Dental maturity in Finnish children, estimated from the development of seven permanent mandibular teeth

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Overall dental maturity was studied semilongitudinally in a group of 248 healthy children born in Helsinki in 1968–73. In all, 738 orthopantomograms were taken of these children at ages of 2.5–16.5 years. Overall dental maturity was estimated by the method of Demirjian and Goldstein, which is based on the development of seven left mandibular permanent teeth. The aim of the study was to construct dental maturity curves for Finnish children and to compare their dental maturity with that of French-Canadian children studied by the same method. The Finnish children were more advanced in dental maturation than French-Canadian children ($p < 0.01$). In boys the advancement was seen at the age of 5–10 years and in girls at the age of 4–12 years. These findings suggest differences in overall dental maturity among white population groups. □ *Dentition; orthopantomography; tooth mineralization*

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Calendric age alone is not sufficient for assessing the stage of development of a growing child. More information is given by developmental ages, such as skeletal age, secondary sex character age, and dental age, which are estimated from the degree of maturation of different tissue systems. Tooth development is a useful measure of maturity, since it represents a series of recognizable events that occur in the same sequence from an initial event to a constant end point.

In many studies of tooth development emphasis has been placed on individual teeth (1–5). The formation of individual teeth is well documented for Finnish children (6–8). Systems for estimating the maturity stage of the whole dentition have also been developed (9–11). In 1973 Demirjian et al. (12) introduced a method for estimating overall dental maturity in which the developmental stages of seven left permanent mandibular teeth are assessed by means of an eight-stage system. Each stage is given a numerical, biologically weighted score, and the sum of the scores provides an estimate of an individual's dental maturity on a scale from 0 to 100. The method was slightly revised in 1976 (13). The same mathematical technique has been used by Tanner et al. (14) in estimating skeletal maturity.

The rate of maturation is influenced by both heredity and environment, and maturity standards may change from one population to another (15). The purposes of the present study were to construct dental maturity curves for Finnish children by means of the seven-teeth scoring system of Demirjian & Goldstein (13) and to compare dental maturity in Finnish and French-Canadian children studied by the same method.

Subjects and methods

The sample comprised 248 healthy Finnish children born in Helsinki and its surroundings in 1968–73 and participating in a longitudinal investigation of dental development (16). In total, 738 panoramic radio-

graphs (orthopantomograms) were taken of these children at ages of 2.5–16.5 years, 389 of the girls and 349 of the boys. The number of radiographs per child ranged from 1 to 6, the mean being 3. Children with any congenitally missing mandibular teeth besides the third molar were not included in the present study.

The first author assessed the stages of mineralization of the seven left mandibular permanent teeth, using the eight-stage system presented by Demirjian et al. in 1973 (12). The scores used in the present study were the revised scores published by Demirjian & Goldstein in 1976 (13). The maturity scores were converted to dental age in accordance with the instructions of Demirjian & Goldstein, using magnified photographs of median curves. The curves were assessed in 0.1-year steps.

To facilitate the construction of median curves, the radiographs were grouped in half-year classes. A class midpoint was considered to represent all the radiographs belonging to a given class. Thus 9.5 years represents all radiographs taken at the age of 9.26–9.75 years. The curves were smoothed by using a moving average of three points in the graphs. Smoothing was not used in the tables.

The intraobserver variation of the present method was studied in a test in which the stages of mineralization of seven left mandibular teeth were assessed twice by the first author on 100 orthopantomograms. The assessments agreed in 90.3% of the cases,

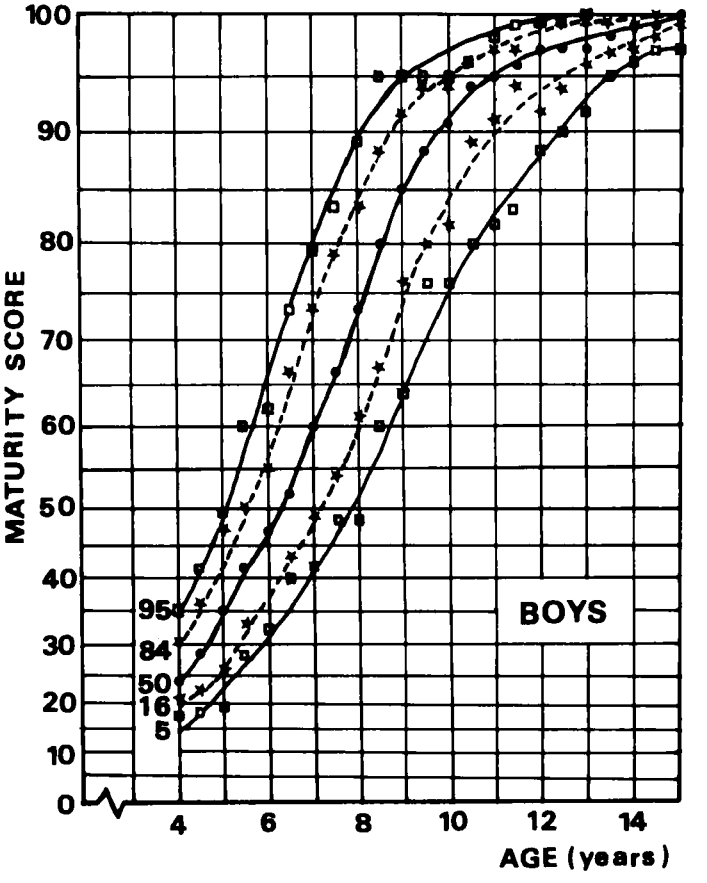

Fig. 1. Dental maturity percentiles for boys (seven permanent left mandibular teeth).

and the difference between the two assessments never exceeded one stage.

Results

The 5, 16, 50, 84, and 95 percentile curves of dental maturity are presented in Fig. 1 for the boys and in Fig. 2 for the girls. The curves resemble each other, although at each age the scores of the girls were higher than those of the boys. From 4 to 6 years of calendric age the differences in dental age were small, but from the age of 7 years onwards the dental age of the girls was at least half a year in advance of that of the boys. The mean maturity scores in 1-year age groups are given in Table 1.

A standardized variable was used to compare dental maturity in Finnish children with that of French-Canadian children. The 0.01 level of confidence was chosen. The standardized variable was constructed by substracting the age- and sex-specific median score of the Canadian children from the score of the Finnish children and dividing the difference by the expected standard deviation given by Demirjian & Goldstein (13).

If the Finnish and Canadian children were equally mature in dental development, the mean of the standardized variable should be close to zero and the standard deviation about one. In the present study the mean was positive throughout the scale, and the standard deviation was close to one. When these values were tested on the basis of the normal distribution with the hypothesis that dental maturity is the same in these two

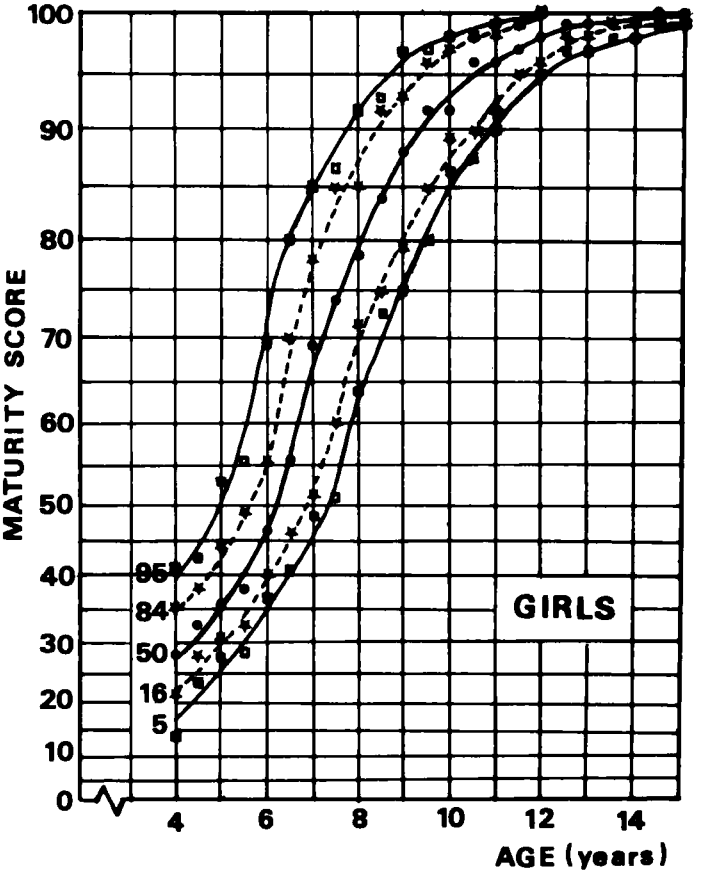

Fig. 2. Dental maturity percentiles for girls (seven permanent left mandibular teeth).

Table 1. Dental maturity scores in 1-year age groups

Age (Years)	Boys			Girls		
	N	Mean	SD	*N*	Mean	SD
2.5–3.5	2	19.5	1.9	5	17.9	6.5
3.6–4.5	17	26.5	7.1	19	30.1	10.1
4.6–5.5	30	36.9	8.6	40	38.3	7.1
5.6–6.5	41	49.1	7.5	30	52.1	9.7
6.6–7.5	41	62.7	10.8	42	68.8	12.4
7.6–8.5	41	73.2	11.6	37	78.8	6.2
8.6–9.5	31	85.3	6.8	42	86.7	7.1
9.6–10.5	34	88.8	5.3	36	93.3	3.4
10.6–11.5	20	94.3	3.1	27	95.6	2.9
11.6–12.5	29	96.0	2.9	29	97.4	1.6
12.6–13.5	15	97.1	1.6	36	99.0	0.9
13.6–14.5	27	98.2	1.2	25	99.3	0.6
14.6–15.5	14	99.5	0.6	14	99.6	0.4
15.6–16.5	7	99.5	0.9	7	100.0	0.0

population groups, the null hypothesis had to be rejected.

Our results thus show that Finnish children were advanced in dental maturity compared with French-Canadian children (Table 2). In boys the difference was about 4.5 months at the age of 5–10 years and about 7 months at the age of 11–12 years. In the girls the difference was seen 1 year earlier and continued 2 years later. The dental ages of Finnish girls were on an average 3.5 months ahead of French-Canadian girls at the age of 4–9 years and 9 months ahead in the age groups 10–14 years.

Discussion

The eight-stage system of Demirjian et al. (12) for assessing tooth development was convenient to use, and the assessments could be repeated. Probably for this reason, it has come into more general use (5, 17, 18). The scoring system worked well, since it resulted in smooth curves, which describe the continuity of biological development. The system seems to be suitable for making population standards and comparing different population groups with each other.

The children in the present study were participating in a longitudinal investigation of dental development. No differences had been observed between the boys and the girls in the emergence of primary teeth (19) or in the development of primary and permanent teeth (8) during the first 3 postnatal years. The present results on overall dental maturity indicated that dental development continues to be similar in the boys and girls during the next 3 years as well. Demirjian & Levesque (20) likewise reported that no differences were observed between the sexes

Table 2. Difference in dental ages between Finnish and French-Canadian children. The dental ages of the Canadian children were taken from median curves published by Demirjian & Goldstein (13)

Age (years)	Boys			Girls		
	No. of Finns	Difference (years)		No. of Finns	Difference (years)	
		Mean	SD		Mean	SD
2.5–3.5	2	0.0	0.28	5	0.02	0.66
3.6–4.5	17	0.09	0.74	19	0.34	0.81
4.6–5.5	30	0.21	0.80	40	0.29	0.50
5.6–6.5	41	0.40	0.57	30	0.20	0.46
6.6–7.5	41	0.34	0.71	42	0.38	0.83
7.6–8.5	41	0.25	0.97	37	0.14	0.59
8.6–9.5	31	0.50	1.00	42	0.38	1.02
9.6–10.5	34	0.24	0.99	36	0.78	1.22
10.6–11.5	21	0.69	0.77	27	0.54	0.90
11.6–12.5	29	0.54	1.34	29	0.69	1.15
12.6–13.5	15	0.01	1.14	36	1.15	1.30
13.6–14.5	27	0.01	1.29	26	0.57	1.03
14.6–15.5	15	0.56	1.18	14	0.13	0.87

in the timing of tooth development up to the age of 5–6 years, whereas at older ages girls were advanced compared with boys. Other authors have reported accordance in the early stages of formation of individual teeth in boys and girls but pronounced differences at later stages and at later ages (1, 2, 7, 21, 22).

Since the Finnish population is ethnically homogeneous, it is likely that the timing of tooth development in the present series of Helsinki children closely resembles that of healthy Finnish children in general. In light of the present results, Finnish children are ahead of French-Canadian children in dental maturity. Since the grading method used is well described both verbally and with diagrams and radiographic examples, inter-examiner variation probably affected the results only very slightly. Nor can the differences in the rate of maturation be explained merely by the fact that the Canadian sample is large and mainly cross-sectional, whereas the Finnish sample is smaller and semilongitudinal.

There is evidence of differences in the developmental schedule of individual teeth between white and nonwhite populations (5, 23). The rate of formation of individual permanent teeth in Finnish children presented by Haavikko (7) agrees closely with that of white children in the United States (2, 9). Compared with Canadian children of predominantly Anglo-Saxon origin (4), the Finnish children were delayed in the development of crowns of premolars, whereas the rate of formation of other teeth was similar in the two groups of children. It is likely that even if differences exist in the rate of tooth formation among white populations, they are so small that it is difficult to discover them merely by comparing mean or median values of individual teeth. Dental maturity scores combine the information from several teeth, and possible differences may thus become more pronounced. The results of the present study suggest that differences in overall dental maturity exist among white populations. Maturity standards should therefore be based on studies made in the same population for which they are going to be used.

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