ORDER OF ERUPTION OF THE PERMANENT HUMAN DENTITION

BY

E. M. B. CLEMENTS, M.B., B.S.

E. DAVIES-THOMAS, M.R.C.S., L.R.C.P.
L.D.S. R.C.S.

AND

KATHLEEN G. PICKETT, B.Sc.

(From the Department of Anatomy, University of
Birmingham)

Whilst the order of eruption of teeth as determined from mean eruption times is relatively constant (Clements, Davies-Thomas, and Pickett, 1953), the times of eruption of individual teeth are very variable, and consequently individual children may be expected to vary greatly in the order in which their teeth erupt. This is shown by Table I, which provides estimates of the 5% and the 95% limits of the ages of eruption in children examined in the course of the Birmingham Anthropometric Survey. It is also evident from Table I and the Chart that eruption times overlap considerably. The explanation is clearly that the eruption times of each tooth are distributed at random, so that late eruption of a tooth with a relatively early mean eruption time may occur after the early eruption of a tooth with a later mean eruption time.

TABLE I.—Mean Eruption Times, and the 5 and 95% Limits of Distribution for the Teeth of Boys and Girls in the Right Upper and Lower Jaws

Tooth	Boys				Girls			
	Mean in Months	S.D.	5-95% Limit of Distribution		Mean in Months	S.D.	5-95% Limit of Distribution	
			Upper	Lower			Upper	Lower
Upper Jaw								
I ₁ ..	84.13	9.97	100.48	67.69	79.46	7.65	92.01	66.83
I ₂ ..	98.17	10.10	114.74	81.51	93.80	12.40	114.13	73.35
C ..	137.56	16.39	164.44	110.51	128.07	14.85	152.43	103.56
Pm ₁ ..	124.96	21.90	160.88	88.83	117.45	14.63	141.45	93.30
Pm ₂ ..	138.22	21.74	173.87	102.35	132.76	22.06	168.93	96.36
M ₁ ..	73.29	10.91	91.19	55.29	71.25	10.79	88.95	53.45
M ₂ ..	143.67	14.93	168.15	119.04	137.94	14.15	161.15	114.59
Lower Jaw								
I ₁ ..	72.96	9.38	88.32	57.48	69.22	6.76	80.29	58.14
I ₂ ..	87.63	9.71	103.55	71.61	84.17	10.12	100.78	67.47
C ..	126.16	14.71	150.28	101.90	112.90	11.99	132.57	93.11
Pm ₁ ..	136.20	19.74	168.76	103.63	126.33	18.87	157.00	95.49
Pm ₂ ..	147.87	20.83	182.24	113.70	139.62	21.88	175.51	103.52
M ₁ ..	73.69	10.99	91.71	55.67	70.08	8.80	84.51	55.57
M ₂ ..	136.87	14.49	160.61	112.93	134.15	13.23	155.85	112.31

I₁=the central incisor tooth; I₂=the lateral incisor tooth; C=the canine tooth; Pm₁=the first premolar tooth; Pm₂=the second premolar tooth; M₁=the first molar tooth; M₂=the second molar tooth.

Chart showing standardized frequency distribution of the eruption times of the permanent teeth in the lower jaw for boys.

Little or no variation would be found in the order of eruption if the early eruption of one tooth was associated with the early eruption of the others. Alternatively, if the times of eruption of the various teeth were independent, all possible variations in the order of eruption would occur. The data on tooth eruption collected in the Birmingham Anthropometric Survey were therefore examined to determine whether or not the order of eruption of teeth which have their mean eruption times close together is constant, and, if variations occur, to estimate the probability of different patterns of eruption.

Method

The records of a tooth have been classified as erupted (the tooth having pierced the gum) or unerupted. Each of these classes has been sub-classified into two further classes by sorting the records of another tooth into classes of erupted and unerupted teeth. The records of two teeth comprise the simplest case, and for these a fourfold table may be constructed to indicate the number of occasions on which (1) both teeth were present, (2) neither tooth was present, and (3) either one or the other tooth was present. Additional teeth may be similarly sub-classified to give 16 possible combinations for four teeth. Only the records of children who were of such an age that erupting teeth might be expected to occur have been examined.

TABLE II.—Occurrence of Erupted and Unerupted I₁ and M₁ Teeth in the Jaws of Children Aged 5-9 Years

Teeth Erupted	Boys	Girls	Total
Upper Jaw			
I ₁	7 (4.7%)	8 (6.6%)	15 (5.6%)
M ₁	142 (95.3%)	113 (93.4%)	255 (94.4%)
$\chi^2=0.46$ (1 d.f.)			
Number of occasions when 1 tooth was erupted	149	121	270
Lower Jaw			
I ₁	55 (53.9%)	45 (54.2%)	100 (54.0%)
M ₁	47 (46.1%)	38 (45.8%)	85 (46.0%)
$\chi^2=0.02$ (1 d.f.)			
Number of occasions when 1 tooth was erupted	102	83	185

Factors which may tend to accelerate or retard the eruptions of certain teeth, such as the early eruption of the premolar teeth following on the early loss of the deciduous teeth, may also affect the frequencies of the orders of eruption (see Leslie, 1951).

Results

The order of eruption of the I₁ and M₁ teeth has been examined in 644 boys and 633 girls aged 5 to 9 years. In each sex the records were divided into a group in which the upper right I₁ tooth had erupted and one in which it had not. The same was done with the lower teeth. Each of these classes was then divided into a subgroup in which the M₁ tooth had erupted and another in which it was still unerupted. The findings are given in Table II. Either one or the other of the two upper teeth was seen alone on 149 occasions in boys and 121 occasions in girls; the corresponding figures for the lower jaw were 102 occasions in boys and 83 occasions in girls; upper I₁ occurred alone seven times in boys and eight times in girls; lower I₁ was seen alone 55 times in boys and 45 times in girls; upper M₁ was seen alone 142 times in boys and 113 times in girls; lower M₁ was seen alone 47 times in boys and 38 times in girls. These proportions are similar for both sexes ($\chi^2=0.46$ and 0.02 (1 d.f.) respectively).

TABLE III.—Occurrence of Erupted and unerupted C, Pm₁, Pm₂, and M₂ Teeth in the Jaws of Children 7–14 Years Old.

No. of Teeth in Group	Classes of Erupted and Unerrupted Teeth				Upper Jaw				Lower Jaw				
					Right		Left		Right		Left		
					Boys		Girls		Boys		Girls		
	C	Pm ₁	Pm ₂	M ₂	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	
3 teeth	1	+	+	+	0	75 (57.7)	82 (58.6)	64 (54.2)	86 (53.4)	30 (25.9)	49 (36.0)	30 (27.8)	52 (38.0)
	2	+	+	0	+	33 (25.4)	44 (31.4)	33 (28.0)	54 (33.6)	77 (66.3)	72 (57.4)	72 (66.7)	77 (56.2)
	3	+	0	+	+	8 (6.1)	1 (0.7)	7 (5.9)	1 (0.6)	8 (6.9)	7 (5.1)	5 (4.6)	6 (4.3)
	4	0	+	+	+	14 (10.8)	13 (9.3)	14 (11.9)	20 (12.4)	1 (0.9)	2 (1.5)	1 (0.9)	2 (1.5)
Total ..					130	140	118	161	116	136	108	137	
2 teeth	5	+	+	0	0	25 (28.4)	42 (49.4)	38 (37.3)	50 (51.6)	52 (45.2)	72 (67.3)	50 (42.7)	71 (59.7)
	6	+	0	+	0	3 (3.4)	0 (0.0)	3 (2.9)	1 (1.0)	4 (3.5)	5 (4.7)	5 (4.3)	5 (4.2)
	7	+	0	0	+	1 (1.1)	3 (3.5)	5 (4.9)	2 (2.1)	51 (44.3)	28 (26.1)	50 (42.7)	40 (33.6)
	8	0	0	+	+	2 (2.3)	1 (1.2)	1 (1.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)	0 (0.0)
	9	0	+	0	+	11 (12.5)	5 (5.9)	6 (5.9)	7 (7.2)	1 (0.9)	0 (0.0)	3 (2.6)	2 (1.7)
	10	0	+	+	0	46 (52.3)	34 (40.0)	49 (48.0)	37 (38.1)	6 (5.2)	2 (1.9)	8 (6.8)	1 (0.8)
Total ..					88	85	102	97	115	107	117	119	
1 tooth	11	—	0	0	0	10 (7.5)	8 (7.5)	5 (3.8)	4 (4.2)	74 (71.9)	123 (86.0)	74 (67.9)	118 (89.4)
	12	0	+	0	0	106 (79.7)	82 (77.4)	101 (77.7)	79 (83.2)	13 (12.6)	11 (7.7)	21 (19.2)	6 (4.6)
	13	0	0	+	0	11 (8.3)	10 (9.4)	14 (10.8)	6 (6.3)	7 (6.8)	3 (2.1)	4 (3.7)	4 (3.0)
	14	0	0	0	+	6 (4.5)	6 (5.7)	10 (7.7)	6 (6.3)	9 (8.7)	6 (4.2)	10 (9.2)	4 (3.0)
Total ..					133	106	130	95	103	143	109	132	

+ = erupted: the tooth has pierced the gum. 0 = unerupted. There were approximately equal numbers of children in each age group.

The records of the C, Pm₁, Pm₂, and M₂ teeth have been sorted in a similar way for 1,135 boys and 1,077 girls from 7 to 14 years old, and the results for the right and left upper and lower jaws are given in Table III. This table should be read as in the following example, reading from line 9 of Table III for the right upper jaw: "Two teeth were erupted and two unerupted on 88 occasions in boys. The Pm₁ and M₂ teeth were the erupted teeth on 11 occasions (12.5%). Two teeth were erupted on 85 occasions in girls and the eruption of the Pm₁ and M₂ teeth together was seen five times (5.9%); and so on for the left side.

All the combinations of these four teeth have been seen, the combinations varying greatly in their frequency. The differences between the distributions have been tested for significance. The frequencies found in the right and left sides in the same sex do not differ statistically. The difference in the frequencies found between the sexes are all significantly different at the 1% level of probability except for three classes: (1) where three teeth have erupted in the lower jaw; (2) where two teeth have erupted in the lower jaw; and (3) where one tooth only has erupted in the upper jaw. The values of χ^2 for the teeth in the upper and lower jaws respectively, are: for three teeth 6.46 and 14.26 (3 d.f.); for two teeth 22.35 and 13.76 (5 d.f.); for one tooth 23.86 and 0.36 (3 d.f.). The distributions are very different in the upper and lower jaws of the same sex.

The frequencies of the various orders of eruption for different combinations of only two or three teeth out of the four teeth tabulated in Table III may be obtained by combining the appropriate lines of the table so as to omit the tooth not required.

Discussion

The present observations substantiate, what is already well known, that there is considerable variation in the order in which human teeth erupt, and extend this knowledge by providing estimates of the frequencies with which different patterns of eruption may occur in British children.

The most frequent order of eruption of the upper and lower I₁ and M₁ teeth, and the upper and lower C, Pm₁, Pm₂, and M₂ teeth, in both sexes is the same as that given by the mean eruption times. These are: the M₁, I₁, and the Pm₁, C, Pm₂, M₂ teeth in the upper jaw; the I₁, M₁, and the C, Pm₁, M₂, Pm₂ teeth in the lower jaw.

The mean time of eruption of the upper I₁ tooth is later than that of the upper M₁ tooth by 11 months in boys and eight months in girls, and this implies that the distributions of these teeth will overlap only slightly. On the other hand, the mean eruption times of the lower I₁ and M₁ teeth hardly

differ in either sex, and so the distributions of these teeth will almost coincide (see Chart). The upper right I₁ tooth was seen to erupt before the corresponding M₁ tooth on 5.6% of occasions, and the lower I₁ tooth on 54.0% of occasions. These observations agree well with the expected values computed from the data of Table I assuming independence. On this assumption I₁ erupts first in 4.0% and 54.8% of all cases in the upper and lower jaws respectively.

Erupted Pm₁, Pm₂, and M₂ teeth were observed without an erupted C tooth 27 times, or on about 10% of occasions, in the right side of the upper jaw, and three times, or on about 1% of occasions, in the right side of the lower jaw. On the assumption that the order of eruption of teeth on the right side is independent of that on the left, both sides will show these three teeth to be erupted on about 1% and 0.1% of occasions in the upper and lower jaws respectively. This condition was observed, however, 13 times in the upper jaw and once in the lower jaw. These observations do not accord with the estimated frequencies, and indicate that the eruption times of corresponding right and left teeth are correlated.

All possible combinations of the orders of eruption of the C, Pm₁, Pm₂, and M₂ teeth actually occur in the Birmingham records. The frequency with which departures occur from the assumed normal order of appearance of the teeth, as given by the mean times of their eruption, implies that the times of eruption of these four teeth are independent of each other.

A similar type of analysis to that undertaken in this study was made by Livy (1885). He compared the eruption times of the corresponding upper and lower teeth in children; he also found that the order of eruption was reversed in a variable proportion of cases in each age group.

It is apparent that many instances of abnormal orders of eruption of teeth which are encountered in the field of orthodontics simply represent extremes of the normal variation; the only sense in which they are abnormal is that they are infrequent.

Summary

The order in which the I₁ and M₁ teeth and the C, Pm₁, Pm₂, and M₂ teeth erupt in British children was investigated and considerable variations were found in both the upper and the lower jaws.

The frequencies of occurrence of the different patterns of eruption were estimated. The most frequent order of eruption was found to be the M₁ tooth followed by the I₁ tooth, and the Pm₁ tooth, followed in succession by

the C, M_2 , and M_1 teeth in the upper jaw; and the I_1 tooth followed by the M_1 tooth, and the C, Pm_1 , M_2 , and Pm_2 teeth in that order in the lower jaw.

The analysis indicates that the times of eruption of teeth with similar mean eruption times on the same side are independent of each other, but that the eruption times of corresponding teeth on the right and left sides are correlated.

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REFERENCES

- Clements, E. M. B., Davies-Thomas, E., and Pickett, K. G. (1953). *British Medical Journal*, 1, 1421.
 Leslie, G. H. (1951). *A Biometrical Study of the Eruption of the Permanent Dentition of New Zealand Children*. Government Printing Office, Wellington.
 Livy, J. (1885). *British Medical Journal*, 2, 241.

MAMMARY ABSCESS

DISADVANTAGES OF ANTIBIOTICS IN ITS MANAGEMENT

BY

C. P. MILLS, F.R.C.S.

(From the Department of Surgery, Postgraduate Medical School of London)

In days gone by the cardinal signs of inflammation, heat, pain, redness, and swelling were all too familiar. Just as the classical picture of lobar pneumonia with its typical crisis is seen no more, so the clinical features of acute pyogenic infections have been greatly altered since the general introduction of antibiotics. No one will deny their immense value in combating what were earlier most severe infections, but in less severe cases they can be a mixed blessing if not used with judgment and restraint. The need for surgery is as great as ever, although its extent may be much restricted. Since antibiotics can mask so effectively many of the arresting features of acute infections, the timing of an operation is becoming more and more important.

A good deal of suffering can, in my opinion, be avoided by a general appreciation of the limitations of antibiotics in the treatment of acute infections, and this point I want to underline by citing the records of four cases of acute mammary abscess. Cases of this sort are no doubt the everyday experience of most active general surgeons, but it is their very frequency which has prompted me to record the following cases.

Case 1

The patient was aged 26. Immediately after a normal delivery her left nipple became sore and cracked, and led to weaning. Two weeks later, 24 days after her confinement, she developed a painful swelling in her left breast. On the twenty-ninth day she was seen by her own doctor, who noticed a painful, red, indurated area in the lower half of the left breast. "Distaquaine penicillin," 400,000 units, was given daily, together with local applications of heat for four days. She was admitted to hospital on the thirty-sixth post-partum day, and 12 days after the onset of symptoms.

The left breast was fuller and more pendulous than the right, which seemed quite normal. There was an obvious swelling in the lower and outer quadrant. Peau d'orange was not seen. The nipple was not retracted, but the lower half of the areola was tethered to a hard, slightly tender non-fluctuant mass, measuring 8 by 8 cm., and easily felt

by the flat of the hand. The skin over the mass was not discoloured and was no hotter than the surrounding breast tissue. There was some fixity of the mass to the underlying pectoral fascia. Glands were not palpable in the axilla.

When she was first seen in hospital the absence of the signs of inflammation and the size, hardness, and fixation of the mass in the breast strongly suggested the diagnosis of a lactation cancer.

On the following day a radial incision was made over the most prominent part of the mass. A very thick-walled multiloculated abscess cavity was entered, which was involving most of the lower half of the breast. Free drainage was established. The pus yielded a profuse growth of a coagulase-positive *Staphylococcus pyogenes*, resistant to penicillin but sensitive to aureomycin, streptomycin, and chloramphenicol. Streptomycin, 0.5 g., was given twice daily for four days. Two weeks later the wound was completely healed, and there was no more than a diminishing thickening. Her total period of disability was 26 days.

Case 2

The patient, aged 32, noticed pain, tenderness, and swelling in her right breast three days after a normal confinement. For the next ten days she was given daily injections of distaquaine penicillin, 300,000 units, and local applications of kaolin poultices. The swelling became less painful but no smaller. On the twenty-fourth post-partum day the baby had to be weaned, when the patient developed a generalized rash. On the thirtieth day her own doctor again prescribed injections of penicillin of the same dosage as previously because the breast and upper arm had become stiff and swollen.

On admission to hospital on the thirty-fifth day—that is, 32 days after the onset of symptoms—her temperature was 98.4° F. (36.9° C.), pulse 80, respirations 20, and white blood cell count 11,000. She was looking in the very best of health. The left breast was normal. The right breast was enlarged and deformed by a large, easily visible swelling in the right lower quadrant. There was no peau d'orange, but a little reddish discoloration and oedema over the centre of the swelling. The upper part of the areola was tethered to the tumour. The mass was hard, smooth, and slightly tender, non-fluctuant, and a little hotter than the surrounding breast tissue. It was fixed to the underlying pectoral fascia. There were three firm, tender glands in the right axilla. There were even fewer signs and symptoms of an acute inflammatory condition in the breast than in Case 1. The patient was a very healthy-looking woman with no evidence of fever or toxæmia, complaining only of a large, slightly tender mass in her right breast.

The fixity of the mass to the skin, areola, and underlying fascia; the oedema of the breast and the upper arm; and the presence of enlarged glands in the axilla were once again very suggestive of a lactation carcinoma. The next day a radial incision was made over the most prominent part of the mass. A great depth of dense inflammatory tissue had to be penetrated to find one small loculus of pus in its centre. Bleeding was profuse and difficult to control. Culture of the pus yielded a profuse growth of *Staph. pyogenes* resistant to penicillin but sensitive to streptomycin, aureomycin, and chloramphenicol.

A section from the abscess wall showed an inflammatory reaction with infiltration by foamy macrophages, plasma cells, and polymorphonuclear cells. There was an area of fat necrosis.

Streptomycin, 1 g. twice daily, was given for six days. She was discharged on the sixteenth post-operative day with a clean granulating wound but still some residual thickening in the breast.

Case 3

This patient, aged 28, was confined five weeks before coming to hospital, and complained of pain in the left breast for two days immediately prior to admission.