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# Agenesis of permanent teeth in 8138 Danish schoolchildren: prevalence and intra-oral distribution according to gender

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**Objective.** The purpose of this study was to describe agenesis of permanent teeth in children with respect to prevalence and intra-oral distribution according to gender.

**Methods and subjects.** The study was population based and included all children in one district of the municipality of Aarhus, Denmark, in 1974–1979 (1657 girls and 1668 boys) and 1992–2002 (2409 girls and 2404 boys). The children underwent systematical clinical and radiographic examination.

**Results.** The period prevalence rates were almost identical for the two time periods (1972–1979: 7.8%; 1992–2002: 7.1%). Girls were affected more frequently than boys, and affected girls had more congenitally missing teeth than affected boys. Unilateral agenesis of the second premolars was more frequent than bilateral agenesis. In children with only one congenitally missing tooth, agenesis of the upper lateral incisors was asymmetrical in girls, but not in boys, whereas the opposite was true for the lower second premolars in boys.

**Conclusion.** The prevalence of agenesis of permanent teeth in Danish schoolchildren seems to be constant over time, and similar to that found in other large, population-based studies. Intra-oral distributions of congenitally missing teeth indicate gender-specific patterns.

## Introduction

Agenesis of permanent teeth (or congenitally missing permanent teeth) has important clinical implications, and studies of its distribution in populations may yield important information on its aetiology. Large, population-based studies have shown that it occurs in between 6.1%[1] and 8.0%[2] of the populations, and more frequently in girls than in boys[3,4]. Congenital absence of only one tooth (third molars excluded) occurs in approximately half of the cases[2,5], whereas congenital absence of six or more permanent teeth (referred to as oligodontia) is rare[6]. The most frequently affected teeth are the second lower premolars[7], and it is usually assumed that congenital absence of teeth tends to be bilateral and symmetrical. The question of uni- or bilateral occurrence has been addressed in a meta-analysis[7], which concluded that unilateral agenesis occurred more frequently than bilateral agenesis in both upper and lower second premolars, whereas bilateral agenesis was more frequent than unilateral agenesis in upper lateral incisors.

Some of the previous studies have been based on study populations that were too small to yield precise estimates, as indicated by the large variation in confidence intervals computed by Polder *et al.*[7], and only some have been population based. As the diagnosis of congenital absence of teeth often requires radiographs to be confirmed, studies based on clinical observations only cannot be considered valid[8].

Agenesis of permanent teeth is known to be of genetic origin, which may be part of the explanation for the ethnic variation[7]. An increase in the prevalence of agenesis of permanent teeth has been recently suggested in a meta-analysis[9], but the findings were inconclusive due to a relatively short time period, and probably also due to differences in methodology.

The purposes of this study, which is based on a large sample of Danish schoolchildren, were to describe the occurrence of agenesis of permanent teeth with respect to prevalence

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and intra-oral distribution according to gender, and to assess if any time trends can be identified in the occurrence of agenesis of permanent teeth in Danish children.

## Materials and methods

All schoolchildren aged 9–12 years in the western district of the municipality of Aarhus, Denmark, were examined as part of systematic oral health care. Radiographs were taken of any unerupted permanent teeth, including second molars. The material was collected during two time periods: 1974–1979 and 1992–2002. The material collected during 1974–1979 has been described previously[5]. The same consultant orthodontist followed the children during both time periods, the children were 9–12 years old, the same radiographic methods were used, and the same consultant orthodontist (S. R.) read the radiographs. None of the children were known to suffer from syndromes, and children with functional disabilities received treatment in specialized clinics and were not included in this study. Third molars were not recorded. The occurrence of teeth lost due to trauma or caries was rare, but information on this was collected from the child's dental record.

Data entry was done using EpiData, and data quality was controlled by double entry. The data were analysed using SPSS version 13.0 for Windows (Chicago, IL, USA), and the precision of estimates was calculated using 95% confidence intervals (CIs). The binomial distribution was used to test for bilateral versus unilateral agenesis, and for symmetry.

## Results

The material collected during 1974–1979 included 1657 girls and 1668 boys, and the material collected during 1992–2002 included 2409 girls and 2404 boys. The period prevalence rate of congenitally missing teeth was 7.8% (95% CI: 6.9%; 8.7%) in 1974–1979 and 7.1% (95% CI: 6.4%; 7.9%) in 1992–2002. As no time trend in the rates was found (difference: 0.6%; 95% CI: –0.5; 1.8), we combined the two materials to obtain a larger number of individuals for the study of intra-oral distributions. Agenesis of one or more permanent teeth among the 8138 individuals was found in 601 subjects or 7.4% (95% CI: 6.8%; 8.0%), more frequently among girls (7.9%; 95% CI: 7.2%; 8.8%) than among boys (6.8%; 95% CI: 6.1%; 7.6%) (difference: 1.1%; 95% CI: 0.00; 2.3%).

Among the children with congenitally missing teeth, 310 (51.6%) were missing only one permanent tooth (girls: 48.9%; boys: 54.7%) (Table 1). The mean number of congenitally missing teeth was higher in girls (mean: 1.87; SD: 1.21) than in boys (mean: 1.67; SD: 1.03) (mean: 0.20; 95% CI: 0.02; 0.38).

Among the 1070 missing teeth, 480 (44.9%) were lower second premolars, 217 (20.3%) were upper second premolars, and 212 (19.8%) were upper lateral incisors (Table 2). Thus, 80% of all missing teeth were located to these three tooth groups. Unilateral agenesis of the lower second premolars was seen more often than bilateral agenesis, both among girls ($P < 0.05$) and among boys (Fig. 1) ($P < 0.01$). A trend towards a similar difference was also found in boys for the upper second premolars and

**Table 1. Distribution of 601 Danish schoolchildren with congenitally missing permanent teeth according to number of missing teeth and gender.**

| Number of congenitally missing permanent teeth | Girls | Boys | Total |
|---|---|---|---|
| | (*n* = 323) | (*n* = 278) | (*n* = 601) |
| 1 | 158 (48.9%) | 152 (54.7%) | 310 (51.6%) |
| 2 | 104 (32.2%) | 94 (33.8%) | 198 (32.9%) |
| 3 | 29 (9.0%) | 14 (5.0%) | 43 (7.2%) |
| 4 | 20 (6.2%) | 14 (5.0%) | 34 (5.7%) |
| 5 | 5 (1.5%) | 1 (0.4%) | 6 (1.0%) |
| 6 | 5 (1.5%) | 1 (0.4%) | 6 (1.0%) |
| 7 | 0 (0.0%) | 1 (0.4%) | 1 (0.2%) |
| 8 | 1 (0.4%) | 0 (0.0%) | 1 (0.2%) |
| 9 | 1 (0.4%) | 1 (0.4%) | 2 (0.3%) |

**Table 2. Intra-oral distribution of 1070 congenitally missing teeth in 601 Danish schoolchildren.**

| | Upper jaw | | | | | | | | | | | | | | Lower jaw | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| Girls | 6 | 2 | 67 | 6 | 1 | 63 | 0 | 1 | 48 | 2 | 9 | 73 | 3 | 5 | 7 | 1 | 129 | 2 | 0 | 9 | 5 | 8 | 16 | 0 | 2 | 133 | 1 | 6 |
| Boys | 1 | 1 | 35 | 4 | 5 | 50 | 0 | 0 | 51 | 7 | 2 | 42 | 1 | 1 | 4 | 0 | 94 | 2 | 2 | 4 | 7 | 15 | 8 | 0 | 0 | 124 | 0 | 5 |
| Total | 7 | 3 | 102 | 10 | 6 | 113 | 0 | 1 | 99 | 9 | 11 | 115 | 4 | 6 | 11 | 1 | 223 | 4 | 2 | 13 | 12 | 23 | 24 | 0 | 2 | 257 | 1 | 11 |

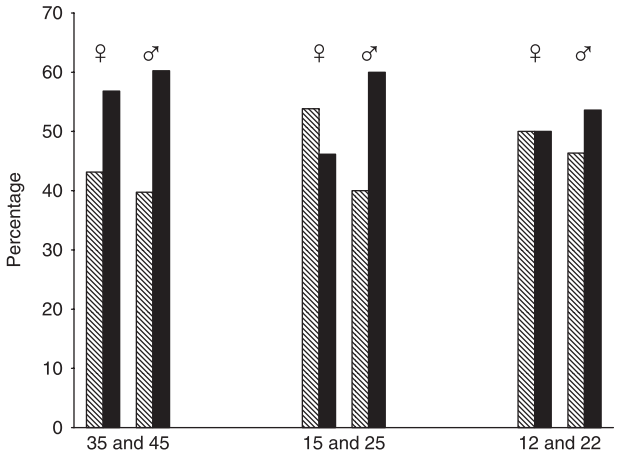


**Fig. 1.** Bilateral (hatched columns) and unilateral (black columns) occurrence of agenesis of second premolars and upper lateral permanent incisors in 601 Danish schoolchildren according to gender.

upper lateral incisors, whereas the trend for girls was either the opposite (upper second premolars) or showed no difference (upper lateral incisors). None of these differences did, however, reach statistical significance.

Table 3 shows the figures for children with agenesis of only one upper or lower second premolar or one upper lateral incisor. Agenesis of the upper lateral incisor was twice as frequent in the right as in the left side ($P < 0.01$) in girls, and agenesis of the lower second premolars was more than twice as frequent in left side as in the right ($P < 0.05$) among boys. For the other teeth, the frequency of agenesis according to side of the mouth showed no differences for either of the genders.

## Discussion

This study confirms the prevalence rates reported in previous studies, and it demonstrates interesting gender-related differences in

**Table 3. Distribution of 262 Danish schoolchildren with agenesis of one premolar or one upper permanent lateral incisor according to gender and side.**

| | | Girls | Boys |
|---|---|---|---|
| Lower second premolar | 45 not 35 | 39 | 27** |
| | 35 not 45 | 39 | 53 |
| Upper second premolar | 15 not 25 | 11 | 6 |
| | 25 not 15 | 13 | 10 |
| Upper lateral incisor | 12 not 22 | 20* | 17 |
| | 22 not 12 | 10 | 16 |

Binomial test; *$P < 0.05$; **$P < 0.005$.

the number and intra-oral distribution of congenitally missing permanent teeth in Danish schoolchildren.

The study was population based, and as the municipal dental services in Denmark enjoy a very high attendance rate (close to 100%), the sample can be considered representative of Danish schoolchildren. The same investigator collected all data and used the same methods and diagnostic criteria throughout the study, which assure high data quality. The development of permanent teeth shows much variation, and it has been demonstrated that premolars may occur very late in some children[10]. This may represent a possible source of bias in the diagnosis of agenesis. In this study, the children were, however, followed until the age of 16 or 18 years, which made it possible to adjust for late developing teeth.

The prevalence estimates found in this study are close to, but slightly higher than those found in a number of other large, population-based studies. Polder *et al.*[7] found no specific ethnic pattern in the prevalence rates, which is consistent with our rates not being consistent higher or lower that those found in other ethnic groups. It is interesting that no difference could be found in the estimates between samples

collected with an almost 20-year time interval. This indicates that agenesis of permanent teeth in Danish schoolchildren is a stable phenomenon over time. The study also confirmed previous findings of a higher frequency of congenitally missing permanent teeth in girls than in boys, whereas the finding of a higher number of congenitally missing teeth in affected girls than in affected boys represents new knowledge. Agenesis of teeth has a genetic component, and is also a component in many syndromes, and in X-linked syndromes (e.g. ectodermal dysplasia) female carriers are less affected than males, and may thus remain undiagnosed. This may also be the case in this study, and it may be one of several possible explanations why girls are more affected by agenesis of permanent teeth than boys.

Analysis of the intra-oral distribution of congenitally missing teeth showed that unilateral agenesis of the lower second premolars was more frequent than bilateral agenesis in both genders. In spite of the large sample size, a similar difference could not be confirmed for upper second premolars and upper lateral incisors. The aetiology of agenesis of permanent teeth is not fully understood, and there is no biological explanation why this condition should affect the dentition on one side of the midline more frequently than the dentition on the other side of the midline. The findings of this study also show that when children with only one congenitally missing tooth are included in the analysis, it becomes possible to demonstrate gender-specific differences in the occurrence of agenesis between the left and the right side.

Our findings on the intra-oral distribution of agenesis of permanent teeth in children may help us better understand the aetiology of agenesis, but the findings need to be substantiated in even larger studies. On the other hand, our study was planned as a large, population-based study on agenesis of teeth, and as such we did not collect data on the genetic background of agenesis of permanent teeth or its association with other dental anomalies.

**What this paper adds**

- Estimates of agenesis of permanent teeth on a sample larger than most of the previous reports.
- Gender-associated differences in intra-oral distribution of agenesis of permanent teeth which have not been reported before.

**Why this paper is important to paediatric dentists**

- Knowledge of prevalence rates of agenesis of permanent teeth, including time trends, is important for planning of dental services at the population level.
- Knowledge of intra-oral distribution of agenesis of permanent teeth is important for diagnosis and treatment planning.

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