Original article

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Dental trauma in the anterior sector: an analysis of the predisposing factors in a group of orthodontic patients

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Abstract

Aim. The aim of this study was to analyze the predisposing factors of upper incisal trauma in children candidates for orthodontic treatment.

Methods. This is a retrospective study involving 102 consecutive patients who requested orthodontic therapy at Pediatric Dentistry Clinic of Bari University's Dental School during the time frame 2012-2019. The distribution of reported dental trauma was analyzed according to gender, type of trauma, etiology, overjet and labial competence.

Results. No substantial association between gender and trauma emerged from our study. Patients between the age range of 11-15 years appear to be at increased risk. A statistically significant correlation between increase in overjet and traumatic events was found. A link was discovered between labial incompetence and trauma, since this condition increases the risk of trauma by exposing part of the surface of the upper incisors. A correlation also emerged between Skeletal Class II and the increased risk of traumatic injury.

Conclusions. Dental trauma, especially in the anterior sector, is a fairly frequent occurrence in pediatric and adolescent patients and is linked to several factors. In our study subjects with Skeletal Class II division I malocclusion with elevated overjet are more predisposed to dental trauma. The limitations of our study are the low number of subjects in the examined sample, and the heterogeneity of the trauma presentation. ***Clin Ter 2020; 171 (6):e481-485. doi: 10.7417/CT.2020.2261***

Key words: *dental trauma, increased overjet, lip incompetence*

Introduction

Prominent (or sticking out) upper front teeth are a common problem in children and evidence suggests that they are more likely to be injured (1, 2).

Epidemiologic studies show a high prevalence of trauma in pediatric age (from 6% to about 30%) with higher occurrence in children aged 1-3 for deciduous dentition, and those aged 7-11 for permanent dentition (3). Furthermore there is a larger incidence in males, which increases with age (3).

Trauma of the upper central incisors represents the most frequent cases (80%), followed by the laterals (14%) and finally the lower centrals (6%). Usually, just one tooth is involved, except for cases of car accidents and sports injuries (4).

The causes of dento-alveolar trauma are mostly accidental factors. In deciduous dentition injuries occur following accidents during play and falls when toddlers start learning to walk. In permanent dentition the causes are attributable to psychomotor retardation, car accidents, accidents at home and sports injuries.

Although trauma is caused by unpredictable events, a series of individual risk factors facilitates his onset, including extra-oral conditions such as obesity, visual impairment and dento-facial factors: caries, endodontic treatment, amelogenesis imperfecta, fluorosis, ankylosis, macrodontia, large overjet and lip incompetence (4-6).

A history of previous dental trauma presents a higher risk of subsequent injuries compared to patients who have no history of trauma (6).

As the combination of trauma with orthodontic treatment seems to render the teeth more susceptible to complications (7), knowledge of the prevalence of previous dental trauma in patients referred for orthodontic treatment is of great importance to the planning and success of any individual orthodontic treatment.

The aim of our study was to obtain data concerning the prevalence of previous traumatic injuries to frontal teeth in candidates for orthodontic treatment and to analyze their distribution according to gender, age, type of tooth, extent of overjet, type of lip coverage and skeletal class.

The null hypothesis of our study was that there are no differences in overjet value, lip coverage and skeletal class between patients with dental trauma and patients with no history of incisal trauma.

Materials and methods

Study Design

We conducted a retrospective observational study on a sample of 121 consecutive patients who underwent orthodontic therapy in the Pediatric Dentistry Clinic of Bari

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University Dental School during the time frame 2012-2019. Minor patients's parental/guardian provided informed written consent for participation in the study and publication of the data for research and educational purposes.

Sampling Criteria

The inclusion criteria of the study were:
– no previous orthodontic treatment
– no cleft lip and palate

The exclusion criteria were:
– records incomplete,
– no cooperative patients,atients with congenitally missing teeth
– patients who lost teeth for caries
– patients with systemic diseases, such as amelogenesis imperfecta

According these criteria the sampling became of 102 subjects.

Study Method

The prevalence of dental trauma was determined by retrospective analysis. Data was collected from patient's hystory, clinical examination and orthodontic pre-treatment records (plaster models, panoramic radiographies and latero-lateral teleradiography and photographs).

During the first visit, the patients were given a standardized questionnaire part of italian guidelines for the prevention and clinical management of dental trauma in individuals in the developmental age (8) comprising a first part with questions regarding age, gender and general anamnesis, and a subsequent specific section with questions related to the kind of trauma, the place, the dynamics, the time passed from the accident to the visit and the medical treatment already provided by a dentist, if any. The Andreasen system (9, 10) was used to classify the trauma:

Overjet (OJ) was calculated on dental casts by measuring with a ruler, parallel to occlusal plane, the distance from the incisal edge of the most labial maxillary incisor to the most labial mandibular incisor. The values obtained were divided into 3 groups based on the result:
– From 1 to 3 mm: regular overjet
– From 3.1 mm to 6 mm: increased overjet
– More than 6.1 mm: very increased overjet

Lip competence (LC) was evaluated by means of pictures taken at the beginning of the orthodontic treatment. If the upper lip covered the upper incisors in relaxed position, there was labial competence. Otherwise, if part of the crown of the upper incisors was exposed and clearly visible, there was labial incompetence. Also, if lip strain was evident on closure, the lips were scored as incompetent.

The Skeletal Class (SC) was evaluated according Steiner's analysis (1953) on lateral cephalograms. Table 1 gives the landmark definitions and the mode of location.

Skeletal Class I, II, and III classification is based on the value of the ANB angle:
– Skeletal class I: ANB angular value 2° ± 2
– Skeletal class II: ANB angular value >4°
– Skeletal class III: ANB angular value <0°

Table 1. Point and angles definitions of Steiner's Analysis.

Points	Definition
N-nasion	The most anterior aspect of the frontonasal suture
S-sella	Centre of the pituitary fossa
A-point	The deepest point on the contour of the premaxilla
B-point	The deepest point on the contour of mandibular symphysis
SNA angle	It is the angle formed at the intersection of line connecting nasion and point A to SN plane
SNB angle	It is the angle formed at the intersection of line connecting nasion and point B to SN plane
ANB angle	It is the angle formed by lines connecting nasion and point A and nasion and point B

Statistical analysis

A data collection form has been completed for each recruited patient. The completed forms have been included in a database created with FileMaker Pro software. Data analysis has been performed with STATA MP12 software.

The quantitative variables were expressed by mean, standard deviation and range, and the categorical variables expressed as proportions, whose confidence interval was indicated at 95%. For the continuous variables, the analysis of normality was performed, and a model of normalization was developed for the non-normal variables by using a logarithmic function.

The normal or normalized continuous variables were compared with the t-student test for independent samples. For the comparison between categorical variables, the chi-square test was performed.

The relationship between the pathologic condition and different factors (gender, age, OJ, LC and SC) was analyzed using the multivariate logistic regression and calculating the value of aOR (adjusted Odds Ratio), with the confidence interval at 95% and the z-score test. For all the tests, a value of $p<0.05$ was considered significant.

Results

15 patients (11 males and 4 females) had anterior teeth trauma and represent our Study Group (S.G.). The remaining 87 subject that had no trauma represent the control group (C.G.). The descriptive statistics are presented in Table 2.

The prevalence of dental trauma was 14,7% and the most frequent causes in deciduous dentition were accidents during play or falls and in mixed and permanent dentition were sports, home and car accidents.

The teeth most involved in our sample were the upper central incisors (Table 3).

Table 4 shows the clinical variables evaluation in groups compared with presence of trauma: it was found that there was a significant association between age (p=.031), OJ (p=.038), LC (p=003). No statistically significant differences emerged in the comparison between group and gender. (p>0,05).

Table 2. Descriptive statistics of S.G. and C.G.

Variables	Sub-groups	S.G.(trauma group) (n=15)	C.G.(no trauma group) (n=87)
Gender	Female Male	4(26,6%) 11(73,4%)	37(42,5%) 50(57,5%)
Age		13.0±6,3	15.9±4,4
*OJ degree	Regular Increased Very increased	5(33,3%) 9(60%) 1(6,7%)	43(49,4%) 27(31%) 7(8%)
LC	Short upper lip Normal upper lip	8(53,3%) 7(46,7%)	16(18,4%) 71(81,6%)
SC	I II III	10(67%) 5(33%)	45(52%) 32(37%) 10(11%)

*From 1 to 3 mm: regular overjet from 3.1 mm to 6 mm: increased overjet
-More than 6.1 mm: very increased overjet

Table 3. Distribution of cases in the S.G. according the number of traumatized teeth and the kind of trauma.

TRAUMATIC EVENT	Tooth 12	Tooth 11	Tooth 21	Tooth 22
Subluxation		4 cases	4 cases	1 case
Intrusion			3 cases	1 case
Not complicated amelo-dentinal fracture		1 case	2 cases	
Ex articulation	1 case	2 cases	2 cases	2 cases

Table 4. Findings of t-student statistics and chi square statistic stratified by study variables and the presence of dental trauma.

Group	Age (means and D.S.)	OJ (means and D.S.)	LC short lip	normal lip
S.G.	13,0 ±6,3	4,7±1,9	8 pz	7 pz
C.G.	15,9 ±4,4	3,7±2,0	24 pz	78 pz
	t=2,2; p=.031	t=2.1; p=.038	χ^2 =8,7; p=.003	

Table 5 describes the relationship between group and gender, age, overjet, labial competence and skeletal class in a multivariate logistic regression model. The variable significantly associated to incisor trauma is SC (Skeletal Class) (aOR = 0.18; p = 0.048; CI 95%: 0.03 - 1.00); no association with other variables are observed (p>0,05).

Table 5. Analysis of the determinants of the "group" variable in a multivariate logistic regression model.

Variables	aOR	z	p	CI. 95%
Gender	0.69	0.5	0.601	0.17 – 2.80
Age	0.92	1.2	0.250	0.80 – 1.10
OJ	5.73	1.9	0.064	0.90 – 36.3
LC	3.02	1.5	0.132	0.72 – 12.78
SC (ANB Value)	0.18	2.0	0.048	0.03 – 1.00

Discussion

The results of this study highlight that a significant percentage of patients in need of orthodontic treatment suffered dental trauma before the beginning of the treatment itself. Indeed, traumatic events have been observed in 14.7% of the total sample of patients, a percentage similar to the one obtained in other studies (10-12). The age range that presents the highest risk of trauma is the 11-15 years range, as already observed in the literature (13-15). Artun et al. (16) reported that maxillary central incisors were most of the traumatized teeth and most of the patients had only one injured tooth. Schatz (14) concluded that the most injuries involved one incisor tooth (74%). The results of the present study are consistent with these previous reports as most of the injuries in the study population involved one central incisor tooth.

No significant correlation between gender and trauma emerged from our work, on the contrary to what is reported in other articles (6, 16, 17), in which a larger incidence in males than in females is illustrated. This fact may reflect

an increasing participation of females in contact sports and other activities which can lead to dental injuries (18).

Indeed, a statistically significant correlation between increase in overjet and traumatic events was shown in our analysis, as confirmed by other studies (5, 10, 11, 19-21). In case of normal occlusion, the energy of the impact is distributed over a wider surface, due to the occlusal contact between the upper and lower incisors, as well as the protective effect of the upper lip. Conversely, in the case of increased overjet, the most protruding dental component bears the brunt of the impact (21).

An association between labial incompetence and trauma is observed, since this condition exposes part of the surface of the upper incisors, increasing the risk of trauma. Lip incompetence can be caused by either a lack of lip tissue or an adverse skeletal pattern. This data is confirmed in the literature (10, 11, 19), where it is highlighted how the children who have increased overjet combined with labial incompetence have a greater risk of maxillary incisors injuries.

In our study we found a correlation between Skeletal Class II (according to the ANB angle) and increased risk in traumatic events. This is in agreement with the work of Borzabadi-Farahani (15) in which they found a significant association between class II skeletal pattern assessed by clinical method and maxillary incisor trauma. In the light of the results, they suggested to proceed with interceptive orthodontic treatment for patients with severe skeletal class II malocclusions in the early mixed dentition also to prevent incisor trauma. On the contrary, Baccetti et al (22) found that only increased overjet and not the concurrent Class II molar and skeletal relationship was the significant predisposing factor for the incisor trauma. They concluded that their findings indicate the opportunity of a differential treatment timing in the correction of the increased overjet (early, 8 years age) versus the other Class II components, when the aim is to prevent incisor trauma. The timing of therapy in class II is a much-debated subject in the literature (23-24). According to some authors, it is necessary to exploit the subject's peak in bone growth. In order to obtain an optimal result on the malocclusion, the peak is evaluated based on the stage of maturation of bones of the wrist and the hand (22) that in females is completed around 12-13 years old, whereas in males it is completed later, around 14-15 years old. Hence, we intervene with a later treatment in a single phase, in permanent dentition. Other studies (24) propose to proceed with two-stage treatment, which involves an interceptive phase in early mixed dentition by means of functional or fixed equipment, followed by a second phase of treatment in permanent dentition. In both cases, the therapeutic modalities obtain optimal skeletal changes, thanks to the reduction of the ANB angle. However, various studies (24) show that early treatment seems to be more effective in cases of very increased overjet (more than 6 mm), since these patients appear to exhibit a reduction in the incidence of trauma with the same orthodontic results.

Efforts should be made to try to reduce the incidence of trauma related to physical activity and other conditions of risk. Prevention covers different levels (25-34). It is essential to protect the body parts exposed to possible lesions with intra and extra oral equipment, in the form of protective headgear and masks. Regulations must be adopted to monitor the patient's activities and relocate those with higher risk of falls to appropriate environments, respecting the safety measures. Secondary prevention measures must be followed when the damage is done, since they are designed to limit the harmful effects through appropriate intervention and speedy recovery (35). Tertiary prevention is a purely orthodontic matter, the aim of which is to reduce complications and reactivate the masticatory function.

The low number of subjects in the examined sample and the heterogeneity of the trauma we investigated represent the limitations of our study.

Conclusions

Our study demonstrates that dental trauma, especially in the frontal sector, is a rather common occurrence in pediatric and adolescence patients, linked to multiple factors discussed above. The subjects with skeletal class II malocclusion with a high overjet and lip incompetence are specifically predisposed to maxillary incisor trauma.

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Ethical policy and Institutional Review board statement: All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki of 1975, as revised in 1983.

Patient declaration of consent: Minor patients's parental/guardian provided informed written consent for participation in the study and publication of the data for research and educational purposes.

Data Availability statement: The data set used in the current study is available within the article.

Abbreviations
S.G.: Study Group
C.G.: Control Group

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