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SCIENTIFIC articles

# Trauma to the primary incisors and its effect on the permanent successors

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## Abstract

*One hundred and twenty-four children who had experienced trauma to their primary incisors were included in this clinical investigation in an attempt to correlate the type of injury occurring to the primary teeth, the age of the patient at the time of trauma with mineralization defects, and intra- and interarch relationships of the permanent incisors.*

*Thirty-four per cent of the children had Angle Class II malocclusion. The intra- and interarch relationships were not correlated significantly with any type of injury.*

*Developmental and mineralization defects were noticed more frequently in central incisors (32.4% discoloration and 11% hypoplasia). Most of the children with affected permanent incisors experienced trauma prior to age five. The incisal one-third of the central and lateral incisors was the most common location of mineralization defects. Discoloration at this location seemed to be unrelated to the child's age at the time of trauma.*

Trauma to the anterior segment of the dental arches is a well-known local etiologic factor in malocclusion. Injuries to this region seem to occur frequently at the stage of the primary dentition and local disturbances to individual teeth have been described widely.[1-4] Little, however, is known about subsequent occlusal consequences to the permanent dentition. The sequellae of injury to the primary incisors generally depends on the spacial relationship with their permanent successors and the stage of development of the latter.

The possible deleterious effect on the crown or root of the permanent incisors has been related to such factors as the degree of resorption of the primary root at the time of injury, the direction of the traumatic force,[5] the type of injury to the primary incisor, and the developmental stage of the permanent tooth bud at the time of the injury.[6] No special attention however, has been paid to the consequences of trauma to the primary dentition regarding the intra- and interarch relationship in the permanent dentition.

The objective of this investigation is to assess the prevalence of morphological disturbances in permanent incisors due to trauma to their primary predecessors, as well as to evaluate the intra- and interarch relationships of the incisors.

## Methods and Materials

Data was obtained from 450 files of children who suffered trauma to their primary incisors. Three hundred and twenty of those children, whose permanent incisors were expected to have been erupted already, were recalled for examination. Only 124 children (38.7%, 67 males and 57 females) with 264 injured primary teeth attended the recall examination. Fourteen children with recurrent trauma to their primary dentition were not included in the study, reducing the number of examined children to 110 and the number of teeth to 235. The mean age of the children at the time of trauma was 4, while the mean age at the time of the recent recall examination was 11.

The distribution of the sample according to the anteroposterior arch relationship was as follows: 83 children had Angle Class I molar relations; 30 had Class II, Division 1 malocclusion; 1 had Class II, Division 2; and 10 children had Class II subdivision (right or left). A total of 414 permanent maxillary incisors were examined. The clinical re-examination consisted of:

A. Morphological examinations of the four maxillary incisors including the following parameters:
   1. Assessment of crown discoloration and its location
   2. Estimation of the extent of enamel hypoplasia and its location
   3. Measurement of the gingival margin height and vertical incisal edge position of the central incisors
   4. Determination of time of eruption (in older patients information was obtained from parents)

B. Determination of intra-arch relationships of the four maxillary incisors, including estimation of crowding and recording of individual tooth malposition
C. Determination of inter-arch relationships including Angle classification and measurement of overjet of the right and left central incisors.

The following data were registered from the patient's file: age at the time of injury, type of trauma, and number and location of the traumatized teeth. The teeth in proximity to the injured teeth are referred to as "nontrauma." Disturbances in the permanent dentition were registered using Andreasen's classification.[6]

Radiographs of the maxillary incisors using the long cone technique were taken.

Chi-square and t-tests were applied to examine the possible correlations of mineralization defects and position of the permanent teeth with:

1. Type of traumatic injury to the primary teeth (luxation, intrusion, or exfoliation, etc.)
2. Results of the immediate postinjury radiographic examination
3. Age of the child at the time of trauma — the children were grouped arbitrarily into the following age groups: 1-3; 3.5-5; and 5.5+.

## Results

The clinical findings were analyzed at the individual tooth level, at the arch level, and at the interarch level.[a]

## Tooth Level

Seventeen children presented with delayed eruption of 36 maxillary incisors. In two children, surgical intervention was necessary to allow eruption of the incisors. Thirty of the teeth presenting with delayed eruption were successors of traumatized primary incisors.

[a] Detailed tables of the results can be obtained upon request from Dr. Brin.

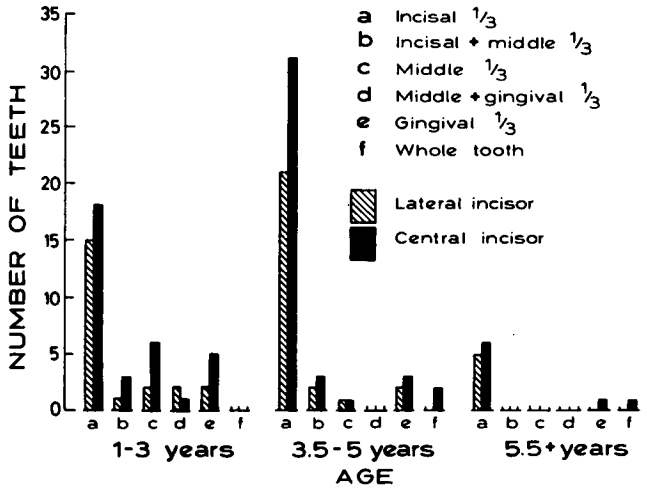


FIGURE 1. Distribution of discoloration location according to age groups at the time of trauma.

Four hundred and fourteen maxillary permanent incisors were examined. Of these, 134 (32.4%) presented with discoloration. The central incisors were the most frequently affected (63%) and white discoloration was the predominant type.

Hypoplasia was found in 11% of the examined teeth; 77% of these were associated with discoloration. In most of the cases, the hypoplastic area did not exceed 3 $mm^2$.

The presence of mineralization defects (hypoplasia and discoloration) and their location and size in relation to the patient's age at the time of trauma are presented in Figures 1 and 2. Most of the children with at least one affected upper incisor experienced trauma prior to age five. This finding was supported statistically in the case of discoloration ($p = .01$) and less so in the case of hypoplasia ($p = .11$). The incisal

TABLE 1. Mineralization Defects as Related to the Most Common Types of Injury to the Primary Incisor

| *Type of Trauma* | *Number of Teeth* | *Teeth Without Defects* | *Teeth With Discoloration Only* | *Teeth With Hypoplasia Only* | *Teeth With Discoloration And Hypoplasia* |
|---|---|---|---|---|---|
| Luxation | 73 (100%) | 39 (53.5%) | 21 (28.7%) | 5 (6.8%) | 8 (11%) |
| Palatal displacement | 30 (100%) | 21 (70%) | 8 (26.7%) | 0 (0%) | 1 (3.3%) |
| Intrusion | 30 (100%) | 13 (43.4%) | 10 (33.3%) | 0 (0%) | 7 (23.3%) |
| Exfoliation | 23 (100%) | 11 (47.8%) | 9 (39.1%) | 0 (0%) | 3 (13.1%) |
| Nontrauma* | 190 (100%) | 143 (75.3%) | 32 (16.8%) | 4 (2.1%) | 11 (5.8%) |

* Teeth in proximity to the injured tooth.

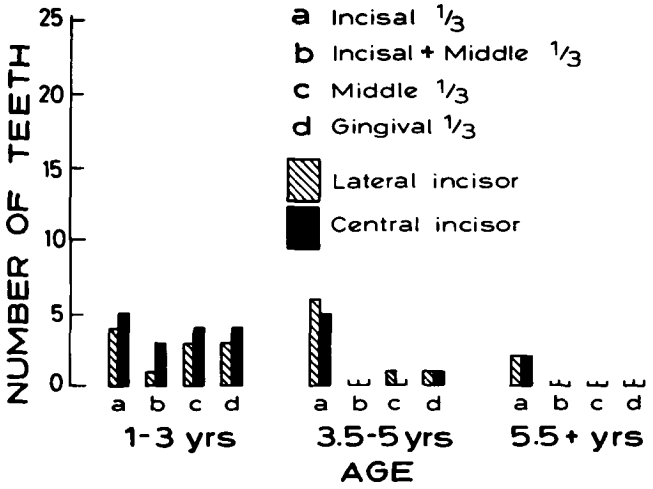


FIGURE 2. Distribution of hypoplasia location according to age groups at the time of trauma.

third of the central and lateral incisors was the most common location (72%) of discoloration in all age groups (Figure 1). In the younger age group the incisal third was affected slightly more by hypoplastic defects than the middle or the gingival thirds; in the older age groups hypoplasia appeared mainly on the incisal third (Figure 2).

Table 1 describes the percentage of mineralization defects in the permanent teeth as related to the most common types of injury to the primary predecessors. The highest percentage of mineralization defects was recorded in the successors of intruded primary incisors, while the lowest percentage of defects was related to palatal displacement.

Uneven gingival margin height was observed in 29 pairs of central incisors, the difference being from 0.5 mm to 1.5 mm and greater.

## Intra-arch level

The vertical position and rotations of the incisors were evaluated. All children with crowded arches were excluded, as crowding may influence the aforementioned variable. Only five pairs of teeth with uneven vertical height and two rotated centrals remained. Thus, no statistical tests were performed. The lateral incisors' vertical positions and rotations were not evaluated, as the comparison of their position at this stage may be misleading (due to the influence of the permanent canine bud).

## Interarch level

Sixty-seven per cent of the children examined had Angle Class I occlusal relationships while the rest exhibited Class II. The mean overjet of the patients in the present sample was 3.9 mm, the range being 0-11 mm.

## Discussion

The effect of trauma to primary incisors on the permanent successors was studied; children who were referred to the Oral Surgery Department following trauma to their primary incisors were examined. The referral to the Oral Surgery Department might indicate a more severe injury since most emergencies in children are treated in the Pedodontic Department. One hundred and twenty-four children (38.7% of the original sample) appeared for re-examination. There was no possibility of assessing whether the poor response to the recall was related to a lesser severity of the sequellae of trauma or to a lack of dental awareness among the remaining 61.3% of recalled patients.

It has been reported widely that children with Class II malocclusions are highly susceptible to trauma to their anterior teeth.[7-10] One-third of the patients in this study presented with a Class II malocclusion in their permanent dentition. It should be remembered, however, that these patients experienced trauma to their primary dentition.

We can assume that a similar occlusal relationship existed in at least part of the children at that stage. This is based on the fact that there is generally no decrease in the frequency of Class II cases in the transition from primary to permanent dentition. If the first permanent molars erupt directly into a Class I or full Class II relationship there is no change in their occlusion later.[11] However, the frequency of Class II may increase, as part of the cases with P termination in the deciduous dentition convert into Class II.[12] This could lead to the assumption that children with Class II malocclusion are also more prone to trauma in the primary dentition.

Trauma to primary incisors has been described as a possible etiology of defects in texture, malposition, and delayed eruption of the permanent successors.[6] In the present study, no influence in tooth position could be observed, but a considerable number of incisors presented with some delay in the eruption time. This finding should be noted with some reservation, since part of the information was obtained from parents. However, in about one-third of these patients, delay in eruption was observed clinically.

The present study revealed that 32.4% of the permanent teeth showed some degree of discoloration, and 11% showed hypoplasia (of these, 77% showed discoloration as well). These figures are similar to those described by other investigators.[13,14] However, a definite comparison to other studies is limited due to sample differences and methods of diagnosis and analysis. For example, in this study all enamel defects were included, regardless of size or appearance.

The distribution of the various mineralization defects according to age groups revealed a similar number of affected teeth in the first two age groups (1-3 and 3.5-5, Figures 1 & 2). As expected in the 5+ age group, a drastic decrease in the number of affected

teeth was observed. No apparent correlation was found between age at the time of injury and location of the mineralization defect. The most common location of these defects was the incisal edge, with the exception of the one- to three-year-old group, where the hypoplastic defects appeared almost equally distributed over different crown areas (Figure 2). When considering larger lesions (affecting both the incisal and middle thirds of the crown), the incisal edge became highly affected in this group as well. The close proximity of the incisal edge of the developing permanent incisor to the traumatized primary tooth may account for the mineralization defects occurring most frequently in the incisal third. It is reasonable to assume that any damage to enamel could occur only during development and maturation — before the enamel becomes fully mineralized, hard, and mature. Significantly, even in cases where the complete outline of the crown can be observed radiographically, enamel maturation still may be taking place.[15] Consequently, a true hypoplastic lesion would be expected to occur only during the early stage of enamel development. However, a "hypoplastic-like" defect also could be the clinical expression of poorly mineralized enamel. This porous surface could chip off easily just after tooth eruption in the oral environment. This would explain the high incidence of "hypoplastic-like" defects in the older age groups. There is still the possibility that the observed defect was caused by another unknown factor unrelated to the trauma.

In agreement with the literature, the appearance of mineralization defects was related most frequently to intrusion in the primary dentition and least frequently to palatal displacement.[6,16] An interesting finding was that approximately 25% of the permanent incisors whose predecessors had not been affected directly by trauma ("nontrauma" group, Table 1) presented with mineralization defects. The reason for this could be their proximity to the trauma site. Haaviko and Rantanen showed that trauma to one of the incisors may affect adjacent teeth indirectly.[17]

The gingival margin height of the successors of traumatized primary teeth has not been evaluated previously. Crowding and ectopic eruption might result in an uneven gingival margin.[18] Lack of guidance in the case of early exfoliation or a change in eruption direction following possible trauma might cause ectopic eruption and consequently a change in gingival margin height. Ravn,[2] quoting Hotz, states that intrusion of the primary incisors, particularly at the age of five years, could potentially change the eruption direction of the permanent incisors. In this study no significant correlation between uneven gingival height in the permanent dentition and any of the variables characterizing the injury was found. A phenomenon which appeared in several cases, and seemed to be related to unequal crown height of the central incisor, was a peculiar smooth notching of the enamel on the labial aspect of the crown near the gingiva. In these cases the gingival margin was unusually contoured, following the enamel surface (Figure 3).

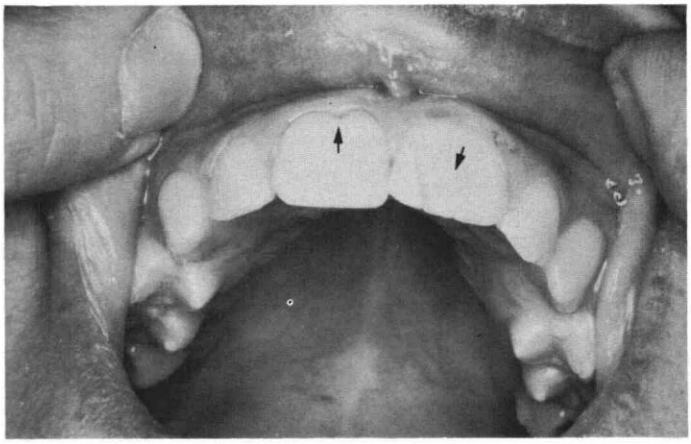

FIGURE 3. The upper central incisor area. Notice a peculiar smooth notching of the enamel, the unusual gingival margin of the right central incisor, and a mineralization defect on the incisal third of the left central incisor.

## Conclusions

1. Children with Class II malocclusion in their primary dentition might be more prone to trauma.
2. Trauma up to age five years has a more deleterious effect on the permanent successor than in the older age group.
3. Trauma to the incisors did not influence rotation, supra- or infraocclusion of the permanent successors.
4. The most common location of mineralization defects was the incisal third of permanent incisors.
5. Intrusion and exfoliation of primary incisors were followed mostly by discoloration and hypoplasia in the permanent incisors.
6. Twenty-five per cent of permanent successors to "nontrauma" primary incisors presented with mineralization defects.

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## Quotable quote: first line of defense against child abuse

Everyone involved in child welfare surely must agree with the conclusion . . . that Amy, the 12-year-old Californian locked up by a judge for refusing to testify against her sexually abusive stepfather, is the victim of a terrible injustice. But her sad story makes it all the more important for us to remind professionals who deal with children to obey legal mandates in reporting suspicions of child abuse.

Unlike Amy, whose stepfather already had begun therapy when an allegation was filed, most child victims of abuse and neglect and their parents receive help only *after* the child protective service is notified. Unfortunately, some professionals who are mandated to report their suspicions — doctors, nurses, social workers, teachers, and many others — are confused or apprehensive about doing so. Others, such as drug treatment counselors, may be forbidden even to report abuse because of federal laws designed to protect their adult clients' confidentiality rights.

This year, New York City will introduce in the state legislature a bill requiring that, in order to be licensed in their professions, mandated reporting sources demonstrate a basic knowledge of the child abuse laws. Federal legislation also may be needed.

"First Line of Defense Against Child Abuse." Letters. The New York Times, Thursday, February 9, 1984, p 28.

## Quotable quote: resilient children

I don't think you can give children too much affection. But you can spoil children by letting them feel that everything they want — the little toys and outings and such — will be theirs. Sometimes this is discussed in terms of the "rights" of the child or the "rights" of the parent. Obviously, both have rights, but that seems to me an extraordinary way of thinking about the situation. Children, like parents, need to recognize that other people have needs, too. This is a point that comes up in the issue of mothers' going to work.

. . . the research indicates that it's not a very important variable. The children of working mothers do no better and no worse.

What they do show is that it's important whether the mother wants to work, whether she is getting satisfaction from work and whether good arrangements are made for child care. Working is not an irrelevant issue, but what is really important is how it is dealt with, what it means to the children and their parents.

Resilient Children: Why Some Children Overcome Their Environments, and How We Can Help (An interview with Michael Rutter.) Psychology Today 18:56-65, March, 1984.