

Clinical and epidemiological survey of adolescents with crown fractures of permanent anterior teeth

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Abstract

A survey of 195 children with treated and untreated anterior tooth fractures was carried out. Their ages ranged from 11 to 21 years. The children were examined for the degree of fracture, Angle classification, amount of overjet, and DMFS. A questionnaire mailed to the parents revealed the age at which fractures occurred, the causes of the accidents, and the parent and child attitudes toward the teeth and treatment of the fractures. Results of this study show that boys suffer injuries to their teeth more often than girls, the male-to-female ratio of the study population being 1.7:1. Eighty-nine per cent of the teeth involved were maxillary central incisors. No mandibular canines and only 2 maxillary canines were involved. Only 28 of the 195 children had Angle's Class II malocclusion; however, almost three-fourths had an overjet of 4 mm or more. A significant relationship was found among the frequency of traumatic injuries of permanent upper incisors, incisal overjet, and the accident proneness of the children. From the replies to the questionnaires most parents and children were concerned about the fractured teeth, especially if they were more severe than enamel fractures.

In recent years a number of investigations have been published on the occurrence of traumatic injuries to permanent incisors in children. Studies have shown that among young people the prevalence of individuals with trauma of the anterior teeth is as high as 25–30% by completion of the 9th grade.¹ In a study in Finland, Jarvinen² found the prevalence of traumatic injuries in permanent incisors to be 19.8% for both sexes, 14.6% for girls and 25.0% for boys. There is general agreement that boys suffer injuries to their teeth more often than do girls.¹⁻⁶

Haavikko³ found that injuries to primary teeth reached a peak in prevalence between 1 and 3 years and those to permanent teeth between the ages of 7 and 13 years.

There is general agreement that maxillary teeth are injured more often than mandibular and that maxillary central incisors are the teeth most likely to be

injured. Haavikko³ found that permanent teeth were injured more often in the maxilla than in the mandible, the ratio being 7.1:1 and the maxillary central incisors were involved in 73% of cases.

York et al.⁵ reported that the majority of fractures involved enamel alone (63%), with 34% involving both enamel and dentine.

O'Mullane⁷ described a significant relationship in children who have suffered one or more general accidents and the frequency of injury sustained to their anterior teeth (accident proneness). In describing accident proneness, O'Mullane stated that a relatively large proportion of accidents occurred in a relatively small proportion of the population at risk. He also stated that a close relationship has been shown between the severity of accidental injuries and the number of subsequent visits to a doctor. Ravn,¹ agreeing with this, states that frequently the same children sustain trauma on several occasions.

General factors that are claimed to predispose to injuries of the permanent incisors include protrusion of the teeth, lip incompetence, accident proneness, and the playing of contact sports. A significant correlation between the occurrence of traumatic injuries and incisal overjet has been found. The frequency of traumatic injury has been reported as higher in Angle's Class II, Division 1 dentitions than in other types of occlusions.⁷⁻⁹ In Jarvinen's study of 1445 orthodontically treated children between the ages of 7 and 16 years, a definite relationship was found between amount of incisal overjet and the frequency of traumatic injuries to permanent upper incisors. In children with overjet of less than 0 mm, no injured upper incisors were found. Injuries were more common in children with increased overjet than children with normal (0–3 mm) overjet, and were increasingly more common with more severe overjets.⁸

The purpose of the present study, in the light of current literature, is to document and describe the

Table 1. Distribution of Population by Age and Sex

Age Years	Sex		Total
	Male	Female	
11-12	2	1	3
13	21	7	28
14	37	20	57
15	24	14	38
16	10	16	26
17	20	8	28
18-21	10	5	15
Total	124	71	195

relationship between the prevalence/severity of anterior tooth fractures and the amount of overjet, accident proneness, sex, and age of study subjects.

Methods and Materials

Study Population

The children in this study were obtained by a screening of 5000 children in Rochester, New York. The screening was carried out by 4 dental hygienists associated with the Eastman Dental Center. Of the 5000 children, approximately 250 were found to have fractures of their anterior teeth. By the time of the present study, 195 of the original 250 could be located. Some of the children had had their fractures treated while others remained untreated.

Examination of Subjects

The children were examined in the health offices of their schools. An Addec portable dental chair with fiberoptic light, a mirror, explorer, and millimeter rule were used. The examination involved dental caries detection, classification of occlusion, and classification of the fractured teeth. No radiographs were taken. The classification of fractures developed by Hargreaves and cited by York et al.⁵ was used:

Class I: fracture of enamel only

Class II: fracture of enamel and dentin

Class III: fracture extending to the pulp

Class IV: fracture of the root

Class V: total avulsion.

The incisal overjet was recorded by 2 methods.

1. It was noted whether or not children had Angle's Class II, Division 1 malocclusion when in centric occlusion.
2. Overjet was measured as the distance between the lingual surface of the maxillary incisor and the labial surface of the mandibular incisor, using a millimeter-scaled gauge. Children were classified into 4 groups according to the amount of overjet. The classification was the same as that used in Jarvinen's study.⁸

Table 2. Frequency of Traumatized Anterior Teeth

Arch	Tooth	Frequency	%
Upper	Central incisor	252	89.4
	Lateral incisor	14	5.0
	Cuspid	2	0.7
	Total upper	268	95.0
Lower	Central incisor	12	4.3
	Lateral incisor	2	0.7
	Cuspid	0	0.0
	Total lower	14	5.0
Both	Total	282	100.0

Group I: negative overjet (less than 0 mm)

Group II: normal overjet (0-3 mm)

Group III: increased overjet (3.1-6 mm)

Group IV: extreme overjet (more than 6 mm).

All examination findings were recorded on an examination form by the assisting dental hygienist. All examinations were carried out by the same dentist (TOO). Data were analyzed using the chi-square and *t*-test statistics.

Questionnaire Survey

In addition to the clinical examination of the children, parents were asked to complete a brief questionnaire survey. This survey sought information on the following topics:

1. When the fracture occurred and the age of the child at the time
2. The cause of the fracture
3. Information about parental attitude toward the incident, whether or not the parent thought it important to follow up and seek treatment
4. The number of times previously that trauma had been sustained to the anterior teeth and whether or not the child had been involved in other general accidents.

Results

The total population examined was 195 children (124 males, 71 females) with the male-to-female ratio being 1.7:1. The mean age of the children was 15.02 years at the time of examination (Table 1).

Of the 195 questionnaires mailed out to parents, 111 were returned (60% response). Children of respondents and nonrespondents did not differ in terms of age, sex, DMFS, overjet, or mean number of fractures.

The frequency of the various types of the anterior teeth involved in the fractures is shown in Table 2. Nine out of 10 fractures involved the upper central incisors. Four per cent of the fractures were lower central incisors, less than 1% were upper canines,

Table 3. Overjet by Sex

Overjet (mm)	Sex		Total
	Male	Female	
0-3	46	32	78
4-6	65	29	94
6	12	6	18
Open bite	1	4	5
Total	124	71	195

$\chi^2 = 6.25$; $P = 0.10$.

and the lower canines were not involved at all. The total number of fractured teeth was 282 for 195 children.

The mean number of fractures per person was 1.4. Only 1 child had 6 fractures while 122 had 1 fracture. A total of 28 children (18 males, 10 females) were found to have Angle's Class II malocclusion. Table 3 shows the amount of overjet by sex. One hundred and seventeen children had an overjet of 4 mm or more, excluding the 5 children with an anterior open bite. However, there was no difference in amount of overjet by sex. Table 4 shows that children with Angle's Class II occlusions tended to have more severe trauma to their anterior teeth than other children. Comparison of Angle's Class II and other occlusions by severity of fracture shows 7% of children with Angle's Class II had avulsed teeth and 79% had enamel/dentine fractures. Comparative values for those with other occlusions were 1% and 64%, respectively. Table 6 shows a modest trend toward children with greater than 6 mm overjet having more severe fractures. However, these differences were not statistically significant.

Most fractures in both sexes were enamel and enamel/dentine, with an almost equal percentage of boys and girls having more severe fractures. Replies to the questionnaires revealed that the age at which the most fractures occurred was 10 years, with a range of 8-12 years.

Falls while walking or running were the most frequent causes of fractures in both sexes. This was fol-

Table 4. Severity of Trauma by Angle's Classification of Occlusion

Severity of Trauma	Angle's Classification		Total
	Angle's Class II	Other	
Enamel only	4 (14.3)*	45 (26.9)*	49
Enamel and dentine	22 (78.6)	107 (64.1)	129
Pulp exposure	0 (0.0)	14 (8.4)	14
Avulsed tooth	2 (7.1)	1 (0.6)	3
Total	28 (100.0)	167 (100.0)	195

$\chi^2 = 11.31$; $P = 0.01$.

* Column per cents.

Table 5. Severity of Fracture by Number of Accidents

Severity of Fracture	Number of Other Accidents		Total
	1-3	4+	
Enamel only	3 (17.6)*	6 (60.0)*	9
Enamel and dentine	12 (70.6)	4 (40.0)	16
Pulp exposure	2 (11.8)	0	2
Avulsed tooth	0 (0.0)	0	0
	17 (100.0)	10 (100.0)	27

$\chi^2 = 11.40$; $P = 0.003$.

* Column per cents.

lowed by bicycle accidents in males and collisions (while on foot) in females. Car accidents, roller skating, and swimming also were listed as causes of accidents in both sexes.

Although the sample was small for whom information on prior accidents was available, there was a statistically significant tendency for children with a greater number of prior accidents to have less severe fractures (Table 5).

Discussion

This study agrees with the general belief that boys suffer injuries to their teeth more often than do girls. The male-to-female ratio of the study population was 1.7:1. The original population from which the sample was drawn had a male-to-female ratio of 1.1:1. The children included in the study were drawn from the original population by examination of the hygienist using a tongue blade and flashlight. It was realized that many well-restored fractures may have gone undetected and that the actual number of females with fractures may have been higher than that in the sample. However, the ratio in the present study lays within the range of that stated by Haavikko³ of 2.4:1 and that reported by York et al.⁵ of 1.2:1. One can assume that although present-day females are more active and more involved in sports than they were, they are not quite as boisterous and do tend to be more mature in their behavior as they grow older. When the children of the questionnaire respondents were compared with those of the nonrespondents no

Table 6. Severity of Fracture by Overjet

Severity of Fracture	Overjet (mm)			Total
	0-3	4-6	>6	
Enamel only	20 (25.6)*	25 (26.6)*	3 (16.7)*	48
Enamel and dentine	52 (66.7)	62 (66.0)	11 (61.1)	125
Pulp exposure	6 (7.7)	4 (4.2)	4 (22.2)	14
Avulsed tooth	0 (0.0)	3 (3.2)	0 (0.0)	3
Total	78 (100.0)	94 (100.0)	18 (100.0)	190

$\chi^2 = 10.48$; $P = 0.50$.

* Column per cents.

difference was found in terms of their mean age, overjet, DMFS, mean fracture per person, or the male-to-female ratio. This gave some assurance that the respondent sample was representative of the population.

The general agreement that maxillary teeth are injured more often than mandibular teeth and that the upper central incisors are the teeth most likely to be injured is upheld in this study. Eighty-nine per cent of the teeth involved were maxillary central incisors. The upper lateral incisors were involved as frequently as the mandible incisors. No mandible canine and only 2 maxillary canines were involved. This study also agrees with Ravn's finding that generally 1 tooth is involved.¹ In this study 1 child had 6 fractures and another 4. The rest were 3 or fewer. Most of the fractures were Class II (enamel/dentine) which disagrees with the findings of York et al.⁵ and Baghdady et al.⁶ who found enamel-only fractures most frequently occurring, but agrees with findings of a study at the University of Otago Dental School which show Class II fractures as being most common.⁵ This variation may suggest that many dental injuries involving minimal hard tissue loss are not reported. In fact, most mothers replying to the question as to why they had not sought treatment of the fracture thought that the fracture was too small to require treatment.

During 1966 and 1970, the Division of Health Examination Statistics conducted a survey that collected information about the health of U.S. youths aged 12-17 years. The target population totaled approximately 22.7 million and was defined as all noninstitutionalized youths aged 12-17 years living in the United States (including Alaska and Hawaii) except those living on lands reserved for the use of American Indians.¹²

To obtain statistically valid estimates about the health of so many people, a probability sample was designed and selected by a complex procedure. The sample consisted of approximately 7500 youths. Among the recorded variables were the following:

1. Vertical overbite and/or openbite
2. Overjet of the upper or lower incisors
3. Posterior crossbite
4. Tooth displacement
5. Buccal segment relationship.

An estimated 82.5% of the youths had upper overjets measuring from 0 through 5 mm. Severe overjets of 5 mm or more occurred in 15% of the sample. Approximately 32% of the youths had a Class II occlusion. Overjet of the lower incisors was rare, occurring in only 2.5%.¹² In comparison, 88.2% of the youths in the present study had an overjet between 0 and 5 mm and 14.4% had a Class II occlusion. No overjet of the lower incisors was recorded.

To assess the relationship of accident proneness to the prevalence/severity of fractures the number of other general accidents was compared to severity of the fractures. It was found that children with 1-3 general accidents tend to have more severe fractures than those with 4 or more general accidents. It is apparent that children who are involved in many accidents tend to sustain less severe injuries than children who are involved in fewer accidents.

In this study, falls while walking or running were the most frequent causes of fractures. Generally, there was no significant difference between the causes of fractures for both male and female except for organized sports, which no female stated as the cause of the accident. Bicycling was also a markedly frequent cause of injury, especially in boys.⁸ This study also agrees with Ravn that falls as a cause occur twice as frequently outside school as inside; this seems natural because it is consistent with the relative amount of time at school and at home.¹

The highest number of injuries for both sexes was found to occur at the age of 10 years in this study, the range of highest frequency being 8-12 years. This reflects the high degree of physical activity of both boys and girls at this age, placing the fully erupted incisors at risk.

Summary and Conclusions

It can be concluded from the results of this study that:

1. Boys are usually more involved in accidents involving fractures than girls, although the severity of the fractures is approximately the same.
2. Children with overjets of 4 mm or more tend to have more severe fractures than those with normal overjet. Also, most children with anterior fractures have Angle's Class I occlusion.
3. Accident-prone children tend to have less severe fractures than children who are involved only in occasional accidents.
4. The age range of 8-12 years has the highest frequency of fractures.

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