

Risk Factors for Traumatic Dental Injuries in an Adolescent Male Population in India

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Abstract

Aim: The aim of this study was to determine the prevalence of traumatic injuries to the anterior teeth and evaluate the role of anatomic risk factors in the occurrence of such injuries in a group with an assumed behavior predisposing them to trauma.

Methods and Materials: The study population consisted of 370 male enrollees of the National Cadet Corps (NCC) in India. Risk factors such as the socioeconomic status (SES) of parents, lip coverage, incisor overjet, and the cause and nature of trauma to anterior teeth were recorded. The Chi-square test was used for testing the association between these factors. Increasing overjet was further analyzed using chi-square for linear trends. Variables found significant were subjected to logistic regression.

Results: A prevalence of 14.9% of traumatic injuries to anterior teeth was found in the study population with sports activities being the most common cause. Permanent maxillary central incisors were most commonly injured with injuries involving enamel and dentin being the most frequently observed. Increased overjet and inadequate lip coverage were significantly associated with the occurrence of trauma. With an odds ratio of 7.2 inadequate lip coverage was identified, using binary logistic regression, as the single most independent risk factor for the occurrence of traumatic injury to the maxillary anterior teeth.

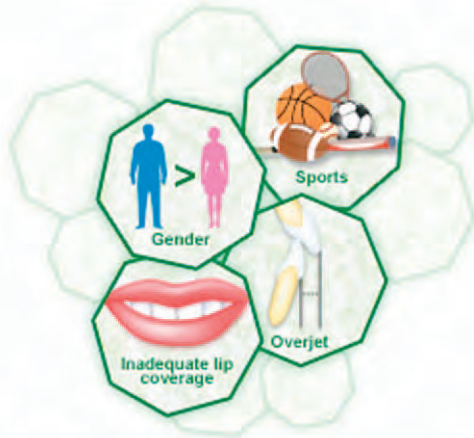
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Introduction

Chronic diseases and injuries are the leading health problems in all but a few regions of the world. While dental caries and periodontal disease have been considered to be the most significant oral health problems worldwide, orofacial trauma is among the most prominent oral health problems among children in developing countries.¹ Trauma to the anterior teeth with the underlying esthetic, psychosocial, functional, and therapeutic problems adversely affect an individual's quality of life.



The literature is replete with epidemiological data citing the prevalence²⁻¹⁹ and incidence^{2,18,20-25} of traumatic injuries to the anterior teeth among various age groups in different populations throughout the world. A significant amount of investigation has also been done concerning the etiological, predisposing, and risk factors in the occurrence of such injuries.^{2,4-6,9,15,16,20,23,26-35} Based on available evidence, these factors can be broadly classified into anatomic and sociobehavioral factors. The anatomic factors consistently reported to increase the risk of occurrence of anterior teeth injuries are substantial maxillary incisor overjet^{2,6,9,11,16,20,22,29} and inadequate lip coverage of the anterior teeth.^{2,6,9,21,22} The sociobehavioral factors reported to increase the predisposition towards traumatic injuries to anterior teeth include gender (males>females),^{2,7,9,11,17,21,22,36} adverse psychosocial environment,³¹ problem behavior,³² increased participation in sports and recreational activities,^{16,30,33,35} and accident proneness.²⁹ Though not as consistently proven as other factors, low socio-economic status (SES) was identified as a risk factor at least in one study by Hamilton et al.¹³

While all of these studies have repeatedly identified these risk factors, no study actually compares the relationship between anatomic and sociobehavioral factors. It is unknown whether trauma predisposing behavior in the absence of anatomic risk factors increases the chance of injury to the anterior teeth. It is also unknown if anatomic factors influence the occurrence of such injuries in a group with an assumed high behavioral risk.

The National Cadet Corps (NCC), the reserve defense forces of India, recruit and train cadets enrolled through voluntary participation of young people from schools throughout the country. Training involves routine participation in drills, exercises, sports, and other recreational activities like mountaineering and trekking. Since the enrollment process is voluntary, it is not surprising to find young people with a more boisterous, aggressive nature with a greater interest in sports and physical activities in such a group.

For the present study, a unit of NCC consisting of high school boys was recruited. This provided an ideal opportunity to test the study objective of assessing the role of anatomic risk factors in occurrence of traumatic injuries to anterior teeth in a high risk behavior group such as adolescent boys with increased participation in sports, recreational, and physical activity. A second objective of the study was to assess the prevalence and distribution of such injuries in this high behavior risk group.

Methods and Materials

The study was conducted among 386 male high school students who were voluntary participants of a NCC unit, recruited from government and private schools in the Udupi district of Karnataka state located in south India. The subjects were in the age group of 14-16 years. Permission to conduct the study was obtained from the commanding officer of the unit. Informed consent was conveyed following an explanation of the scope, purpose, and procedure of the study to the subjects and their parents. All the 386 subjects agreed to participate in the study.

A proforma was prepared to collect data during a brief face-to-face interview to obtain information about the following:



- Occupation, income, and education of the parents.
- The history of any orthodontic treatment of the subjects.
- The history, cause, and treatment of any injury to the anterior teeth.
- The findings of clinical examination.

The proforma was pilot tested on 30 subjects prior to the main study.

A single examiner, trained and calibrated for the criteria used, conducted both the interview and the clinical examination at the NCC training facility. The clinical examination was carried out under natural daylight conditions with subjects seated on a chair with a high backrest and the examiner standing behind the subject. The standard conditions for examination, infection control, and data recording were followed according to the World Health Organization (WHO) Basic Oral Health Survey Guidelines (1997).³⁷ A sufficient number of plane mouth mirrors, Community Periodontal Index (CPI) probes, and gauze pads were packed for each day of work.

The clinical examination included a visual inspection for lip coverage as the subject entered the examination room without subject awareness. Lip coverage was recorded as adequate if the lips covered the maxillary incisors in a rest position and as inadequate if the majority of the crown height was exposed and visible. Each subject was then examined for the measurement of maxillary incisor overjet using the CPI probe as described by the 1997 WHO Basic Oral Health Survey Guidelines.³⁸ The overjet findings were grouped into three categories: 0–3.5 mm, 3.5–5.5 mm, and above 5.5 mm. Next, all maxillary and mandibular anterior teeth from canine to canine

were examined for traumatic injury. Trauma was scored according to the criteria used for conducting a study in similar field circumstances by Sgan-Cohen et al. without use of radiographs and pulp vitality testing as follows:⁹

- 0 = No evidence of trauma
- 1 = Trauma limited to enamel
- 2 = Trauma involving dentin
- 3 = Trauma involving the pulp
- 4 = Treated trauma, which had clearly involved at the least the dentin and usually restored with a composite restoration.
- 5 = Discoloration due to trauma (verified by interview)
- 6 = Avulsed tooth due to trauma (verified by interview)

Intra-examiner variability was checked through duplicate examination of every tenth subject.

The SES of the subjects' families was calculated according to the modified Kuppaswamy scale for SES for an Indian population, which uses the occupation, income, and education of the parents to arrive at SES scores.³⁹

Data analysis was done using SPSS version 10.0 (SPSS, Inc., Chicago, IL, USA) and included descriptive statistics (frequency distribution and cross tabulation). Statistical significance for the association between occurrence of dental injuries and the SES, lip coverage, and maxillary overjet was carried out using the Chi-square test. The level of significance set was $p < 0.05$. The Chi-square test for linear trends was used to further validate the association with maxillary overjet. Binary logistic regression was used to identify the independent risk associated with variables found significant in the Chi-square analysis.

Results

A total of 386 14- to 16-year-old male cadets were interviewed and examined as part of this cross-sectional survey. Sixteen were excluded because they had a history of or were currently receiving orthodontic treatment. Kappa values were calculated for the clinical assessment of lip coverage, overjet measurement, and trauma classification. All scores were greater than 0.80 which suggests a very good intra-examiner agreement.

Of the 370 subjects included in the study, 182 (49.15%) had a SES score of 3 or less which is indicative of a lower middle class or lower groups on the modified Kuppaswamy's SES scale. The remaining 188 (50.85%) subjects belonged to a higher middle class or a high SES group with scores of 4 or 5.

Prevalence and Distribution of Anterior Tooth Injuries

Fifty-five of the 370 subjects examined had experienced traumatic dental injury to at least one of their anterior teeth resulting in an overall prevalence of 14.9%. Among them 23 (41.8%) had experienced injury to more than one of their anterior teeth. Overall, 78 injured teeth were identified in the study population.

The right maxillary central incisor was the most common tooth involved which accounted for 41% of the injuries followed by the left maxillary central incisor with 35.8%. Together the maxillary central incisors accounted for approximately 77% of the injuries.

The mandibular teeth accounted for 22% of the injured teeth with the central incisors being most commonly involved. Injury involving enamel and dentin was the most common type found (Table 1).

Cause of Injuries

The most common cause of injury was related to sports activities as reported in 49% of the subjects who had experienced anterior teeth injuries. Most of these injuries were sustained due to either falling during play or contact with the playing equipment such as balls and bats. Seven subjects each reported injury due to an accidental fall or due to impact with foreign objects accounting for 25.4% of the injuries. One subject had experienced injury during a fight and 12 were due to involvement in road accidents (Table 2).

Risk Factors

Using the Chi-square test, the associations between occurrence of anterior teeth injuries and lip coverage and the occurrence of anterior teeth injuries and maxillary overjet were found to be statistically significant (Table 3).

With regard to SES and its relationship to dental trauma, among the low SES group 14.3% had experienced anterior teeth injuries compared to 15.4% among the high SES group. The difference was not statistically significant.

While only 7.3% of individuals with adequate lip coverage had experienced injury, 41% of those with inadequate lip coverage had anterior teeth injuries.

Table 1. Distribution and type of injuries.

Trauma Score	Tooth 13*	Tooth 12*	Tooth 11*	Tooth 21*	Tooth 22*	Tooth 23*	Tooth 31*	Tooth 32*	Tooth 33*	Tooth 41*	Tooth 42*	Tooth 43*	Total
1	0	0	9	2	0	0	2	0	0	2	0	1	16 (20.5%)
2	0	0	23	24	1	0	3	0	0	4	2	0	57 (73%)
3	0	0	0	1	0	0	0	0	0	0	1	0	2 (2.56%)
4	0	0	0	1	0	0	0	0	0	1	0	0	2 (2.56%)
5	0	0	0	0	0	0	0	0	0	0	0	0	0 (0%)
6	0	0	0	0	0	0	1	0	0	0	0	0	1 (1.3%)
Total	0 (0%)	0 (0%)	32 (41%)	28 (35.8%)	1 (1.3%)	0 (0%)	6 (7.7%)	0 (0%)	0 (0%)	7 (9%)	3 (3.9%)	1 (1.3%)	78 (100%)

*FDI Tooth Numbers

While 8.85% of subjects with a normal overjet had experienced anterior tooth injury those with a greater overjet tended to result in such injuries. By comparison 22.0% of those with an overjet from 3.5–5.5 mm experienced injury and 32% among those with an overjet of more than 5.5 mm had experienced such injuries. A statistically significant association was found between the occurrence of anterior tooth injury and increasing overjet when analyzed using the Chi-square for linear trends ($p < 0.00001$).

Using binary logistic regression analysis, lip coverage was identified as the strongest

predictive factor for occurrence of anterior tooth injury. A person with inadequate lip coverage has a 7.2 times greater chance of experiencing anterior tooth injury than a person with adequate lip coverage (Table 4).

Discussion

The present study was a retrospective collection of data on traumatic anterior teeth injuries. Bastone et al.² stated such a study design has a major disadvantage because some oral injuries such as alveolar fractures and soft tissue injuries may not always be evident at the time of the examination if the injury occurred sometime beforehand. Other injuries could also be missed if signs and symptoms do not exist at the time of the study examination. Another shortcoming of retrospective studies is the accuracy of a patient's recall of the injury if the accident occurred months or even years before the examination. This is particularly true in children.

The objective of the present study was to assess the effect and role of anatomic risk factors as identified from earlier research. Specifically, the objective was to determine the influence of maxillary incisal overjet and inadequate lip coverage in the occurrence of injuries to anterior teeth among a group showing behavioral predisposition towards dental trauma. Young

Table 2. Cause of injury.

Cause	Number of Subjects
Cannot recollect	02 (3.6%)
Sports Activity	27 (49.1%)
Road traffic accident	07 (12.7%)
Inadvertent fall	12 (21.8%)
Impact with foreign objects	07 (12.7%)
Total	55

Table 3. SES, lip coverage, overjet, and prevalence of anterior traumatic tooth injuries.

Risk Factor		Trauma		Total	P value
		Yes	No		
SES	Low	26 (14.3%)	156 (85.7%)	182	.758
	High	29 (15.4%)	159 (84.6%)	188	
	Total	55 (14.9%)	315 (85.1%)	370	
Lip Coverage	Adequate	21 (07.3%)	266 (92.7%)	287	> .001
	Inadequate	34 (41.0%)	49 (59.0%)	83	
	Total	55 (14.9%)	315 (85.1%)	370	
Overjet	> 3.5 mm	21 (08.8%)	217 (91.2%)	238	> .00001*
	3.5 - 5.5 mm	18 (22.0%)	64 (78.0%)	82	
	> 5.5 mm	16 (32.0%)	34 (68.0%)	50	
	TOTAL	55 (14.9%)	315 (85.1%)	370	

$p < 0.05$ - Statistically significant, * By Chi square for linear trends

Table 4. Binary logistic regression analysis containing variables, overjet, and lip coverage. (Statistical significance $p < 0.05$)

Explanatory Variable		Relative Odds	95% Confidence Limits	Significance
Lip Coverage Inadequate versus adequate		7.25	(3.60, 14.5)	< 0.0001
Overjet	> 3.5 - 5.5 mm versus < 3.5 mm	1.95	(0.92, 4.12)	0.81
	> 5.5 mm versus < 3.5 mm	1.58	(.66, 3.78)	0.30

males who frequently participate in sports and physical activity were identified to be at a higher risk for the occurrence of anterior teeth injuries.

The NCC in India recruits and trains the reserve defense forces of the country by voluntary participation of children from schools across the country. A school unit of NCC consisting of 386 14 to 16-year-old male school students from various government and private schools of the Udupi district in Karnataka, India provided an ideal setting to achieve the study objective. Since participation was voluntary it was assumed participants were at high risk for injury of the anterior teeth because the cadets were inherently boisterous and their training involves sports and other physical and recreational activity.

Since current or past orthodontic treatment can alter anatomic risk factors, cadets with a history of such treatment were excluded from the study.

Vernier calipers provide an accurate measurement of overjet under ideal conditions. However, since the study was carried out under field circumstances feasibility prevailed over scientific accuracy to some extent and a CPI style periodontal probe was used to measure overjet. The CPI style probe served the need, since its markings were located at 3.5 mm and 5.5 mm which facilitated the grouping of the subjects into ranges of 0-3.5 mm, 3.5-5.5 mm, and 5.5 mm and above. Normal overjet was considered to be in the range of 0-3.5 mm.⁶ The calibration exercise and the Kappa values showed good agreement for these measurements in terms of intra-examiner variability which validated the examination procedure.

Standardized procedures, according to WHO guidelines, and the universal infection control precautions were followed during the examination. Classification of dental injuries, as mentioned by Sgan-Chen et al.,⁹ was selected as it suited the examination circumstances and the ultimate objective of the study.

The overall prevalence of traumatic injuries to anterior teeth was 14.9% which is higher than the prevalence of 13.80% found in a study by Gupta, et al. conducted among 2,100 school children of the same district.¹⁰ Since subjects in this study were only those with a high predisposition towards injury to the anterior teeth this difference was expected. The prevalence of dental trauma in various epidemiological studies has been found to differ considerably, ranging from 6% to 34% among high school children, depending upon the trauma classification, the dentition studied, as well as the geographical and behavioral differences between study locations and countries.²

Traumatic injuries most commonly involved the maxillary central incisors, as was also seen in studies by others.^{2,3,4,7,11} Injury involving enamel and dentin was found to be the most common, unlike other studies^{3,4,6,10} where injuries involving enamel only were most common. A high behavioral predisposition of the study group might have made it vulnerable not only to the occurrence of injury but also increased the tendency towards a more severe form of injury.

The most common cause of traumatic injuries to anterior teeth has been shown to vary between populations and across different age groups. The impact of foreign objects during sports

activities was identified as the most common cause of injuries in this study which reflected the characteristics of the study group. Sports, physical, and recreational exercises form the core of training in the NCC.

The SES of the subjects did not affect the occurrence of anterior teeth injuries, which seemed to be more influenced by the anatomic factors and increased physical activity of the study group.

As a group with high behavioral risk, the subjects did show a higher prevalence of traumatic injuries to the anterior teeth which were of more severe nature, but within the group the risk of occurrence of injury was determined by anatomic factors only. As was seen in several previous studies^{2,6,9,11,16,20,22,29} the risk of injury to the anterior teeth increased significantly with an increase in incisal overjet beyond 3-4 mm. Inadequate lip coverage has been shown as an important risk predictor^{2,6,9,21,22} and was found to be a significant determinant for the occurrence of such injuries in the present study. Binary logistic regression analysis involving increased incisal overjet and inadequate lip coverage was conducted to determine the most powerful independent predictor for occurrence of injury to the anterior teeth. With an odds ratio of 7.2, inadequate lip coverage was identified as the most powerful independent predictor for occurrence of anterior teeth injuries. This is in agreement with the findings of the study by Burden DJ.¹¹



Conclusion

Although a higher prevalence along with more severe traumatic injuries to anterior teeth were found in the present study group as compared to similar subjects from the general population, anatomic risk factors such as an increased incisal overjet and inadequate lip coverage were identified as significant predictors for the occurrence of traumatic injuries to anterior teeth even within this group with a high behavioral predisposition.

Education of authorities, parents, and children involved with sports and recreation activities at school is recommended regarding the risk factors involved in the occurrence of these dental injuries. Screening programs could be conducted for school children to identify those with high anatomic and behavioral risk for occurrence of traumatic injury to the anterior teeth so appropriate preventive measures such as preventive orthodontic treatment and use of mouthguards can be implemented.

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