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## THE CERVICAL ENAMEL LINE MESIALLY AND DISTALLY ON THE HUMAN MAXILLARY DECIDUOUS MOLARS

by  
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### INTRODUCTION

The cervical enamel line is the term used by the author, among others, to designate the boundary line between the anatomical crown and root complex of a tooth.

This boundary line is referred to in the odontological and dental-anthropological literature in many connections. Often, however, the cervical enamel line is only mentioned sporadically in wider contexts.

For comparative purposes *Pedersen & Thyssen* (1942) described the course of the cervical enamel line facially and lingually on the permanent and deciduous molars in man and in some anthropoid apes. This work is the first systematic and detailed account of the condition mentioned. Likewise, *Jørgensen* (1956) described the course of the enamel line facially and lingually on the deciduous molars. His investigation, which was undertaken on a very large material, did not, however, include the course of the enamel line mesially and distally on these teeth. *Pedersen & Thyssen* in an unpublished study observed »racial differences» in the course of the enamel line approximately on the molars — though the latter differences were less than was the case facially and lingually.

Investigations by *Choquet* (1899, quoted from *Thorsen*, 1917), *Thorsen* (1917), *Fujita & Nakayama* (1941), *Birrer* (1952) show that the »enamel-cementum zone» on human teeth exhibited certain variations. According

to these authors it should be possible to diagnose the following enamel-cementum relationships: 1) the enamel overlaps the cementum, 2) enamel and cementum are just in contact (juxtaposition), 3) enamel and cementum are not in contact and 4) the cementum overlaps the enamel.

In the present report an account will be given of some observations made by the author of the cervical enamel line mesially and distally on the human maxillary deciduous molars,  $m_1$  sup. and  $m_2$  sup. The results of the investigation, which had both qualitative and quantitative aims, may later serve as a basis of comparison with similar observations made on teeth derived from individuals belonging to other racial groups.

#### MATERIAL

The material comprised in all 1297 human maxillary deciduous molars: 544 1st molars and 753 2nd molars. These teeth were extracted and collected in Denmark between 1963 and 1966. The teeth were sent to the Royal Dental College, Copenhagen, by school dental clinics and practising dentists. During the collecting period and transport the teeth were kept moist. On arrival they were cleaned in the following manner: 1) storage in 15 % sodium hypochlorite solution (technical) for 48 hours, 2) rinsing with water, 3) storage in approx. 15 % hydrogen peroxide for 2 hours and 4) rinsing with water. Thereafter, until the examination, the teeth were kept in water to which was added a disinfectant, viz. 10 % Rodalon ®.

During the actual recording procedure the teeth were completely dry on the outer surface.

All the teeth were identified by the author in accordance with a method described earlier (*Carlsen, 1965*), and on the basis of the morphological criteria that *Jørgensen (1956)* has shown to be valid for the two types of teeth in question.

Only one condition was necessary in order for the specimens to be included in the material: the cervical enamel line had to be intact on at least one approximal surface.

Table I shows the composition and size of the material.

Table I  
*Grouping of the specimens examined*

Type of tooth	Number of specimens examined	
	dext.	sin.
$m_1$ sup.	277	267
$m_2$ sup.	361	392

On  $m_1$  sup. the cervical enamel line was intact both mesially and distally on 279 specimens, intact only mesially on 247 specimens and intact only distally on 18 specimens.

On  $m_2$  sup. the cervical enamel line was intact both mesially and distally on 540 specimens, intact only mesially on 137 specimens and intact only distally on 74 specimens.

#### METHOD

The observations of the cervical enamel line were made by means of a stereomicroscope (Reichert, Austria). Magnification:  $\times 10$ . The author considered this degree of magnification appropriate for the purpose, in that the mesial or distal section of the enamel line could be contained in one visual field — the overall view was thus not lost and the recording procedure was not particularly time-consuming.

All the specimens were identically oriented when recorded. They were placed on wax on the object plate so that the occlusal surface faced away from the observer. The light (7 V) fell on the specimen from an oblique occlusal direction.

A pilot study gave sufficient insight into the total variation in the course of the cervical enamel line approximately on  $m_1$  sup. and  $m_2$  sup. to enable main types of course to be established. As a result of this preliminary examination some recording experience was acquired, and likewise it was possible to note the variation in the course of the enamel line within the main types.

In order to avoid damage to the cervical part of the enamel, no attempt was made in the present investigation to remove overlapping cementum by mechanical means. What was recorded, therefore was the »phenotype» of the enamel line, whether this was identical with or different from the »genotype».

#### *Typology*

To the author's knowledge, no classification has hitherto been published of the course of the cervical enamel line mesially and distally on the human  $m_1$  sup. and  $m_2$  sup. Such a classification will be proposed here.

It should be noted that in this work the curvature of the enamel line will be constantly evaluated from a point on the tooth *outside* the enamel surface, i.e. on the root (Carlsen, 1967).

*m<sub>1</sub> sup. : mesially*

On both *m<sub>1</sub> sup.* and *m<sub>2</sub> sup.* the boundary between the mesial and facial section of the enamel line was set to correspond to the junction between the mesial and facial surfaces of the root stem.

On both *m<sub>1</sub> sup.* and *m<sub>2</sub> sup.* the boundary between the mesial and lingual section of the enamel line was set to correspond to the junction between the mesial and lingual surfaces of the root stem or, in so far as a mesiolingual, false enamel extension (see below, also Fig. 25) was present, to correspond to its most apical point.

Neither *Pedersen and Thyssen* nor *Jorgensen* stated how they demarcated the facial or lingual section of the cervical enamel line from the adjoining sections.

*Type I:* the enamel line run in a concave curve. The facial part of this was located further occlusally than the lingual part. The curvature was clearly more pronounced facially than lingually (Fig. 1).



Fig. 1. *m<sub>1</sub> sup. sin.*: mesial aspect. Cervical enamel line: type I.

*Type II a:* the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual section (Fig. 2).

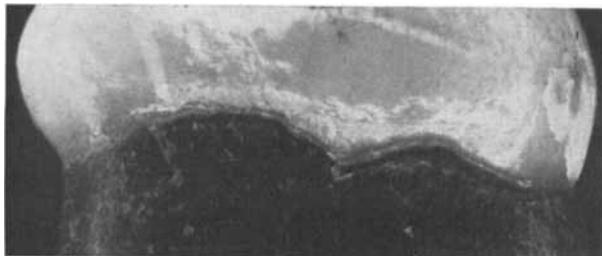


Fig. 2. *m<sub>1</sub> sup. sin.*: mesial aspect. Cervical enamel line: type II a.

*Type II b*: the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual section. The most occlusal part of the facial section of the curve was convex or straight (Fig. 3).

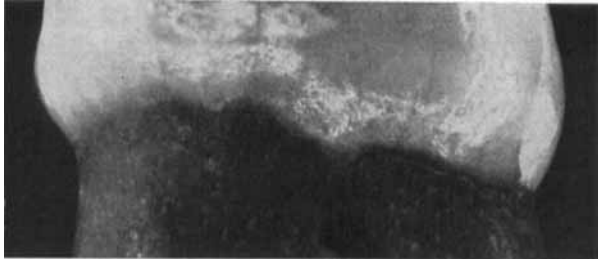


Fig. 3.  $m_1$  sup. sin.; mesial aspect. Cervical enamel line: type II b.

*Type III a*: the enamel line run in a concavo-convexo-concave curve. The facial, concave section of the curve was larger and was located further occlusally than the middle and the lingual sections of the curve (Fig. 4).



Fig. 4.  $m_1$  sup. sin.; mesial aspect. Cervical enamel line: type III a.

*Type III b*: the enamel line run in a concavo-convexo-concave curve. The facial section of the curve was larger and was located further occlusally than the middle and the lingual sections. The most occlusal part of the facial section of the curve was convex or straight (Fig. 5).

*$m_2$  sup.: mesially*

*Type I a*: the enamel line run in a concave curve. The facial or middle part of the curve was located furthest occlusally (Fig. 6).

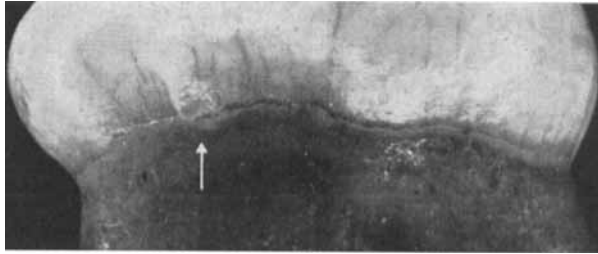


Fig. 5.  $m_1$  sup. sin.: mesial aspect. Cervical enamel line: type III b. The arrow marks an enamel extension. Explanation later in text.

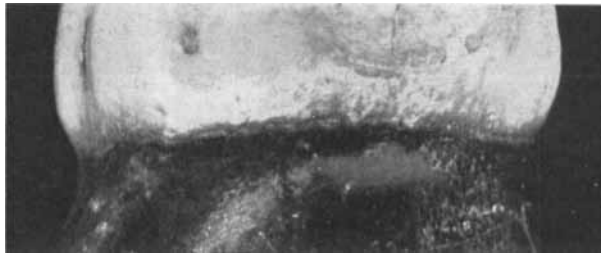


Fig. 6.  $m_2$  sup. dext.; mesial aspect. Cervical enamel line: type I a.

*Type Ib*: the enamel line run in a convexo-concave curve. The facial, convex section of the curve was considerably smaller than the lingual section (Fig. 7).



Fig. 7.  $m_2$  sup. dext.; mesial aspect. Cervical enamel line: type I b.

*Type II a*: the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual section. The two sections of the curve were usually more slightly curved than was found in type II a mesially on  $m_1$  sup. (Fig. 8).



Fig. 8.  $m_2$  sup. sin.; mesial aspect. Cervical enamel line: type II a.

*Type II b*: the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual section. The most facial and/or the most occlusal (or occlusolingual) part of the facial section of the curve was convex or straight (Fig. 9).

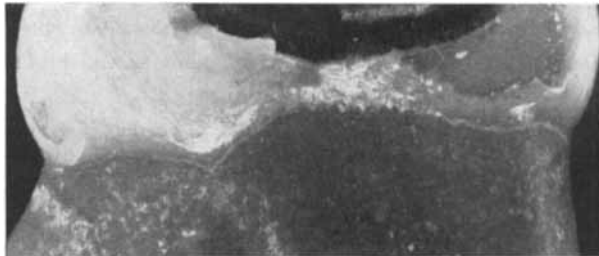


Fig. 9.  $m_2$  sup. dext.; mesial aspect. Cervical enamel line: type II b.

*Type III a*: the enamel line run in a concavo-convexo-concave curve. The facial, concave section of the curve was larger and was located further occlusally than the middle and the lingual sections of the curve (Fig. 10).



Fig. 10.  $m_2$  sup. dext.; mesial aspect. Cervical enamel line: type III a.

*Type III b*: the enamel line run in a concavo-convexo-concave curve. The facial section of the curve was larger and was located further occlusally than the middle and the lingual sections. The most facial and/or the most occlusal (or occlusolingual) part of the facial section of the curve was convex or straight (Fig. 11).



Fig. 11.  $m_2$  sup. dext.; mesial aspect. Cervical enamel line: type III b.

*$m_1$  sup. et  $m_2$  sup.: distally*

On both  $m_1$  sup. and  $m_2$  sup. the boundary between the distal and facial sections of the enamel line was set to correspond to the junction between the distal and facial surfaces of the root stem.

On both  $m_1$  sup. and  $m_2$  sup. the boundary between the distal and lingual sections of the enamel line was set to correspond to the junction between the distal and lingual surfaces of the root stem or, in so far as a distolingual, false enamel extension (see below, also Fig. 25) was present, to correspond to its most apical point.

It should be noted at this point, as is clearly shown by Fig. 12 and Fig. 25, that there may be (and often is) a considerable difference in recording, for instance, the distal section of the enamel line and the course of the enamel line viewed in a distal aspect.



Fig. 12.  $m_2$  sup. sin.; distal aspect. Cervical enamel line: type I a. The arrows indicate the facial and lingual border points of the distal section of the enamel line.

*Type Ia*: the enamel line run in a concave curve. The facial or middle part of the curve was located furthest occlusally. On  $m_1$  sup. the curvature may be more pronounced facially than lingually (Fig. 12). See also Fig. 1 and Fig. 6.

*Type Ib*: the enamel line run in a convexo-concave curve. The two sections of the curve were approximately equal in size, though the lingual, concave one was usually the larger (Fig. 13).

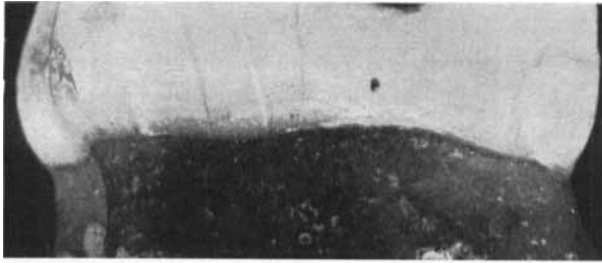


Fig. 13.  $m_2$  sup. dext.; distal aspect. Cervical enamel line: type I b.

*Type IIa*: the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual — especially on  $m_1$  sup. (Fig. 14).

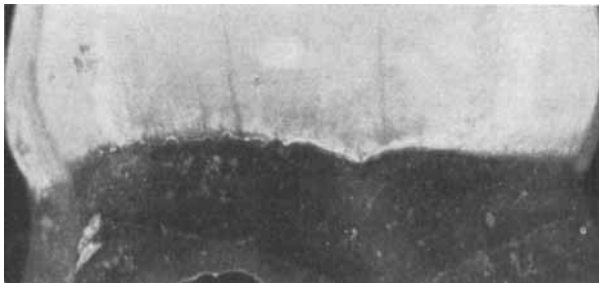


Fig. 14.  $m_2$  sup. dext.; distal aspect. Cervical enamel line: type II a.

*Type IIb*: the enamel line run in a concavo-concave curve. The facial section of the curve was larger and was located further occlusally than the lingual — particularly on  $m_1$  sup. The facial and/or the most occlusal part of the facial section of the curve was convex or straight (Fig. 15).

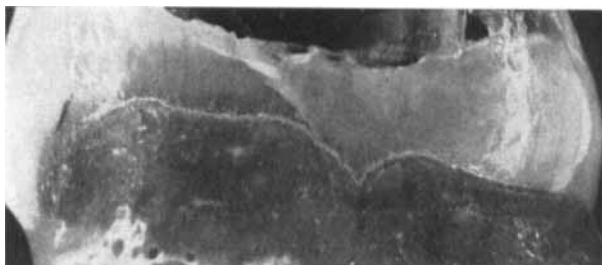


Fig. 15.  $m_1$  sup. dext.: distal aspect. Cervical enamelline: type II b.

*Type III a:* the enamel line run in a concavo-convexo-concave curve. The facial, concave section of the curve was located further occlusally than the middle and the lingual sections (Fig. 16).



Fig. 16.  $m_1$  sup. dext.: distal aspect. Cervical enamelline: type III a.  
Note the general direction of the enamel line.

*Type III b:* the enamel line run in a concavo-convexo-concave curve. The facial section of the curve was located further occlusally than the middle and the lingual sections. The facial and/or the most occlusal part of the facial section of the curve was convex or straight (Fig. 17).



Fig. 17.  $m_2$  sup. dext.: distal aspect. Cervical enamelline: type III b.

*Type IV*: the enamel line run in a convex curve (Fig. 18).

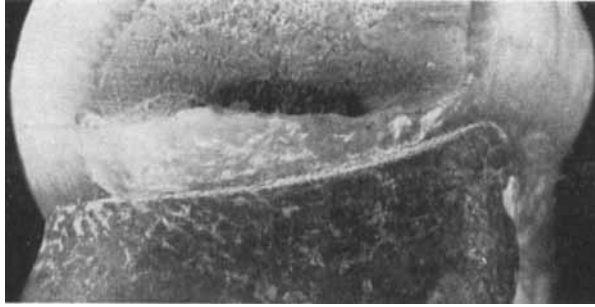


Fig. 18.  $m_1$  sup. sin.; distal aspect. Cervical enamel line: type IV.

*Type V*: the course of the enamel line was a straight line (Fig. 19).

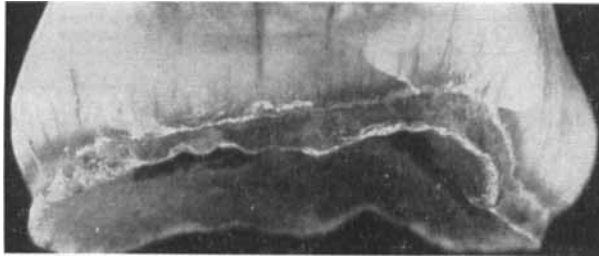


Fig. 19.  $m_1$  sup. sin.; distal aspect. Cervical enamel line: type V.

*Type VI*: the enamel line run in a convexo-convex curve (Fig. 20).



Fig. 20.  $m_2$  sup. dext.; distal aspect. Cervical enamel line: type VI.

## RESULTS

The results obtained are shown in Tables II, III, IV and V. A total of 2114 observations were made.

Table II

*The course of the cervical enamel line mesially on  $m_1$  sup., 526 recordings*

Type	dext.		sin.	
	Number	%	Number	%
I	3	1.1	4	1.5
II a	104	39.2	83	31.8
II b	15	5.7	20	7.7
III a	109	41.1	122	46.7
III b	34	12.8	32	12.3

Table III

*The course of the cervical enamel line mesially on  $m_2$  sup., 677 recordings*

Type	dext.		sin.	
	Number	%	Number	%
I a	7	2.1	5	1.5
I b	8	2.4	5	1.5
II a	7	2.1	10	2.9
II b	24	7.2	26	7.6
III a	37	11.0	32	9.4
III b	252	75.2	264	77.2

Table IV

*The course of the cervical enamel line distally on  $m_1$  sup., 297 recordings*

Type	dext.		sin.	
	Number	%	Number	%
I a	33	22.0	28	19.0
I b	29	19.3	31	21.1
II a	11	7.3	12	8.2
II b	15	10.0	19	12.9
III a	11	7.3	13	8.8
III b	19	12.7	12	8.2
IV	12	8.0	16	10.9
V	14	9.3	14	9.5
VI	6	4.0	2	1.4

Table V

*The course of the cervical enamel line distally on m<sub>2</sub> sup., 614 recordings*

Type	dext.		sin.	
	Number	%	Number	%
I a	24	8.2	31	9.7
I b	57	19.4	49	15.3
II a	23	7.8	27	8.4
II b	52	17.7	60	18.7
III a	25	8.5	43	13.4
III b	77	26.3	80	24.9
IV	4	1.4	1	0.3
V	5	1.7	3	0.9
VI	26	8.9	27	8.4

## DISCUSSION

On the basis of the available study material it was not possible to determine whether there might be any sex difference as regards the approximal course of the enamel line on m<sub>1</sub> sup. and m<sub>2</sub> sup., since in no case was there any information as to the sex derivation of the teeth.

*A. The cervical enamel line; description in textbooks*

In those textbooks of dental morphology in which the course of the cervical enamel line mesially and distally on the human, maxillary deciduous molars is referred to at all, this has been done in an extremely brief manner.

*Wheeler* (1965), for example, said the following regarding m<sub>1</sub> sup. mesially, »The cervical line mesially shows some curvature in the direction of the occlusal surface.« *Re* m<sub>1</sub> sup. distally, »The cervical line may curve occlusally, or it may extend straight across from the buccal surface to the lingual surface.« *Re* m<sub>2</sub> sup. mesially, »There is very little curvature to the cervical line. Usually it is almost straight across from buccal surface to lingual surface.« *Re* m<sub>2</sub> sup. distally, »The cervical line is approximately straight, as was found mesially.« On comparing these descriptions with the corresponding observations made by the present author a considerable difference is noticeable. However, as *Wheeler* gave no description of the material nor specific reference to any original source, a discussion of the observed discrepancy would be of no interest.

In describing  $m_1$  sup. *Krogh-Poulsen* (1945) stated, »The gingival line runs at about the same level all the way round. Only mesiofacially, opposite the tuberculum molare, does it turn sharply apically.» In the present material the author noted that on both  $m_1$  sup. and  $m_2$  sup. it was now and then possible to demonstrate even a marked decline in the general course of the cervical enamel line from the facial towards the lingual surface. An example of this is shown in Fig. 16.

The author also noted that the enamel line could well be located further apically on the lingual surface of  $m_1$  sup. than opposite the tuberculum molare.

Although in the available material the cervical enamel line as a rule extended further occlusally on the mesial than on the distal surface, the reverse was nevertheless also observed — especially on  $m_1$  sup. The same phenomenon has been observed on the human maxillary deciduous canine by *Jørgensen* (1956).

#### *B. Genuine enamel extensions*

In the author's proposed classification of the course of the cervical enamel line approximately on  $m_1$  sup. and  $m_2$  sup. main type II corresponds to *Pedersen & Thyssen's* type 4 (and possibly type 5). *Pedersen* (1949) in his monograph defined the type 4 course of the enamel line facially and lingually on the human molars as follows, »Type 4 is that in which the enamel streams in the direction of the bifurcation, forming a small triangle which divides the enamel margin into mesial and distal halves which are more or less curved. The height of the enamel extension does not exceed about  $1\frac{1}{2}$  millimeters.» What is involved here might therefore be termed *pointed* enamel extensions. Extensions of this shape approximately on the maxillary deciduous molars point up towards the bifurcation or the groove between the mesiofacial and lingual root components, as well as towards the bifurcation or the groove between the distofacial and lingual root components. *Weski & Contreras* (1924), *Watson & Woods* (1926), *Marseillier* (1937), *Krogh-Poulsen* (1945) and *Tratman* (1950) observed similar extensions approximately on the maxillary permanent molars. On *Marseillier's* drawings of  $m_1$  sup. and  $m_2$  sup. such extensions are also shown, but they are not described in the text. In their reference to the enamel extensions (»some irregularities of the enamel margin») on the human molars *Watson & Woods* point out that »A careful examination of a great number of deciduous molars revealed a total absence of this abnormality.» As to these authors' material, it is only stated that it was composed of extracted teeth.

*Tratman* pointed out that he observed enamel extensions on  $m_1$  sup. and  $m_2$  sup. derived from *Mongoloids*; he did not, however, specify the location of these extensions.

Apparently *Weski & Contreras* (1924) were the first to refer in more detail to the morphological features in question associated with the enamel line.

*Pedersen & Thyssen's* definition (in Danish) of the type 4 enamel line stated, »Type 4: The enamel projects a usually triangular extension clearly visible to the unaided eye, in an apical direction, — — —.» When they here expressly wrote »usually», this must be taken to express that enamel extensions of other *shapes* have also occurred in the material of the authors concerned. It is conceivable, therefore, that some enamel extensions were not pointed but that, on the contrary, their most or more apical part appeared more or less rounded. There is, accordingly, correspondance with the present author's main type III. In such cases one can speak of enamel extensions that appeared less acute, i.e. *rounded* extensions. In the present main type III such enamel extensions, i.e. convex parts of the cervical enamel line, could be observed with definite topographical relation to the bifurcation or the groove between the mesiofacial or the distofacial and lingual root components.

The part of the enamel line marked with an arrow on Fig. 5 was located in direct topographical relation to the groove mesially on the mesiofacial root component. Such straight, or more or less convex, parts of the enamel line in direct topographical relation to grooves on the facial root components of maxillary molars are regarded by the author as being enamel extensions. As far as  $m_1$  sup. was concerned, they justify the establishment of type II b and type III b mesially. Similar extensions on  $m_1$  sup. distally and on  $m_2$  sup. mesially and distally were included in the b-types.

In addition to mesially on  $m_1$  sup., extensions of the type mentioned were also found in the following positions: 1) distally on  $m_1$  sup. and  $m_2$  sup. corresponding to the groove on the distofacial root component; 2) mesially on  $m_2$  sup. corresponding to a single groove on the mesiofacial root component, and 3) mesially on  $m_2$  sup. corresponding to the two grooves described by *Carlsen & Andersen* (1966) on the mesiofacial root component (Figs. 21 A and B).

The author terms enamel extensions in definite and direct topographical relation to either bifurcations or root grooves *genuine* extensions.

In connection with the above-mentioned enamel extensions it is emphasized that macroscopically visible serrations or other irregularities of the cervical enamel line as noted by *Fujita & Nakayama* (1941) as well as

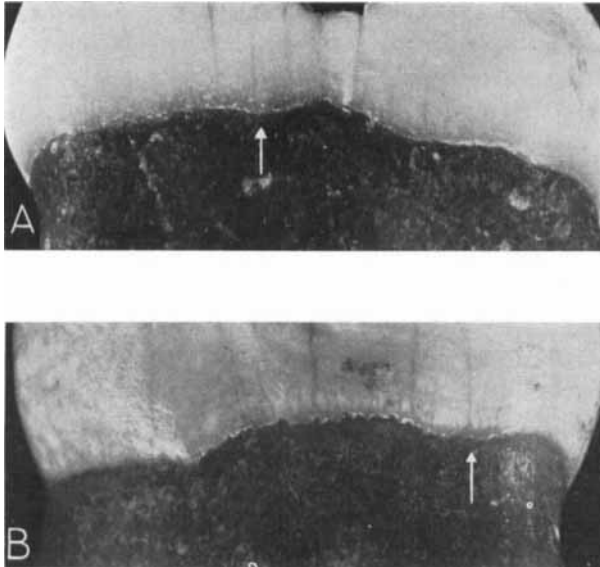


Fig. 21. A:  $m_2$  sup. sin.; mesial aspect. B:  $m_2$  sup. dext.; mesial aspect. On A the arrow marks an enamel extension related to the lingual groove on the mesial surface of the mesiofacial root component. On B the arrow marks an enamel extension related to the corresponding facial root groove.

by *Pedersen & Thyssen (1942)* — and of which an example from the present author's material is shown in Fig. 22 — must not be confused with faintly manifested enamel extensions. In this connection the author expressly draws attention to the fact that both pointed and rounded enamel extensions, larger as well as smaller than those shown in the illustrations, may occur within the types concerned.



Fig. 22.  $m_1$  sup. sin.; distal aspect. Irregular shape of the cervical enamel line.

At this point it should also be stressed that the degree of difficulty in recording the cervical enamel line may vary; the thickness of the enamel layer cervically, differences of colour etc. may play a part. The present author cannot, however, agree with *Fujita & Nakayama* when they stated »Wir haben sogar den Eindruck bekommen, dass die Schmelz-Zementgrenze der Milchzähne im allgemeinen noch komplizierter gebaut ist als die der permanenten Zähne.»

When, for example, *Pedersen & Thyssen* (1942) as well as *Jørgensen* (1956) take the absolute height of the enamel extensions into account in their classifications of the enamel line (type 4 and 5), they did not thereby — in the present author's opinion — obtain a sufficiently concise expression for the »ability» to form an enamel extension in the individual case. The height of the enamel extension should, in order to be meaningful, be expressed relatively, e.g. as a percentage of the maximum height of the crown (*Carlsen*, 1967). An evaluation of this kind was not, however, undertaken in this investigation.

No enamel extensions corresponding to *Pedersen & Thyssen's* type 6 were observed approximately in the available material. *Jørgensen* (1956) and possibly *Tratman* (1950) have demonstrated such enamel extensions facially on  $m_2$  sup., as has the present author (Fig. 23). Note in Fig. 23 the enamel pearl located the most bifurcal part of the extension. Enamel pearls in this area may, as pointed out by e.g. *Jørgensen* (1956) and *Kerr* (1961), be covered with a layer of cementum. In *Jørgensen's* account of the occurrence of enamel pearls on  $m_2$  inf. one finds the following comment, »When observed through a magnifying glass, however, the teeth were often seen to have minute, flat enamel areas in their bifurcations. These enamel formations were usually covered with cementum and therefore only appeared when for some reason or other the cementum had flaked off.»



Fig. 23.  $m_2$  sup. dext.; facioapical aspect. Pronounced enamel extension running into the bifurcation between the facial root components. Note the enamel pearl located in the bifurcation.

On both  $m_1$  sup. and  $m_2$  sup. the author observed a phenomenon which may present difficulties in differential diagnosis, especially as regards any cementum-covered enamel extensions. What is involved was a well-defined, rounded, crest-like structure, which extended approximately from the »tip» of an enamel extension up to the bifurcation. The cervico-bifurcal extent of the crest corresponded to that of the root stem and varied with the latter. The crest in question is peculiar in that it was located, so to speak, in the middle of an interradicular projection.

The author's type VI was presumably identical with *Kleinschmidt's* (1931) so-called »Ape line», encountered, for example, on *Chimpanzee* molars.

*Pedersen & Thyssen* (1942) stated, »Where there are supernumerary roots, — — —, the enamel projects an extension on each side of these.» In the present material two specimens of  $m_2$  sup. were found to have a supernumerary mesiolingual root each. Enamel extensions were observable on both sides of these roots — but the lingual extensions were considerably higher than the mesial ones (Fig. 24). The two specimens of  $m_2$  sup. referred to were from the right and left sides respectively. These two teeth are included in Table I but not in Table III.



Fig. 24.  $m_2$  sup. sin.; mesiolingual aspect. Four-rooted specimen. Original magnification:  $\times 2$  (approx.).

### C. False enamel extensions

The stippled arrow on Fig. 25 marks an well-defined, apically directed projection in the course of the cervical enamel line. Facially to this »convexity», yet another could be seen. It was indicated by a solid arrow and was located in direct topographical relation to the groove between the distofacial and lingual root components. This was, accordingly, a genuine enamel exten-

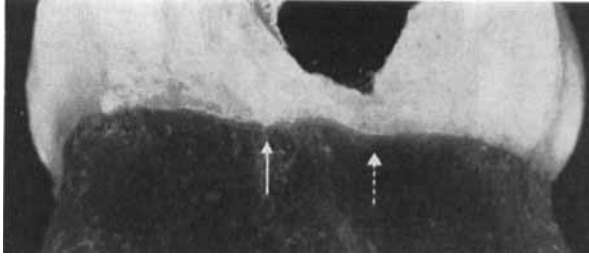


Fig. 25.  $m_2$  sup. dext.; distolingual aspect. Solid arrow: genuine enamel extension; stippled arrow: false enamel extension.

sion. The convexity indicated by the stippled arrow definitely had no direct relation to a root groove or bifurcation. It represented the junction of the lingual and distal sections of the enamel line.

The author calls a configuration of the enamel line of this kind, with no direct topographical relation to root grooves or bifurcations, a *false* enamel extension.

False enamel extensions seem to have been mentioned only once before in the odontological literature (*Alexandersen, 1962*) in connection with his description of the course of the enamel line on the human mandibular permanent canine. Major differences in direction and certain combinations of curvatures in two adjoining sections of the enamel line seem to accentuate and, by and large, to favour the appearance of false enamel extensions. In the author's material false enamel extensions were observed mesiolingually, distolingually and distofacially on  $m_1$  sup. and  $m_2$  sup. On  $m_2$  sup. false enamel extensions were also found mesiofacially.

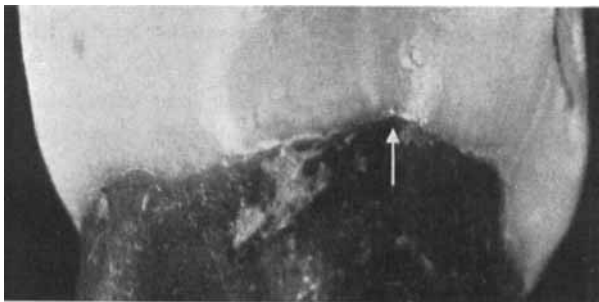


Fig. 26.  $m_2$  sup. sin.; mesiofacial aspect. Note the notch — indicated by the arrow — in the enamel line.

Lack of smoothness of the transitional area between two adjoining sections of the enamel line need not necessarily have a positive manifestation, i.e. as a pointed or rounded extension. It may also appear negatively, viz. as a concavity (U-shaped or V-shaped). A notch of this kind in the enamel line, located mesiofacially on  $m_2$  sup., is shown in Fig. 26. A similar phenomenon has been demonstrated distally or distofacially on the mandibular permanent molars (*de Jonge-Cohen*, 1920) and on  $m_2$  inf. (*Jørgensen*, 1956).

It may be mentioned that on a few  $m_2$  sup. the author found a «false», distolingual enamel extension in direct topographical relation to an apparently hitherto unnoticed groove distolingually on the lingual root component (Fig. 27).



Fig. 27.  $m_2$  sup. sin.; distolingual aspect. Note the «false» distolingual enamel extension and the corresponding root groove.

Mesially and distally on  $m_2$  sup. and distally on  $m_1$  sup. it was sometimes impossible to decide with the b-types whether the facial convex course of the enamel line should be regarded as a genuine or false enamel extension, or as a combination of the two. Consequently, the phenomenon was merely recorded without any further attempt to decide which of the three conditions in fact existed. In some instances the false extension is easy to diagnose, in others the genuine; but many doubtful cases are met with — hence the procedure chosen.

Occasionally both a genuine and a false enamel extension could be observed on  $m_2$  sup. in the mesiofacial and distofacial area of the enamel line as well as distofacially on  $m_1$  sup.

*Jørgensen* does not seem to have commented on the facial, false extensions on  $m_2$  sup. in relation to the mesiofacial and distofacial root components. At all events, these «structures» were not mentioned or included in his classification of the course of the enamel line facially. On the contrary, the same author described the enamel line facially on  $m_1$  sup. in the fol-

lowing way, »In other cases in which the tuberculum molare was located above the mesial root a softly curved enamel extension had developed above the distal root, — — —.» The extension mentioned was presumably identical with the false, distofacial extension observed by the present author on the type of tooth in question. *Jørgensen* did not express any further reflection on the »special» position of this enamel extension and the consequent lack of topographical relation to the facial bifurcation.

Finally, it must be pointed out that the facial, »concave» section of the curve in types II b and III b may at times be completely dominated by a convexity (Fig. 17). One imagines that sometimes in such situations it is a question of combinations, i.e. partial merging, of genuine and false extensions.

To conclude, it is suggested that the description of the cervical enamel line on the individual human teeth should, as far as possible, be undertaken as a whole. In this way a considerably better survey of the conditions will be obtained. The level of the enamel line mesially, distally, facially and lingually, the relative height of the enamel extensions etc. can thereby be presented much more easily and in a natural manner. The reason why the present author, despite this attitude, did not follow the recommended procedure is that *Jørgensen*, as mentioned, has already earlier given a very detailed account of the course of the enamel line both facially and lingually on the two types of teeth dealt with in this paper.

#### SUMMARY

The cervical enamel line is the term used by the author, among others, to designate the boundary line between the anatomical crown and root complex of a tooth.

In the present report an account is given of some observations made by the author of the cervical enamel line mesially and distally on the human maxillary deciduous molars,  $m_1$  sup. and  $m_2$  sup. As far as is known, no systematic studies of these features have previously been published. The material, grouped as shown in Table I, comprised 1297 specimens in all. These teeth were extracted and collected in Denmark from 1963 to 1966.

The enamel line was examined by means of a stereomicroscope. Magnification:  $\times 10$ . The course of the enamel line both mesially and distally on  $m_1$  sup. and  $m_2$  sup. could be classified into a number of different types. These are described in the section entitled »Typology», and they are illustrated in Figs. 1—20.

A total of 2114 observations were made. Their distribution is shown in Tables II, III, IV and V.

In section A of the discussion it is pointed out that in textbooks of dental morphology the course of the enamel line approximately on  $m_1$  sup. and  $m_2$  sup. is either not described at all or only in extremely brief fashion.

In section B the main discussion is of so-called genuine enamel extensions, i.e. those with a definite and direct topographical relation to either bifurcations or root grooves. See, for instance, Figs. 2, 3 and 4.

So-called false enamel extensions are referred to in section C. This deals with extensions that have no direct topographical relation to bifurcations or root grooves. See, for example, Fig. 25. Major differences in direction and certain combinations of curvature in two adjoining sections of the enamel line seem to accentuate and, on the whole, to promote the appearance of these enamel extensions.

#### RÉSUMÉ

##### LE BORD CERVICAL DE L'ÉMAIL À LA PARTIE MÉSIALE ET À LA PARTIE DISTALE DES MOLAIRES SUPÉRIEURES TEMPORAIRES HUMAINES

Le bord cervical de l'émail, tel est le terme par lequel l'auteur, entre autres, désigne la ligne délimitant la couronne anatomique d'une dent d'une part, et son ensemble radiculaire d'autre part.

La présente communication rend compte de quelques observations faites par l'auteur sur le bord cervical de l'émail à la partie mésiale et à la partie distale des molaires supérieures temporaires humaines,  $m_1$  sup. et  $m_2$  sup. A la connaissance de l'auteur, aucune étude systématique de ces questions n'a encore été publiée. Le matériel, dont le tableau I montre la répartition en groupes, comprenait au total 1297 pièces. Ces dents ont été extraites et recueillies au Danemark pendant les années 1963—66.

Le bord cervical de l'émail a été examiné à l'aide d'un microscope stéréoscopique. Grossissement:  $10\times$ . Le trajet du bord cervical de l'émail sur les deux catégories de dents considérées, tant à la partie mésiale qu'à la partie distale, pouvait être ramené à plusieurs types différents. Description de ces types sous le titre »Typology», et illustration de leurs principes aux Fig. 1—20.

Un total de 2114 observations ont été effectuées. Leur classement ressort des tableaux II, III, IV et V.

Dans la partie A de la discussion, l'auteur souligne que les manuels de morphologie dentaire ne décrivent que très sommairement ou pas du tout

le trajet du bord cervical de l'émail dans les parties proximales sur  $m_1$  sup. et  $m_2$  sup.

La partie B consiste principalement en une discussion sur les «vrais prolongements d'émail», c'est-à-dire les prolongements d'émail ayant un rapport topographique certain et direct soit avec les zones de bifurcation radiculaire, soit avec les sillons radiculaires. Voir par exemple les Fig. 2, 3 et 4.

La partie C traite des «pseudo-prolongements d'émail». Ce sont des prolongements qui ne présentent pas de rapport topographique direct avec les zones de bifurcation radiculaire ni avec les sillons radiculaires. Voir par exemple Fig. 25. Ainsi, les divergences marquées entre les directions de la ligne de l'émail dans deux segments voisins et certaines combinaisons de courbures contiguës semblent provoquer une accentuation de ces prolongements d'émail, et même en favoriser l'apparition.

#### ZUSAMMENFASSUNG

##### DIE ZERVIKALE SCHMELZGRENZE MESIAL UND DISTAL DES HUMANEN, TEMPORÄREN OBERKIEFERMOLAREN

Als die zervikale Schmelzgrenze bezeichnet der Verfasser, wie es auch andere getan haben, die Grenzlinie zwischen der anatomischen Krone eines Zahnes und dessen Wurzelkomplex.

In der vorliegenden Mitteilung werden einige vom Verfasser am zervikalen Schmelzrand des humanen, temporären Oberkiefermolaren,  $m_1$  sup. und  $m_2$  sup., mesial und distal gemachten Beobachtungen erläutert. Systematische Untersuchungen dieser Verhältnisse sind soweit bekannt nicht früher veröffentlicht. Das Material, dessen Gruppierung aus der Tabelle I hervorgeht, bestand aus 1297 Präparaten. Diese Zähne wurden in Dänemark in den Jahren 1963—66 extrahiert und gesammelt.

Die Beobachtungen am Schmelzrand wurden mit Hilfe eines Stereomikroskopes bei einer 10-maligen Vergrößerung durchgeführt. Sowohl mesial als auch distal konnte der Verlauf der Schmelzgrenze bei den beiden angeführten Zahntypen in mehrere verschiedene Typen klassifiziert werden. Diese werden genauer beschrieben im Abschnitt: »Typology», und prinzipiell illustriert in den Figuren 1—20.

Es wurden im ganzen 2114 Observationen vorgenommen, deren Verteilung aus den Tabellen II, III, IV und V ersichtlich ist.

Im Abschnitt A der Diskussion wird hervorgehoben, dass der Verlauf des Schmelzrandes approximal beim  $m_1$  sup. und  $m_2$  sup. in zahnmorphologischen Lehrbüchern entweder überhaupt nicht oder nur äusserst kurz beschrieben wird.

Im Abschnitt B werden im wesentlichen sogenannte echte Schmelzsporen diskutiert, d.h. Schmelzsporen mit einer sicheren und direkten topographischen Relation zu entweder Bifurkationen oder Wurzelfurchen, wie z.B. die Figuren 2, 3 und 4.

Sogenannte falsche Schmelzsporen werden im Abschnitt C besprochen. Es handelt sich um Sporen, die keine direkte topographische Relation zu Bifurkationen oder Wurzelfurchen haben, z.B. die Figur 25. Grosse Richtungsunterschiede und bestimmte Krümmungskombinationen in zwei benachbarten Sektionen der Schmelzlinie scheinen das Vorkommen dieser Schmelzsporen zu akzentuieren und diese überhaupt zu fördern.

#### *Technical Notes*

All the photographs used were made by the photographic department (Head: Mrs. I. Kragballe), the Royal Dental College, Copenhagen.

*Technical data.* Camera: Linhof, Technika; diaphragm: 30; low-power magnifying lens: 40 mm; film: Agfa-Gevaert, Isopan 15°, 6×9; light source: Philips, ultraviolet lamp: HPW, 125 W, TYP 57202E/70; exposure time: approx. 45 sec.

Original magnification: × 6—7.

During exposure the specimens were placed on the end of a rod and fixed to it with plasticine. The rod was pushed through a piece of fine-meshed, black material — acting as an optical background — and into sand in a container. The latter was painted black on the inside. The specimens occupied a position corresponding to the optical axis of the camera — level with the opening of the container.

In the figures the specimens are oriented in the same manner as during the recording procedure, i.e. occlusally upwards.

#### REFERENCES

- Alexandersen V.*, 1962: Root conditions in human lower canines with special regard to double-rooted canines. *Tandlægebladet* 66: 53—80.
- Birrer H.*, 1952: Zur Kenntnis der Schmelz-Zement-Zone des menschlichen Zahnes. *Acta anat.* 15: 228—242.
- Carlsen O.*, 1965: Tanddiagnostisk metodik. *Tandlægebladet* 69: 3—22.
- Carlsen O. & J. Andersen*, 1966: On the anatomy of the pulp chamber and root canals in human deciduous teeth. III. *Tandlægebladet* 70: 421—442.
- Carlsen O.*, 1967: Deskriptionssystematik. In: *Krogh-Poulsen, W.*: Tændernes morfologi. 3. udgave, 3. oplag. Munksgaard, København.
- Choquet J.*, 1899: Note sur les rapports anatomiques existant chez l'homme entre l'émail et le ciment. *L'Odontologie*. See *Thorsen*, 1917.
- Fujita T. & A. Nakayama*, 1941: Zur Morphologie des Schmelzrandes am Zahnhals nebst ihrer Beziehung zur Halskaries. *Dtsch. Zahn-, Mund- u. Kieferheilk.* 8: 146—157.
- Jonge-Cohen Th. E. de*, 1920: Die Kronen-Wurzelgrenze der unteren Zähne. *Anatomische Hefte*. I. Abt. 174. Heft. 58: 195—212.
- Jørgensen K. D.*, 1956: The deciduous dentition. A descriptive and comparative anatomical study. *Acta odont. scand.* 14: suppl. 20.

- Kerr D. A.*, 1961: The cementum: its role in periodontal health and disease. *J. Periodont.* 32: 183—189.
- Kleinschmidt O.*, 1931: *Der Urmensch*. 2. Aufl. Leipzig.
- Krogh-Poulsen W.*, 1945: *Tændernes Morfologi*. 2. Udg. Munksgaard, København.
- Marseillier E.*, 1937: *Les dents humaines morphologie*. Paris.
- Pedersen P. O. & H. Thyssen*, 1942: Den cervicale Emaljerands Forløb hos Eskimoer. *Odont. T.* 50: 444—492.
- Pedersen P. O.*, 1949: The east Greenland eskimo dentition. Numerical variations and anatomy. *Meddelelser om Grønland*, vol. 142. København.
- Thorsen G.*, 1917: Tandens gingivale parti i forbindelse med nogen undersøkelser over det anatomiske forhold mellem emalje og cement. *Norske Tannlægeforen. Tid.* 27: 63—81.
- Tratman E. K.*, 1950: A comparison of the teeth of people. *Yearbook of Physical Anthropology* 6: 272—314.
- Watson A. E. & E. C. Woods*, 1926: Some irregularities of the enamel margin observed in human molars. *Brit. dent. J.* 47: 854—858.
- Weski O. & R. Contreras*, 1924: Befunde und Vorgänge im Interradikuläräume mehrwurzliger Zähne. *Vjschr. Zahnheilk.* 40: 229—246.
- Wheeler R. C.*, 1965: *Dental anatomy and physiology*. Philadelphia and London.

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