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ON THE ORDER OF ERUPTION OF PERMANENT TEETH IN FINNISH CHILDREN IN THE LIGHT OF CROSS-SECTIONAL MATERIAL

by

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Early studies differ somewhat in their data on the eruption sequence of permanent teeth (18, 11, 2). At a much later date, when more attention had begun to be paid to individual variations in the tooth eruption sequence, *Schultz* presented, in 1950, an eruption formula for modern man — $(I_1M_1)\ I_2\ (P_1CP_2)\ M_2M_3$, in which the order of eruption may vary inside the parentheses.

Cohen's (1928) material consisted of 2,848 schoolchildren from Minneapolis between the ages of five and fifteen. Among the boys the order of eruption in the upper jaw was $M_1I_1I_2P_1P_2CM_2$ and in the lower jaw $M_1I_1I_2CP_1P_2M_2$, the average age of eruption of teeth M_1 and I_1 being the same, 6.4 years. Among the girls the eruption sequence in the upper jaw was the same, except that the average eruption ages of P_2 and C were identical, 10.7 years. In the lower jaw the order was $M_1I_1I_2CP_1P_2M_2$.

Ekman (1938) investigated the eruption of teeth in Finnish 16,991 children. According to his results the general eruption sequence in the left jaw is the same for boys and girls: $M_1I_1I_2P_1P_2CM_2$ in the upper jaw and $M_1I_1I_2CP_1P_2M_2$ in the lower jaw.

Steggarda & Hill (1942) investigated the eruption time of permanent teeth among different races and noted differences between the upper and the lower jaws of girls and boys. The greatest differences involved the canines. According to *Steggarda & Hill,* the eruption sequence in boys is $M_1I_1I_2P_1P_2CM_2$ in the upper jaw and $M_1I_1I_2P_1CP_2M_2$ in the lower jaw. In girls the upper canine erupts before the second upper molar, and the first lower

incisor and first lower molar may variously appear first among the permanent teeth, while the canine erupts before the first molar in the lower jaw. According to a later study, the order of eruption (in the upper and lower jaws among boys and girls) was $M_1I_1I_2P_1P_2CM_2$ [16].

Hurme's (1949) material included more than 93,000 children from various American states and several European countries. The most common eruption sequence reported by him for the upper jaw was $M_1I_1I_2P_1P_2CM_2$ and for the lower jaw $M_1I_1I_2CP_1P_2M_2$.

No difference in the eruption sequence associated with sex can be demonstrated in any of the other studies [10, 13, 14, 15, 21] either, any more than a difference between the left and right sides [19].

The sequence during the second eruption phase of the permanent dentition in a material of 220 Canadian children was most commonly: $P_1P_2CM_2$ (49 %) and $P_1CP_2M_2$ (16 %) in the upper jaw, and $CP_1P_2M_2$ (46 %) and $CP_1M_2P_2$ (19 %) in the lower jaw [13].

Welander's (1957) material consisted of 1,213 Swedish children. The most common eruption sequence was $M_1I_1I_2P_1CP_2M_2$ in the upper jaw and $I_1M_1I_2CP_1P_2M_2$ in the lower jaw.

The results of two published longitudinal studies, one of which included 34 boys and 30 girls [15] and the other 57 boys [20], differ very little from each other: According to the former, the eruption sequence of the upper dentition was usually $M_1I_1I_2P_1CP_2M_2$ and that of the lower $I_1M_1I_2CP_1P_2M_2$. According to the latter study, the eruption sequence of the teeth in the upper jaw was primarily (in the case of 26 %) $M_1I_1I_2P_1CP_2M_2$ and secondarily (23 %) $M_1I_1I_2P_1P_2CM_2$, while in the lower jaw it was correspondingly $I_1M_1I_2P_1CP_2M_2$ (18 %) and $I_1M_1I_2CP_1P_2M_2$ (16 %).

The foregoing studies indicate that the most common eruption sequence in the upper jaw is $M_1I_1I_2P_1$ (CP_2) M_2 and in the lower jaw (M_1I_1) I_2 (CP_1) P_2M_2. Deviating results have been reported by *Noyes, Schour & Noyes* (1948), according to whom both premolars in the lower jaw erupt before the canines. The only investigators to have observed a decisive difference between boys and girls with respect to the order of eruption of their teeth are *Steggarda & Hill* (1942), although the differences in question

are included in the formulas presented in the foregoing which show average times of eruption.

Deviating from the aforementioned sequences of eruption, which have been regarded as generally valid, the chronological mean for the eruption of M_2 may nevertheless be lower than that for the eruption of CP_1 and P_2 ([9, 3, 4]). Similar results were arrived at by *Koski & Garn,* and in 1957 they revised the eruption formula drawn up by *Schultz,* as follows: (I_1M_1) I_2 $(P_1CP_2M_2)$ M_3, which encompasses all the variations in the eruption of teeth observed among modern human beings.

The purpose of the present study is to determine the order of eruption of permanent teeth among Finnish children on the basis of cross-sectional material. The development of the permanent dentition in Finnish children has previously been investigated by *Vuorinen* 1926, *Ant-Vuorinen* 1932, *Ekman* 1938 and *Haataja* 1963.

MATERIAL AND METHOD OF STUDY

The present material is part of a larger body of data, which the Finnish Center for Study in Child Growth and Development collected during the years 1955—57. A total of 1,642 Finnish children, 808 of them boys and 834 girls, was involved. They ranged in age from five to fifteen. The selection of the material has been explained in an earlier report (*Haataja* 1963).

The examinations were performed with a mouth mirror and a probe in a well-lighted room. A tooth was considered erupted if its edge had penetrated the mucous membrane. Wherever a tooth had been extracted on account of caries or trauma, it was counted as erupted.

The order of eruption was checked against the formula used by *Koski & Garn* by taking the teeth erupting in the variable phases of stages I and II separately. The examination of the first eruption phase involves I_1 and M_1 enclosed in parentheses. Both teeth erupt, according to the formula cited, before I_2. The second eruption phase involves P_1, C, P_2 and M_2 — which are apt to erupt in any order — and they erupt before M_3.

The only way checking of the eruption sequence of individual teeth during the development of the dentition can be done in the case of material of the kind we are dealing with, is to con-

sider separately only those cases among the subjects in which some tooth marked inside parentheses is the only one having appeared. In checking the second eruption phase, attention was paid not only to the foregoing but also to the occurrence of various combinations and their frequencies as well as to a comparison of the eruption sequence by pairs. In order to determine the differences between boys and girls, between upper and lower jaws, and between the right and left sides of the jaws, the tests were performed with an χ^2-test and the control of the eruption sequences with a t-test.

RESULTS

Since no statistically significant difference could be detected between eruption sequences in the left and right sides of the jaws, the results are reported only for the left side.

The results relating to the appearance of the teeth belonging to the first eruption phase (I_1M_1), taken separately for the upper and lower jaws in both girls and boys, are presented in Table 1.

Table 1

The occurrence of I_1 and M_1 on the left side of the upper and lower jaws in boys and girls

Jaw	Upper jaw				Lower jaw			
Tooth	Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%
I_1	11	13.7	4	5.3	12	30.0	18	33.2
M_1	69	86.3	72	94.7	28	70.0	36	66.8
$I_1 + M_1$	80	100.0	76	100.0	40	100.0	54	100.0

The results with respect to the appearance of the teeth belonging to the second eruption stage ($P_1CP_2M_2$), taken separately as well as in different combinations in upper and lower jaws among girls and boys, are presented in Table 2 and Figures 1, 2, 3 and 4. Comparison of the eruption sequences of tooth pairs in upper and lower jaws separately among girls and boys is presented in Table 3. The results of the t-tests dealing with the eruption sequences are shown in Tables 4 and 5.

Table 2

The appearance of C, P_1, P_2 and M_2 on the left side of the upper and lower jaws in boys and girls

Tooth or group of teeth	Upper jaw				Lower jaw			
	Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%
P_1	33	18.0	57	22.2	22	12.9	15	5.3
P_2	9	4.9	5	1.9	10	5.6	15	5.3
C	12	6.6	18	7.0	24	14.0	53	18.7
M_2	2	1.1	3	1.2	3	1.8	—	—
P_1P_2	38	20.8	31	12.1	7	4.1	3	1.1
P_1C	23	12.6	44	17.1	33	19.3	58	20.5
P_1M_2	1	0.5	5	1.9	1	0.6	—	—
P_2C	—	—	2	0.8	3	1.8	9	3.2
P_2M_2	1	0.5	—	—	1	0.6	—	—
C M_2	—	—	1	0.4	2	1.2	8	2.8
P_1P_2C	53	29.0	65	25.3	55	32.2	96	33.9
P_1C M_2	3	1.6	16	6.2	9	5.3	25	8.8
$P_1P_2M_2$	8	4.4	8	3.1	1	0.6	—	—
P_2C M_2	—	—	2	0.8	—	—	1	0.4
Total	183	100.0	257	100.0	171	100.0	283	100.0

Table 3

Comparison by pairs of the eruption sequence of C, P_1, P_2 and M_2

Pair of teeth	Upper jaw				Lower jaw			
	Boys		Girls		Boys		Girls	
	No.	%	No.	%	No.	%	No.	%
C P_1	192	9.9	236	17.8	131	49.6	188	75.5
P_1C		90.1		82.2		50.4		24.5
C P_2	184	34.2	242	62.0	194	76.8	329	87.8
P_2C		65.8		38.0		23.2		12.2
C M_2	160	88.9	295	90.5	243	97.1	430	99.8
M_2C		11.1		9.5		2.9		0.2
P_1P_2	138	84.8	252	97.1	171	80.7	251	80.5
P_2P_1		15.2		8.3		19.3		19.5
P_1M_2	302	98.7	415	91.7	254	95.3	362	95.9
M_2P_1		1.3		2.9		4.7		4.1
P_2M_2	218	95.4	267	83.9	195	82.1	283	81.6
M_2P_2		4.6		16.1		17.9		18.4

EVALUATION OF RESULTS

Table 1 reveals that both among girls and boys there are a greater number of individuals whose M_1 erupts first and fewer whose sole permanent tooth is I_1. This phenomenon is more clearly observable in the upper than in the lower jaw, in which I_1 occurs as the only erupted tooth relatively more frequently than in the upper jaw.

If the eruption sequence is observed among the teeth enclosed within the second pair of parentheses by taking into account only the percentile frequency of their occurrence singly, then we will obtain among the boys for the upper jaw P_1 (CP_2) M_2 and for the lower jaw $CP_1P_2M_2$, and correspondingly among the girls $P_1CP_2M_2$ and C (P_1P_2) M_2 (Table 2) — with no significant difference appearing in the eruption sequence of the teeth enclosed in parentheses.

If the investigation is carried out so as to take into account in addition the appearance of the teeth in question in all the observed different combinations, the general eruption sequence obtained among the boys will be $P_1P_2CM_2$ in the upper jaw and (P_1C) P_2M_2 in the lower jaw and among the girls correspondingly $P_1CP_2M_2$ and $CP_1P_2M_2$ (Figures 1, 2, 3, 4 and Tables 3, 4, 5).

In testing, using the χ^2-test, the eruption sequence of different pairs of teeth among boys and girls, it was observed that in the upper jaw of boys P_2 erupts before C ($\chi^2 = 12.15$; $P < 0.001$) and in the lower jaw of girls C erupts before P_1 ($\chi^2 = 16.05$; $P < 0.001$), which statistically amounts to a highly significant difference.

With respect to the order of eruption of the teeth in the upper and lower jaws, a highly significant statistical difference was noted among the boys between the pairs of teeth P_1 C ($\chi^2 = 22.96$; $P < 0.001$), P_2C ($\chi^2 = 26.51$; $P < 0.001$), and P_2M_2 ($\chi^2 = 11.01$; $P < 0.001$). Among the girls a highly significant statistical difference was correspondingly observed in the eruption sequences of P_1C ($\chi^2 = 78.78$; $P < 0.001$) and P_2C ($\chi^2 = 24.98$; $P < 0.001$). Statistically significant is also the difference between P_1P_2 ($\chi^2 = 9.9$; $P < 0.01$) and CM_2 ($\chi^2 = 7.756$; $P < 0.01$) with respect to the order of their eruption.

Figures 1, 2, 3, and 4 and Table 2 show that the most common

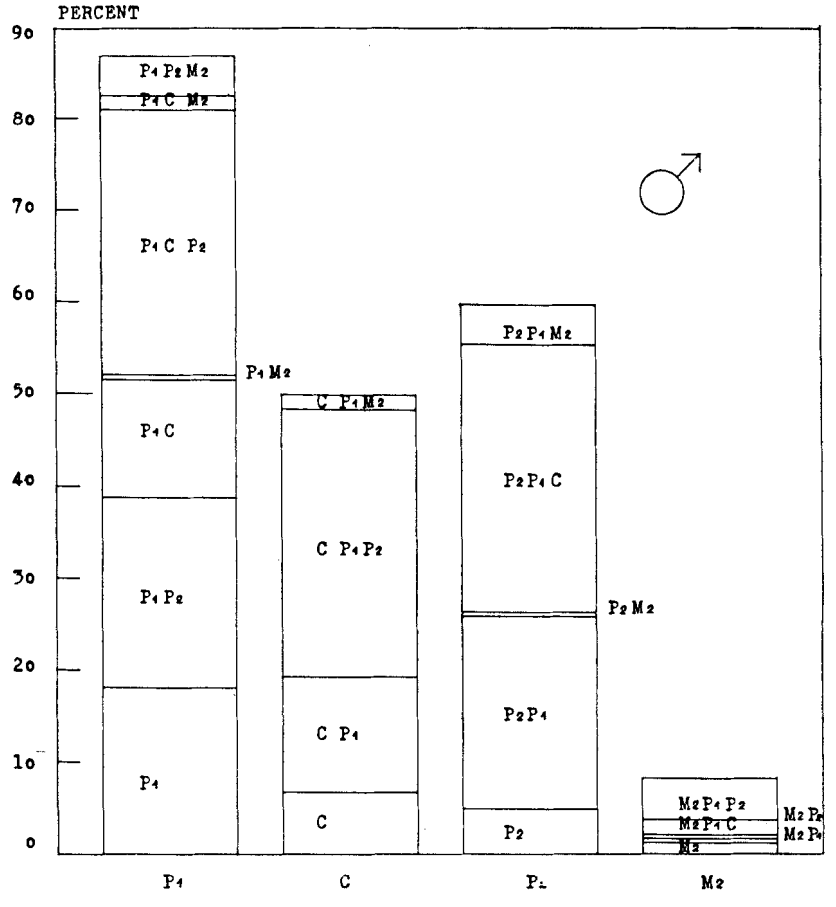

Fig. 1. Relative frequency of various combinations of the maxillary permanent teeth P_1 P_2C and M_2 present on the left side in 183 boys.

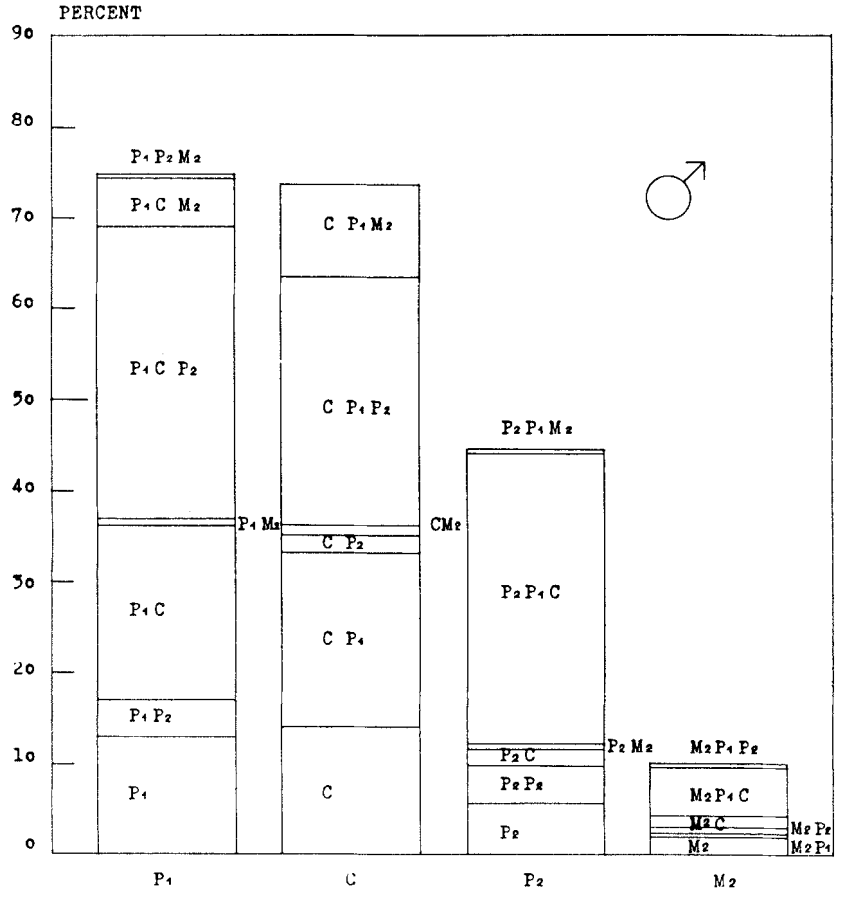

Fig. 2. Relative frequency of various combinations of the mandibular permanent teeth P_1 P_2C and M_2 present on the left side in 171 boys.

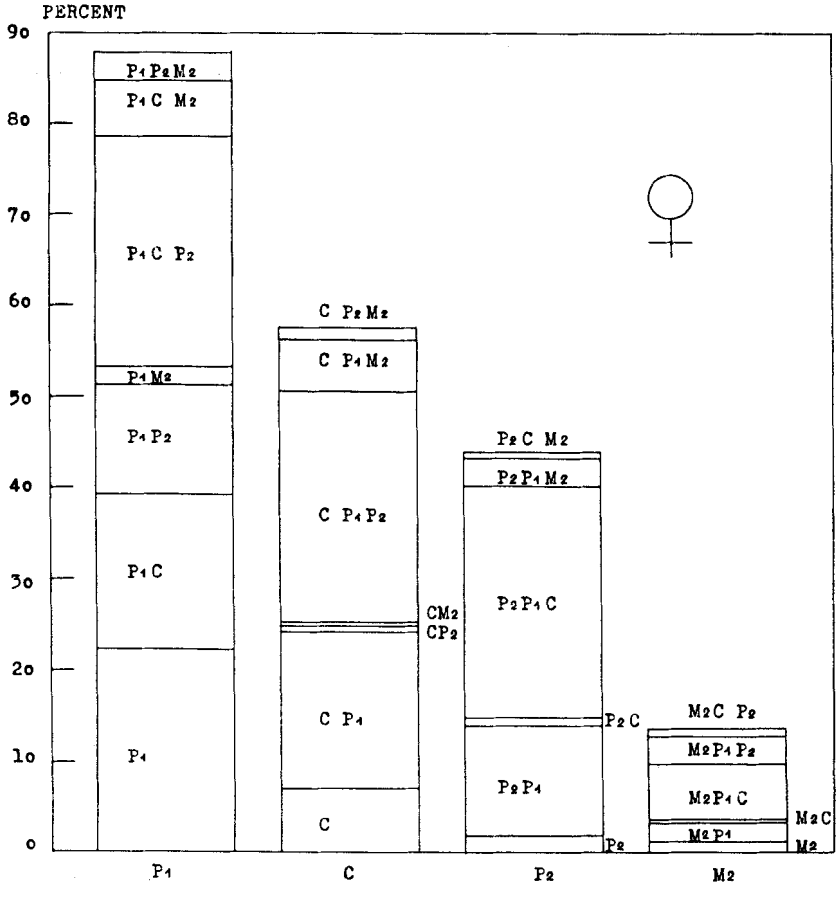

Fig. 3. Relative frequency of various combinations of the maxillary permanent teeth P_1 P_2C and M_2 present on the left side in 257 girls.

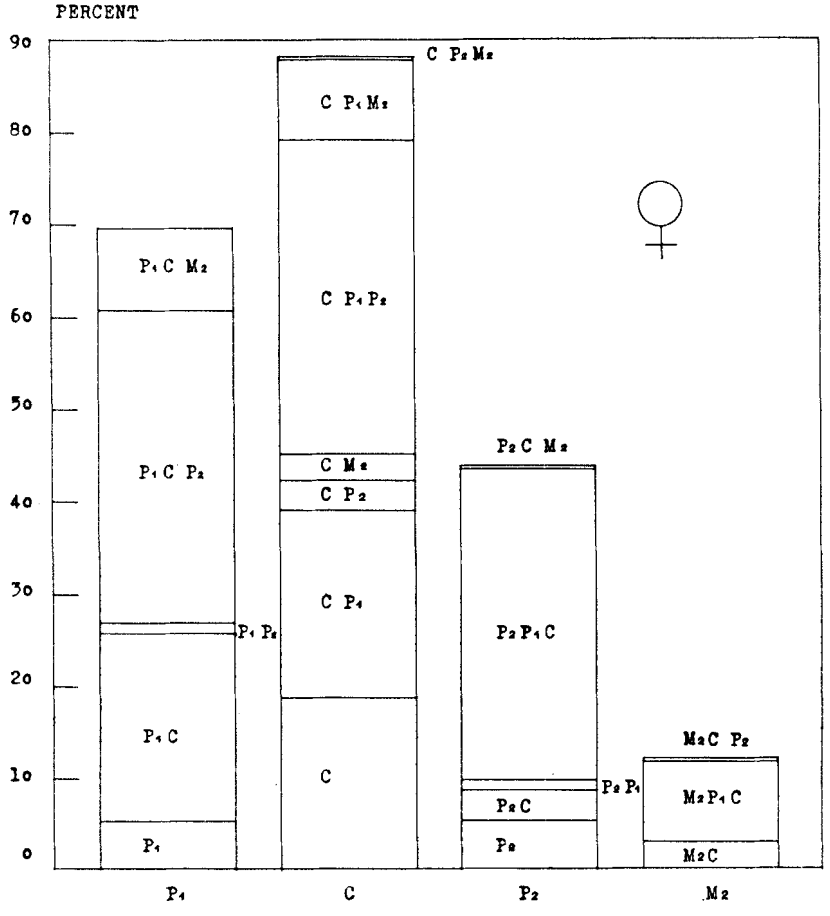

Fig. 4. Relative frequency of various combinations of the mandibular permanent teeth P_1 P_2C and M_2 present on the left side in 283 girls.

Table 4

t-tests of eruption sequence of teeth in boys

Left lower jaw

Number of boys: 171, from which number the percentages have been computed. Order of eruption: (P_1C) P_2M_2

Test results:

Pairs of teeth	%	t	P
P_1 before C	18.13	0.28	..
C „ P_1	16.95	.	.
P_1 before P_2	38.01	6.97	0.001
P_2 „ P_1	8.19	.	.
C before P_2	39.77	6.41	0.001
P_2 „ C	11.11	.	.
P_2 before M_2	43.86	8.01	0.001
M_2 „ P_2	8.77	.	.

Left lower jaw

Number of boys: 183. Order of eruption: P_1P_2C M_2

Test results:

P_1 before P_2	32.79	8.46	0.001
P_2 „ P_1	5.46	.	.
P_2 before C	30.60	2.13	0.05
C „ P_2	20.77	.	.
C before M_2	48.35	10.11	0.001
M_2 „ C	6.56	.	.

Table 5

t-tests of eruption sequence of teeth in girls

Left lower jaw

Number of girls: 283, from which number the percentages were computed. Order of eruption: C $P_1P_2M_2$

Test results:

Pairs of teeth	%	t	P
C before P_1	25.09	9.32	0.001
P_1 „ C	0.63	.	.
P_1 before P_2	34.63	7.82	0.001
P_2 „ P_1	8.83	.	.
P_2 before M_2	43.46	14.00	0.001
M_2 „ P_2	1.17	.	.

Left lower jaw

Number of girls: 257. Order of eruption: P_1C P_2M_2

Test results:

P_1 before C	39.30	8.58	0.001
C „ P_1	8.95	.	.
C before P_2	30.74	3.66	0.001
P_2 „ C	17.12	.	.
P_2 before M_2	40.08	8.48	0.001
M_2 „ P_2	9.73	.	.

combination of erupted teeth in the present material is the simultaneous appearance of CP_1P_2 in the oral cavity. Among the boys, not a single CP_2M_2 combination was observed in the upper and lower jaws. Nor was there a combination of CP_2 and CM_2 in the upper jaw. Among the girls, again, no observations were made of P_2M_2 having erupted singly at the same time or, in the lower jaw, of either the P_1M_1 or $P_1P_2M_2$ combination.

An examination of the eruption sequence by pairs of teeth presented in Table 3 reveals that in the present material, too, there are those for whom the chronological mean value representing the eruption of M_2 is lower than in the case of the teeth C_1P_1 and P_2. The cases in which M_2 had erupted before C are more common among both girls and boys in the upper than in the lower jaw, whereas those cases in which M_2 erupted earlier than P_1 or P_2 appear to be slightly more common in the lower than in the upper jaw among both the girls and the boys.

Dahlberg & Epling (cited by *Koski & Garn* 1957) report higher percentages for M_2P_2, M_2P, and M_2C in the lower jaw of Pima Indian children than the ones in the present study, their figures being 47.5, 6.3 and 6.7 % respectively. The corresponding values given by *Koski & Garn* represent only part of the total material included in the research project of the Finnish Center for Study in Child Growth and Development, and the difference is due to this circumstance. Neither study has brought to light any difference in eruption sequence between the upper and lower jaws of boys and girls.

SUMMARY

The observation of the eruption sequence of teeth in Finnish children was carried out and checked against the formula devised by *Koski and Garn*. The number of subjects was 1,642, of whom 808 were boys and 834 girls. The material was collected in connection with a research project sponsored by the Finnish Center for Study in Child Growth and Development.

Among the teeth included in the first eruption phase, it proved to be most common in both boys and girls for the M_1 to be the first permanent tooth to erupt. This is more clearly to be observed in the upper than in the lower jaw, where the I_1 appears

as the sole erupted tooth relatively more often than in the upper jaw.

The order of eruption of the teeth in the second eruption phase among boys is $P_1P_2CM_2$ in the upper jaw and $(P_1C)\ P_2M_2$ in the lower jaw, and among girls correspondingly $P_1CP_2M_2$ and $CP_1P_2M_2$. A statistically highly significant difference between boys and girls is noted in the eruption sequence of P_2 and C in the upper jaw and of C and P_1 in the lower jaw. Among boys, highly significant statistical differences are observed in the eruption sequence of the pairs P_1C, P_2C, and P_2M_2, while among girls the differences involve the eruption sequence of P_1C and P_2C.

There are cases in the material where the chronological mean for the eruption of M_2 is lower than for C, P_1, and P_2. In the present material, however, the eruption sequences of M_2C, M_2P_1 and M_2P_2 are relatively less frequent than in the case of English children.

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RÉSUMÉ

ORDRE DE L'ÉRUPTION DES DENTS PERMANENTES CHEZ LES ENFANTS FINLANDAIS, A LA LUMIÈRE D'UNE ÉTUDE TRANSVERSALE

L'observation de l'ordre de l'éruption des dents chez les enfants finlandais a été effectuée et comparée à la formule établie par *Koski et Garn.* Le nombre de sujets était de 1642, dont 808 garçons et 834 filles. Le matériel a été réuni à l'occasion d'un projet de recherche réalisé avec l'appui du Centre Finlandais d'Études sur la Croissance et le Développement des Enfants.

Parmi les dents comprises dans la première phase de l'éruption, M_1 s'est révélée, chez les garçons et chez les filles, être le plus souvent la première dent permanente faisant son éruption. Ce fait est plus clairement observé au maxillaire supérieur qu'au maxillaire inférieur, où I_1 se présente relativement plus souvent

qu'au maxillaire supérieur comme la seule dent ayant fait son éruption.

L'ordre de l'éruption des dents dans la seconde phase de l'éruption chez les garçons est $P_1P_2CM_2$ au maxillaire supérieur et (P_1C) P_2M_2 au maxillaire inférieur, et chez les filles de manière correspondante $P_1CP_2M_2$ et $CP_1P_2M_2$. Une différence hautement significative du point de vue statistique entre les garçons et les filles apparait dans l'ordre de l'éruption de P_2 et C au maxillaire supérieur et de C et P_1 au maxillaire inférieur. Chez les garçons, des différences hautement significatives du point de vue statistique son observées dans l'ordre de l'éruption des groupes P_1C, P_2C et P_2M_2, tandis que, chez les filles, les différences intéressent l'ordre de l'éruption de P_1C et P_2C.

Il y a des cas dans ce matériel où la moyenne chronologique pour l'éruption de M_2 est plus basse que la moyenne pour C, P_1 et P_2. Cependant, dans le présent matériel, les ordres d'éruption M_2C, M_2P_1 et M_2P_2 sont relativement moins fréquents que dans le cas des enfants anglais.

ZUSAMMENFASSUNG

ÜBER DIE DURCHBRUCHSREIHENFOLGE DER PERMANENTEN ZÄHNE BEI FINNISCHEN KINDERN IM SPIEGEL EINES DURCHSCHNITTS-MATERIALES

Die Durchbruchsreihenfolge der Zähne wurde nach dem Schema von Koski und Garn an 1642 finnischsprachigen Kindern (808 Jungen und 834 Mädchen) beobachtet. Das Material gehört zum TLT-Material.

Bei den Zähnen der ersten Zahnwechselphase findet man bei Mädchen und Jungen häufiger, dass M_1 als erster bleibender Zahn durchbricht. Dies tritt im Oberkiefer deutlicher in Erscheinung als im Unterkiefer, wo I_1 als einziger durchgebrochener Zahn relativ häufiger ist als im Oberkiefer.

Die Durchbruchsreihenfolge der Zähne in der zweiten Zahnwechselphase ist bei den Jungen im Oberkiefer $P_1P_2CM_2$ und im Unterkiefer (P_1C) P_2M_2 und bei den Mädchen entsprechend $P_1CP_2M_2$ und $CP_1P_2M_2$. Zwischen Mädchen und Jungen wurde statistisch ein sehr relevanter Unterschied festgestellt in der Durchbruchsreihenfolge zwischen den Zähnen P_2 und C im Ober-

kiefer und C und P_1 im Unterkiefer. Bei den Jungen wurde statistisch zwischen den Zähnen von Ober- und Unterkiefer ein äusserst relevanter Unterschied in der Durchbruchsreihenfolge der Zahnpaare P_1C, P_2C und P_2M_2 festgestellt, bei den Mädchen liegt der Unterschied deutlicher in der Durchbruchsreihenfolge von P_1C und P_2C.

Das Material weist Fälle auf, bei denen der zeitliche Mittelwert des Durchbruchs von M_2 niedriger liegt als der von C, P_1 und P_2. Bei diesem Material sind jedoch die Durchbruchsreihenfolgen M_2C, M_2P_1 und M_2P_2 relativ seltener als z.B. bei englischen Kindern.

REFERENCES

1. *Ant-Wuorinen, T. A.:* Lisätietoja suomalaisten hampaiston vaihtumisesta, Helsinki 1932.
2. *Bean, R. B.:* Stature and eruption of permanent teeth in American, German and Philippine children. Amer. J. Anat. *27:* 113, 1914.
3. *Bergston,* 1935; Cited by *Nanda* 1960.
4. *Clements, E. M. B., E. Davies-Thomas & K. G. Pickett:* Order of eruption of the permanent human dentition. Brit. med. J. *27:* 1425, 1953.
5. *Cohen, F. T.:* The dates of eruption of the permanent teeth in a group of Minneapolis children. J. Amer. dent. Ass. *15:* 2337, 1928.
6. *Dahlberg & Epling:* Cited by *Koski & Garn* 1957.
7. *Ekman, T. H. J.:* Untersuchungen über den Zahnwechsel bei Kindern in Finnland, Helsinki, 1938.
8. *Haataja, J.:* Cephalic, facial and dental growth in Finnish children. Suom. Hammaslääk. Toim. *59* suppl. 1, 1963.
9. *Hrdlicka, A.:* Physiological and medical observations among the Indians of Southwestern United States and Northern Mexico. Smithsonian Institution, Washington (Bur. Am. Ethnol., Bull. no. *34,* 1908).
10. *Hurme, V. O.:* Ranges of normalcy in the eruption of permanent teeth. J. Dent. Child. *16:* 11, 1949.
11. *James, W. W. & A. T. Pitts:* Some notes on the dates of eruption in 4 850 children, aged under 12. Proc. roy. Soc. Med. *5:* 80, 1912.
12. *Koski, K. & S. M. Garn:* Tooth eruption sequence in fossil and modern man. Amer. J. Phys. Anthrop. *15:* 469, 1957.
13. *Lo, R. T. & R. E. Moyers:* Studies in the etiology and prevention of malocclusion. I. The sequence of eruption of the permanent dentition. Amer. J. Orthodont. *39:* 460, 1953.
14. *Massler, M. & I. Schour:* The development of human dentition. J. Amer. dent. Ass. *28:* 1153, 1941.
15. *Nanda, R. S.:* Eruption of human teeth. Amer. J. Orthodont. *46:* 363, 1960.

16. *Noyes, F. B., L. Schour & H. J. Noyes:* Oral Histology and Embryology, Philadelphia 1948.
17. *Schultz, A. H.:* The physical distinctions of man. Proc. Am. Phil. Soc. *94:* 428, 1950.
18. *Sewill, H.:* Growth of the jaws and first and second dentition. Dental Items of Interest *13:* 265, 1891.
19. *Steggarda, M. & T. J. Hill:* Eruption time of teeth among Whites, Negroes and Indians. Amer. J. Orthodont. and Oral Surg. *28:* 361, 1942.
20. *Sturdivant, J. E., V. B. Knott & H. V. Meredith:* Interrelations from serial data for eruption of the permanent dentition. Angle Orthodont. *32:* 1, 1962.
21. *Welander, E.:* Några frågor rörande metodik och problematik vid kariesskliniska undersökningar avseende permanenta tänder hos barn. Svensk tandläk.-T. *50:* 501, 1957.
22. *Wuorinen, T. A.:* Beitrag zur Kenntnis des Zahnwechsels bei den Finnen. Helsinki 1926.