Statistics On Eruption Of The Permanent Dentition From Serial Data For North American White Children

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A 1962 paper in *Angle Orthodontist*[2] analyzed "data for age of gingival emergence on each of twenty-eight permanent teeth in fifty-seven North American white boys." The present paper reports an analysis of corresponding data on fifty North American white girls. For convenience, the tables in this paper all juxtapose comparable statistics on girls and boys.

Detailed discussions of aims, subjects, and procedures are given in the 1962 paper; it will suffice here to include succinct statements on these matters. The aims pertain to relations among variables denoting age and order of gingival emergence for permanent teeth other than the third molars.

The subjects were enrolled in a longitudinal research program within the period between 1946 and 1960. They were American-born, predominantly of northwest European ancestry, above average in socioeconomic status, residents of Iowa City, and unselected by use of odontic criteria.

Utilizing hydrocal dental casts secured semiannually on each subject, two investigators made independent estimates of "age at which the alveolar mucosa is pierced and exposure of the crown of a tooth approximates one millimeter in diameter." These estimates were made to the nearest month, supplemented where necessary by reference to intraoral roentgenograms, and pooled to yield data of reasonable validity (see earlier paper by Sturdivant, Knott and Meredith[2]).

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Relations Among Means and Standard Deviations for Age of Tooth Eruption

Assembled in Table I are the obtained statistics for central tendency and variability in age of gingival emergence of each permanent tooth studied. From both sexes it is found:

1. Means for homologous teeth on the left and right sides of a given dental arch are practically alike.

2. Means for corresponding permanent incisor and canine teeth in the two dental arches are systematically lower for the mandibular arch. For premolar and first molar teeth in the two arches, comparable teeth are similar in mean age at gingival eruption.

3. Variability, expressed in terms of standard deviation, is higher for the canine and premolar teeth than for the incisors and first molar teeth. For the maxillary dental arch, the obtained standard deviations for first molar teeth are approximately one half those for canine teeth.

Examination of Table I in regard to sex differences shows:

1. The obtained means representing age of gingival emergence of permanent teeth differ most for the mandibular canine teeth (female mean earlier, on average, by 0.7 years). There are smaller sex differences in means for

Table I

Means and Standard Deviation for Age (in years) of Gingival Emergence of 28 Permanent Teeth in White Boys and Girls

Tooth	Maxillary Arch						Mandibular Arch					
	Means for Girls		Means for Boys		Standard Deviations		Means for Girls		Means for Boys		Standard Deviations*	
	Right	Left	Right	Left	Girls	Boys	Right	Left	Right	Left	Girls	Boys
Central incisor	6.9	6.9	7.0	7.0	0.81	0.54	6.0	6.0	6.0	6.0	0.60	0.65
Lateral incisor	7.9	7.9	8.0	8.1	0.74	0.77	7.1	7.1	7.2	7.2	0.76	0.66
Canine	10.8	11.0	11.2	11.2**	1.35	1.00	9.8	9.8	10.5	10.5	1.10	0.92
First premolar	10.3	10.3	10.5	10.5**	1.23	0.97	10.1	10.1	10.6	10.6	1.04	0.87
Second premolar	11.1	11.2	11.4	11.4	1.21	0.99	11.0	10.8	11.3	11.4	1.18	0.93
First molar	6.2	6.2	6.1	6.2	0.61	0.51	6.0	6.0	6.1	6.1	0.63	0.46
Second molar	11.9	11.9	11.9	11.9	0.93	0.74	11.2	11.2	11.6**	11.5**	0.96	0.87

Girls, N = 50; Boys, N = 57.
* Composite S.D.'s for each sex calculated from S.D.'s for homologous teeth on the right and left sides of the arch.
** N = 56.

premolar teeth and negligible differences between sex means for central incisor or first molar teeth.

2. Females are slightly more variable than males in age of eruption of permanent canine, premolar and molar teeth.

Eruption Associations of Homologous Teeth on the Two Sides of Each Arch

Table II gives, for each sex separately, correlation statistics (r's), computed from series of gingival eruption ages for seven pairs of permanent teeth on the left and right sides of (a) the maxillary arch and (b) the mandibular arch. Findings are:

1. Seventeen of the obtained coefficients lie between $r = .96$ and $r = .90$. The other eleven coefficients fall between $r = .89$ and $r = .77$.

2. On each sex, associations are significantly higher for (a) maxillary right and left central incisors than maxillary right and left first premolars, and (b) mandibular left and right central incisors and first molars than mandibular left and right second premolars.

Collectively, the statistics displayed in Table II support the generalization that a moderately high positive relationship exists between ages of gingival eruption of corresponding teeth on the two sides of a given dental arch.

An alternative approach to associations on the right and left sides of each dental arch consists in analyzing differences secured by subtracting the gingival emergence age of a tooth on one side of a given arch from the gingival emergence age of its homologue on the opposite side of the same arch. Table III lists (a) intervals of time by which homologous teeth on the left and right differ in age of gingival emergence and (b) relative frequencies with which various time differences occur. It can be seen that for each sex:

1. The most clustered or compact

Table II

Correlation Coefficients (r's) Expressing the Relation Between Gingival Eruption Ages of Corresponding Permanent Teeth on the Right and Left Sides of the Dental Arches

	Tooth pair:						
Sex	1-1	2-2	3-3	4-4	5-5	6-6	7-7
			Maxillary Arch				
Girls	.94	.88	.90	.86	.91	.92	.92
Boys	.94	.89	.91*	.77*	.79	.88	.84
			Mandibular Arch				
Girls	.96	.93	.89	.86	.83	.92	.90
Boys	.92	.91	.92	.91	.80	.95	.91*

Girls, N = 50; Boys, N = 57.
* N = 56.

distributions are those for the permanent first molar teeth. For neither dental arch does a difference between ages of right and left eruption of corresponding teeth exceed nine months.

2. The most dispersed or scattered distributions are for the permanent premolar teeth. Left and right eruption ages of corresponding teeth differ by intervals varying between one and three years for 6 per cent to 12 per cent of premolar maxillary teeth, and for 2 per cent to 8 per cent of premolar mandibular teeth.

Prior to constructing the above table, differences were distributed taking account of sign. On finding these distributions were approximately symmetrical, Table III was compiled disregarding sign.

Eruption Associations of Complementary Teeth on the Right Side of the Two Arches

The sex specific correlation coefficients presented in Table IV were computed using paired series of gingival eruption ages for seven comparable permanent teeth in the right maxillary and mandibular dental arches. Inspection of Table IV reveals:

1. Six of the fourteen coefficients fall between $r = .85$ and $r = .76$. The eight remaining lie between $r = .75$ and $r = .66$.

2. Taking both sexes together, relationships are highest (above $r = .80$) for the canine teeth, and lowest (below $r = .70$) for the first premolar teeth.

Joint examination of Tables II and IV yields the following generalization in regard to age of gingival emergence of permanent teeth other than the third molars: Positive associations between homologous teeth on the two sides of a given dental arch are systematically higher than those between tooth antagonists on one side of the two dental arches.

As in the previous section, tooth interrelations were studied by the alternative method of tabulating differences. Since some permanent teeth erupt earlier in the mandibular arch than in the maxillary arch (see Table I), differences for the two arches were derived and tabled with specification of their direction. Explicitly, age of gingival emergence for a particular tooth in the mandibular arch was subtracted from age of gingival emergence for its complementary tooth in the maxillary arch.

Table V displays the relative frequencies with which various differences occur in the sample for each sex. Selected findings are:

1. Gingival eruption of the right mandibular tooth antedates that of the

Table III

Percentage Frequency With Which Comparable Teeth on the Two Sides of the Dental Arches Differ in Time of Gingival Emergence

Differences Categories (months)	Incisor Teeth Central		Incisor Teeth Lateral		Canine Teeth		Premolar Teeth First		Premolar Teeth Second		Molar Teeth First		Molar Teeth Second	
	G*	B*	G	B	G	B	G	B	G	B	G	B	G	B
Maxillary Arch														
Less than 1**	36	44	28	32	20	36	32	25	12	30	52	33	24	26
1 - 3	36	35	24	26	20	18	18	27	26	19	16	33	32	25
3 - 6	20	19	38	30	38	27	24	22	32	21	28	27	26	32
6 - 9	4	2	2	7	14	11	4	13	16	19	4	7	10	11
9 - 12	4		6	5	4	3	10	5	4	5			6	3
12 - 18			2			5	4	2	8	2			2	3
18 - 24					2		6	3	2	2				
More than 24					2		2	3		2				
Mandibular Arch														
Less than 1	58	44	30	35	26	30	14	33	24	26	44	63	32	29
1 - 3	28	37	32	32	20	28	26	26	16	18	30	26	24	34
3 - 6	14	15	32	24	30	31	36	25	24	39	20	11	24	23
6 - 9		2	4	7	18	9	10	12	22	9	6		12	9
9 - 12		2	2	2			6	2	8	3			4	5
12 - 18					4	2	6	2	2				4	
18 - 24										3				
More than 24					2		2		4	2				

* The letters G and B represent girls and boys, respectively.

** Difference = eruption age for a specified tooth on one side of a designated arch minus eruption age of the corresponding tooth on the other side of the arch. Differences tabulated without regard to sign.

Table IV

Correlation Coefficients (r's) Expressing the Relation Between Gingival Eruption Ages of Complementary Teeth on the Right Side of the Dental Arches

Tooth Type	Girls*	Boys*
Central incisors	.85	.73
Lateral incisors	.73	.67
Canines	.83	.82
First premolars	.69	.67
Second premolars	.66	.79
First molars	.68	.78
Second molars	.81	.67**

* Girls, N = 50; boys, N = 57.
** N = 56.

right maxillary tooth by six months or more for 88 per cent of central incisors and canines (girls), 85 per cent of central incisors (boys), 76 per cent of lateral incisors (boys), 70 per cent of lateral incisors (girls), and 63 per cent of canines (boys). In none of these distributions does gingival emergence of a maxillary tooth precede that of its antagonist by more than six months.

2. Approximately 90 per cent of the right first molars erupt in each arch within periods not exceeding one year. This finding holds on both sexes. On boys, similar percentage frequencies are obtained for corresponding right premolars and second molars.

3. Ranges of variation for the right premolars on girls extend from earlier emergence of maxillary teeth by more than two years to earlier emergence of mandibular teeth by more than two years.

Eruption Relations Among Seven Teeth on the Right Side of Each Arch

The upper portion of Table VI presents correlation coefficients for all possible pairings of seven permanent teeth on the right side of the maxillary arch. In the lower portion of this table comparable statistics are presented for relationships among gingival eruption ages of seven permanent teeth on the right side of the mandibular arch. Table VI shows:

1. For teeth of the maxillary arch, the obtained coefficients vary from $r = .45$ to $r = .83$ on girls, and from $r = .40$ to $r = .77$ on boys. Teeth of the mandibular arch yield r's dispersed from .53 to .91 on girls and from .34 to .83 on boys. In every pairing, the hypothesis that the obtained correlation could have occurred by chance (assuming no association for the population) may be rejected at the one per cent level of confidence.

2. For each sex, coefficients above $r = .70$ are found (a) in the maxillary arch on relating eruption ages of central incisor with lateral incisor, central incisor with canine, and first premolar with second premolar, also (b) in the mandibular arch on relating eruption ages of central incisor with lateral incisor, central incisor with canine, lateral incisor with canine, canine with first premolar, and first premolar with second premolar. For girls only, seven other r's are above .70; four pertaining to associations of first premolar with incisor or canine teeth, and three pertaining to associations of second molar with first molar or second premolar teeth.

3. In the maxillary arch there are significantly higher correlations for first premolar with second premolar than for first premolar with first molar. In the mandibular arch, significantly lower associations are found for (a) central incisor with first molar than with lateral incisor, (b) lateral incisor with first molar than with canine, and (c) canine with first molar than with first premolar. In short, relationships tend to be higher for adjacent teeth than for those separated by two or more other teeth.

Exhibited in Table VII are tooth relations on the right side of each dental arch with respect to eruption order.

Table V

Percentage Frequencies With Which Corresponding Teeth of the Right Maxillary and Mandibular Arches Differ in Time of Gingival Eruption

Difference Categories	Incisor Teeth				Canine Teeth		Premolar Teeth				Molar Teeth			
	Central		Lateral				First		Second		First		Second	
(months)	G*	B*	G	B	G	B	G	B	G	B	G	B	G	B
+36 to +42**				2	4									
+30 to +36						2	2						2	
+24 to +30			4		6		2		2		2			
+18 to +24	4	7	4	4	14	10	2		6					4
+12 to +18	44	32	26	23	24	19	12	3	6	3	2	2	16	5
+ 6 to +12	40	46	36	47	40	32	22	21	24	23	16	7	44	34
0 to + 6	10	12	22	17	6	30	26	30	24	30	52	45	26	28
0 to — 6***	2	3	8	7	6	7	14	32	16	30	22	41	10	16
— 6 to —12							6	9	16	7	4	5	2	11
—12 to —18							12	3	2	5	2			2
—18 to —24								2		2				
—24 to —30							2		2					
—30 to —36														
—36 to —42														
—42 to —48									2					
Mean****	0.9	1.0	0.8	0.8	1.1	0.7	0.2	-0.1	0.2	0.1	0.2	0.0	0.6	0.3

* The letters G and B symbolize girls (N = 50) and boys (N = 56), respectively.

** Maxillary tooth erupts between 3.0 years and 3.5 years later than its mandibular antagonist.

*** Gingival eruption of maxillary tooth precedes that of comparable mandibular tooth.

**** Mandibular central incisor erupts earlier than maxillary central incisor by 0.9 years for girls and 1.0 years for boys, mandibular lateral incisor erupts earlier than maxillary lateral incisor by 0.8 years for both sexes, and so forth.

Table VI

Correlation Coefficients (r's) Expressing the Relation Between Gingival Emergence Ages for All Possible Pairings of Seven Permanent Teeth on the Right Side of Each Dental Arch

Tooth	2		3		4		5		6		7	
	G*	B*	G	B	G	B	G	B	G	B	G	B
					Maxillary Arch							
1	.78	.74	.78	.72	.72	.46	.59	.56	.57	.55	.55	.44
2			.69	.62	.55	.44	.55	.49	.45	.46	.54	.40
3					.75	.65	.66	.67	.51	.47	.61	.52
4							.83	.77	.59	.45	.62	.58
5									.63	.52	.69	.64
6											.81	.70
					Mandibular Arch							
1	.91	.82	.87	.75	.81	.62	.61	.53	.56	.34	.63	.38
2			.87	.83	.74	.68	.58	.65	.55	.48	.61	.40
3					.86	.82	.66	.73	.53	.54	.66	.48
4							.72	.80	.67	.43	.70	.43
5									.60	.43	.75	.44
6											.80	.68

* The letters G and B symbolize girls (N = 50) and boys (N = 56), respectively.

Examples of findings that can be drawn for this table are the following:

1. Formation of the permanent dental arches commences with the gingival emergence of the first molar or central incisor teeth. For the right maxillary arch of girls, the first molar antedates the central incisor in 88 per cent, succeeds the central incisor in 10 per cent, and emerges at the same time as the central incisor in 2 per cent. Corresponding findings on boys are 98 per cent first molar preceding, and 2 per cent first molar following. For the right mandibular arch of girls, the central incisor antedates the first molar in 46 per cent and succeeds it in 54 per cent. Comparable findings on boys are central incisor preceding 64 per cent, following 34 per cent, and erupting at the same time 2 per cent.

2. Most commonly the fourth tooth to erupt is (a) the first premolar in the maxillary arch and (b) the canine in the mandibular arch. For the right maxillary arch of girls, eruption number four frequencies are first premolar 68 per cent, canine 18 per cent, second premolar 8 per cent, second molar 2 per cent, with first and second premolar simultaneously 2 per cent, also canine and second premolar simultaneously 2 per cent. Corresponding percentage frequencies on boys are 73, 12, 9, 2, plus first premolar tied 2 per cent each with canine and second premolar. For the right mandibular arch of girls, order four eruption frequencies are 76 per cent canine, 18 per cent first premolar, 2 per cent second molar, 2 per cent second premolar, and 2 per cent canine and first premolar together. Comparable values on boys are 50, 41, 5, 2, and 2 for joint eruption of second premolar and second molar.

3. The sixth tooth to pierce the right alveolar mucosa is almost always the canine, second premolar, or second molar. Probabilities for sixth order maxillary emergence in each sex, approximate one-third canine, one-fifth second molar, and two-fifths second premolar.

Table VII

Percentage Frequency With Which Different Permanent Teeth Have a Designated Eruption Order in the Right Quadrant of Each Dental Arch

Order of Eruption	Incisor Teeth				Canine Teeth		Premolar Teeth				Molar Teeth				Ties		
	Central		Lateral				First		Second		First		Second		Teeth	%-age	
	G*	B*	G	B	G	B	G	B	G	B	G	B	G	B		G	B
Maxillary Arch																	
First	10	2									88	98					
Second	88	96	2								8	2			1-6	2	
Third			98	98							2				1-2		2
Fourth					18	12	68	73	8	9			2	2			
															4-3		2
															4-5	2	2
															3-7	2	
Fifth					36	35	26	21	34	29			7				
															3-5		2
															3-5-7		2
															5-7	2	
Sixth					32	35	4		40	37			22	22			
															5-7		2
Seventh					12	12		2	14	17			72	65			
Mandibular Arch																	
First	46	64									54	34					
Second	54	34	6								40	64			1-6		2
Third			94	100							6						
Fourth					76	50	18	41	2	2			2	5			
															3-4		2
															5-7	2	
Fifth					12	38	68	39	12	12			2	5			
															3-5	2	
															4-5	2	2
															4-7		2
Sixth					6	10	8	10	54	49			24	23			
															3-7	2	
															4-5		2
															5-7	2	2
Seventh					2		4	2	24	32			66	62			

* The letters G and B represent girls (N = 50) and boys (N = 56), respectively.

Table VIII

Zero-Order and Higher-Order Correlation Coefficients for Permanent Teeth Erupting in Early and Late Childhood

Variable(s)	Maxillary Arch						Mandibular Arch					
	3*		4		5		3		4		5	
	G**	B**	G	B	G	B	G	B	G	B	G	B
1***	.78	.72	.72	.46	.59	.56	.87	.75	.81	.62	.61	.53
2	.69	.62	.55	.44	.55	.49	.87	.83	.74	.68	.58	.65
6	.51	.47	.59	.45	.63	.52	.53	.54	.67	.43	.60	.43
1 and 2	.79	.73	.72	.48	.60	.57	.89	.84	.81	.69	.61	.65
1 and 6	.78	.72	.75	.52	.69	.61	.87	.81	.85	.66	.68	.59
2 and 6	.76	.65	.67	.52	.70	.59	.87	.85	.80	.69	.67	.66

* 3 = canine, 4 = first premolar, 5 = second premolar.
** The letters G and B symbolize girls (N = 50) and boys (N = 57), respectively.
*** 1 = central incisor, 2 = lateral incisor, 6 = first molar.

For the right mandibular arch, gingival eruption number six is usually the second premolar or second molar. In both sexes chances of mandibular eruption at this rank are near one in two for the second premolar, one in four for the second molar, and one in ten for the canine.

The right quadrant of each dental arch was examined in respect to the whole sequence of eruptions from the first permanent tooth to the seventh permanent tooth. In the maxillary arch seventeen serial variations were found for girls and nineteen for boys. In the mandibular arch there were twenty-one and twenty-six varieties of tooth succession for girls and boys, respectively. It will suffice to itemize those sequences occurring at frequencies exceeding 15 per cent.

Two sequences were found in the maxillary arch at frequencies between 18 per cent and 26 per cent. Explicitly, (1) sequence 6-1-2-4-3-5-7 occurred in 22 per cent of girls and 26 per cent of boys, and (2) sequence 6-1-2-4-5-3-7 occurred in 18 per cent of girls and 23 per cent of boys.

In the mandibular arch frequencies above 15 per cent were obtained for one sequence on girls and two sequences on boys. Specifically, (1) succession 1-6-2-3-4-5-7 occurred in 24 per cent of girls and 16 per cent of boys, and (2) succession 1-6-2-4-3-5-7 occurred in 18 per cent of boys. The next frequency rank obtained in the mandibular arch is 14 per cent for sequence 6-1-2-3-4-5-7 on girls.

Predicting Eruption of the Canine, First Premolar and Second Premolar Teeth

This section examines the efficiency with which age of gingival emergence of permanent incisor and/or first molar teeth can be used to predict age of gingival emergence of permanent canine and/or premolar teeth.

Table VIII presents zero-order and multiple correlation coefficients basic in the discovery of prediction formulas that yield clinically useful eruption forecasts. The table shows:

1. In the maxillary dental arch, the highest zero-order coefficients are those representing the association between gingival emergence of the central incisor and gingival emergence of the canine. Specific *r*'s for this association are .78 on girls and .72 on boys.

2. The coefficients for maxillary canine with central incisor are prac-

tically the same as those obtained for maxillary canine with any combination of the three early-erupting permanent teeth. This means that a complex formula derived to predict age of canine eruption from eruption ages of the central incisor, lateral incisor, and first molar teeth would not afford more precise forecasts for age of canine eruption than the forecasts resulting from a simple formula utilizing only eruption age of the central incisor.

3. In the mandibular dental arch, the highest zero-order r's (considering both sexes jointly) are those registering the relationship between gingival emergence of the lateral incisor and gingival emergence of the canine. Obtained coefficients for this relationship are .87 on girls and .83 on boys.

4. Multiple correlation R's fail to support the hypothesis that multivariant regression equations (based on combinations of eruption ages for the central incisor, lateral incisor, and first molar teeth) can appreciably raise the level of predictive efficiency attainable by estimating age of canine eruption from age of lateral incisor eruption.

Equations utilizing a single independent variable (central incisor or lateral incisor) to predict ages of eruption of the permanent canines are:

Maxillary canine for girls = 1.27 (eruption age of maxillary central incisor) + 2.1

Maxillary canine for boys = 1.34 (eruption age of maxillary central incisor) + 1.9

Mandibular canine for girls = 1.32 (eruption age of mandibular lateral incisor) + 0.4

Mandibular canine for boys = 1.00 (eruption age of mandibular lateral incisor) + 3.2

Taking the first of these formulas to illustrate their use, let it be assumed that a certain girl erupts her maxillary right central incisor on her sixth birth anniversary. The formula predicts eruption of her maxillary right canine at age 9.7 years ($1.27 \times 6.0 + 2.1 = 9.7$).

The "long-run" efficiencies of the four formulas, in serial order, are 37 per cent, 31 per cent, 51 per cent, and 44 per cent (see Guilford[1]). Exact predictions (predictions without error) are 100 per cent efficient. It follows that, viewed in reference to this criterion of perfect forecasting, efficiency levels between 30 per cent and 50 percent are no more than moderately satisfactory. The standard errors of estimate for the four formulas, again in serial order, are 0.8 years, 0.7 years, 0.6 years, and 0.5 years.

Equations for predicting age of gingival emergence of the premolar teeth are not presented since none can be derived that have efficiency levels at or above 30 per cent for both sexes.* Forecasting that fails in minimizing error to this extent is not considered sufficiently useful to warrant recommendation.

An alternative perspective on relations between early- and late-erupting permanent teeth is attained by examining time intervals from gingival emergence of incisor teeth to gingival emergence of canine and premolar teeth. Findings for the maxillary arch (right side) are as follows:

1. There is a period of at least two years between eruption of the central incisor and eruption of the canine. For three children in four (78 per cent of girls and 80 per cent of boys) gingival emergence of the canine follows gingival emergence of the central incisor by intervals varying from three years to five years.

2. For about nine children in ten

* Reference to Table VIII will indicate that for both dental arches, on girls only, the 30 per cent efficiency level is attainable in predicting eruption age of the first premolar from eruption age of the central incisor.

(88 per cent of girls and 90 per cent of boys) gingival emergence of the first premolar succeeds gingival emergence of the central incisor by periods between two years and five years. Approximately seven children in ten (76 per cent of girls and 70 per cent of boys) erupt the second premolar at intervals varying between three years and five years after eruption of the central incisor.

3. The canine and premolar teeth, in a few individuals, do not pierce the alveolar mucosa until fully six years after emergence of the central incisor.

Findings for the mandibular arch are:

1. For girls, occasionally the permanent canine or first premolar erupts within a year after eruption of the permanent lateral incisor. For boys, a minimum interval of two years separates emergence of the lateral incisor and emergence of the canine or either premolar.

2. Eruption of the permanent lateral incisor precedes eruption of the permanent canine by two years to four years for approximately nine children in ten (90 per cent of girls and 94 per cent of boys). Similarly, for roughly nine children in ten (88 per cent of girls and 93 per cent of boys) the lateral incisor antedates the first premolar by periods varying from two years to four years. Intervals between eruption of the lateral incisor and the second premolar, for about three children in four of each sex, vary from three years to five years.

3. The lapse of time rarely exceeds five years from gingival emergence of the lateral incisor to gingival emergence of the canine and first premolar.

Summary

Odontic relationships are investigated using longitudinal records for age of gingival emergence of permanent teeth in white children. Sections of the report treat: relations among means and standard deviations for age of tooth eruption, eruption associations of homologous teeth on the two sides of each dental arch, eruption associations of opposing teeth on the right side of the two arches, eruption relationships among seven permanent teeth on the right side of each arch, and possibilities of predicting ages of eruption for the canine and premolar teeth from eruption ages for the incisor and first molar teeth.

The data were obtained from hydrocal casts of both dental arches accumulated on children enrolled in a long-term research program. Age of gingival emergence of each permanent tooth except the third molars was estimated by two odontologists working independently. The subjects were 107 American-born white children predominantly of northwest European descent and of above average socioeconomic status. It is found:

1. Incisor and canine teeth typically pierce the alveolar mucosa at earlier ages in the mandibular arch than in the maxillary arch.

2. The mandibular canine tooth shows the largest sex difference in age of gingival emergence.

3. Dispersions are smaller for eruption age of incisor and first molar teeth than for eruption age of canine and premolar teeth.

4. There are moderately strong, positive associations between eruption ages for homologous permanent teeth on the two sides of a given arch (r's from .77 to .96) and for complementary teeth on the right side of the two arches (r's from .66 to .85).

5. Relationships among gingival emergence ages for all possible pairings of seven permanent teeth on the right side of each arch range from weak positive to moderately strong. Correlations are higher for pairs of adjacent teeth

than for pairs separated by two or more intervening teeth.

6. Sequences of tooth emergence occurring in each sex at frequencies above 15 per cent are 6-1-2-4-3-5-7 and 6-1-2-4-5-3-7 for the maxillary arch and, for the mandibular arch, 1-6-2-3-4-5-7. No sequence is common to more than 26 per cent of the sample for either sex.

7. Gingival eruption age of the mandibular canine can be predicted fairly satisfactorily from gingival eruption age of the mandibular lateral incisor. The "long-run" forecasting error is less than seven months for two children in three, and less than 14 months for 19 children in 20.

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