Pattern and Treatment of Facial Trauma in Pediatric and Adolescent Patients

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Abstract: Pediatric maxillofacial trauma is a challenge for surgeons. There are no completely defined protocols, and sometimes, the initial management could be complex. The aim of this research was to perform a retrospective study to analyze the pattern and treatment of maxillofacial fractures in pediatric and adolescent patients. We reviewed the clinical records of 2986 patients treated at the Oral and Maxillofacial Surgery Division of Piracicaba Dental School between 1999 and 2008. Seven hundred fifty-seven patients were younger than 18 years and were divided into 3 groups according to age; the age and sex of the patients, etiology, fractures, and associated injury, treatment, and complications were evaluated. Five hundred thirty boys (70.01%) and 227 girls (29.99%) were treated for injuries with major prevalence in adolescents. The most common injury causes were bicycle accidents (29.06%) and falls (28.40%). The mandible was the most fractured bone (44.8%); associated injuries were lacerations of the soft tissue and dental trauma. Surgical treatment was performed in 75 cases (30%) with minor complications (10% of surgical patients). We conclude that maxillofacial trauma in children is associated to fall and bicycle accidents; the mandible is more affected than other maxillofacial structures, and frequently, nonsurgical treatment is performed.

Key Words: Pediatric trauma, pediatric injuries, treatment

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Facial fractures are uncommon injuries in children. Pediatric maxillofacial fractures are present in 1% to 15% of all facial fractures, showing different clinical features when compared with adult patients. The flexibility of the facial skeleton in children, the relative protection offered by the lack of pneumatization of paranasal structures, and the protection of the malar region by the prominent buccal fat pad in children contribute to reduce the frequency of these fractures.

Worldwide, the major causes of fractures in children are vehicle accidents, falls, violence, and sports-related accidents; their incidence is influenced by social, cultural, and environmental factors because the rates of fractures are different between countries. On the other hand, the treatment has changed in the last years. In Brazil, maxillofacial fractures have been studied in adult patients with limited information regarding facial trauma in children from 0 to 18 years.

The aim of this research was to review and compare the etiology, frequency, and distribution of maxillofacial fractures and analyze the changes in the last 10 years in pediatric and adolescent patients treated at the Division of Oral and Maxillofacial Surgery of Piracicaba Dental School, Sao Paulo, Brazil.

PATIENTS AND METHODS

Data were collected from patients attended at the Division of Oral and Maxillofacial Surgery of State University of Campinas, Brazil, from April 1999 to December 2008. The information was obtained from clinical notes and surgical records using a standardized data collection form. Subjects 18 years or younger were included in the admission and were divided into 3 groups according to ages: group 1 (0–5 years, infants), group 2 (6–12 years, school-aged children), and group 3 (13–18 years, adolescents). The data record included patient’s sex and age, etiology and location of the fracture, associated injury, treatment, and complications.

The etiology of trauma was related to bicycle accidents, vehicle accidents (car and motorcycle), pedestrian accidents, sports-related accidents, falls, and violence. The fractures were associated to mandible, maxilla, isolated nasal bone, frontal bone, zygomatic bone, and nasal-orbital-ethmoid complex.

The classifications of the fractures were based on conventional radiographic study and computed tomographic examinations, and the segment displacement was evaluated with clinical and imaging techniques. They were classified in nondisplaced and displaced. Sign and symptoms of the patient were evaluated as pain, neurologic disturbance of infraorbital nerve, asymmetry with evaluation of osseous fragment displacement, occlusion alteration, and diplopia. The surgical and nonsurgical treatments were evaluated, and the patient had to submit to at least 3 months of postoperative follow-up. Exclusion criteria were charts that did not had complete information about the trauma, unacceptable postoperatively reduction of fracture (evaluated with computed tomography), and postsurgical follow-up less than 3 months.

RESULTS

Etiology, Age, and Sex Distribution

In 120-month review, 2986 patients (from 1 to 97 years) were treated for facial injuries at the Division of Oral and Maxillofacial Surgery of Piracicaba Dental School. Seven hundred fifty-seven patients (25.35%) who are 18 years or younger were included (mean
age, 11.1 years). There were 530 boys (70.01%) and 227 girls (29.99%), in a ratio of 2.3:1. The incidence of maxillofacial injury increased with age: 156 cases in infants and preschool (20.61%), 257 in school-aged children (33.95%), and 344 in adolescent group (45.44%; Table 1).

The causes of injuries were bicycle accidents (29.06%), falls (28.40%), vehicle accidents (8.32%), and violence (8.06%). Falls were the first cause of facial injuries in children younger than 6 years with 103 cases (66.03%). For other groups (school-aged children and adolescents), bicycle accidents were more common (Table 2).

### Location and Type

Maxillofacial fractures were reported in 250 cases (33.02%; Table 3). The most common fracture was the mandibular fracture with 108 cases (43.20%) followed by nasal bone fractures, 77 cases (30.80%). Midfacial fractures were observed in 58 cases (23.20%) that included fractures of the zygomatic complex, isolated zygomatic arch, Le Fort I, Le Fort II, and blow-out fractures. Mandibular and midfacial fractures were present in 4 cases (1.6%), and nasal and midfacial associated fractures, in 3 cases (1.2%). Other maxillofacial fractures such as frontal, nasal-orbital-ethmoid complex, or Le Fort III fractures were not observed (Table 4).

In mandible, 139 fractures in 112 patients were observed, distributed by condyle (43.17%), parasympysis (18.70%), body and angle with 21 cases each (15.11%), 9 cases in the symphysis (6.47%), and 2 cases of mandibular ramus (1.44%; Table 5).

### Associated Injuries

In patient with maxillofacial trauma, soft-tissue injury was present in 334 patients (44.12%), lacerations of perioral and intraoral tissue being more frequent (mainly in tongue and mucosal lips); 216 patients presented dental trauma with 261 injured teeth. The most common etiology was bicycle accidents (37.96%), falls (34.26%), pedestrian accidents (9.26%), and car accidents (5.09%). The most common dental injury was avulsion (29.88%), lateral luxation (16.09%), crown fracture (14.18%), and intrusive luxation (12.64%).

### Treatment

Maxillofacial fractures were present in 250 patients, and 75 (30%) of them underwent surgical treatment (13 school-aged children and 62 adolescents). In 18 patients with maxillofacial fractures in group 1, conservative treatment was performed with diet management and analgesic therapy. These patients had fragments with little or no displacement, and the occlusion was not compromised, presented limited occlusion alterations that did not warrant any surgical treatment.

Of 112 patients with mandible fractures, 55 patients (45.53%) were subjected to an open reduction and internal fixation. Surgical treatment of bilateral condylar fracture was performed in 4 cases, with reduction and fixation of the one affected side (exclusively for group 3), and open reduction of midfacial fractures was performed in 20 patients (30.65%; exclusively for group 3).

Postsurgical complications were observed in 7 patients (9.3%) showing dehiscence (1 patient), postoperative bleeding (1 patient), eye movement restriction (1 patient), and facial paresthesia (3 patients) (only group 3). One patient with infection related to internal fixation in group 2 was recorded.

### DISCUSSION

### Sociodemographic Situation and Etiology of Trauma

Several investigations about pediatric maxillofacial injuries have been performed to recognized their patterns and treatments. Some factors such as geographical location and socioeconomic status are related to the causes of injuries (Table 6).

In this research, we evaluated patients from 0 to 18 years, as reported in other studies. The World Health Organization considers children as those with ages ranging from 0 to 18 years. However, there are differences within this group related to age, such as the etiology of trauma and its treatment.

Children younger than 5 years live in a protected family environment, which contributes to the low frequency of accidents. On the other hand, the face is protected by the frontal prominence with a small projection of the face mainly by the lack of development of the parasinal sinuses and the presence of temporary teeth.
With increasing age and development of paranasal sinuses, the face becomes less flexible and less protected. In fact, for a child patient, the cranium-face ratio is 8:1, whereas for an adult patient, this ratio decreased to 2:1. Given this relationship, if the infant receive a direct trauma, he is more likely to present a fracture of the cranium when compared with an older child or adolescent who will likely to present a face fracture.

On the other hand, in maxillofacial trauma, some research showed that boys were more affected than girls with ratios ranging from 2:1 to 6:1. The results of our study are consistent with these previous reports (Table 2).

Our results showed an increase of maxillofacial fractures according to age, with a high frequency in the adolescent group. The etiology of lesion also presented relationship with age: in patients younger than 6 years, the trauma presented low or middle energy (falls), whereas in patients older than 12 years, the trauma was related to high-energy trauma (transport vehicles). These results are in agreement with other researches.

In European countries, vehicular accidents represent 30% to 80% of maxillofacial trauma, whereas that in Africa, the principal cause of maxillofacial trauma was violence. In our sample, bicycle accidents and falls were the most common causes of maxillofacial injury (29.06% and 28.40%, respectively) with higher incidence in boys; interpersonal violence was present mainly in adolescent males. For bicycle accidents, the use of safety devices is still very limited or simply not respected by parents or by the same person, showing deficiencies in the programs for education and accident prevention.

Our results showed only 4 patients younger than 6 years with facial fractures that could be associated to interpersonal violence.

### TABLE 4. Distribution of 138 Patients With Midfacial Fractures

<table>
<thead>
<tr>
<th>Region of Fracture</th>
<th>Fracture 1</th>
<th>Fracture 2</th>
<th>0–5</th>
<th>6–12</th>
<th>13–18</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zygomatic complex</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>13</td>
<td>28</td>
<td>45</td>
<td>32.61</td>
</tr>
<tr>
<td>Zygomatic Arch</td>
<td>—</td>
<td>—</td>
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<td>0</td>
<td>2</td>
<td>2</td>
<td>1.45</td>
</tr>
<tr>
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<td>Le Fort II</td>
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<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1.45</td>
</tr>
<tr>
<td>Zygomatic complex</td>
<td>Zygomatic arch</td>
<td>—</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.72</td>
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<tr>
<td>Zygomatic complex</td>
<td>Nasal</td>
<td>—</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.18</td>
</tr>
<tr>
<td>Zygomatic complex</td>
<td>Le Fort I</td>
<td>—</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.72</td>
</tr>
<tr>
<td>Zygomatic complex</td>
<td>Orbital floor</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0.72</td>
</tr>
<tr>
<td>Nasal</td>
<td>—</td>
<td>—</td>
<td>5</td>
<td>24</td>
<td>48</td>
<td>77</td>
<td>55.80</td>
</tr>
<tr>
<td>Le Fort I</td>
<td>—</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>4.35</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>9</td>
<td>38</td>
<td>91</td>
<td>138</td>
<td>100</td>
</tr>
</tbody>
</table>

*Data are the number of patients in the age group.
— indicates that there was no fracture 2.

### TABLE 5. Distribution of the 112 Patients With Mandible Fracture

<table>
<thead>
<tr>
<th>Region of Fracture</th>
<th>Fracture 1</th>
<th>Fracture 2</th>
<th>0–5</th>
<th>6–12</th>
<th>13–18</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandible angle</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>11</td>
<td>9.82</td>
</tr>
<tr>
<td>Mandible angle</td>
<td>Mandible body</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>4.46</td>
</tr>
<tr>
<td>Mandible angle</td>
<td>Parasymsynthesis</td>
<td>—</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>4.46</td>
</tr>
<tr>
<td>Condylar process</td>
<td>—</td>
<td>—</td>
<td>7</td>
<td>7</td>
<td>32</td>
<td>46</td>
<td>41.07</td>
</tr>
<tr>
<td>Condylar process</td>
<td>Parasymsynthesis</td>
<td>—</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>4.46</td>
</tr>
<tr>
<td>Condylar process</td>
<td>Symphysis</td>
<td>—</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>3.58</td>
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<tr>
<td>Condylar process</td>
<td>Mandible body</td>
<td>—</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>4.46</td>
</tr>
<tr>
<td>Mandible body</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>7.14</td>
</tr>
<tr>
<td>Mandible body</td>
<td>Parasymsynthesis</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>2.68</td>
</tr>
<tr>
<td>Parasymsynthesis</td>
<td>—</td>
<td>—</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>11</td>
<td>9.82</td>
</tr>
<tr>
<td>Symphysis</td>
<td>—</td>
<td>—</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2.68</td>
</tr>
<tr>
<td>Mandible ramus</td>
<td>—</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1.79</td>
</tr>
<tr>
<td>Symphysis</td>
<td>Zygomatic complex</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1.79</td>
</tr>
<tr>
<td>Parasymsynthesis</td>
<td>Zygomatic complex</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1.79</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>15</td>
<td>17</td>
<td>80</td>
<td>112</td>
<td>100</td>
</tr>
</tbody>
</table>

*Data are the number of patients in the age group.
— indicates that there was no fracture 2.
Domestic violence is an important medical-legal situation and should be approached in a critical way. Our maxillofacial surgery department has established protocols for handling these cases, including psychologic and legal support.

**Treatment and Complications**

The choice of treatment for pediatric patient will depend on the characteristics of fracture, complexity, age of the patient, concomitant injuries, and teething stage. Internal fixation and subperiosteal dissection can alter the osteogenic potential of periosteum with internal or external scarring that may further restrict growth. So when possible, a conservative treatment should be preferred, particularly in patients with osseous growth phase.18

In our sample, conservative treatment was used in 175 cases of fractures (70%), which is consistent with previous researches.1,19 This treatment was indicated for minimum or absent displacement of fracture (image study) and adequate reproduction of occlusion. Midface fractures in pediatric patients are uncommon (0.5% to 17%) because the mandible and cranial provide protection and absorb most of the impact.18 Our results showed 21 cases of midface fractures due to vehicular accidents (high-energy impact) of which 8 (36.84%) were present in groups 1 and 2. These results support the hypothesis that exists in a positive relationship between midface fractures and the pneumatization grade of paranasal sinuses.20 Isolated fractures of the nasal bones represented the 30.08% of fractures (77 cases) and were the second most affected facial bone. The high incidence is probably due to higher projection of this bone structure.21 Most cases of nasal fractures in our study were treated in a conservative way because of the interference in the respiratory function that was not presented or the patient aesthetics.

The mandible is the most vulnerable facial bone, probably because of its mobility, projection, and anatomy; in these patients, mandible fractures could be caused by low-energy trauma, such as falls or bicycle accidents.14,15 The high incidence of condylar fractures is characteristic of the pediatric mandible fractures.14,19 In fact, in the research of Iida and Matsuya,4 condylar fractures were the most common (36% of mandible fractures). In contrast, condylar fractures are less common in adult patients12; our results showed that there is a higher incidence of condylar fractures (60 cases) in the adolescent group.

Seventy-five patients (30%) were submitted to open reduction and rigid internal fixation. The great osteogenic potential of a child with high rates of healing may be related to the reduced need for surgical treatment.18,22 Postsurgical complications were associated to the surgical site, suture dehiscence, infection, and paresthesia. Any other kind of complication, such as temporomandibular joint ankylosis, visual dysfunctions, growth disorders, or aesthetic complications, was not observed; we believe that physiotherapy applied in surgical and nonsurgical patients is very important to the success of treatment and for minor complications. Zachariades et al19 showed that early mobilization is the key in the management of surgical and nonsurgical patients and is important for the reduction of complications such as ankylosis or altered growth.

This research revealed interesting features about the etiology of the pediatric maxillofacial injuries that were associated to high occurrence of fall and bicycle accidents. We consider that it is important to inform parents about the care that must be adopted for the prevention of domestic accidents in infants and recommend the obligatory use of safety devices in cyclists.

All this information will contribute to the implementation of specific programs for the prevention of accidents so as to direct the hospital attendance according to the needs of the affected population.

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