Original Article

Dental Sequelae of Pediatric Maxillofacial Trauma

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Abstract

Purpose: Our goal was to explore dental complications in the pediatric population following facial trauma and identify those at risk. **Patients and Methods:** We queried children with fractures of tooth-supporting regions presenting from 2000 to 2014. Data elements included demographics, treatment method, and dental outcome measures. **Results:** A total of 117 subjects were identified. The average age at injury was 10.41 years, and average follow-up was 2.9 years. Fractures were grouped as mandibular (62.39%), maxillary (22.22%), or combination (15.39%). Dentition at time of injury was classified as primary (17.95%), mixed (38.46%), or permanent (43.59%). Conservative management was employed in 41.88%, open reduction and internal fixation (ORIF) in 49.57%, and closed reduction and external fixation in 8.55%. The majority (67.52%) did not experience any dental trauma or sequela. Dental avulsion (10.26%), subluxation (10.26%), dysgenesis (5.13%), and development of a crossbite (5.13%), openbite (3.42%), and occlusal cant (0.85%) were observed. Avulsion was more likely in subjects requiring ORIF ($P < 0.05$). Development of an openbite, crossbite, or occlusal cant was more likely in subjects requiring ORIF or with combination fractures ($P < 0.05$). **Conclusions:** Fracture severity, treatment method, and dental age are all strong predictors for adverse dental complications. Treating specialists should be cognizant of the increase in risk of complication in these patients.

Keywords: *Dentition, developing teeth, mandible fracture, open reduction internal fixation, pediatric*

Introduction

Management of facial fractures in the pediatric population has long been a topic of interest and debate among surgeons and dentists treating maxillofacial trauma. Although these injuries are relatively uncommon, comprising approximately 3%–6% of all facial fractures,[1] they are of particular concern due to their potential impact on the developing facial skeleton and its associated structures, dentition in particular.[2] Fractures of the alveolar process can account for as much as 60% of all facial fractures in patients under the age of 6 years.[1] As the patient population increases in age, the distribution of fractures tends to take on a notably more inferior pattern with a significantly greater number of fractures seen in the subcondylar, body, angle, and parasymphasis regions of the mandible.[1,3] By the age of 12 years and the development of the full permanent dentition, fracture patterns become strikingly more similar to those encountered in the adult population. It is also at this point that the prevalence of zygomaticomaxillary complex and LeFort fractures begins to substantially increase. In short, it is clear that developing dentition influences patterns of fracture, but few have examined the impact of maxillofacial fractures, and the interventions required to manage them, on developing dentition. Moreover, few studies have identified predictors for potential complications in dental development following facial fracture. It was the goal of this study to explore the potential adverse complications experienced by pediatric patients who suffer from maxillofacial fractures, especially in the mixed dentition stage (ages 7–11), and to highlight those at greater risk for these complications to optimize collaborative management of these patients.

Patients and Methods

Our Level-1 pediatric hospital's IRB-approved pediatric facial fracture database was queried for patients who suffered traumatic injury resulting in facial fractures from 2000 to 2014. Inclusion criteria for the study consisted of patients suffering fracture of the tooth-supporting

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or tooth-enclosing regions of the mandible or maxilla in primary, mixed, or permanent dentitions; patients with initial and follow-up radiographic survey, either panoramic X-ray or computed tomogram; patients with at least 12 months elapsed following initial injury. Specific data elements collected included age, date of injury, date of surgery, gender, ethnicity, surgical and medical history, medication history, as well as follow-up procedures, management, and outcome measures.

Radiographic evaluation was performed independently by two pediatric dentists (OB, BL). Initial and follow-up computed tomograms/panoramic X-rays were used to evaluate the pre- and post-treatment condition of the dental structures, noting any change, damage, or impendence over time. In addition, patients' clinical records were reviewed to determine the degree of fracture displacement, treatment modality used, and any need for additional surgical interventions.

Adverse outcomes with particular attention to dental sequelae were quantified by pediatric dentists. Teeth were referred to using the universal numbering/lettering system [Figure 1]. Adverse dental outcomes were noted for tooth avulsion, subluxation, and dysgenesis of developing dentition (i.e., cyst formation, failure of eruption, tooth agenesis) and the development of a crossbite, openbite, or occlusal cant. Univariate analysis was performed, with statistical significance defined as $P < 0.05$.

Table 1: Patient demographics

Data element	*n* (%)
n	117
Age	10.41 years (range: 1.03-18.68 years)
Follow-up	2.9 years (range: 1.00-13.27 years)
Fracture location (%)	
Mandible	73 (62.39)
Maxilla	26 (22.22)
Combination	18 (15.39)
Dentition (%)	
Primary	21 (17.95)
Mixed	45 (38.46)
Permanent	51 (43.59)
Treatment (%)	
Conservative	49 (41.88)
ORIF±IMF	58 (49.57)
CREF	10 (8.55)
Outcomes (%)	
No adverse outcomes	79 (67.52)
Adverse dental outcomes	38 (32.48)
Tooth avulsion	12 (10.26)
Tooth subluxation	12 (10.26)
Tooth dysgenesis	6 (5.13)
Crossbite	6 (5.13)
Openbite	4 (3.42)
Occlusal cant	1 (0.85)

ORIF±IMF: Open reduction and internal fixation with or without intermaxillary fixation, CREF: Closed reduction and external fixation

Results

One hundred and seventeen pediatric facial fracture subjects were identified that met our inclusion criteria [Table 1]. The average age at injury was 10.41 years (range: 1.03–18.68), and average follow-up was 2.9 years (range: 1.00–13.27 years). Fracture types included those of the mandible (62.39%), maxilla (22.22%), or combination (15.39%). Dental development at the time of initial injury was classified as primary (17.95%), mixed (38.46%), and permanent (43.59%). Conservative management was employed in 41.88%, open reduction and internal fixation with or without intermaxillary fixation (ORIF ± IMF) was used in 49.57%, while closed reduction and external fixation (CREF) was used in 8.55% of subjects. The majority of subjects ($n = 79$, 67.52%) had no adverse outcomes; however, adverse dental outcomes were seen in 32.48% ($n = 38$) of subjects [Table 2]. Dental avulsion (10.26%), subluxation (10.26%), dysgenesis of developing dentition (5.13%), and the development of a crossbite (5.13%), openbite (3.42%), and occlusal cant (0.85%) were observed. Subjects with more severe fractures, requiring ORIF ± IMF, were significantly more likely to develop dental complications overall. Dental avulsion was more likely in subjects requiring ORIF ± IMF ($P < 0.05$). Subjects in primary or mixed dentition were more likely to require follow-up dental intervention than those in permanent dentition ($P < 0.05$). The development of an openbite, crossbite, or occlusal cant was significantly more likely in those who had a combination fracture of the maxilla and mandible or those requiring ORIF ± IMF ($P < 0.05$).

Discussion

Traumatic injuries resulting in maxillofacial fractures remain a commonly encountered entity in the pediatric patient population.[4,5] These fractures in pediatric patients have a unique set of characteristics and challenges, which make them different from their adult counterparts. The developing dentition in the native mandible and maxilla is an important consideration when evaluating and managing these fractures. No study has looked comprehensively at specific dental sequelae following facial fractures during primary and mixed dentition.[6-9] In our retrospective radiographic evaluation of patients being treated for maxillofacial fractures at our institution, we find that fracture severity, mode of treatment, and patient stage of development are all strong predictive factors for adverse effects on the developing dentition. Our findings suggest that more severe fractures which require ORIF ± IMF are significantly more likely to develop long-term dental complications ($P < 0.05$). In fact, all patients in this study identified to have developed dental sequelae were treated with ORIF ± IMF. In addition, those patients whose injuries occurred while the patient was in primary and

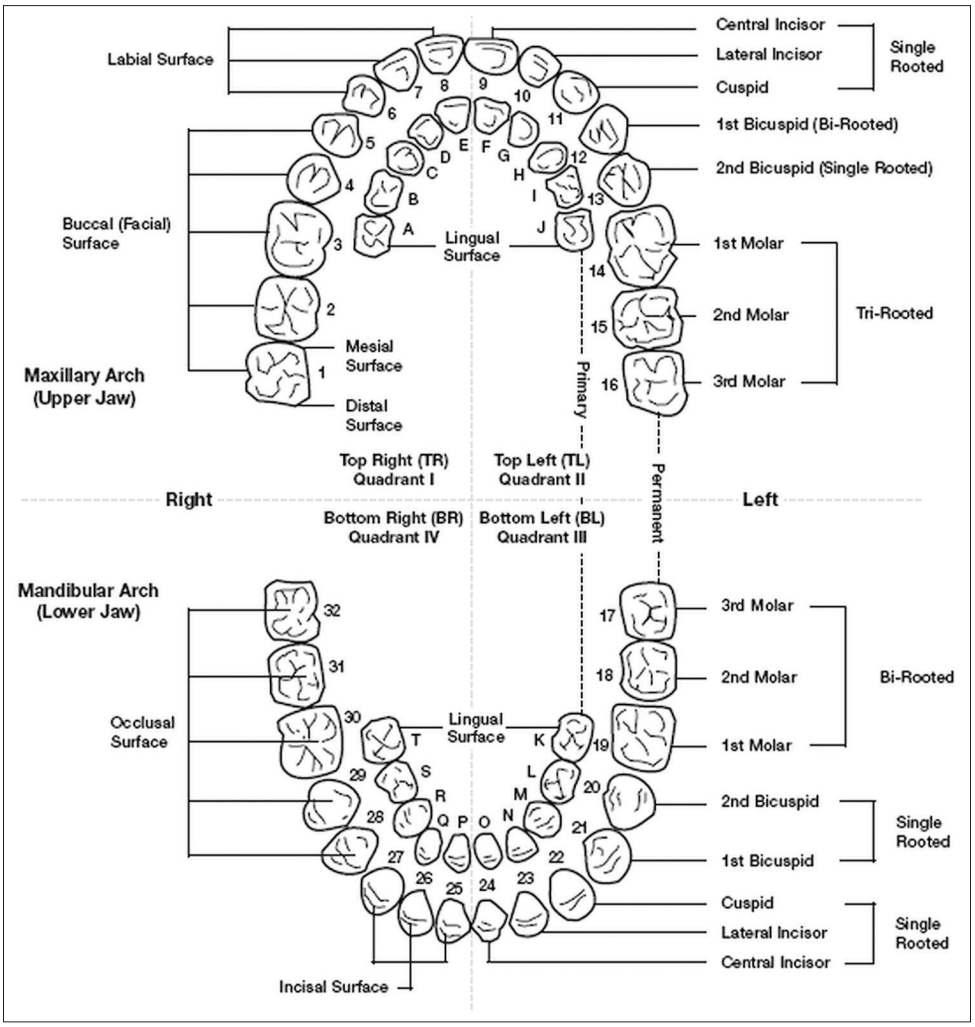

Figure 1: The universal numbering/lettering system

Table 2: Detailed demographics of patients with adverse dental outcomes

Gender	Age at injury	Dentition	Fracture	Treatment	LOF	Dental complication
Male	8.62	Mixed	Mandible	Conservative	1.54	Subluxation of 23, 24
Male	2.70	Primary	Maxilla + mandible	ORIF	6.12	Avulsion of K, L, M, S, T; crossbite
Male	16.43	Permanent	Maxilla	ORIF + IMF	5.18	Subluxation of 2, 3, 4, 5; crossbite
Female	5.75	Primary	Mandible	Conservative	1.52	Subluxation of E
Male	5.03	Primary	Maxilla + mandible	Conservative	3.56	Subluxation of F
Male	9.59	Mixed	Mandible	Conservative	1.95	Crossbite
Female	7.21	Mixed	Maxilla + mandible	Conservative	4.38	Avulsion of 22
Male	15.51	Permanent	Maxilla + mandible	ORIF	1.76	Crossbite
Male	7.61	Mixed	Maxilla + mandible	ORIF	4.26	Avulsion of 25; crossbite
Male	12.65	Mixed	Maxilla + mandible	ORIF	3.22	Openbite
Female	13.12	Permanent	Maxilla	ORIF	3.09	Openbite
Male	16.49	Permanent	Maxilla + mandible	ORIF	2.33	Subluxation of 10
Male	18.68	Permanent	Mandible	ORIF	4.72	Subluxation of 24, 25
Female	17.07	Permanent	Maxilla + mandible	ORIF	2.26	Openbite
Female	2.56	Primary	Maxilla + mandible	Conservative	1.25	Avulsion of E, F
Male	12.32	Permanent	Maxilla	ORIF	7.51	Openbite
Female	6.66	Mixed	Maxilla + mandible	ORIF	2.99	Avulsion of J, K
Female	2.46	Primary	Maxilla	Conservative	1.04	Subluxation of E, F
Male	16.76	Permanent	Maxilla + mandible	CREF	1.06	Crossbite

Contd...

Table 2: Contd...

Gender	Age at injury	Dentition	Fracture	Treatment	LOF	Dental complication
Female	7.46	Mixed	Mandible	Conservative	4.06	Crossbite
Male	9.06	Mixed	Mandible	Conservative	1.11	Subluxation of R
Female	1.69	Primary	Mandible	ORIF+IMF	3.62	Subluxation of Q, R, S
Female	5.96	Mixed	Mandible	Conservative	1.04	Dysgenesis of 1
Male	7.89	Mixed	Maxilla + mandible	Conservative	5.12	Avulsion of 8
Male	5.77	Mixed	Mandible	Conservative	3.68	Dysgenesis of 25
Male	11.87	Permanent	Maxilla + mandible	ORIF+IMF	1.27	Openbite
Female	7.30	Mixed	Maxilla + mandible	ORIF	13.27	Occlusal cant
Male	12.49	Permanent	Mandible	Conservative	3.11	Avlusion of 12, 20; dysgenesis of 17
Male	5.03	Primary	Maxilla + mandible	Conservative	4.23	Subluxation of N, M
Male	4.67	Primary	Mandible	Conservative	2.80	Subluxation of R, Q
Male	16.83	Permanent	Mandible	ORIF	2.09	Avulsion of 30
Male	8.80	Mixed	Maxilla	ORIF	5.59	Avulsion of 5; dysgenesis of 2, 4 (related to surgical hardware)
Male	5.69	Primary	Mandible	ORIF	9.66	Dysgenesis of 22, 28
Female	4.31	Primary	Mandible	ORIF	4.97	Avulsion of K
Male	2.69	Primary	Mandible	ORIF	7.03	Dysgenesis of 9, 22, 30
Male	14.56	Permanent	Maxilla	ORIF	3.13	Avulsion of 7, 8
Female	12.40	Permanent	Mandible	ORIF	2.57	Avulsion of 26
Female	3.24	Primary	Mandible	ORIF	7.29	Dysgenesis of 19 (related to surgical hardware)

LOF: Length of follow-up, ORIF: Open reduction and internal fixation, ORIF±IMF: Open reduction and internal fixation with intermaxillary fixation, CREF: Closed reduction and external fixation

mixed dentition were more likely to require additional dental intervention when compared with those in permanent dentition ($P < 0.05$).

Our study has several limitations. We concede that it is retrospective and underpowered and is simply a descriptive analysis of a specific cohort of patients. Furthermore, we have a relatively short follow-up period for some patients, with not all primary and mixed dentition patients having been followed into permanent dentition. In an effort to strengthen our data, we limited our review to patients seen before 2014 to gain longer follow-up. However, while 30% of patients had not achieved permanent dentition by the time of last follow-up, we believe that any complication within this group of patients would have already presented within the principal follow-up period.

Conclusions

These data demonstrate that maxillofacial trauma in the pediatric population can have potentially detrimental effect on the developing dentition. Patients at increased risk will be those who are in primary or mixed dentition at the time of injury; those requiring ORIF ± IMF; and those with combined fractures of the maxilla and mandible. The awareness of these risks can at least warn the treating surgeon that these patients will need more of a team approach, with close dental follow-up to avoid or manage these issues in a timely manner.

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Conflicts of interest

There are no conflicts of interest.

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