

MAXILLARY INCISOR TRAUMA IN PATIENTS WITH CLASS II DIVISION 1 DENTAL MALOCCLUSION: ASSOCIATED FACTORS

Sınıf II Bölüm 1 Dental maloklüzyonu Olan Hastalarda Kesici Diş Travması ile İlişkili Faktörler

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Received: 06/05/2016

Accepted: 17/06/2016

ABSTRACT

Purpose: The aim of this study was to assess the association between the presence of maxillary incisor trauma (MIT) with age, gender, dentition type, the degree of overjet (OJ), lip form, respiratory type and dental arch form in patients with Class II division 1 dental malocclusion.

Subjects and Methods: 256 patients (mean age: 15.80 ± 2.2) were included in this study. The patients' gender, dentition type, superior lip form, dental arch form and respiratory type were recorded. Participants were divided into four groups according to the severity of OJ: 3.5 mm < Group 1 (OJ I) ≤ 6 mm with competent lip, 3.5 mm < Group 2 (OJ II) ≤ 6 mm with incompetent lip, 6 mm < Group 3 (OJ III) ≤ 9 mm, 9 mm < Group 4 (OJ IV). Mann Whitney-U test was used to examine the group differences for trauma and non-trauma groups. Logistic regression analysis was used to assess the factors for trauma and their risk indicators.

Results: 3.5 mm < OJ II ≤ 6 mm with incompetent lip had the highest odds of experiencing MIT among the OJ groups with an odds ratio (OR) of 3.143 and 95% confidence interval (CI) 1.125-2.779. The odds were 3.572 times higher in the group with short lip form than found in the group with normal lip form (OR 3.572, 95% CI 1.130-2.340).

Conclusion: The age, gender, respiratory type and dental arch form were not significantly associated the risk of MIT. OJ between 3.5 mm and 6 mm (with incompetent lip) and short lips increased the risk of having maxillary incisor trauma in patients with Class II division 1 malocclusion.

Keywords: Pedodontics dentistry; orthodontics; malocclusion; incisor; trauma

ÖZ

Amaç: Bu çalışmanın amacı Sınıf II Bölüm 1 dental maloklüzyonu olan hastalarda üst kesici diş travması (ÜKT) ile yaş, cinsiyet, dentisyon tipi, overjet derecesi (OJ), üst dudak formu, solunum tipi ve dental ark formu arasındaki ilişkiyi belirlemektir.

Hastalar ve Yöntem: Çalışmaya 256 hasta (ortalama yaş: 15.80 ± 2.2) dahil edildi. Hastaların yaş, cinsiyet, dentisyon tipi, overjet derecesi, üst dudak formu, solunum tipi ve dental ark formu değerlendirildi. Hastalar, overjet derecesine göre 4 gruba ayrıldı: Yeterli dudak kapanışı ile 3,5 mm < Grup 1 (OJ I) ≤ 6 mm, yetersiz dudak kapanışı ile 3,5 mm < Grup 2 (OJ II) ≤ 6 mm, 6 mm < Grup 3 (OJ 3) ≤ 9 mm, 9 mm < Grup 4 (OJ 4). İkili karşılaştırmalarda Mann Whitney-U testi kullanıldı. Travma durumunu etkileyen faktörler ve bunların risk düzeylerinin belirlenmesi amacıyla lojistik regresyon modeli analiz edildi.

Bulgular: OJ'ye göre yetersiz dudak kapanışı ile 3.5 mm < OJ II ≤ 6 grubunda göreceli olasılıklar oranı (GOO) 3.143, 95% güven aralığında (GA) 1.125-2.779 olarak hesaplandığından en yüksek travma risk değerinin bu grupta olduğu belirlendi. Kısa dudak formu normal dudak formu ile karşılaştırıldığında travma riski daha yüksek bulundu. (GOO 3.572, 95% GA 1.130-2.340).

Sonuç: Yaş, cinsiyet, solunum tipi ve dental ark formu ile ÜKT arasında anlamlı bir ilişki bulunmadı. Sınıf II Bölüm 1 dental maloklüzyonu olan hastalarda 3.5 mm ile 6 mm arasında OJ varlığı ve kısa dudak formu ÜKT görülme riskini arttırmıştır.

Anahtar kelimeler: Çocuk diş hekimliği; ortodonti; maloklüzyon; kesici; travma

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Introduction

Dental trauma is one of the most prevalent clinical problems in children/adolescents and adults (1). Previous studies which were carried out in different countries have shown that the prevalence of incisor trauma ranges from 6% to 34% (2-6). The highest prevalence has been found in patients who are between 9 and 15 years old and males are affected more than females (3, 7, 8).

Maxillary incisors are the most frequently affected teeth in both primary and permanent dentition injuries (9). The etiology of maxillary incisor trauma (MIT) includes oral predisposing factors (7), which have been identified as increased overjet, incompetence lip coverage of the upper anterior teeth and Class II division 1 malocclusion (9-11). Earlier studies have suggested that patients with increased overjet and lip incompetence were more prone to have MIT (7, 9, 12). Others, however, have shown that overjet is a minimal risk factor for MIT (8, 13) and no association between MIT and incompetence lip coverage was found (9, 14-16).

Because of these inconsistent findings, the aim of this study was to assess the association between the presence of MIT with age, gender, dentition type, the degree of overjet (OJ), lip form, respiratory type and dental arch form in patients with Class II division 1 dental malocclusion. The null hypothesis of this study is that the high degree of overjet and short lip form, which are among the risk factors in relation to Class II division 1 dental malocclusion, do not increase the risk of dental trauma.

Subjects and Methods

Study protocol was approved by the Ethical Committee of Istanbul University, Medical Sciences, and Faculty of Dentistry (no: 2013/247). 256 patients (N=256, mean age: 15.80 ± 2.2) were examined in the clinics of the departments of Pediatric Dentistry and Orthodontics of the Istanbul University Faculty of Dentistry. The inclusion criteria of this study were: to have history of dental trauma and Class II molar relationship, to have fully erupted permanent first molars, good general and dental health. Patients with physical and/or mental disabilities were excluded from the study. Data was collected from pretreatment dental records, patients' history and clinical examination. Pretreatment dental records include a standardized questionnaire, pretreatment study models, x-rays and

photographs. The patients have had dental trauma to maxillary incisors before the orthodontic treatment. Their records were considered to represent the trauma group. Information regarding gender, age at the time of injury, cause of trauma, number of injured teeth, type of tooth and type of trauma were recorded.

The gender, dentition type (mixed or permanent), superior lip form (short or normal), dental arch form (ovoid or square), and respiratory type (nasal or mouth) of patients were also evaluated by two investigators. The trauma records were assessed as injuries to hard dental tissues and the pulp (enamel infraction, enamel fracture, enamel-dentin fracture, complicated crown fracture, uncomplicated crown-root fracture, complicated crown-root fracture, root fracture) and periodontal (concussion, subluxation, extrusive luxation, lateral luxation, intrusive luxation, avulsion) according to the criteria of World Health Organization and was modified by Andreasen and Andreasen (17).

The degree of original overjet (OJ) was measured and patients were further grouped under four entities according to the recommendations described in Index for Orthodontic Treatment Need (IOTN) (18) as follows: Group 1; $3.5 \text{ mm} < \text{OJ I} \leq 6 \text{ mm}$ with competence lip coverage, Group 2; $3.5 \text{ mm} < \text{OJ II} \leq 6 \text{ mm}$ with incompetence lip coverage, Group 3; $6 \text{ mm} < \text{OJ III} \leq 9 \text{ mm}$ and Group 4; $9 \text{ mm} < \text{OJ IV}$. Lip competent of the upper incisors was subdivided into two categories: competence or incompetence. If the lip in relaxed position covered the upper incisors, lip coverage was considered as competence (9). If the maxillary incisors crowns were not covered by the upper lip and they were clearly visible, lip coverage was classified as incompetence.

Statistical analysis

All collected data were imported to Statistical Package for Social Sciences (SPSS) for Windows software, version 18.0 (SPSS Inc., Chicago, IL, USA). Frequency and percentage for qualitative variables, mean and standard deviation for quantitative variables were given as descriptive statistics. The normality of the distribution was tested with Kolmogorov-Smirnov and Shapiro-Wilk test. Distribution of the data did not meet the requirements of normal distribution. Mann Whitney-U test was used to compare the medians of the variables for trauma and non-trauma groups. Logistic regression analysis was also used to determine the factors for trauma and their risk

indicators. The confidence interval was set to 95% and $p < 0.05$ was considered statistically significant.

Results

The descriptive characteristics of the study sample are presented in Table 1. The mean age of, trauma group (n=38) and non-trauma group (n=218) were 15.28 ± 2.31 and 15.79 ± 2.27 respectively. 38 (23 males and 15 females) of 256 patients with Class II division 1 had MIT. The prevalence of dental trauma was 14.8% and the most frequent causes of injuries were falls (89.5%). The types and treatment of 47 injured maxillary incisors are presented in Table 2. The maxillary permanent central incisors were the most commonly affected teeth (87.2%). Enamel fracture was the most common dental trauma type in patients with MIT (51.06%). Fractures involving enamel and dentin accounted for 23.40%, and only 3 subjects had trauma with pulpal exposure (6.38%). The restorative treatment has been mostly applied (65.96%). Table 3 represents that 27 patients had only one tooth affected (71.05%), nine patients had only two (23.68%) and two patients had three involved (5.26%). Incisor trauma occurred only in maxillary arch (92.1%) and 7.9% (3 patients) had

injuries to both maxillary incisors and mandibular incisors (Table 3). Table 4 shows that the differences in the proportion of subjects with MIT by gender, age, respiratory type and dental arch were not statistically significant. When the clinical variables were evaluated in groups compared with presence of MIT, it was also found that there was a significant association between the dentition type ($p = .038$), OJ ($p = .022$), lip form ($p = .005$) and occurrence of trauma. Table 5 represents the frequency distribution of maxillary incisor trauma in study sample by logistic regression analysis of variables (dentition type, OJ, lip form) that are significantly associated to MIT. The odds were 2.843 times higher in the group of mixed dentition which had greater odds of MIT when compared to that of the group with permanent dentition (OR 2.843, 95% CI 0.942-2.109). Group 2 had the highest odds of MIT among the OJ groups (odds ratio OR 3.143, 95% confidence interval CI 1.125-2.779). The odds were 2.112 times higher in Group 3 and 2.632 times higher in the group with Group 4 when compared with the less overjet. The odds were 3.572 times higher in the group of short lip form which had greater odds of MIT when compared to the group with normal lip form (OR 3.572, 95% CI 1.130-2.340).

Table 1. Descriptive statistics of the study groups.

Variables	Sub-groups	Trauma group (n=38) n(%)	Non-trauma group (n=218) n(%)
Gender	Female	15(39.5)	118(54.1)
	Male	23(60.5)	100(45.9)
Dentition Type	Mixed	11(28.9)	33(15.1)
	Permanent	27(71.1)	185(84.9)
*Overjet Degree (OJ)	Group 1	13(34.2)	117(53.7)
	Group 2	4(10.5)	26(11.9)
	Group 3	13(34.2)	43(19.7)
	Group 4	8(21.1)	32(14.7)
Superior Lip Form	Short	10(26.3)	40(18.3)
	Normal	28(73.7)	178(81.7)
Respiratory Type	Nasal	31(81.6)	198(90.8)
	Mouth	7(18.4)	20(9.2)
Dental Arch	Ovoid	36(94.7)	196(89.9)
	Square	2(5.3)	22(10.1)

* $3.5 \text{ mm} < OJ I \leq 6 \text{ mm}$ with competence lip coverage (Group 1), $3.5 \text{ mm} < OJ II \leq 6 \text{ mm}$ within competence lip coverage (Group 2), $6 \text{ mm} < OJ III \leq 9 \text{ mm}$ (Group 3) and $9 \text{ mm} < OJ IV$ (Group 4).

Table 2. Distribution of the trauma types and treatment of 47 injured teeth.

		n(%)
Injuries to hard dental tissues and the pulp	Enamel infraction	2(4.26)
	Enamel fracture	24(51.06)
	Enamel-dentin fracture	11(23.40)
	Complicated crown fracture	3(6.38)
	Complicated crown-root fracture	1(2.13)
Injuries to the periodontal tissues	Subluxation	5(4.26)
	Intrusion	3(2.13)
	Lateral luxation	3(2.13)
	Avulsion	2(4.26)
¹Total		54
Number of injured teeth	11	28(56)
	21	13(26)
	12	2(4)
	41	3(6)
	51	3(6)
	61	1(2)
²Total		50
Treatment type	Endodontic	12(25.53)
	Restorative	31(65.96)
	Implant	1(2.12)
	Orthodontic	3(6.38)

¹Some teeth had more than one type of injury

²All injured teeth in maxillary and mandibular arches.

Table 3. Number and location of traumatic injuries in 38 patients.

		n(%)
Number of injured teeth per patient	One	27(71.05)
	Two	9(23.68)
	Three	2(5.26)
Number of injured teeth per dental arches	Maxilla	35(92.1)
	Maxilla and mandibula	3(7.9)

Table 4. Findings of Mann-Whitney U statistics stratified by study variables and the presence of maxillary incisor trauma (OJ: overjet).

	Gender	Age	Dentition Type	OJ	Superior Lip Form	Respiratory Type	Dental Arch
Mann-Whitney U	3535.000	3556.000	3570.000	3249.000	3812.000	3759.000	3942.000
Wilcoxon W	27406.000	4297.000	4311.000	27120.00	4553.000	27630.00	4683.000
Z	-1.665	-1.424	-2.078	-2.295	-2.141	-1.709	-.941
Asymp. Sig. (2-tailed)	.096	.155	.038	.022	.005	.087	.347

Table 5. Logistic regression analysis of the variables in relation to maxillary incisor trauma (S.E: standard error, df: degree of freedom, sig: significance, OR: odds ratio, CI: confidence interval).

	B	S.E	Wald	df	*Sig.	OR	CI %95 Lower upper	
Gender			3.015	2	.555			
Female	.341	.552	.382	1	.537	.711	.241	.997
Male	.235	.491	.228	1	.633	1.264	.183	.910
Age	1.309	.935	1.962	1	.161	.270	.943	1.687
Dentition type			6.502	2	.039			
Mixed	1.045	.423	6.110	1	.013	2.843	.942	2.109
Permanent	.708	.399	3.143	1	.076	2.029	.628	1.436
Overjet			12.468	4	.014			
Group 1	2.343	.682	11.812	1	.001	1.416	2.137	3.632
Group 2	1.145	.524	4.775	1	.029	3.143	1.125	2.779
Group 3	.752	.424	3.143	1	.076	2.122	.6624	1.875
Group 4	.968	.448	4.663	1	.031	2.632	0.872	1.146
Superior Lip Form			8.668	2	.013			
Short	1.273	.433	8.664	1	.003	3.572	1.130	2.340
Normal	.537	.300	3.198	1	.074	1.711	.450	1.084
Respiratory Type			5.826	2	.120			
Nasal	.771	.519	2.205	1	.138	.463	.567	1.280
Mouth	.404	.690	.342	1	.559	.668	.373	1.584
Dental arch			5.615	2	.060			
Ovoid	.250	.649	.149	1	.700	.779	.218	1.776
Square	.775	.636	1.482	1	.223	.461	.132	1.604
Constant	1.309	.935	1.962	1	.161	.270	.943	1.687

Omnibus Test: chi-square value = 491.350, Prob = 0.000

-2 Log likelihood= 669,249 ; **Cox&Snell R Square**= 0.695 ; **Nagelkerke R Square**= 0.689

Hosmer and Lemeshow Test: chi-square value= 4.886 , Prob=0.558 > 0.05

*Statistically significant at $p < 0.05$.

Discussion

The greater number of incisor trauma has been observed in patients with Class II division 1 dental malocclusion when compared to other types of orthodontic malocclusion (19). Therefore, this study was carried out to assess the association between the presence of MIT and gender, age, dentition type, the degree of overjet (OJ), lip form, respiratory type and dental arch form among patients with Class II division 1 dental malocclusion.

Schatz *et al.*(20) showed that only 2.6% of the patients have had injuries that affect incisors of both arches at the same time. In the present study 3 patients (7.9%) had both maxillary and mandibular incisor teeth injuries. Previous studies also reported that the maxillary central incisors were the most affected (1, 4, 5, 9, 10, 12, 21). Because of the higher prevalence

of injuries in the maxilla, this study focused on the MIT. Atabek *et al.*(21) observed that most frequent causes were falls (70.1%) which support the findings of the present study (89.5%) that was carried out in Turkey. Artun *et al.* (14) reported that maxillary central incisors were most of the traumatized teeth and most of the patients had only one injured tooth. Schatz *et al.*(20) concluded that most injuries involved one incisor tooth (74.6%). The results of the present study were consistent with these previous reports as most of the injuries in the study population involved one incisor tooth (71.05%).

One of the most common types of dental trauma is enamel fracture or enamel-dentin fracture without pulp exposure (1, 3, 8, 9, 14, 16). Schatz *et al.*(20) observed that 39.4% of the patients had enamel fractures while 48.1% had enamel-dentin fractures without pulp exposure. In contrast, Dua *et al.*(22)

and Altun *et al.*(23) have found, respectively, 50% and 44.6% enamel fracture, which they suggested as the most common type of dental trauma. Similarly, this study showed that enamel fracture was the most common (51.06%) type of MIT in patients with Class II division 1 dental malocclusion which is followed by enamel-dentin fracture without pulp exposure (23.40%). Sari *et al.*(24) mentioned that the restorative treatment and pulpectomy were the most preferred treatment modalities for permanent dentition. Restorative treatment followed by endodontics was also performed in the present study.

The frequency of incisor trauma in children and adolescents has been reported to be between 6% and 49% (1, 16, 22, 25, 26). Tümen *et al.*(27) found the prevalence of dental trauma as 8% in Turkish patients having primary dentition. Altun *et al.*(23) observed that the prevalence of dental trauma was 9.5% in Turkish patients having permanent dentition. In the present study, 14.8% of the patients with Class II division 1 dental malocclusion had dental trauma in mixed and permanent dentition. Accordingly, the presence of Class II division 1 dental malocclusion has been found to increase the risk of dental trauma.

Several studies reported that prevalence of traumatic injuries in males was higher than in females (1, 3, 20, 25, 28). Due to increased sport or outdoor/indoor activities in females, a reduction in the gender ratio was stated in a study by Traebert *et al.* (29). Some studies found no difference between males and females (11, 30). Similarly, there were no significant differences between the gender and MIT in patients with Class II division 1 malocclusion in the present study. The patients between 8-11 years of age are more prone to traumatic injuries to anterior teeth (6, 31-33). Zaleckiene *et al.*(28) found that peak age of traumatic injuries in permanent dentition is between 10-12 years. In the present study, no significant relation was observed between the age and the occurrence of MIT. On the other hand, there were significant differences between the dentition type and MIT. This study shows that subjects in mixed dentition are under greater risk of having MIT than those in permanent dentition with Class II division 1 malocclusion.

To determine the relationship between the presence MIT and OJ, subjects were divided into four groups based on the severity of overjet and lip competence/incompetence. According to Järvinen (15), the range of injuries increased in relation to the larger overjet (>6mm). Burden (10) observed increased overjet and lip incompetence as risk factors in relation to traumatic

injury. Borzabadi-Farahani *et al.*(12) reported that, in children with OJ>3.5 mm, the odds of MIT had increased significantly (OR=2.83) compared to children who have normal overjet (OJ≤3.5 mm). Årtunet *et al.*(14) who calculated the odds of MIT before adolescence have found that it was 3.7 times higher in subjects with overjet larger than 9.5 mm and 2.8 times higher in subjects with overjet 6.5 to 9.0 mm when compared to subjects who have normal overjet. Calculated odds of MIT in the present study was 2.632 times higher in patients with overjet larger than 9 mm, and it was 2.122 times higher in patients with overjet 6.0 to 9.0 mm compared to those having overjet 3.5 to 6 (with competent lip).

In a meta-analysis, Petti (34) evaluated the articles published between 1990 and 2014 regarding the association between large overjet and traumatic dental injuries, it was found that the presence of large overjet could be co-responsible in the occurrence of traumatic dental injuries. Similarly, when compared to patients having an overjet of <6 mm and incompetence lip, the odds of experiencing MIT were higher than in patients with an overjet between 3.5 mm and 6 mm (with incompetent lip) in the present study. Also in some studies (9, 12, 16) lip competence was not found to be associated with maxillary incisor trauma. Compared with patients having an overjet between 3.5 mm and 6 mm (with competent lip), the odds of experiencing MIT was 3.143 times the higher in patients with an overjet between 3.5 mm and 6 mm (with incompetent lip) in this study. One of the characteristics of Class II division 1 dental malocclusion is the dental arch forms which have not yet been numerically defined (20, 32). There were no significant relationship between dental arch form and the occurrence of MIT in this study. There are contradictory evidence on the influence of respiratory function on the development of orofacial structures. Oral respiratory type is another characteristic feature of Class II division 1 dental malocclusion. However, this study found no association between oral respiration and higher risk of MIT.

Conclusion

The age, gender, respiratory type and dental arch form were not found to be significantly associated with higher risk of MIT. The results of this study showed that overjet between 3.5 mm and 6 mm (with incompetent lip) and short lips increased the risk of experiencing MIT in patients with Class II division 1 malocclusion.

Source of funding

None declared

Conflict of interest

None declared

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