

# Tooth Formation Age Estimated on a Few Selected Teeth

## A Simple Method for Clinical Use

KAARINA HAAVIKKO

*Department of Pedodontics and Orthodontics, Institute of Dentistry,  
University of Helsinki*

---

Abstract

---

HAAVIKKO, K.: *Tooth Formation Age Estimated on a Few Selected Teeth. A Simple Method for Clinical Use.* Proc. Finn. dent. Soc. 70: 15—19, 1974.

The aim of the study was to investigate whether it is possible to make reliable estimates of the tooth formation age using only a few selected teeth. The material consisted of data on 885 children in the age range from 2 to 13 years. The teeth to be selected were those that showed the least variability, and whose formation stage was easily estimated on roentgenograms. Attention was also paid to the age at which they became fully formed. The variability was calculated as the mean range of the age distributions of the tooth formation stages. Altogether nine teeth were selected. With these nine teeth six different groups were formed. The correlation between the group age and mean formation age (the mean of the formation ages of all the teeth) was computed for every child. The correlation coefficients were highly significant, being 0.88—0.93 for the three groups in the age period 2.5 to 9 years and 0.82—0.88 for the three groups in the age period 10 to 13 years. The teeth recommended for use in estimating the formation age: teeth 47, 46, (16), 44, 41 from birth to nine years of age and teeth 47, 44, 13, 43 from 10 years onwards.

**Key words:** Dental age — Tooth formation age — Teeth calcification age

**Address:** Fabianinkatu 24, SF - 00100 Helsinki 10, Finland

---

The dental age of the individual defined according to the tooth formation stage is one index of biological age. Dental age has many advantages compared with other indices of biological age. Tooth formation can be examined throughout the growing stage from birth to the age 18 or 19 and the teeth are less responsive to both nutritional modification and hormonal extremes than many other developing systems of the body (GARN et al. 1965a, b). KROGMAN (1968a, b) considered the indices of skeletal age, dental age, tooth formation age, hand age, menarche and the maximum of the growth spurt and

concluded that tooth formation age and menarche are best suited to the determination of the biological developmental stage because they vary least. LEWIS and GARN (1960) came to the same conclusion.

When dental age is determined carefully, the formation stage of each tooth is defined, and the age corresponding to each formation stage read from one of the available tables. Tables of age estimates for tooth formation stages have been published by e.g., NOLLA (1960), FANNING (1960, 1961), MOORREES et al. (1963), NANDA and CHAWLA (1966) and HAAVIKKO (1970). The tooth formation age of the child is then obtained by calculating the mean of all the tooth for-

mation age estimates. However, the process is rather complicated, and time-consuming for clinical work.

Methods in which certain teeth are chosen to represent the whole dentition have been applied, for example in recording dental caries (WELANDER 1960) and dental plaque and gingivitis (RAMFJORD 1959).

The aim of this study is to determine whether it is possible to make satisfactory estimates of tooth formation age using only a few selected teeth, and to discover which teeth would give the best and most reliable information.

#### MATERIAL AND METHOD

The data on 885 children in the age range from 2 to 13 years were partly collected for an earlier study (HAAVIKKO 1970) and supplemented in 1970—72. Table 1 shows the age and sex distributions of the children. They were kindergarten and elementary school pupils from the centre of Helsinki, 84 children being patients of the Department of Pedodontics, Institute of Dentistry, University of Helsinki. An orthopantomogram was taken of each child, and the date of birth was recorded. The formation stages of all the teeth of each child were assessed by the author on the material of the earlier study and the supplementary material. The codes for the formation stages of all the teeth were transformed tooth by tooth to age

estimates on IBM Computer forms, using the age medians for tooth formation stages given by HAAVIKKO (1970). The variability of the tooth formation stages was analysed and the ages at which the teeth were fully formed were calculated on the basis of the material collected for the earlier study. The variability was estimated for each tooth according to the magnitude of the mean range of the age distributions of its formation stages and the teeth were arranged in order of variability.

It was decided to select separate teeth for the age period from birth to 9 years of age and the period from 10 years onwards. This is because the least variable teeth,  $M_1I_1I_2$ , are already fully formed at about 9—10 years of age. The teeth selected were the upper and lower  $M_1$ ,  $C$ ,  $I_1$  and the lower  $M_2$ ,  $P_1$ ,  $I_2$ . From these teeth six groups (Table 3) were formed. The correlation between the group age (the mean of the formation ages of teeth included in the group) and the mean formation age (the mean of the formation ages of all the teeth) was computed for each child. The correlations of groups, 1, 2 and 3 were studied in children from 2.5 to 9 years of age and those of groups 4, 5 and 6 in children from 10 to 13 years of age.

#### RESULTS

The results are presented in Tables 2, 3, and 4. Table 2 shows the variability of the different teeth as represented by the mean of the 10 to 90 percentile age ranges of the formation stages of each tooth. The three least variable teeth were the lower  $I_1$ ,  $I_2$  and  $M_1$ , in boys and both the  $M_1$ s and the upper  $I_2$  in girls. The teeth chosen for the first age period were the least variable teeth in the dentition. In the second age period, the  $P_1$ s were the least variable, followed by the  $C$ s and the  $M_2$ s and finally the  $P_2$ s. The most variable were the  $M_3$ s, the mean distribution range of which was of a different size class. On the whole the variability of the teeth is smaller in girls than in boys.

Table 3 presents the nine teeth selected according to the criteria chosen and the six groups formed from these teeth, three for the age period from 2.5 to 9 years and three for

TABLE 1

*Age and sex distribution of the material*

Age	Boys	Girls	Total
2	3	1	4
3	5	11	16
4	25	26	51
5	38	41	79
6	40	45	85
7	57	51	108
8	52	55	107
9	63	49	112
10	50	60	110
11	47	62	109
12	46	28	74
13	23	7	30
Total	449	436	885

TABLE 2

Means of the 10 to 90 percentile age ranges of the formation stages of each tooth arranged in increasing order of magnitude (left and right side combined)

Boys		Girls	
Tooth	Range in years	Tooth	Range in years
lower I <sub>1</sub>	1.74	lower M <sub>1</sub>	1.50
» I <sub>2</sub>	1.80	upper M <sub>1</sub>	1.58
» M <sub>1</sub>	1.88	» I <sub>2</sub>	1.65
upper I <sub>1</sub>	1.92	lower I <sub>2</sub>	1.70
» M <sub>1</sub>	1.98	» P <sub>1</sub>	1.71
» I <sub>2</sub>	2.03	upper P <sub>1</sub>	1.80
» P <sub>1</sub>	2.24	» I <sub>1</sub>	1.82
lower P <sub>1</sub>	2.26	lower I <sub>1</sub>	1.86
upper C	2.40	» C	1.87
» M <sub>2</sub>	2.42	» M <sub>2</sub>	2.08
lower M <sub>2</sub>	2.52	upper C <sub>1</sub>	2.18
» C	2.53	» P <sub>2</sub>	2.28
upper P <sub>2</sub>	2.69	» M <sub>2</sub>	2.32
lower P <sub>2</sub>	2.82	lower P <sub>2</sub>	2.34
upper M <sub>3</sub>	4.36	upper M <sub>3</sub>	4.06
lower M <sub>3</sub>	4.71	lower M <sub>3</sub>	4.10

TABLE 3

The nine selected teeth arranged in six groups,

Teeth selected	47	16	46	44	13	43	42	11	41
Age period of the selected teeth	Group	Sets of selected teeth							
From 2.5 to 9 years	1	16	46	44				11	
	2		46	44					41
	3	47	46	44					41
From 10 to 13 years	4	47		44	43				
	5	47		43	13	43			
	6	47				43			

the period from 10 to 13 years. Most of the teeth of the younger age period reach full formation at 9—10 years. The only exceptions are teeth 47 and 44.

The correlations between the group age and the mean formation age are very high (highly significant  $p < 0.001$  in all groups (Table 4). There were no perceptible differences between boys and girls. The mean formation age given by the whole correlation highly significant in all cases,  $p < 0.001$  dentition was

TABLE 4

The correlation coefficients between the group age estimates and the mean formation age estimates

Group	Coefficient of correlation *		
	Boys	Girls	Total
1	0.92	0.93	0.93
2	0.89	0.88	0.88
3	0.91	0.92	0.92
4	0.89	0.82	0.85
5	0.90	0.86	0.88
6	0.88	0.76	0.82

\* correlation-highly significant in all cases,  $p < 0.001$

most closely approached group 1, comprising teeth 16, 46, 44 and 11, where the correlation coefficient was 0.93, and almost the same result was reached with group 3, comprising teeth 47, 46, 44 and 41. In the older age period the correlation was highest with group 5 (cc. = 0.88), comprising teeth 47, 44, 13, 43. The differences between the first three groups and those between the last three groups very small.

#### DISCUSSION

The age range of the children investigated in the earlier study went up to 19 years, but there was no reason to test the dental age of the over 13-year-olds. The tooth formation stages were defined for the different teeth up to the Root completed ( $R_c$ ) stage, and by the age of ca 13 all the teeth have reached this stage, with the exception of the wisdom teeth. No reliable use could be made of the final formation stage, Apex closed. Knowledge was not available of the age at which this stage was reached in the individuals and because it gives the same age estimate for the tooth, although the chronological age increases.

The teeth of the first age period, I<sub>1</sub>, I<sub>2</sub>, M<sub>1</sub>, reach full maturity as early as the age of 9 to 10 years and they were the least variable teeth in the dentition. This was the reason for selecting different teeth for the age period from 10 years onwards. The first premolar and second molar were included in the group of early maturing teeth to balance the group age estimation. The upper lateral incisor

showed a very little variability, but was omitted, because it had a greater tendency to malposition, rotation, crowding and absence than the first incisor. The second premolar was omitted, because it showed the greatest variability of all the teeth, excluding the wisdom teeth. The large range of age distribution (2.8—6.5 years) of the formation stages of the wisdom teeth shows that they could hardly ever be used for estimating dental age, or at least one must bear in mind that average age range is 4—5 years.

The ranges of the age distributions of the formation stages were about 80 % of those reported by GARN et al. (1959), FANNING (1961), and MOORREES et al (1963), but those authors took the 5 to 95 % level.

Only teeth from the left side were selected. In the material of the earlier study the formation stages of the left and right sides were defined and when no statistical differences were found, the results of the two sides were combined. In the opinion of the author it would not make any difference if the teeth of the other side were used as well. The analogous teeth ought to be used in cases in which factors which might affect the formation of the teeth are detected, as periapical processes or premature loss of deciduous teeth, abnormal path of eruption or crowding. The teeth of the lower jaw were preferred to the teeth of the upper jaw. This was because the formation stage can be estimated on roentgenograms (orthopantomograms) more easily and somewhat more exactly for teeth in the lower jaw.

The correlation coefficients of groups 1, 2 and 3 are very high, exceeding 0.94. It seems that the formation of all the teeth, excluding the wisdom teeth, is controlled by the same growth system, and that aberrant development occurs with few, individual teeth and is mostly caused by extrinsic factors. In the older age groups (4, 5 and 6) the coefficients of correlation are a little lower, though still significant. The reason for the lower correlations may be that the teeth in the older age groups are somewhat more affected by extrinsic factor at a later stage of development and a later age. The high correlations are to some extent attributable to the fact that this material is basically the same as that used for the

estimates of the mean age of the tooth formation stages.

According to the results of this study, it seems possible to make reliable estimates of the tooth formation age using only a few teeth. The teeth recommended for use are 47, 46, (16), 44, 41 from birth to 9 years of age and 47, 44, 13, 43 from 10 years onwards. The mean formation ages of these two sets of four teeth show high correlation with the mean formation age of all the teeth (coefficients of correlation 0.94 with the former set, 0.88 with the latter set).

#### REFERENCES

- FANNING, E. A. 1960 A longitudinal study of tooth formation and root resorption. Thesis D. D. S., University of New Zealand.
- FANNING, E. A. 1961 longitudinal study of tooth formation and root resorption. *N. Z. dent. J.* 57: 202—217.
- GARN, S. M., LEWIS, A. B. and D. POLACHEK 1959 Variability of tooth formation. *J. dent. Res.* 38: 135—148.
- GARN, S. M., LEWIS, A. B. and R. BLIZZARD 1956. Endocrine factors in dental development. *J. dent. Res.* 44: 243—258.
- GARN, S. M., LEWIS, A. B. and R. KEREWKY 1965 Genetic, nutritional and maturational correlates of dental development. *J. dent. Res.* 44: Part 2: 228—421.
- HAAVIKKO, K. 1970 The formation and the alveolar and clinical eruption of the permanent teeth. An orthopantomographic study. Thesis, Helsinki. *Suom. Hammaslääk. Toim.* 66: 103—170.
- KROGMAN, W. M. 1968b Biological timing and the dento-facial complex. Part I. *J. Dent. Child.* 35: 175—185.
- KROGMAN, W. M. 1968b Biological timing and the dento-facial complex. Part II. *J. Dent. Child.* 35: 328—341.
- LEWIS, A. and S. M. GARN 1960 The relationship between tooth formation and other maturational factors. *Angle Orthodont.* 30: 70—77.
- MOORREES, F. A. FANNING, E. A. and E. HUNT, JR. 1963 Age variation of formation stages for ten permanent teeth. *J. dent. Res.* 42: 490—502.
- NANDA, R. S. and T. N. CHAWLA 1966 Growth and development of dentitions in Indian children. I. Development of permanent teeth. *Amer. J. Orthodont.* 52: 837—53.
- NOLLA, C. 1960 The development of permanent teeth. *J. Dent. Child.* 27: 254—266.
- RAMFJORD, S. 1959 Incides for prevalence and incides of periodontal disease. *J. Periodont.* 30: 51—59.
- WELANDER, E. 1960 Partial recording of dental caries. *Acta odont. scand.* 18: 377—406.

## Lyhennelmä

HAAVIKKO, KAARINA: *Hampaistoiän määrittäminen käyttämällä vain muutamia valittuja hampaita. Yksinkertainen menetelmä kliiniseen käyttöön.*

Tutkimuksen tarkoitus oli selvittää, kuinka luotettavasti hampaistoikä voidaan määrittää käyttämällä vain muutamia valittuja hampaita. Aineiston muodosti 885 lapsesta, iältään 2.5—13-vuotiaita, otetut ortopantomogrammit, joista oli määritetty jokaisen hampaan kehitysaste. Kaikki kehitysasteet muunnettiin kukin vastaavaksi iäksi käyttämällä tekijän hampaidenkehitysastetaulukoita (Haavikko 1970). Hampaiden valinnan kriteerinä oli, että hampaan täytyi kuulua vähiten vaihteleviin, sen kehitysvaiheen täytyi olla helposti määritettävissä ja kehityksen täytyisi kestää mahdollisimman kauan.

Kaikkiaan yhdeksän hammasta valittiin, ja niis-

tä muodostettiin kuusi ryhmää (taulukko 3). Näistä kolme ensimmäistä testattiin 2.5—9-vuotiailla ja kolme jälkimmäistä 10—13-vuotiailla. Jokaiselle lapselle laskettiin nyt kolmen eri ryhmän hampaiden antama keskiarvoikä ja sitä verrattiin saman lapsen kaikkien hampaiden antamaan ikäkeskiarvoon. Korrelaatiokertoimet laskettiin eri ryhmien ikäkeskiarvon ja kaikkien hampaiden antaman ikäkeskiarvon suhteella (taulukko 4). Korrelaatiot olivat erittäin korkeat lähes kaikilla ryhmillä vaihdellen 0,82—0,93. Hampaistoikä voidaan tutkimuksen tulosten mukaan määrittää luotettavasti käyttämällä vain muutamia hampaita. Tekijä suosittelee hampaiden 47, 46, (16), 44, 41 käyttöä syntymästä 9. ikävuoteen, ja hampaiden 47, 44, 43, 13 käyttöä 10 ikävuodesta eteenpäin, joiden ryhmien korrelaatiokertoimet olivat vastaavasti 0,93 ja 0,88.