Tooth Size and Tooth Formation in Children with Advanced Hypodontia

BODIL RUNE, D.D.S.
KARL-VICTOR SARNÄS, D.D.S., M.S., Odont. Dr.

Advanced hypodontia may be a serious clinical problem. In long-term treatment planning the number of remaining teeth, their size and development is of importance. In the following study advanced hypodontia designates four or more congenitally missing permanent teeth, excluding the third molar. During the years 1963 through 1972 children with this condition were referred from the Department of Orthodontics of the Public Health Service to the Maxillo-Facial and Cleft Palate Center at Malmö University Hospital for further clinical evaluation and possible orthodontic-prosthodontic treatment. Many of these patients demonstrated their remaining teeth to be smaller than normal; delayed development and eruption of the second molar was also noted. These observations initiated the present study.

TOOTH SIZE

Material and methods

The patient group consisted of 45 boys and 46 girls ranging in age from 7 to 19 years, a mean age of 11 and 12 years, respectively. Children with facial clefts and/or craniofacial anomalies were not included. A primary diagnosis was made with the aid of full mouth radiographs at the Department of Orthodontics, Public Dental Health Service, and confirmed by panoramic radiographs at the Maxillo-Facial and Cleft Palate Center. The distribution of missing permanent teeth in each sex, excluding the third molar, in relation to the upper and lower jaws is given in Table I. The average number of missing teeth in boys was 6.0 and in girls 6.9, thus there was not a significant difference in sex distribution. In both boys and girls, 56 per cent of the missing teeth were from the upper jaw and an equal number of teeth were missing from each side. The second premolar was the most commonly missing tooth, 277 out of 590 teeth or almost 50 per cent, whereas the upper medial incisor was present in all children.

Contralateral hypodontia (e.g., lower second right and left premolars) was observed in 247 instances accounting for 84 per cent of all missing teeth.

The definitions and technique for measuring tooth size were in accordance with those of Seipel[1] and were performed on dental casts using the same type of caliper as that used by Seipel. Using this technique, one could evaluate the mesiodistal space required for normal tooth alignment. Errors in measurement, as determined by studies of casts obtained on two different occasions, were similar to those of Seipel.

Only the medial incisor, the canine and the first molar were measured, as these teeth are rarely missing or maldeveloped.[2] Mean values of tooth size for right and left side were compared with those of a reference group of 13 year-old nonselected children studied by Seipel.

Results

Mean tooth size in these children was almost always statistically signifi-

From the Department of Orthodontics, Public Dental Health Service, and The Maxillo-Facial and Cleft Palate Center, University Hospital, Malmö, Sweden.

TABLE I

The distribution of missing permanent teeth in boys (N=45) and girls (N=46) with advanced hypodontia. Third molar not included.

	Upper		*Lower*		*Total*
	Boys	*Girls*	*Boys*	*Girls*	
Medial incisor	0	0	12	17	29
Lateral incisor	33	34	5	9	81
Canine	14	10	5	7	36
First premolar	32	38	16	15	101
Second premolar	56	77	70	74	277
First molar	6	9	0	4	19
Second molar	10	10	13	14	47
Total	151	178	.121	140	590

cantly smaller than in nonselected children, the only exception being the upper medial incisor in girls (Table II). In reference to the upper canine and the first molar in girls, the student's t-test could not be applied as the variances were not sufficiently similar. There was no significant difference between boys and girls in the total amount of reduction in tooth size of the lower jaw or when anterior and posterior teeth were compared.

Discussion

Hypodontia has previously been reported to be associated with reduction in crown size and delayed development of the remaining teeth.[3-7] Using sex-specific t-scores in a group of 19 subjects with agenesis of multiple teeth including the third molar, Garn and Lewis[6] found hypodontia to be associated with crown-size reduction in the remaining teeth, and more severely in anterior than in posterior teeth. By comparing tooth size (mesiodistal breadth) in our group of 91 children with advanced hypodontia with tooth size in Seipel's reference group, similar findings were noted. The third molar, however, was not included in our study because the inconsistent development and eruption of that tooth may easily lead to false diagnosis.

The difference between boys and girls in reference to variances for the upper canine and first molar teeth can hardly be explained by differences in patterns of eruption. The first molar will rarely be prevented from erupting. This quite frequently happens to the canine due to crowding and the tooth may be measured as undersized, con-

TABLE II

Mean tooth-size in mm (mesiodistal breadth) in boys (N=45) and girls (N=46) with (present study) and without (Seipel 1946) advanced hypodontia. Differences in mean analysed by student's t-test.

	BOYS			*GIRLS*		
	Present study	*Seiple*	*Diff.*	*Present study*	*Seipel*	*Diff.*
Upper jaw:						
Medial incisor	8.58	8.84	—.26*	8.55	8.62	—.07
Canine	7.79	8.10	—.31*	7.39	7.73	**
First molar	10.36	10.69	—33*	10.11	10.47	**
Lower jaw:						
Medial incisor	5.33	5.51	—.18*	5.20	5.42	—.22*
Canine	6.77	7.12	—.35*	6.47	6.69	—.22*
First molar	10.96	11.24	—.28*	10.56	10.98	—.42*

* $0.001<P<0.01$

** Requirements for "t" test not fulfilled. Cast of one girl incomplete.

TABLE III

The distribution of missing teeth in 85 children with advanced hypodontia of the permanent dentition.

	Upper		Lower		
	Boys	*Girls*	*Boys*	*Girls*	*Total*
Medial incisor	0	0	9	16	25
Lateral incisor	24	34	4	9	71
Canine	15	10	1	4	30
First premolar	30	33	18	15	96
Second premolar	56	65	61	59	241
First molar	2	3	0	0	5
Second molar	8	12	5	11	36
Third molar*	23	29	23	35	110
Total	158	186	121	149	614

*Third molar aplasia recorded in children aged 12 years or more.

tributing to a larger variance. Accordingly, a large variance should have been found for the canine in both sexes but, in fact, this did not occur and no explanation can be offered for this discrepancy.

Tooth Formation

Material and methods

The material partly overlapped the above described. It consisted of 42 boys and 43 girls with advanced hypodontia, referred to the Maxillo-Facial and Cleft Palate Center during the years 1963 through 1972. The diagnosis was confirmed by panoramic radiographs repeated at one or two year intervals. Distribution of missing permanent teeth, including the third molar, in relation to sex and jaw is given in Table III. The total number of missing teeth was 614 with an average of 6.6 in boys and 7.7 in girls. Panoramic radiographs were taken at the age of 6 through 19 years, the mean age at the time of examination being 11 years for boys and 12 for girls. The formation stage of each developing tooth was determined from these radiographs. Five stages of crown formation were recorded: C_i=crown incipient, C_{co}= crown coalescent, $Cr\frac{1}{2}$=crown half completed, $Cr\frac{3}{4}$=crown three fourths completed, Cr_c=crown completed, and three stages of root formation: $R\frac{1}{4}$, $R\frac{1}{2}$, $R\frac{3}{4}$, all according to the norms described by Haavikko.[8] As only transitional stages were regarded as relevant to the age of the child at the time of examination, the final stages of root completion and apical closure were omitted.

Double determinations of formation stages were done by the same investigator on twenty panoramic radiographs after an interval of six weeks. The determinations corresponded well with the norms of Haavikko. In a few cases discrepancies were noted, but these never exceeded one formation stage. The mean age for individual formation stages of each tooth was compared with the norms given by Haavikko in her study of 1162 "normal, healthy" individuals from Helsinki aged 2 to 21 years (Fig. 1).

Results

In 85 children with advanced hypodontia, tooth formation was found to be delayed in relation to the chronological age. Developmental timing differed from that of nonselected children within the range of 2.4 years prematurity to 7.8 years retardation (Table IV), a mean of 1.8 years delay for boys and 2.0 for girls. Tooth development showed considerable variation from one child to another, the delay in each child being of approximately the same

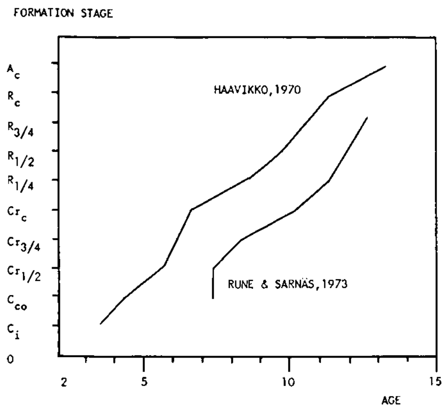

Fig. 1 Development of the upper second premolar in girls with and without advanced hypodontia.

degree for all remaining teeth at all stages of crown and root formation. In both sexes the delay was less marked in the lower jaw. No discernible pattern of developmental timing in tooth formation could be ascertained in relation to sex, age, or number and distribution of missing teeth. However, a tendency to excessive retardation was found in teeth contralateral to those missing. Further, abnormal molar root morphology in the form of taurodontia or a single root with one large pulp chamber was observed in a considerable number of children.

Discussion

In 85 children with advanced hypodontia of permanent teeth, delay of tooth formation was observed. This finding is in accordance with previous studies by Garn et al.,[9] who found delayed formation of premolar and molar teeth in 22 Ohio children with agenesis of the lower left third molar.

In the present study, comparison was made between children with advanced hypodontia and children from a nonselected Scandinavian population. The differences found between these two groups may thus be regarded more as an indication of conditions in Scandinavia than as a definite statement of tooth formation timing.

No sex differences in tooth formation were observed, contrary to the findings of Garn et al.,[10] who in a study of 255 children over a period of 18 years, reported a small difference between boys and girls early in life with a steadily increasing divergence. Nor could a distal-to-mesial gradient for formation delay be ascertained, as described by Garn and Lewis.[6] This may be due to the disparity in age distribution of the two studies. The present material did not permit a complete study of teeth normally formed at an early age.

It has been suggested that reduction in tooth number involves "interaction between a stage-specific developmental suppression and a variable delay in tooth formation."[3] This concept is compatible with the present finding of marked delay in formation of contralaterals to missing teeth.

Abnormal tooth morphology has been considered a part of the pathological entity of tooth size variation and was described in 25 of 33 children with advanced hypodontia studied by Ravn.[11] The abnormal molar root morphology observed in the present material may thus be regarded as part of the deviant pattern from normal tooth formation. The finding of less severe delay in lower jaw tooth formation may be more apparent than real due to the greater difficulty in recognizing tooth contours in the upper jaw on panoramic radiographs.

Summary and Conclusion

Tooth size and tooth development were studied in children with advanced hypodontia of the permanent dentition. Reduced tooth size and delayed tooth development were observed. These findings are of importance for long-

TABLE IV

Mean age, in years, for tooth formation stages in children with advanced hypodontia and delay, in years, as compared to "normal, healthy" children.

	Formation stage	Upper Mean age	Upper Delay	Lower Mean age	Lower Delay
Medial incisor	Cr c	6.4	3.1	—	—
	R ¼	7.1	1.7	6.9	3.3
	R ½	7.3	0.7	6.4	0.6
	R ¾	9.0	1.8	7.3	1.0
Lateral incisor	Cr c	8.5	3.9	—	—
	R ¼	7.2	0.4	7.0	1.9
	R ½	8.4	1.1	7.4	1.2
	R ¾	9.3	1.1	9.1	2.2
Canine	Cr ¾	6.8	3.5	—	—
	Cr c	8.4	3.9	7.1	3.0
	R ¼	9.3	2.6	8.2	1.6
	R ½	10.4	2.3	9.6	2.0
	R ¾	11.0	1.6	10.6	1.5
First premolar	Cr ½	7.5	3.2	6.7	2.8
	Cr ¾	10.7	4.9	7.4	2.3
	Cr c	9.0	2.5	8.4	2.7
	R ¼	10.5	2.3	9.5	1.4
	R ½	10.8	1.4	11.0	1.5
	R ¾	11.7	1.1	12.3	1.9
Second premolar	C co	8.3	3.9	7.9	3.5
	Cr ½	8.2	2.5	7.2	2.1
	Cr ¾	8.6	2.2	9.1	3.0
	Cr c	9.7	2.9	8.6	1.9
	R ¼	11.2	2.6	9.3	0.8
	R ½	11.7	1.9	10.7	1.1
	R ¾	13.2	1.6	11.7	0.8
First molar	Cr c	7.4	3.9	—	—
	R ¼	8.9	3.1	—	—
	R ½	9.0	3.0	6.8	0.8
	R ¾	9.8	2.8	8.4	1.9
Second molar	C co	7.3	3.2	7.1	3.0
	Cr ½	8.7	3.5	8.7	3.5
	Cr ¾	10.0	3.9	9.9	3.5
	Cr c	10.8	3.7	10.3	3.1
	R ¼	11.4	1.6	10.6	1.3
	R ½	12.4	1.4	11.7	0.9
	R ¾	13.7	1.8	12.5	0.8
Third molar	Ci	10.4	1.2	10.3	0.6
	C co	12.7	3.1	10.4	0.2
	Cr ½	13.3	2.8	11.3	—0.3
	Cr ¾	14.0	1.6	12.4	—0.2
	Cr c	14.5	1.5	14.5	0.5
	R ¼	15.7	0.2	14.6	—1.1
	R ½	16.8	1.3	15.9	—0.8
	R ¾	15.8	—1.2	15.8	—2.4

term orthodontic-prosthodontic treatment planning.

Käkcentralen, MAS
214 01 Malmö, Sweden

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