients) reported not wearing seat belts at the moment of the accident and 20% (two patients) reported wearing seat belts.

The most common symptom reported was pain (92.1% – 129 patients), followed by infraorbital nerve dysfunction (60.7% – 85 patients). Forty subjects (28.6%) reported dental occlusion changes and only 4 (2.9%) reported diplopia.

The most common signs observed were edema, asymmetry, ecchymosis, laceration, mouth-opening restriction, cracking, abrasion, hematoma, and malocclusion. These data are presented in Table 1.

With respect to oral hygiene conditions, 80 subjects (57.1%) showed normal hygiene conditions, 36 presented good hygiene conditions (25.7%), and 24 subjects (17.2%) showed bad hygiene conditions.

The fractures were classified according to Jackson's classification of 1989. Type I fractures were sustained in 76 patients (54.3%), and this was the main injury in our study, whereas type II fractures were observed in three patients (2.1%) and type III fractures were observed in 38 patients (27.1%). Type IV fractures occurred in only six patients (4.3%), fractures with exclusive involvement of the ZA were sustained in 16 patients (11.5%), and bilateral arch involvement was found in one patient (0.7%).

There were 122 subjects (87.2%) who underwent surgical treatment. The three-point surgery approach (i.e., intraoral, subciliary and upper eyelid incision) was performed in 46 subjects (32.9%), the intraoral approach was performed in 60 subjects (42.8%), the two-point access approach was performed in eight subjects (5.7%), and Gillies's temporal method was performed in four

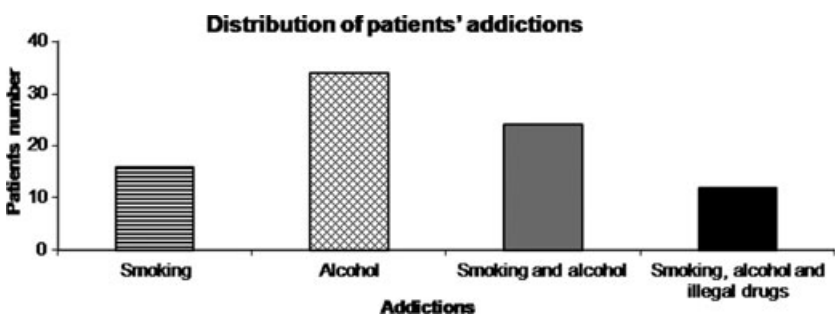

Fig. 2. Distribution of patients' addictions.

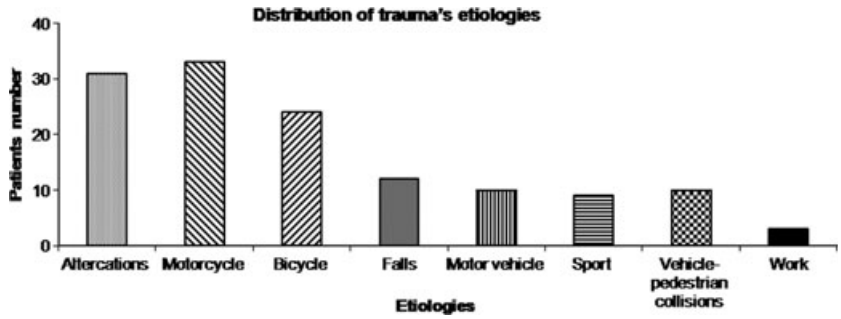

Fig. 3. Distribution of trauma etiologies.

Table 1. The signs observed in patients

Signs	Patients number	Percentage
Edema	100	71.4
Asymmetry	96	68.6
Ecchymosis	95	67.9
Laceration	53	37.9
Opening mouth restriction	42	20
Cracking	36	25.7
Abrasion	33	23.6
Hematoma	28	20
Malocclusion	19	13.6

patients (2.9%). The four-point access approach (i.e., intraoral, subciliary, and coronal incision) was carried out in three subjects (2.1%), and Al-Kayat and Branley access was performed in one subject (0.7%). Eighteen subjects (12.9%) did not receive surgical treatment and were treated in a conservative way. The conservative treatment consisted solely of soft diet therapy, not sleeping on the affected site, and clinical follow-up until complete recovery, without the use of RIF as described in a recent study.

Fifty-three subjects (37.9%) received antibiotic drugs during the post-operative period, and this was not required in 87 subjects (62.1%).

Fifty-four subjects (38.6%) suffered ZOC and ZA fractures associated with other traumas, and the most affected non-maxillofacial area was the upper limb region, which was encountered in 25.7% of cases (36 subjects). Sixty-eight patients (48.6%) of 140 cases of fracture sustained isolated ZOC and/or ZA fractures. Seventy-two subjects (51.4%) sustained associated traumas; associated facial fractures were found in 42 (30%), and the remaining were limb trauma and/or fracture. These data are presented in Table 2.

The total ZOC and ZA fractures are described in Table 3. Thirty-six isolated fractures (25.7%) involved the left ZOC, 35 involved the right ZOC (25%), 11 included the left ZA (7.9%), five included the right ZA (3.6%), and one patient sustained a bilateral ZA fracture. Twenty-seven fractures involved both the ZOC and the ZA on the right side (19.3%) and 25 involved both the ZOC and the ZA on the left side (17.8%).

A total of 42 subjects (42%) presented ZOC and ZA fractures associated with other facial fractures. These associated fractures consisted of 19 (13.6%) Le Fort fractures, 17 (12.1%) mandibular fractures, 14 (10%) nasal bone fractures, 8 (5.7%) orbital fractures, 6 (4.3%) maxilla fractures, 3 (2.1%) frontal bone fractures, and Nasal-orbital-ethmoid fracture, and occipital bone fractures affected one patient (0.7%) each.

By crosschecking the data collected regarding etiology and type of fracture, we detected that type I fractures exhibited the most etiologies, as described in Table 4.

The place of plate fixation was variable according to the fracture pattern, as described in Table 5. The antibiotic therapy was also variable according to the type of fracture (Table 6).

Complications are described in Fig. 4. Complications were observed in 16 of 22 (13.1%) patients who underwent surgical treatment. The complication most observed during the post-operative assessment was ectropion, which occurred in 8 of 57 patients (14%) who received the subciliary approach as a part of treatment. The second most important complication observed was epiphora, which occurred in 2 of 57 patients (3.5%). On the other hand, no complications were observed in subjects who were treated conservatively.

Nineteen patients was were followed up over 1 year, 17 patients were followed up over 1 month and nine patients received post-operative clinical appointments for 2–3 months. The period of post-operative evaluation was on the same day, and 2 years was the longest period of follow-up evaluation.

Discussion

The major studies pertaining to several types of facial fractures (3, 16) and the studies restricted solely to ZOC and/or ZA fractures (6–8, 10–20) showed a prevalence of the male gender. In this study, we detected a prevalence of roughly 4:1.

The most affected age group in this study was from 31 to 40 years. These results are similar to and in agreement with other studies (6, 7, 10–12, 14, 16–18, 20). On the other hand, in similar studies, the prevalent age group was 21–30 (15, 19). Another study found a mean age of 34 years old (1), and this result is similar to our findings.

Men from 21 to 40 years old were the group that sustained the most ZOC and/or ZA fractures. This

Table 2. Relationships among fracture type, associated facial fractures, non-maxillofacial fractures, and the use of antibiotic therapy

Type of fracture	Antibiotic therapy	%	Isolated fractures	Associated facial fractures	Associated non-maxillofacial trauma	Facial fractures + non-maxillofacial trauma
Type I	Yes	31.6	7	3	5	9
	No	68.4	32	4	13	3
Type II	Yes	33.3	–	–	–	1
	No	66.7	1	–	–	1
Type III	Yes	50	9	4	2	4
	No	50	10	2	5	2
Type IV	Yes	83.3	–	2	–	3
	No	16.7	1	–	–	–
Zygomatic arch	Yes	25	–	1	2	1
	No	75	8	1	3	–
Bilateral zygomatic arch	Yes	–	–	–	–	–
	No	100	–	1	–	–

Table 3. Zygomatico-orbital complex (ZOC) and zygomatic arch (ZA) fractures

Diagnosis	Quantity	Percentage
ZOC	71	50.7
ZA	16	11.5
ZOC + ZA	52	37.1
Bilateral zygomatic arch	1	0.7

Table 4. Relationships between etiology and type of fracture

Etiology	Type of fracture	Quantity	Percentage
Altercation	Type I	15	48.4
	Type II	1	3.2
	Type III	10	32.3
	Type IV	1	3.2
	Zygomatic arch (ZA)	3	9.7
	Bilateral zygomatic arch	1	3.2
Motorcycle accident	Type I	20	60.6
	Type III	9	27.3
	Type IV	1	3
	ZA	3	9.1
Motor vehicle accident	Type I	3	30
	Type III	3	30
	Type IV	3	30
	ZA	1	10
Bicycle accident	Type I	15	62.5
	Type III	4	16.7
	Type IV	1	4.1
	ZA	4	16.7
Sports activities accidents	Type I	6	66.7
	Type III	2	22.2
	ZA	1	11.1
Falls	Type I	8	66.7
	Type III	4	33.3
Vehicle–pedestrian collisions	Type I	5	50
	Type II	1	10
	Type III	4	40
Others	Type I	3	37.5
	Type II	1	12
	Type III	2	25
	ZA	2	25

result also showed that men in this period of life are more susceptible to traffic accidents and altercations and also probably are more affected by facial fractures (3, 6).

In several studies (7, 17), the time periods between the trauma, the initial evaluation, and surgical treatment were slightly higher than was expected. Nevertheless, several factors must be considered, as during the time between evaluation and trauma, systemic conditions and associated injuries require stabilization before the patient can be released to surgery (7). However, we observed that the majority of initial evaluations were carried out on the day of the injury, and almost all patients underwent surgical treatment within 3 days of the day of trauma. In recent retrospective studies, most cases were evaluated between the second (16, 20) and fourth days post-injury (20). Other studies observed 4 days (16, 17) and 5 days (18) as the mean times from trauma to surgical treatment. Accurate anatomic reduction in the primary setting, usually within 2 weeks of injury, is imperative because this is the best opportunity to restore patients to their pre-injury status (21).

In our study, the period between the initial evaluation and surgical treatment in the majority of cases was 3 days or less, as was the period between hospital admission and surgery day and the period between hospital admission and discharge. The majority of subjects were discharged 1 day after surgical treatment, and just three subjects were discharged 3 days or more after hospital admission. The time period between surgery and hospital discharge observed in our study was similar to other retrospective research (7).

It was detected that roughly 25% of patients abused alcohol and/or used illegal drugs. These data are in agreement with another study (7). A recent study reported an association of alcohol abuse with 30% of zygomatic fractures (8).

The most common etiologies were altercations, traffic accidents (15), and assaults (10–12, 14–16, 18). In our research, traffic accidents (which comprised motorcycle, bicycle, motor vehicle, and vehicle–pedestrian accidents) were the most frequent etiologies observed, and altercations were the second most prevalent. Other surveys showed traffic accidents as the most common etiology (19, 20); whereas some showed altercations as the most important (4, 6, 8, 17, 22).

Table 5. Relationships between type of fracture and place of fracture point fixation

Type of fracture	Place of fractures' point fixation	Quantity	Percentage
Type I	Without surgical treatment	13	17.1
	ZMB	44	57.9
	ZMB/FZS	1	1.3
	ZMB/IOR	1	1.3
	IOR/FZS	1	1.3
	ZMB/IOR/FZS	16	21.1
Type II	ZMB	2	66.7
	IOR	1	33.3
Type III	Without surgical treatment	1	2.6
	ZMB	9	23.7
	ZMB/FZS	1	2.6
	IOR/FZS	2	5.3
	ZMB/IOR/FZS	25	65.8
Type IV[1]	ZMB/IOR/FZS	3	50
	ZMB/IOR/FZS/ZAB	3	50
Arch	Without surgical treatment	4	25
	Without surgical fixation		
	Intraoral	4	25
	Gillies	4	25
	Surgical fixation		
	Al-Kayat and Branley	1	6.2
	Two points	1	6.2
	Three points	2	12.6
Bilateral zygomatic arch	Without surgical fixation – intraoral	1	0.7

ZMB, zygomatic maxillary buttress; IOR, infraorbital rim; FZS, frontozygomatic suture; ZAB, zigomatic arch buttress.
[1]Reconstruction with titanium mesh.

Table 6. Relationships between surgical approach and use of antibiotic therapy

Approach	Antibiotic therapy	Quantity	Percentage
Intraoral	Yes	15	25
	No	45	75
Two points	Yes	4	50
	No	4	50
Two points	Yes	27	58.7
	No	19	41.3
Two points	Yes	3	100
	No	–	–
Gillies method	Yes	–	–
	No	4	100
Al-Kayat and Branley	Yes	1	100
	No	–	–
Without surgical treatment	Yes	3	16.7
	No	15	83.3

The motorcycle accidents in this study showed that most patients reported wearing an open helmet at the moment of injury. We believe that this kind of helmet is inefficient at preventing facial traumas. When vehicle accidents were analyzed, it was observed that almost all subjects reported not wearing a seatbelt at the moment of injury. A study carried out in Canada from 1992 to 1997 showed that traffic accidents were the most common etiology (70%) of fractures, and only 33% patients were wearing seatbelts (5). Another recent analysis has concluded that drivers sustain fewer facial fractures when airbags are deployed, either alone or in combination with a seatbelt. For passengers, airbags provide significant protection from lacerations but have no impact on the incidence of facial fractures. The use of any protective device decreases the incidence of facial trauma sustained in motor vehicle accidents; however, airbags provide the best protection of all the currently available devices (23).

The present results showed that 50.7% of fractures affected the ZOC, 11.5% affected the ZA, 37.1% affected both bones, and 0.7% affected the bilateral ZA. Another study showed a large number of ZA fractures (27.3%) (4).

Considering the distribution of side fractures, we detected that 25.4% affected the left ZOC, 24.8% the right ZOC, 7.9% the left ZA, 3.6% the right ZA, and the remaining involved the ZOC, the ZA, and the bilateral ZA. There was a larger incidence of fractures on the left side in several studies (4, 6–8, 20, 21), and our findings are consistent with these reports.

Associated facial fractures affected 42% of cases in this study, whereas other studies obtained different results (4, 7), probably because of the number of subjects evaluated. Le Fort was the most common fracture observed, followed by mandibular fractures and those of the nasal bone. A recent retrospective study (16) detected other facial fractures mainly in the nasal bone and mandible. Moreover, others previously showed mandibular, maxillary, and nasal fractures as the most common associated facial fractures (7, 15).

Moreover, in our study, 38.6% subjects sustained ZOC and ZA fractures associated with other non-maxillofacial areas trauma. These findings are in agreement with another survey that observed associated injuries in 45.5% of the subjects (7), and in both studies the superior limb was the most affected region of the body followed by the inferior limb.

We observed that more than half the subjects in this study reported infraorbital nerve dysfunction. In recent studies, different percentages of this were observed, such as 45.5% (7), 94.2% (17), and 24.6% (8). Most authors reported that the majority of cases of sensorial infraorbital nerve dysfunctions were resolved within 3 months. There is complete recovery in cases of slight or absence fracture displacement (24). Unfortunately, in our study it was not possible to fully analyze nerve recovery inasmuch as several subjects did not attend post-operative clinical appointments.

In this study, pain, changes in dental occlusion, and diplopia were resolved after surgery. In most cases, occlusion changes occurred because of a sensorial nerve dysfunction after the trauma. In these subjects, we did not observe any changes in dental occlusion during preoperative evaluations. We also observed edema, asymmetry, and ecchymosis as the most frequent signs observed. A recent retrospective study described several ocular signs and symptoms in patients after orbitozygomatic fractures, i.e., diplopia, enopthalmos, proptosis,

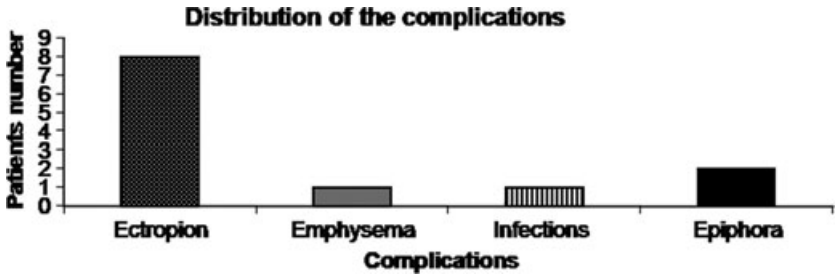

Fig. 4. Distribution of complications in patients undergoing surgical treatment.

reduced acuity, retinal hemorrhage, retinal detachment, retinal tear, corneal injury, traumatic mydriasis, laceration canthal ligament, and others. The authors postulated that the variable incidence of ocular findings was related to the mechanism of injury, and the majority of ocular signs were a transient problem with complete recovery (10). In a previous study in which zygomatic fractures were managed by closed reduction, the most frequent signs and symptoms were mouth-opening difficulty, followed by visual flattening of the cheek, asymmetry, infraorbital sensorial nerve dysfunction, and diplopia. The majority showed a degree of reduction upon post-operative assessment (16).

The current treatment protocol (6) was applied in all patients and took into account the different techniques that could be used to achieve satisfactory results. In cases with little or no fracture displacement or when subjects chose not to undergo surgery, conservative therapy was performed. The percentage undergoing conservative therapy was different when compared to other epidemiologic studies, likely due to unequal sample sizes (7, 8, 20). The conservative treatment consisted solely of soft diet therapy, not sleeping on the affected site, and clinical follow-up until complete recovery, without the use of RIF or intermaxillary fixation techniques as described in a recent study that showed twelve fractures that were managed in a conservative way (15).

The surgical treatment was performed only in fractures with marked displacement or in comminuted fractures as described in previous studies (7, 8, 15, 20, 21, 25, 26). We performed an intraoral approach in 42.8% of subjects, followed by the three-point approach, two-point access, the Gillies method, a four-point approach, and the Al-Kayat and Branley method. These results are in agreement with some studies (7, 14, 25), while others report the Gillies lift as the most frequently employed approach to achieve fracture reduction (11, 26).

We also observed that the place of plate fixation was highly variable, and one-point fixation (zygomatic maxillary buttress) was most frequently used to treat fractures. A retrospective study showed that one-point fixation was used in four patients, two-point fixation was required in 13 patients, and 56 subjects sustained three-point fixation (15).

Regarding post-operative complications rates, a recent review reported that most complications related to ocular problems, such as ectropion, diplopia, enophthalmos, and uncommon visual loss (25). Other complications during the post-operative period, such as facial asymmetry, exophthalmus, enophthalmos, inferior orbital nerve dysfunction, epiphora, ectropion, hypertrophic scars, ocular motion restriction, and plate removal have been observed in other studies (7, 8, 15, 18). A study conducted in the 1990s observed that 6 of 30 patients who had been approached through the skin or conjunctiva of the lower eyelid had some noticeable problem with the eyelid as a post-operative complication (6). Another survey noted seven patients with some problem with lower eyelid incision. However, three of them had permanent ectropion and required surgical intervention (16). In this retrospective study, ectropion (14%) was detected as the complication most observed during the follow-up evaluations, followed by epiphora and emphysema. These complications were described as a transient and were not found to be a permanently troublesome. The complications such as diplopia and enophthalmos were not observed inasmuch as the amount of fracture type IV (which require orbital reconstruction and more related to these kind of complications) were just found in only six cases.

The infection rate was rather different from previous studies and several did not show any results regarding post-operative infection rates (2, 6, 7, 15, 20, 22). Infections often occurred when the intraoral approach was performed, and mainly in patients with unsatisfactory oral hygiene conditions (7). Nevertheless, the oral hygiene data indicated that most subjects presented normal oral hygiene in this study, and these data did not affect the infection rate when we performed the intraoral approach.

Antibiotic therapy in ZOC and/or ZA fractures is controversial. Several studies established that antibiotics may be appropriate solely in some specific cases, i.e., when fractures are contaminated through an open reduction, when an intraoral incision is used to access the fracture site, when surgical emphysema is present, when an open reduction exists, when RIF is performed, and when orbital grafting is required (27, 28). However, others advise antibiotic therapy to avoid periorbital cellulitis and maxillary sinusitis in compound fractures, especially when open reduction is performed through an intraoral approach (26).

Conservative treatment and closed fracture are not antibiotic therapy indications, inasmuch as the overuse of antibiotics has several implications such as adverse effects and increasing antimicrobial resistance in subjects (28, 29). There have not been routine reports regarding antibiotic therapy after fractures of the zygoma and orbital floor, but in cases of orbital cellulitis after such injuries, antibiotic drugs are routinely used (30).

It is remarkable that there was a controversy concerning antibiotic drugs in isolated zygomatic complex fractures and we agree that in specific cases of ZOC and ZA fracture that antibiotics are indicated as a part of the treatment. In this study, antibiotic therapy was always applied during the intraoperative period. Although in some patients this therapy was also used during the post-operative period, such as in cases with associated facial fractures or associated traumas in non-maxillofacial areas, significant swelling and hematoma volume, and when the subject had a systemic disease. We never used antibiotic prophylaxis as a part of the treatment of ZOC and/or ZA fractures.

Post-operative evaluations were scheduled weekly up to 1 month post-surgery; thereafter, the patients were advised to return every month. However, this protocol was not met in all cases, as several patients did not return for clinical assessment. The shortest period of post-operative evaluation was on the same day, and the longest period was 2 years of follow-up assessment. A recent study showed that 74% of patients attended all scheduled visits. Those patients were followed for 7 months (from 3 to 22 months) of post-operative evaluation (14).

We conclude that this retrospective study of ZOC and/or ZA fractures over a 71-month period was a study that generated relevant and suitable epidemiologic data. The results are in agreement with those of several other studies, and the treatment protocol used gave reliable results and low complication rates.

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