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Avulsion of primary teeth and sequelae on the permanent successors

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Abstract – The purpose of the present study was to determine the frequency of avulsion of primary teeth and the location of the avulsed tooth in a representative population of Danish children. Also, the frequency and the type of developmental disturbances in the permanent successors were assessed and related to age at the time of injury. The material included dental records of 4238 children from three clinics in Municipal Dental Health Services near Copenhagen, Denmark. The children were born between 1 January 1983 and 31 December 2000. Thirty-five children (0.8%) were identified as having avulsed in all 44 primary teeth most frequently the maxillary incisors (89%). Thirty-three fully erupted permanent successors were included in the study, the prevalence of developmental disturbances was 30% (10 teeth). The results showed the risk of developmental disturbances in the permanent successors to be more frequent the younger the age at the time of injury ($P = 0.04$). Discolouration affected all 10 permanent teeth, but also hypoplasia and horizontal enamel hypoplasia were found.

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Key words: avulsion; dental trauma; developmental disturbances; exarticulation; permanent teeth; primary teeth; sequelae

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Epidemiological studies show that approximately 30% of all children under the age of seven have sustained injuries to one or more of their primary incisors (1, 2) and that most of the injuries to the primary dentition and the more serious ones happen in the ages 2–4 years (3–5). Avulsions make up 7–13% of all injuries to primary teeth (6), but data are few.

The close topographic relationship between apex of the primary tooth and the developing permanent successor explains the risk of developmental disturbances in a permanent tooth after avulsion of the primary predecessor (Fig. 1).

The purpose of the present study was to investigate the frequency of avulsion of primary teeth and the location of the avulsed tooth in a representative population of children. Also, the frequency and the type of developmental disturbances in the permanent successors will be assessed along with their correlation to the time of injury.

Materials and methods

The material in this study included all children from three clinics in the Danish Municipal Dental Health Services in Lyngby-Taarbaek, Hilleroed and Taarnby, born between 1 January 1983 and 31 December 2000.

Dental records of these 4238 children have been examined, and 35 children (0.8%) with a total of 44 avulsed primary teeth have been identified and included in the study. The fully erupted permanent successors have been examined and an assessment of developmental disturbances was made. Permanent successors, which had not fully erupted by 31 December 2000 were excluded from the data on sequelae. The day 31 December 2000 was chosen as a dead-line for assessing developmental disturbances in permanent successors.

If hypoplasia was found in a permanent successor and a general hypoplastic disorder was diagnosed in the same patient the permanent tooth was excluded from the data on sequelae. The clinical assessment of the permanent successors was performed by artificial light from the operation lamp after the teeth had been dried with cotton rolls and air. All surfaces were examined.

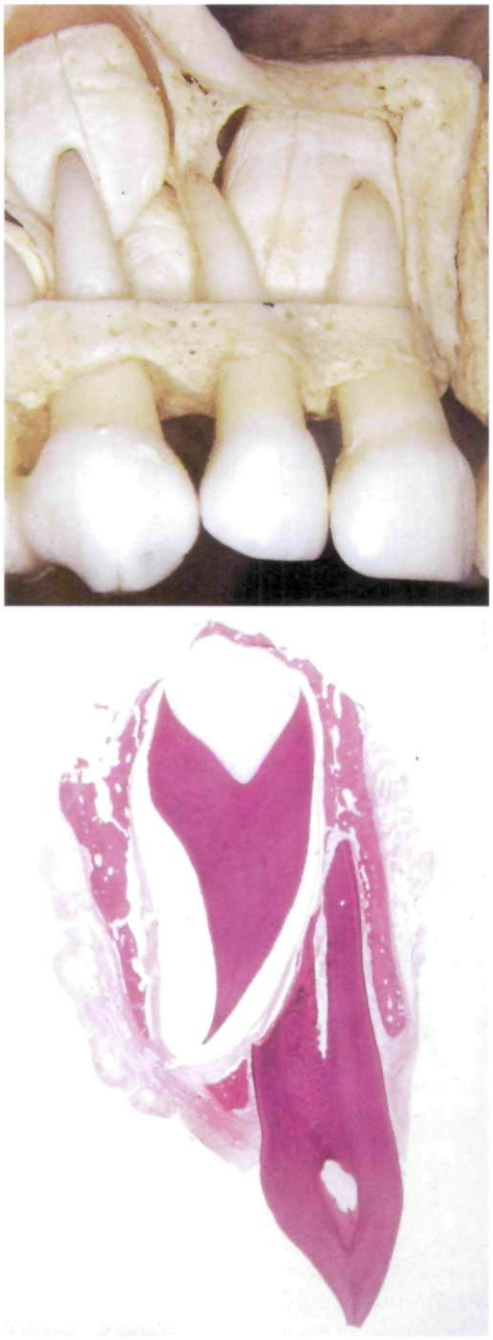

Fig. 1. The anatomic and histological relationship between the primary teeth and their permanent successors [From Andreasen & Andreasen (6)].

The following classification has been used in the registration of developmental disturbances in the permanent successors (6):

Discolouration:
White or yellow-brown discolouration of enamel, sharply demarcated. Extent varying from small spots to larger areas, without detectable defects in the enamel surface.

Hypoplasia:
White or yellow-brown discolouration of enamel with detectable defects in the enamel surface. Extent varying from small spots to larger areas.

Horizontal enamel hypoplasia:
A narrow horizontal indentation encircling the crown. Incisally discolouration and/or hypoplasia might be found.

Crown dilaceration:
A deviation of part of the crown in relation to the long axis of the tooth.

Results

Frequency of avulsion of primary teeth

Thirty-five children of the included 4238 children had experienced avulsion of one or more primary teeth, giving a prevalence of 0.8% (95% CI: 0.6–1.1%). Twenty-seven children had avulsed one primary tooth, seven children had avulsed two primary teeth, and a single child had avulsed three primary teeth, in total 44 teeth. In the age group of 0–1 years no avulsions were found, therefore this age group was excluded from the following results.

Location and distribution of avulsed primary teeth

The most frequently avulsed primary teeth were the maxillary incisors (89%). The right central maxillary incisor made up 41% of the avulsed teeth (Table 1).

Frequency of developmental disturbances in the permanent successors

Thirty-three permanent successors had fully erupted by 31 December 2000. Developmental disturbances were seen in 10 teeth (30%) (95% CI: 17.4–47.3%), more frequently in teeth where the injury to the primary tooth happened at an early age. When the frequency of developmental disturbances was related to the age at the time of avulsion, the following results were found (Fig. 2).

Types of developmental disturbances in the permanent dentition

As previously mentioned, developmental disturbances were found in 10 of the 33 fully erupted

Table 1. Distribution of avulsed teeth

Tooth, FDI system	53	52	51	61	62	63
NO	0	3	18	13	5	1
NO	0	0	3	1	0	0
Tooth, FDI system	83	82	81	71	72	73

FDI, Federation Dentaire Internationale.

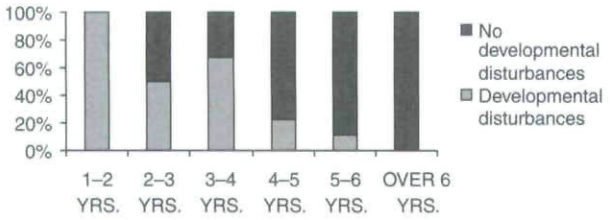

Fig. 2. Developmental disturbances in the permanent successors related to age at the time of injury.

Table 2. Types of developmental disturbances in different age groups (The age groups refer to the time of injury to the primary tooth)

	Erupted permanent teeth (NO)	Discolouration only (NO)	Discolouration + Hypoplasia (NO)	Discolouration + Horizontal enamel hypoplasia (NO)
1–2 year	2		1	1
2–3 year	2	1	1	
3–4 year	2	2		
4–5 year	3	1	1	1
5–6 year	1	1		

permanent successors (30%). Discolouration was found in all 10 affected teeth. Of these 10 teeth, five had more than one type of developmental disturbance: three teeth also showed hypoplasia (9%), and two teeth also showed horizontal enamel hypoplasia (6%). No crown dilacerations were found. When the type of developmental disturbance was related to the age at the time of avulsion, the following results were found (Table 2).

Discussion

Frequency of avulsion of primary teeth

In the present study the prevalence of avulsion of primary teeth is found to be 0.8%, which is much less than the 7–13%, that Andreasen and Andreasen mention in 'Textbook and Color Atlas of Traumatic Injuries to the Teeth' (6). However, their calculations are based on hospital data, i.e. avulsions out of the total number of traumatic injuries to primary teeth, whereas our data represent the number of avulsions found in the standard population of children from the three clinics participating in the study.

Distribution of avulsed primary teeth

Location and distribution of avulsed primary teeth in this study are in agreement with the results that Ravn found in his study on avulsions in 1975 (3). In both studies the right central maxillary incisor is the most frequently avulsed tooth. Andreasen and Andreasen (6) also mention the right central maxillary incisor to be the most often avulsed tooth. The use of a comforter may account for the more frequent avulsion of maxillary incisors, but the present study suggests no explanation to the distribution of the avulsed teeth.

Frequency of developmental disturbances in the permanent successors

In the present study, the prevalence of developmental disturbances in the permanent successors is 30%. Andreasen and Ravn (7), Brin et al. (8) and Andreasen and Andreasen (6) found a prevalence of 52%, Ravn 74% (3) and von Arx 38% (9). A possible explanation to the lower prevalence in this study could be, that the data are from a standard population of children and that the majority of children were older than 4 years at the time of injury.

When the age at the time of injury is compared with the frequency of developmental disturbances, the results show that the younger the child is at the time of traumatic injury to the primary teeth the higher the risk of developmental disturbances in the permanent successors (age: 1–3, 3–5 and 5 year, $P = 0.04$)

This agrees with studies by Ravn (3) and Selliseth (4) and illustrates that the permanent tooth germ is more susceptible to injuries in the early stages of development. However, disturbances in the mineralization also occur after complete formation of the crown. This is because of the fact that the pre-eruptive maturization of the enamel still takes place during the initial stages of root formation.

Types of developmental disturbances in the permanent dentition

Apex of the primary tooth and the germ of the permanent successor are usually only separated by a thin layer of soft tissue. Avulsion of a primary tooth can mechanically affect the developing permanent tooth by interfering with the enamel mineralization. The affected enamel will appear white clinically because of a lower mineral content compared with the surrounding enamel. If breakdown products from bleeding spread to an area where formation of enamel is still taking place the result will be a yellow-brown discolouration (9, 6).

In the present study all 10 permanent teeth with developmental disturbances presented various degrees of discolouration making this the most common disturbance. This is in accordance with other studies (7, 8).

According to Andreasen and Andreasen (6) hypoplastic defects may be caused by a localized damage to the enamel matrix before the mineral-

ization is completed. In the present study the occurrence of hypoplasia and horizontal enamel hypoplasia were 9 and 6%, respectively. Brin et al. found a frequency of hypoplasia of 13% (8) and Andreasen and Ravn found a frequency of horizontal enamel hypoplasia of 7% (7).

A more severe type of disturbance, the crown dilaceration, is the result of already formed hard tissue being displaced non-axially in relation to not yet mineralized enamel matrix (10, 6). In this material there were no crown dilacerations. This may be because of the limited number of affected teeth and the children being relatively old at the time of injury.

The more severe the type of developmental disturbance is the more extensive and expensive treatment is needed to compensate for it. Other studies show, that the most serious disturbances are found when the injury is sustained at an early age (7, 3, 9, 4). Because of the limited number of teeth in the various type groups in the present study it has not been possible to do reliable statistics on the type of developmental disturbances compared with the age at the time of injury. Further studies with a larger material are needed to assess a connection.

Selliseth (4) mentions, that the risk of serious damage to the permanent tooth is bigger when the age at the time of injury is under 2 years. He explains this partly by the fact that the surrounding bone at this age is less calcified and therefore does not protect the tooth germ as well as later on, when the bone will be better calcified.

Another explanation could be that apex of the primary incisor has a vestibular angulation before the physiological resorption sets in. A palatinal displacement of the root is required in order to avulse the tooth, thereby increasing the risk of damage to the closely related permanent tooth germ.

Conclusions

1 The prevalence of avulsion of a primary tooth in a representative population of Danish children was found to be 0.8%.

2 The most frequently avulsed primary tooth was the right central maxillary incisor.

3 The prevalence of developmental disturbances in permanent teeth following avulsion of the primary predeccessors was 30%.

4 The lower the age at the time of injury, the greater the risk of developmental disturbances in the permanent successors.

5 Discolouration was the most frequently seen developmental disturbance in the permanent successors.

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