EFFECT OF EARLY CLASS II TREATMENT ON THE INCIDENCE OF INCISOR TRAUMA

By

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Many studies have demonstrated the frequency of dental injuries in children and adolescents. The purpose of this study was to evaluate the prevalence and the effect on incidence of incisor trauma in patients that participated in a clinical trial designed to investigate early growth modifications in the treatment of CLII malocclusion. The subjects were categorized into 3 groups based on the type of treatment during phase-1: (1) headgear/biteplane, (2) bionator, (3) no treatment observation group. All 3 groups underwent phase-2 treatment with fixed appliances. Incisor injury was scored at every data collection point with the Ellis index by a single-blinded examiner using dental casts, intraoral photos, panoramic and periapical x-rays. Twenty-five percent of the subjects had some level of incisor trauma at baseline exam. No significant differences were found in regards to sex and prevalence of injury at baseline, but males did show higher incidence of injury throughout the course of treatment. No differences in incidence of trauma were found between the 3 groups throughout treatment. The majority of the injuries were minor and consisted of enamel fractures only (80%). Seventy-eight percent of the injuries occurred in the maxillary incisors with central incisors being the most common. Early orthodontic treatment does not seem to affect the incidence of incisor injury. The majority of the

injuries prior to and during treatment were minor, therefore the cost benefit ratio of orthodontic treatment in order to prevent incisor trauma is doubtful.

CHAPTER 1
INTRODUCTION

Dental injuries are common and present an important dental public health problem. Many epidemiological studies during the last three decades have shown the frequency of dental injuries in children and adolescents.[1-8] The occurrence of dental injuries in a population can be defined by its prevalence and incidence. The prevalence of incisor injury has been reported to range from 6% to 34%.[9-11] Falls, collisions, sporting activities, and traffic accidents have been reported to be the main cause of most dental injuries.[12,13] Variables such as age, gender, socio-economic status, and behavioral problems may also influence the frequency of dental trauma. Bauss et al.[12] and Caliskan et al.[13] both found that patients aged 8—11 years exhibited the highest prevalence of dental trauma. It has been shown that incisor injuries occur more frequently in males.[14,15] Socio-economic influences can also have a significant effect on a child's experience with dental injuries.[16,17] Studies have shown a positive correlation between the frequency of incisor trauma with increased protrusion,[18,19] Class II malocclusion,[3,20] increased overjet,[21-24] and lip incompetence.[19,25] Early orthodontic treatment for children with such characteristics has been recommended in order to prevent incisor trauma and its sequelae.[22,25] Nguyen et al.[23] had suggested the incorporation of overjet as a malocclusion item into orthodontic treatment indices because of its potential correlation with dental trauma.

Although the indications for early orthodontic treatment in order to diminish the likelihood of trauma to permanent incisors have been presented by several authors, Koroluk et al.[26] found the majority of injuries to be minor and easily treated at low cost and with good long-term prognosis. They concluded that early growth modification might have some effect on the incidence of trauma but the expected cost of trauma per child to be less for those who had a 2-phase orthodontic treatment.

The efficacy of early intervention is largely dependent on the timing of treatment and peak occurrence of injury. Orthodontic intervention could be ineffective with minimal benefits if dental trauma occurs before the start of treatment. Currently, few reports are available regarding the effectiveness of early orthodontic treatment in order to reduce the incidence of incisor trauma.

The purpose of this study was to evaluate the prevalence and the effect on incidence of incisor trauma in patients that participated in a clinical trial designed to investigate early growth modifications in the treatment of CLII malocclusion.

CHAPTER 2
MATERIALS AND METHODS

Subjects

The subjects were part of a previous prospective, longitudinal, randomized clinical trial designed to examine and report the effectiveness of early treatment with headgear/biteplane (HG/BP) or with bionator (B) in patients with Class II malocclusion and compare results with changes over a similar time period in an observation (C) group. A stratified block randomization procedure was used to assign a treatment protocol (HG/BP, B, C) during Phase-1 for each patient. Strata were defined by severity of Class II malocclusion, need for preparatory treatment, mandibular plane angle, race, and gender. After completing Phase-1, all groups underwent fixed appliances in Phase-2, followed by a retention/follow-up period. The study design and subject selection are described in detail in the previous publication.[27]

Inclusion Criteria

The inclusion criteria included: bilateral greater than or equal to one-half-cusp Class II molars, or unilateral greater than one-half-cusp Class II molars, fully erupted permanent first molars, not more than 3 permanent canines or premolars, positive overjet and overbite, and good general and dental health.

Methods

Incisor injury was assessed at all data collection (DC) points using the Modified Ellis Classification (Figure 2-1). Maxillary (#7—10) and mandibular (#23—26) incisors were scored. Study models, intraoral/extraoral photos, x-rays (lateral cephlogram, panoramic, and periapicals taken during Phase-2) obtained at each DC point was used to inspect incisor injury. Any existing or new restorations on each tooth were noted. One trained and reliability tested examiner [DRC] recorded all injuries. The records for all DC points of each patient were evaluated at the same time in order to eliminate the chance of recording errors over time.

Overjet was assessed for each patient at all DC points using the lateral cephalograms taken at each data collection period.

Data Analysis

Statistical comparisons were performed at baseline (DC 1), end of Phase 1 (DC 5), baseline at Phase 2 (DC 7), and end of Phase 2 (DC F). Relationships between outcomes and covariates were examined with chi-square and Fisher exact tests. For all analyses, a p-value less than 0.05 was considered statistically significant. Pearson's correlation coefficient was used to examine any relationship between initial overjet and trauma.

Score	Injury Description
0	Non injured tooth
1	Fracture of the crown involving enamel only
2	Fracture of the crown involving enamel and dentin
3	Fracture of crown involving pulp (untreated, pulp cap, pulpotomy, root filling)
4	Nonvital without crown fracture
5	Root fracture
6	Lost due to trauma
7	Missing tooth

Figure 2-1. Modified Ellis Classification.

CHAPTER 3
RESULTS

Table 3-1 presents the subject characteristics by treatment group. At DC 1, 64 of the 261 participants (25%) had some level of incisor trauma (B=27 (31%), HG/BP=18 (19%) , C=19 (23%)). The differences in the distribution of subjects with trauma to each treatment group were not statistically significant (P = 0.18). Figures 3-1 and 3-2 shows the distribution and severity of injury to maxillary and mandibular teeth. The majority (80%) of the injuries were scored as a minor fractures involving enamel only. Fractures involving enamel and dentin consisted of 19% and only 1 subject had trauma with pulpal exposure. The maxillary incisors had the highest number of injuries (77%), with central incisors being the most common. The prevalence of incisor trauma at DC 1 were not statistically significant between males and females (P = 0.27), with 21% of females and 27% of males having some degree of incisor trauma.

Since the majority of the injuries occurred in the maxilla, further analysis focused on the incidence of only maxillary incisor injury. As shown in Table 3-2, there were no differences in the incidence of new trauma between treatment groups during phase-1 (DC1—5), between treatment phases (DC5—7), during phase-2 (DC7—F), and overall (DC1—F). As seen in Figure 3-3, there was a statistically significant higher incidence of trauma in males compared with females during the entire study. During the entire course of the study, only the control group and not the HG/BP or bionator groups showed a statistically significant higher incidence of trauma in males than females (Figure 3-4).

Overjet was measured to determine if overjet correlated with trauma in males. The mean overjet value at baseline was 5.81mm (± 2.77 SD; range, 0.87–13.2) for males and 5.48mm (± 2.30 SD; range, 0.51–11.2) for females. No correlation was found between initial overjet value and amount of upper incisor trauma at baseline (Pearson Correlation Coefficient = 0.02; P =

0.75). When evaluating baseline overjet and change in upper incisor injury as continuous variables throughout treatment between DC 1 to DC F, a borderline significant correlation of 0.23 (P = 0.0549) was found in the control group, but not detected in the headgear or bionator groups (correlations -0.11, -0.06, respectively).

Table 3-1. Subject characteristics by treatment group.

Characteristic	B (n=87)	C (n=81)	HG/BP (n=93)	P-value
Sex (% female)	40%	38%	38%	0.93
Race (% white)	87%	93%	95%	0.20
Age at baseline: mean (s.d.)	9.6 (1.1)	9.5 (0.8)	9.7 (0.8)	0.74
Initial molar class severity#				
% mild	26%	30%	31%	
% moderate	26%	26%	23%	0.95
% high	47%	44%	46%	

definition of initial molar class severity: mild (bilateral 1/2 cusp), moderate (at least 1 side 3/4 cusp), or severe (at least 1 side full cusp).

Table 3-2. Incidence of incisor injury (maxillary incisors).

	Treatment group (% new injury)			
Time point	B	HG/BP	C	P
DC 1 – DC 5	22.1	17.7	22.5	0.69
DC 5 – DC 7	4.3	1.4	6.7	0.25
DC 7 – DC F	3.2	2.9	10.9	0.13
DC 1 – DC F	28.4	22.5	33.3	0.36

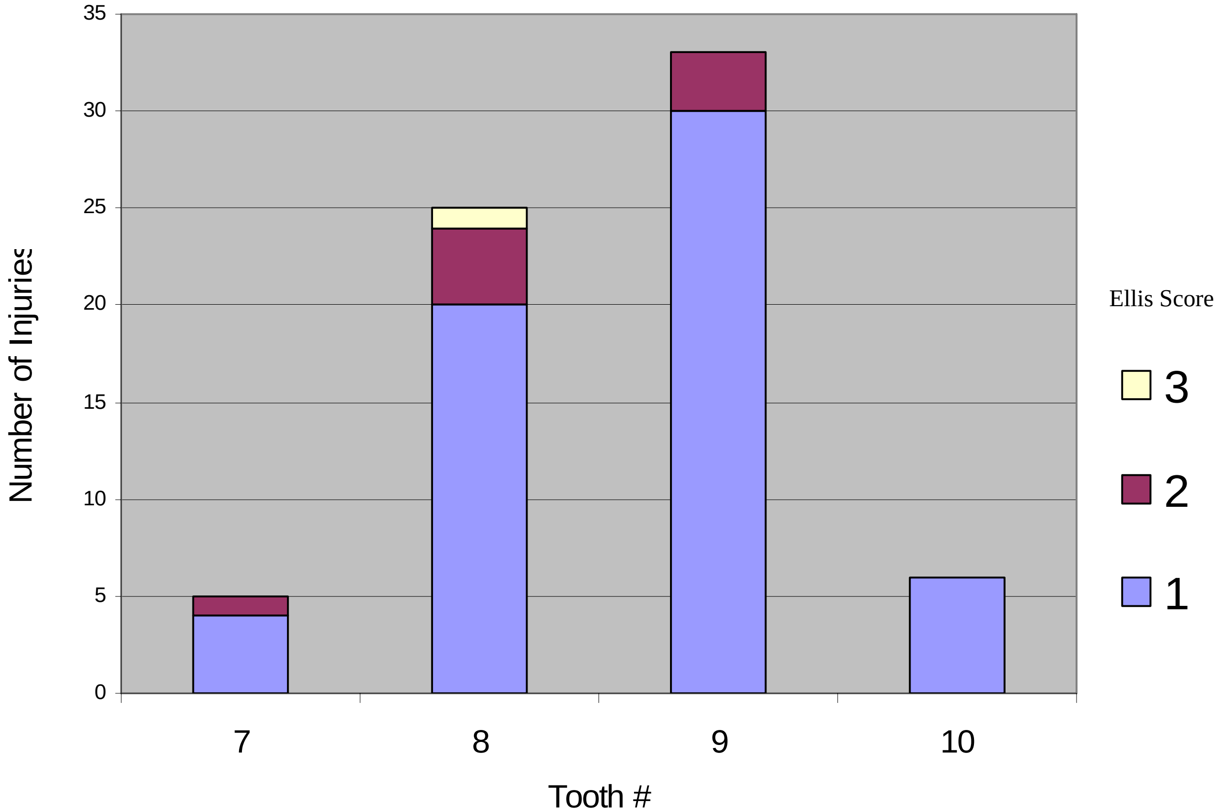

Figure 3-1. Maxillary incisor injury distribution and severity.

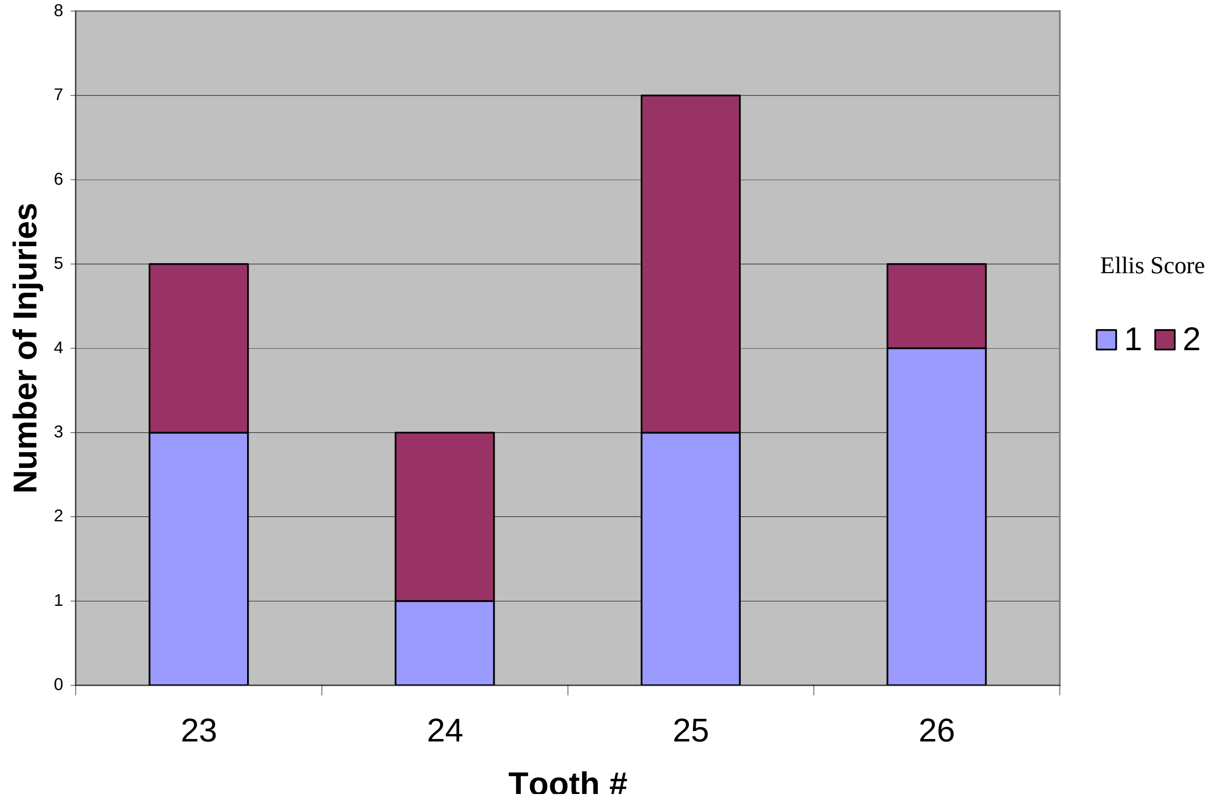

Figure 3-2. Mandibular incisor injury distribution and severity.

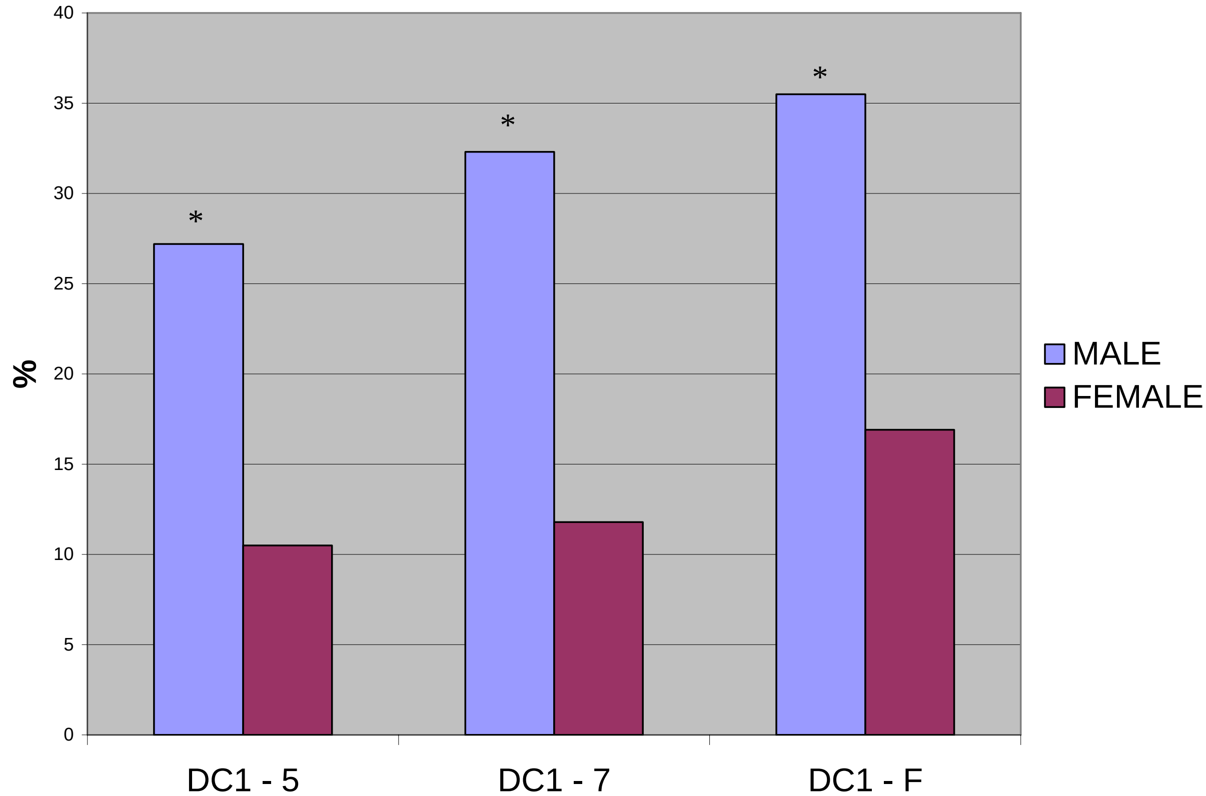

Figure 3-3. Incidence of injury in males vs. females throughout treatment. * = P < 0.05.

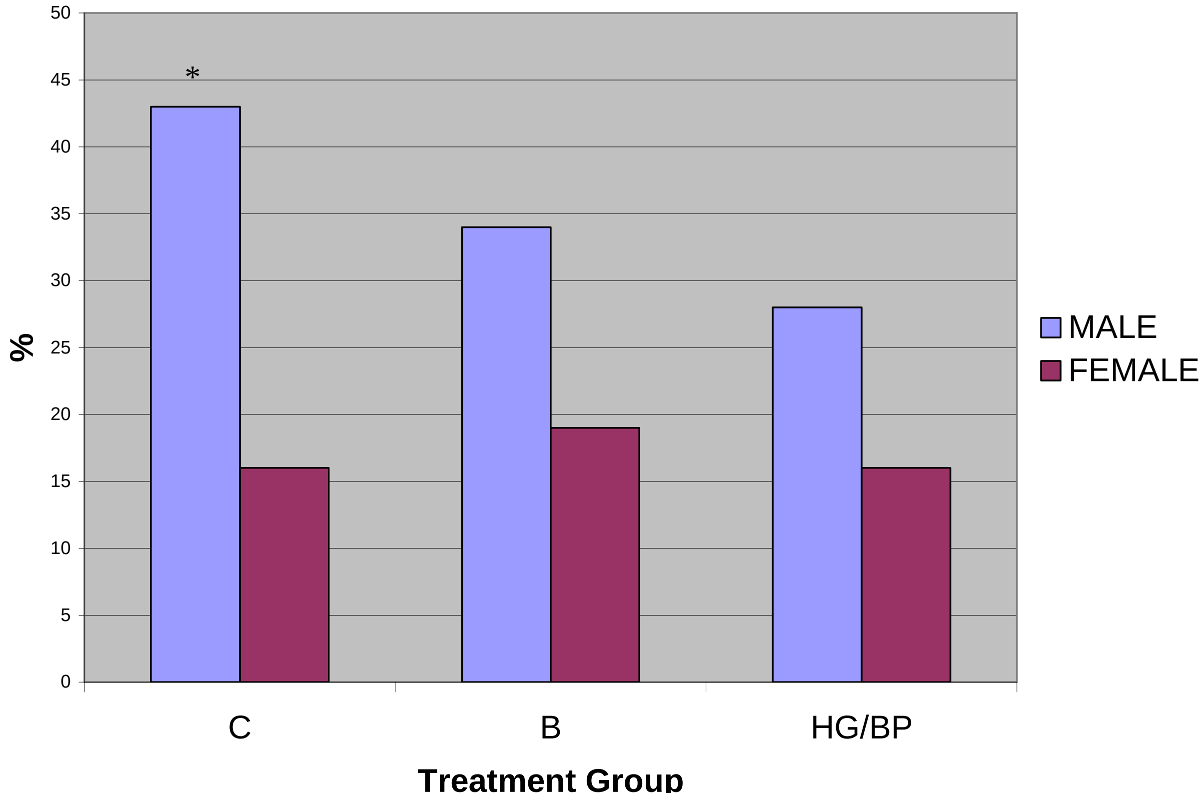

Figure 3-4. Incidence of injury in sex between treatment groups from DC1-F (maxillary incisors). * = $P < 0.05$.

CHAPTER 4

DISCUSSION

In this study, we found 25% of the subjects had some level of incisor trauma at the baseline exam which falls in the range of previously reported prevalence of incisor injury of 6% to 34%.[9-11] This shows that a significant number of patients already had some form of dental trauma during early childhood. In a study of Brazilian preschool children from birth to 6 years old, 35.5% of the children already had signs of dental trauma.[28] Therefore, if orthodontic early treatment is to have any effect on the incidence of this early incisor trauma, orthodontic treatment would most likely need to be initiated soon after the eruption of the permanent incisors. Thus, determination of the initial onset of trauma would be pertinent to prevention.

The prevalence of incisor injury at baseline was not statistically different between boys and girls at the mixed dentition stage. This is similar to the results found by Koroluk et al.[26] Marcenes et al.[29] also found no difference in prevalence between boys and girls at 9 years of age living in Syria. However, we observed that males had a higher incidence of trauma during the phase-2 treatment period. This finding is consistent with several investigators.[12,14,15] This could be due to increased activity of boys at this age.

Throughout the trial, the incidence of incisor trauma was not statistically significant between the 3 treatment groups. All three groups showed a trend of decreased incidence between phase 1 and phase 2. Bauss et al.[12] and Caliskan et al.[13] both found that children aged 8 -11 years, an age range where phase I treatment usually occurs, exhibited the highest prevalence of dental trauma. Children at these ages may exhibit increased risk-taking behaviors and physical leisure activities such as school sports[30], therefore increasing the risk of injury during treatment. Nonetheless, the decrease in incidence between phase 1 and phase 2 may implicate the potential benefit of early treatment in order to reduce risks of trauma later on.

During early childhood, several nondental factors may also play a role in affecting dental trauma and should be considered. Socio-economic influences can also have a significant effect on a child's experience with dental injuries.[17] Nicolau et al.[16] found that adolescents who experienced adverse psychosocial environments, such as non-nuclear families, paternal punishments, and poor school performance along the life course had more traumatic dental injuries than their counterparts who experienced more favorable environments.
Mercenes et al.[14] discovered a higher incidence of incisor injury in children from mothers with higher educational background. Odoi et al.[31] associated behavioral problems such as peer relationship problems, hyperactivity/inattention, and emotional distress with occurrence of traumatic dental injury. Perheentupa et al.[32] attributed increased tooth trauma to high alcohol consumption and overweight.

We observed that approximately 78% percent of total incisor injury occurred in the maxillary incisors while 22% occurred in the mandibular incisors. Most of the injuries involved the maxillary central incisors followed by maxillary lateral incisors. This is in agreement with previous studies.[12,13,33] It is very likely that the susceptibility of teeth to trauma is related to their position in the dental arch. Maxillary incisors are usually the most anteriorly positioned teeth, therefore it is conceivable that they will have the highest frequency of trauma.

Some studies found enamel-dentin fractures without pulpal involvement to be the most common form of injury. [4,13] Other investigations, in contrast, report enamel fracture or luxation to be the most common fracture type. [1,5,6] Our investigation revealed the majority of trauma consisted of enamel fractures. Only 19% of the injuries involved dentin, and only 1 subject had trauma with pulpal exposure. Fortunately, this shows that the majority of trauma is minor and could be fixed with composite restorations with good long term prognosis.[34] Therefore, the cost of treating an injured tooth with restorations versus cost of orthodontic prevention must be considered in order to determine the optimal cost/benefit ratio.

The reports on whether increased overjet may play a significant predisposing factor for incisal trauma are conflicting. Bauss et al.[12] found higher prevalence of trauma in subjects with overjet values greater than 3mm. Jarvinen[24] attributed increased trauma to overjet values 6mm or greater. However, some studies found that increased overjet may not be positively correlated with the risk of dental injury.[22,35] Koroluk et al.[26] found no differences between mean overjet of patients with and without incisor trauma at baseline. In this study, we found no correlation between initial overjet and prevalence of trauma. In addition, we found no correlation between changes in overjet with incidence of trauma throughout treatment. The conflicting results reported by the literature may be due to several factors such as trauma classification, dentition studied, geographical and behavioral differences between study locations and countries. Nonetheless, it seems logical that patients with severe overjet may be at greater risk of injury simply because the incisor protrusion.

CHAPTER 5
CONCLUSIONS

In conclusion, we have found that a significant number of patients already had some level of incisor injury prior to any treatment. No correlations were found between initial overjet values and prevalence of trauma. Early orthodontic treatment did not seem to have a significant effect on the incidence of trauma. The majority of the injuries that occurred prior to and during treatment were minor and consisted of enamel fractures. Most of the injuries occurred in the maxillary central incisors and in general, males showed higher risk of trauma than females.

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BIOGRAPHICAL SKETCH

David Ruey Chen was born in Taichung, Taiwan in 1978. He received his BS in biological sciences from the University of California Davis in 2000. He graduated from the University of California San Francisco in 2004 obtaining a Doctor of Dental Science degree and was inducted into the Omicron Kappa Upsilon National Dental Honor Society. He continued his dental education at the University of Florida and received a degree of Master of Science with a certificate in orthodontics in 2007.