# Eruption pattern of permanent teeth in a rural community in northeastern Finland

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Cross-sectional data on permanent tooth eruption were collected by examining the children and adolescents 5–15 years old in a northeastern municipality of Finland. There were 1008 subjects in the whole sample, 483 girls and 525 boys. The results showed statistically significant differences between the girls and boys in timing of eruption of some permanent teeth, indicating earlier eruption in girls than in boys. This difference was most clearly seen in the second phase of the mixed dentition. Interindividual variation in the emergence age was also wider in the second phase of the mixed dentition. The present results seem to indicate earlier eruption of the permanent teeth in rural children in northeastern Finland than in other parts of the country. □ *Mixed dentition; permanent tooth; tooth emergence; tooth eruption*

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The time of eruption of the permanent teeth has been studied among different ethnic groups and within the same ethnic group by several researchers. Table 1 summarizes some of these data. Eruptional pattern of the dentition is usually studied roentgenographically (2, 7, 8). There is no exact method to determine the developmental stage of the permanent teeth clinically. Reports on eruption of the permanent teeth are usually based on the criterion that the tooth has just pierced the gingiva (1, 3, 5, 6), whereas little information is available about the timing of the later eruptional stages. Data on the clinical tooth eruption are important for annual check-ups, during which screening for orthodontic treatment is also performed.

The aim of the present investigation was to study clinically the eruption pattern of permanent teeth in 5- to 15-year-old girls and boys in a rural community in northeastern Finland.

## Materials and methods

This cross-sectional study was undertaken in Juuka, a municipality of about 7500 inhabitants in northeastern Finland. The examined subjects were all the children and adolescents between 5 and 15 years old in that area; only one boy with cerebral palsy and mentally handicapped children were excluded. In Finland children start school in August of the calendar year in which they become 7 years old, and school attendance is compulsory until the age of 16. In Juuka all the children go to kindergarten 1 year before they start school. The study group consisted of 1008 subjects, 483 girls and 525 boys, with from 69 to 115 individuals in each age cohort. Table 2 shows the distribution of the sample by age and sex. The examination was performed during two terms when the children and adolescents came for their annual dental check-up in the public dental care center of Juuka. There were four dentists, SK, HK, AP, and RP, who performed the examinations in connection with the routine check-up and preventive and operative dental treatment of the children.

### *Clinical dental examination*

The developmental stage of the dentition was determined by classifying the clinical eruption of each tooth into four grades:

Table 1. The median age (years) of eruption of certain permanent teeth in different populations

| References | Population | *n* | Maxilla | | | | | | Mandible | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $I_1^*$ | | $I_2$ | | $M_1$ | | $I_1$ | | $I_2$ | | $M_1$ | |
| | | | G† | B | G | B | G | B | G | B | G | B | G | B |
| Hurme, 1949 (1) | Whites | 93,000 | 7.2 | 7.5 | 8.2 | 8.7 | 6.2 | 6.4 | 6.3 | 6.5 | 7.3 | 7.7 | 5.9 | 6.2 |
| Haavikko, 1970 (2) | Finnish children | 1,162 | 6.7 | 6.9 | 7.8 | 8.3 | 6.4 | 6.4 | 6.2 | 6.3 | 6.8 | 7.3 | 6.3 | 6.3 |
| Hägg & Tarranger, 1986 (3) | Swedish children | 212 | 6.8 | 7.2 | 7.9 | 8.3 | 6.3 | 6.5 | 6.0 | 6.3 | 7.0 | 7.5 | 6.1 | 6.4 |
| Okamoto, 1934 (4) | Japanese children | 11,257 | 7.3 | 7.6 | 8.4 | 9.0 | 6.6 | 6.8 | 6.6 | 6.8 | 7.4 | 7.7 | 6.1 | 6.4 |
| Höffding et al., 1984 (5) | Japanese children | 1,819 | 7.1 | 7.2 | 8.0 | 8.0 | .. | .. | .. | .. | 6.9 | 6.8 | .. | .. |
| Manji & Mwaniki 1985 (6) | Kenyan African children | 6,914 | 6.5 | 6.8 | 7.6 | 8.0 | 5.4 | 5.7 | 5.4 | 5.2 | 6.6 | 6.9 | 4.7 | 5.2 |

*$I_1$ = permanent central incisors; $I_2$ = permanent lateral incisors; and $M_1$ = first permanent molar.
† G = girls; B = boys.

grade 0 = not visible in the oral cavity; grade 1 = at least one cusp visible; grade 2 = the whole occlusal surface/mesiodistal width of the tooth visible; and grade 3 = in occlusion or at the occlusal level if the antagonistic tooth is not fully erupted.

To evaluate intraexaminer consistency, RP registered hard stone casts of the dentition of 40 children twice at an interval of 1 week. Kappa values of 0.88–1.0 with 95% confidence limits were high.

Independently of each other both RP and SK and RP and HK examined 20 children selected by means of invitation to dental check-up. In addition, 40 hard stone casts were examined independently of each other by RP and AP. Interexaminer consistency for the 28 studied variables between SK and RP, HK and RP, and AP and RP, with kappa values of 0.57–1.0, 0.69–1.0, and 0.64–1.0, respectively, were satisfactory. The lowest kappa value (0.57) between SK and RP was for the eruption stage of the mandibular right first molar, whereas for 24 variables the kappa value was 1.00. Between HK and RP the lowest value (0.69) was for the eruption stage of the mandibular left second molar, and for 14 variables the kappa value was 1.00. The lowest kappa value (0.64) between AP and RP was for the eruption stage of the maxillary right central incisor, the value being 1.00 for 21 variables.

Table 2. Distribution of 1008 children and adolescents of a rural community by age and sex

| Age, years | Girls (*n* = 483), % | Boys (*n* = 525), % | Total, *n* |
|---|---|---|---|
| 15 | 9.7 | 5.9 | 78 |
| 14 | 9.1 | 8.6 | 89 |
| 13 | 8.5 | 9.0 | 88 |
| 12 | 11.0 | 11.8 | 115 |
| 11 | 7.2 | 6.5 | 69 |
| 10 | 7.9 | 11.2 | 97 |
| 9 | 10.4 | 7.6 | 90 |
| 8 | 11.8 | 9.9 | 109 |
| 7 | 8.9 | 10.7 | 99 |
| 6 | 8.7 | 9.7 | 93 |
| 5 | 6.8 | 9.1 | 81 |
| Total | 100.0 | 100.0 | 1008 |

### *Statistical treatment of the data*

Analyses of variance were used to compare the developmental stage of the dentition between the girls and boys in three age groups, 5–8 years, 9–12 years, and 13–15 years, with an equal number of children in each age group and with age in months as covariate.

## Results

In the present sample about half of the 5-year-old children had all deciduous teeth

Table 3. Difference in eruption stage (0–3) of permanent teeth between girls and boys in three age groups

| Tooth | Age group | | |
|---|---|---|---|
| | 5–8 years, $p^*$ | 9–12 years, $p^*$ | 13–15 years, $p^*$ |
| Maxilla | | | |
| Central incisor | 0.942 | · | · |
| Lateral incisor | 0.034 | 0.174 | · |
| Canine | 0.206 | 0.001 | 0.267 |
| First premolar | 0.868 | 0.093 | 0.054 |
| Second premolar | 0.540 | 0.545 | 0.604 |
| First molar | 0.443 | · | · |
| Second molar | · | 0.000 | 0.012 |
| Mandible | | | |
| Central incisor | 0.129 | 0.307 | · |
| Lateral incisor | 0.286 | 0.327 | 0.943 |
| Canine | 0.020 | 0.000 | 0.131 |
| First premolar | 0.871 | 0.147 | 0.023 |
| Second premolar | 0.692 | 0.087 | 0.442 |
| First molar | 0.412 | · | · |
| Second molar | · | 0.000 | 0.046 |

* By analysis of variance (age in months as covariate).

with no permanent first molars visible, while the other half of that age group was in the first phase of a mixed dentition. Two girls among the 10-year-old children already had all the permanent teeth in occlusion. On the other hand, six adolescents, five girls and one boy, were still in the second phase of mixed dentition at the age of 15.

Because no difference in our data was detected in the eruption ages between contralateral permanent teeth, only the teeth on the right side of the maxilla and mandible were included in the analyses.

The analyses of variance (Table 3) showed that the difference in eruption stage of the permanent teeth between girls and boys was statistically significant in the following cases: in the youngest age group (5–8 years) for the eruption of the maxillary lateral incisors and mandibular canines, in the intermediate age group (9–12 years) for all the canines and second molars, and in the oldest age group (13–15 years) for all the second molars and mandibular first premolars. The difference between the sexes was most clearly seen in the intermediate age group (Figs. 1–7). Our results showed that mandibular teeth erupted earlier than maxillary ones; in premolars and molars (Figs. 4–7) there was less difference in emergence ages between the jaws than in incisors and canines (Figs. 1–3).

In the present study the individual variation in the emergence age was about twice as great for teeth in the second phase of mixed dentition as for teeth in the first phase of mixed dentition (Table 4).

## Discussion

In the present cross-sectional study the eruptional status of the dentition was registered during clinical examination. We did not consider the possible effects of premature eruption of the permanent successor owing to early extraction (9) or delayed eruption owing to delayed exfoliation (10) on the eruption age of the permanent teeth. However, in the current Finnish population only a few children have their deciduous teeth extracted because of caries (11).

Detailed information about the timing of clinical eruption is obtainable only in longitudinal examinations using sophisticated instruments unsuitable for epidemiologic studies. In the present study the exam-

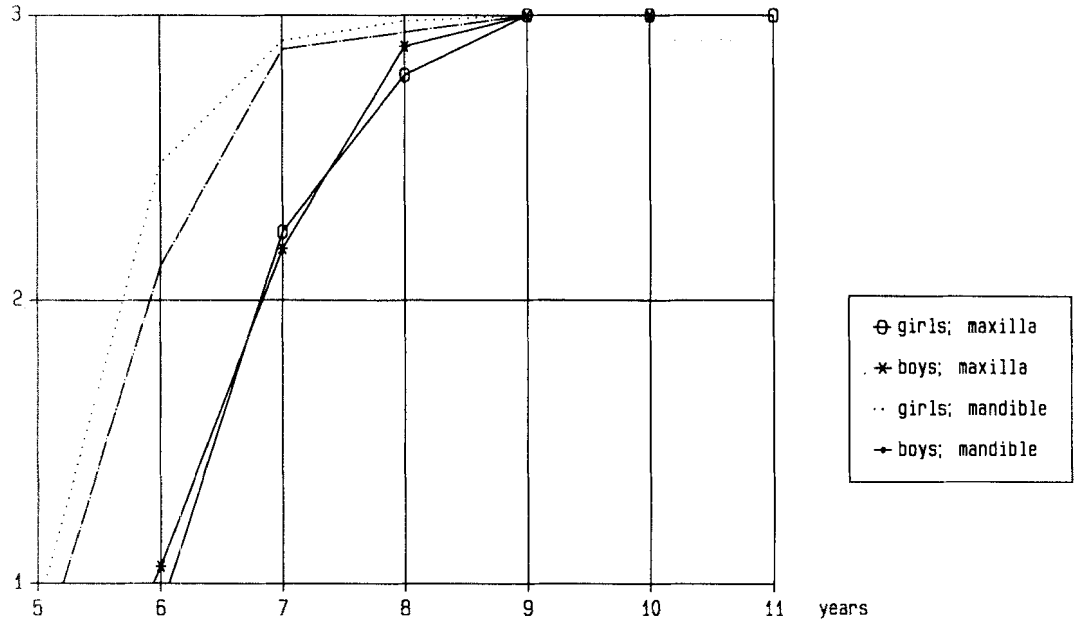


Fig. 1. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular central incisors in girls and boys at different ages.

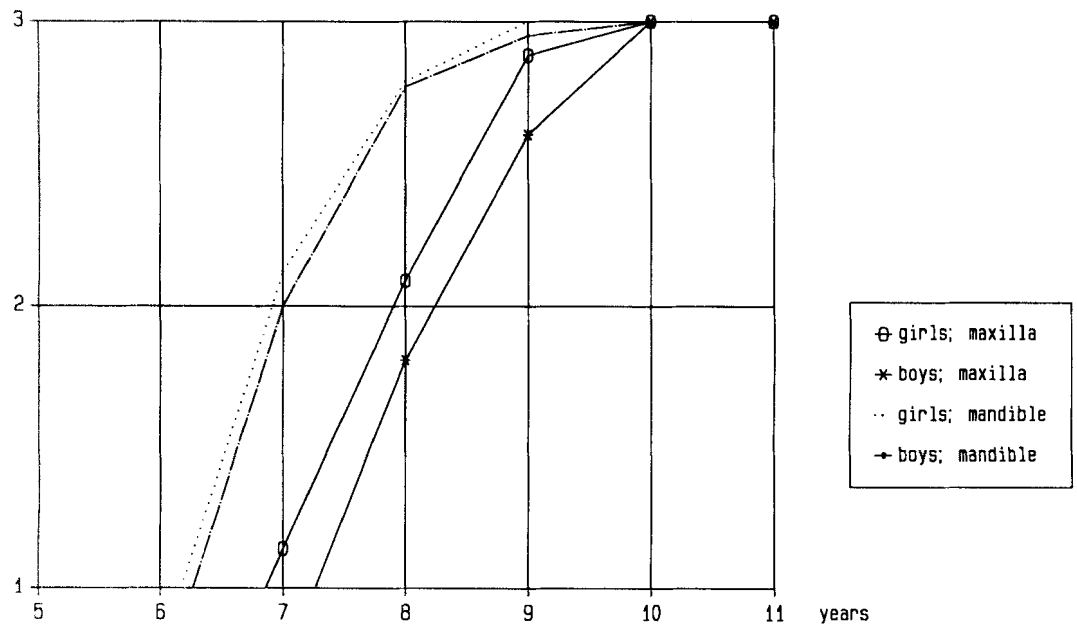


Fig. 2. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular lateral incisors in girls and boys at different ages.

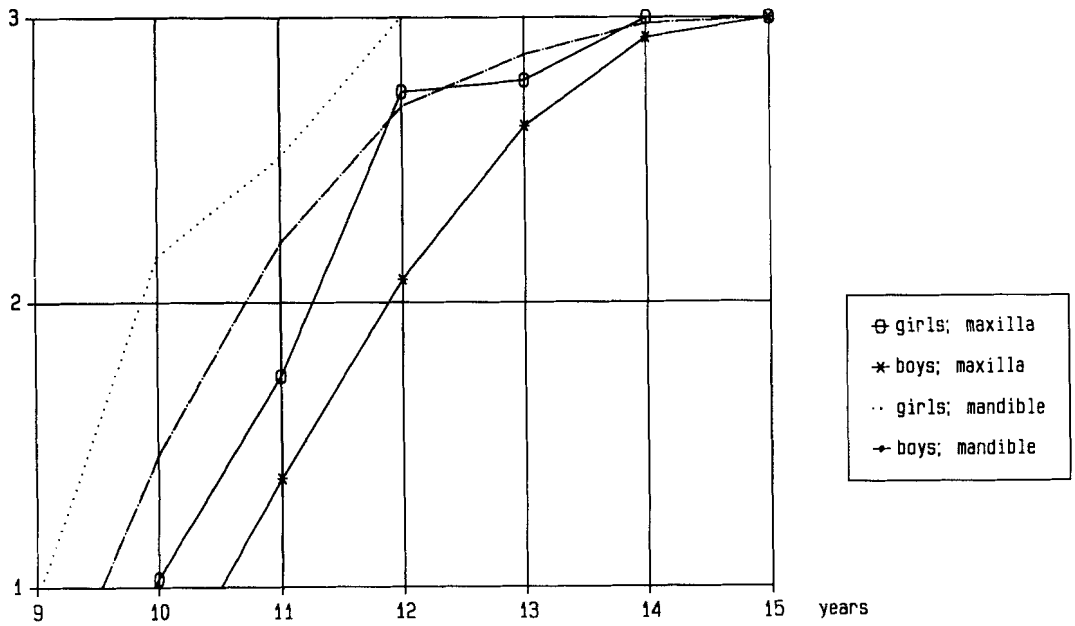


Fig. 3. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular canines in girls and boys at different ages.

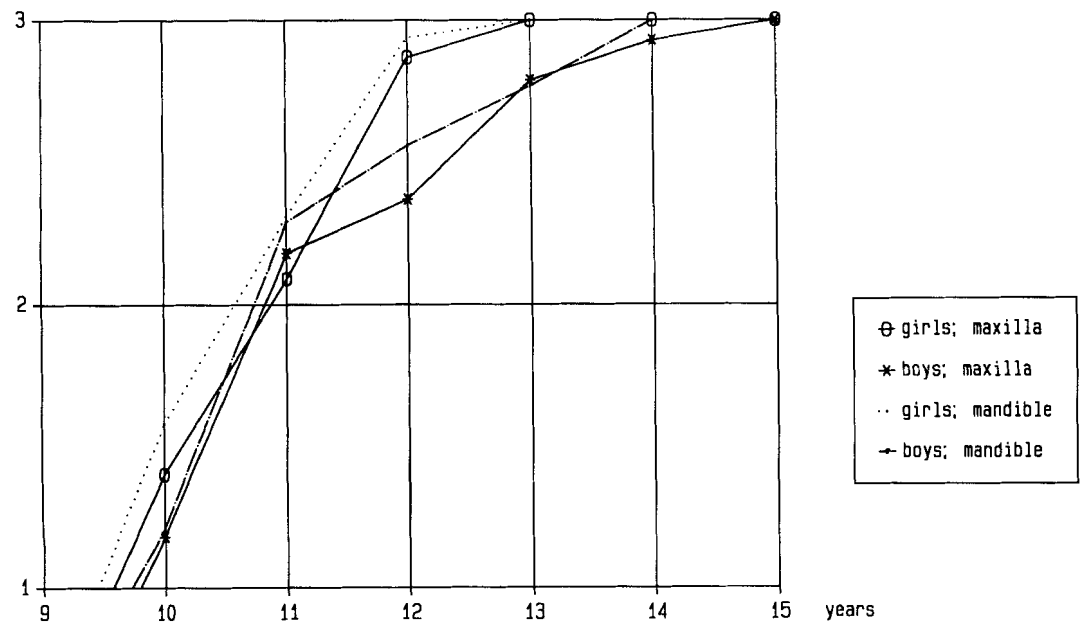


Fig. 4. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular first premolars in girls and boys at different ages.

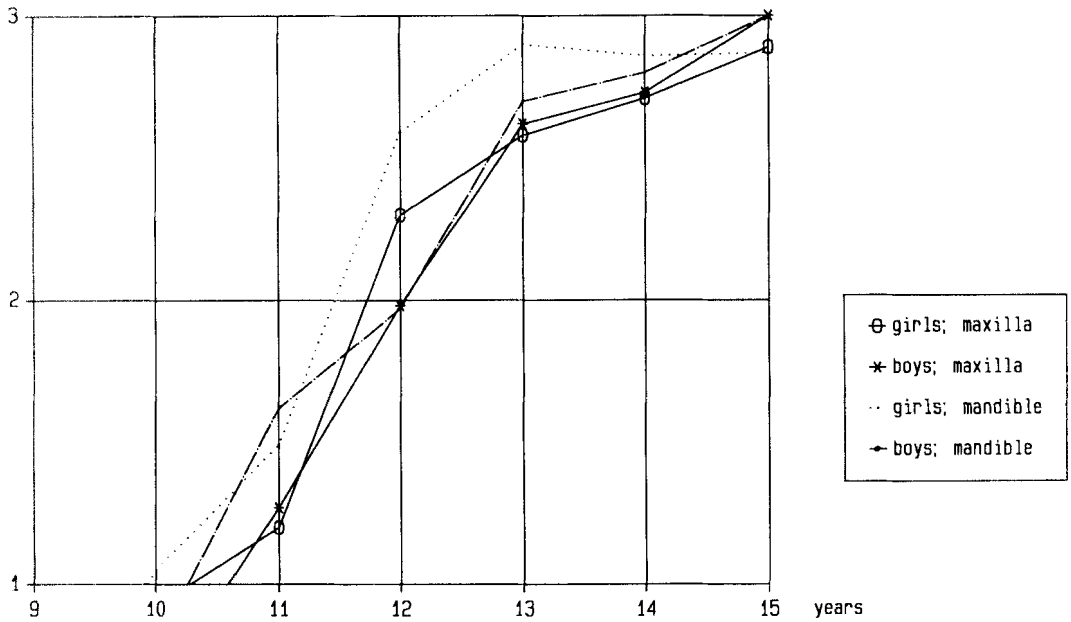


Fig. 5. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular second premolars in girls and boys at different ages.

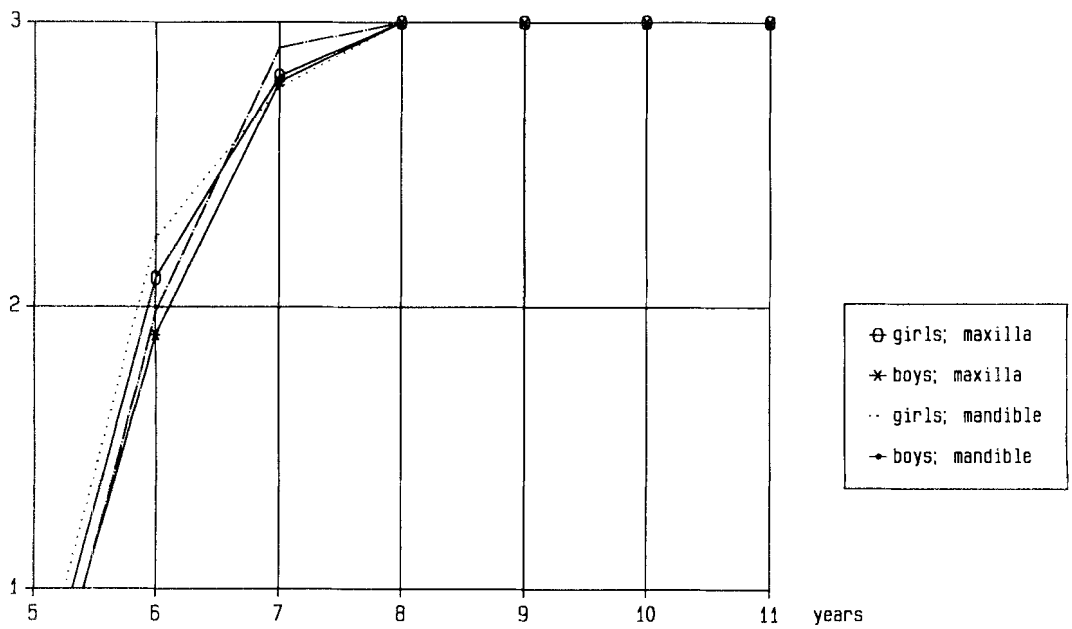


Fig. 6. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular first molars in girls and boys at different ages.

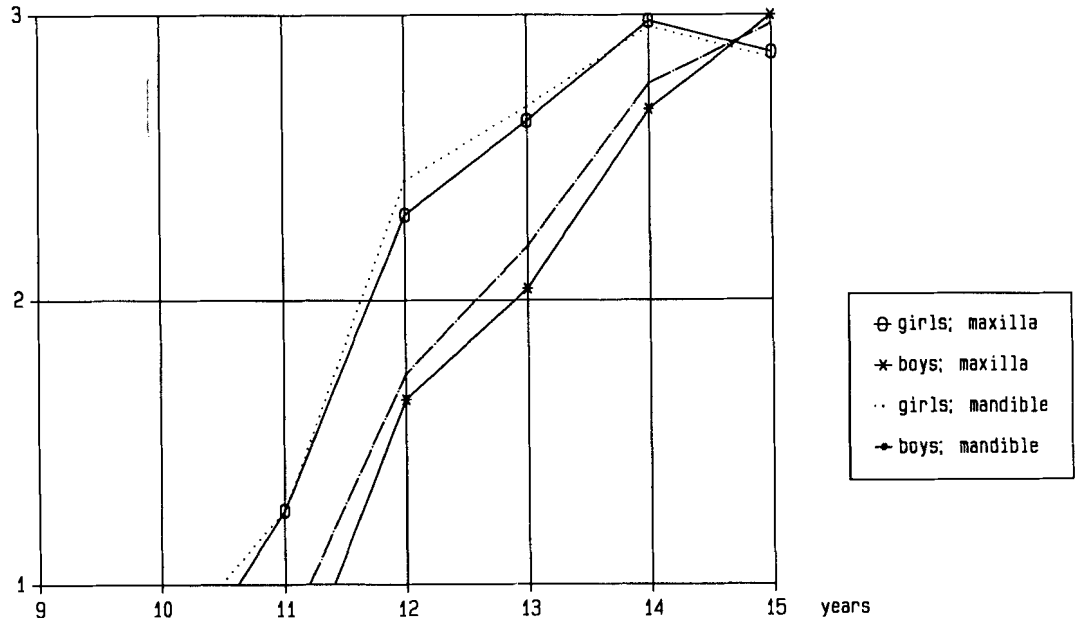


Fig. 7. Mean values of attained clinical eruption stage (1–3) of maxillary and mandibular second molars in girls and boys at different ages.

inations were performed in connection with routine check-ups and preventive and operative dental treatment of the children. Roentgenograms were taken only when indicated for the dental treatment. As always when a continuous process is divided into discrete categories, there were some problems of classification. However, intra- and inter-examiner consistencies of the method were good. The classification used to assess the developmental stage of the dentition seemed adequate for a cross-sectional study.

There appears to be a high degree of concordance in eruptional pattern of the permanent teeth between whites and Japanese (12). African blacks, American Indians, American blacks, and Filipinos, on the other hand, have been reported to be considerably more precocious dentally than European and American whites (6, 12–18). In the present sample, however, the permanent teeth erupted earlier than might be assumed on the basis of some previous studies of Scandinavians (2, 3).

Earlier studies agree that the median age of eruption of permanent teeth in girls is in advance of boys (1–3, 5, 6). This was also true in the present sample. Manji & Mwaniki (6) found that the difference in emergence age between the sexes was 2–10 months. In our study it was 1–8 months and was most clearly seen in the intermediate age group.

Table 4. The range of tooth emergence (grade 1) in years during the first and second stage of mixed dentition in rural children

| Permanent tooth | The range of tooth emergence (years) | |
|---|---|---|
| | Maxilla | Mandible |
| The first stage of the mixed dentition | | |
| Central incisor | 5.9–8.9 | 5.3–6.4 |
| Lateral incisor | 6.7–8.8 | 6.3–9.3 |
| First molar | 5.3–7.3 | 5.6–7.2 |
| The second stage of the mixed dentition | | |
| Canine | 8.4–13.0 | 8.3–12.4 |
| First premolar | 8.1–12.4 | 8.6–13.0 |
| Second premolar | 8.6–15.6 | 9.1–13.8 |
| Second molar | 9.7–14.1 | 9.2–14.8 |

As an exception to this finding, for example, Höffding et al. (5) found that in Japanese children the permanent lateral mandibular incisors emerged earlier in boys than in girls. In our study there was a tendency for maxillary central incisors to erupt earlier in boys than in girls.

As shown in Figs. 5 and 7, there was a slight decrease at the end of the eruption curve for the second molars in girls. The reason for this is that in five 15-year-old girls, one of them with a diagnosis of amelogenesis imperfecta, these teeth were still erupting.

According to most studies, no significant differences exist between the left and the right side in eruption of teeth (5, 19–22). There is also agreement that mandibular teeth generally erupt earlier than maxillary teeth (2, 6). The present results support these findings.

Our finding that the individual variation in the emergence age was about twice as great for the teeth in the second phase as for teeth in the first phase of mixed dentition is in accordance with the finding of Hägg & Taranger (3).

When our results on eruption age of the permanent teeth are compared with those of other Scandinavian studies (2, 3), the Juuka children seemed to be more precocious dentally. With regard to an earlier study of a Finnish population (2) this difference might be partly explained by the secular trend in earlier eruption timing of the permanent teeth in people today as compared with children 20 years ago. On the other hand, the recent study by Nyström et al. (8) on Finnish children and adolescents suggests that there are differences in dental maturity also within a fairly homogeneous population. Their conclusion was that the dental age of the children in the rural community of Kuhmo in northeastern Finland was significantly higher than that of the children in the city of Helsinki. When considering the role of environmental versus genetic factors, the explanation of these differences is hardly to be found in environmental factors, since nutrition and availability of dental services in different parts of Finland are nearly the same. More likely, this difference is explained by genetic factors; the children in these samples represent a population that has stayed in the same community for several generations.

In summary, the present results showed that there are statistically significant differences between the girls and boys in timing of eruption of some permanent teeth, indicating earlier eruption in girls than in boys. This difference is most clearly seen in the second phase of mixed dentition. Individual variation in the emergence age is about twice as great for the teeth in the second phase as for teeth in the first phase of mixed dentition. On the whole, mandibular teeth generally erupt earlier than maxillary antagonists. Our results indicate that the permanent teeth erupt earlier in children in northeastern Finland than in other parts of the country.

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