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Dentistry — Designation system for tooth developmental stages

Médecine bucco-dentaire — Système de désignation des stades de développement dentaire

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Foreword

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Introduction

Many age estimation methods using various body systems exist; however, the human dentition is considered one of the most accurate biological indicators of chronological age. Because tooth development is predominantly regulated by genetics, environmental factors have only a minimal effect on the development process.

Dental age assessment is typically based on 2D radiographic data correlating the degree of tooth development to the chronological age of a population. However, there are different scoring systems, with different numbers of stages and nomenclature of stages. Furthermore, different methods use the same scoring system and have different time intervals. Therefore, the number of dental developmental stages can vary greatly depending on the method used. In addition, some methods only offer diagrams, without descriptors, of tooth stages, which can lead to ambiguity in stage assignment and can affect the accuracy of the result of a technique.

Therefore, creating a standardized terminology with diagrams for tooth developmental stages is vital to improve the consistency of these score attributions, add objectivity to the assessment and improve the accuracy of the results.

For the purposes of this document, the tooth designation is assigned as outlined in ISO 3950.

Dentistry — Designation system for tooth developmental stages

1 Scope

This document specifies a method for designating the coding and nomenclature for tooth developmental stages using a single letter and number to facilitate data entry and support interoperability.

The first letter represents the part of the tooth (crown, root and apex), and the number represents the stage of development of the tooth part.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1942, *Dentistry — Vocabulary*

ISO 20888, *Dentistry — Vocabulary and designation system for forensic oro-dental data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942, ISO 20888 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org

3.1 **Crown developmental stages** (see Annex A)

3.1.1
stage C0
crown developmental stage at which no appearance is observed

Note 1 to entry: No visible evidence of development is observed.

3.1.2
stage C1
crown developmental stage at which bud is present but no evidence of mineralisation is observed

3.1.3
stage C2
crown developmental stage at which developed enamel is minute

Note 1 to entry: Stage C2 is analogous to the stage at which mineralisation has commenced.

Note 2 to entry: The incisal edge can be seen as a straight line (incomplete outline) in anterior teeth.

Note 3 to entry: In posterior teeth, isolated cusp tips can be seen as small isolated triangles with gaps in between.

3.1.4
stage C3
<anterior teeth> crown developmental stage at which the incisal edge with added mesial and distal angles can be seen

Note 1 to entry: Stage C3 is analogous to the stage at which the coalescence of cusps begins.

Note 2 to entry: The amount of enamel visible is minute (thin band).

3.1.5
stage C3
<posterior teeth > crown developmental stage at which the cusps are connected but with a gap in the middle (ring-shaped)

Note 1 to entry: Stage C3 is analogous to the stage at which the coalescence of cusps begins.

Note 2 to entry: The amount of enamel visible is minute (thin band).

3.1.6
stage C4
crown developmental stage at which the amount of enamel visible is thick and continuous, the dentine formation is not visible in the radiograph yet and the outline of the incisal edge or the occlusal surface is complete

Note 1 to entry: Stage C4 is analogous to the stage at which the cusp outline is completed.

3.1.7
stage C5
crown developmental stage at which part of the dentine can be seen as a thin band in the radiograph and the pulp is absent

Note 1 to entry: Stage C5 is analogous to the stage at which the crown is half-developed.

3.1.8
stage C6
crown developmental stage at which a thick layer of dentine can be seen, the pulp chamber can be seen, the pulp roof outline is not yet defined (straight line) and the crown edges are divergent

Note 1 to entry: Stage C6 is analogous to the stage at which the crown is three-quarters developed.

3.1.9
stage C7
crown developmental stage at which the outline of the whole crown is complete, the pulp roof well defined (closed umbrella shape in anterior teeth and open umbrella shape in molars with the dentine convexity in the middle and the pulp horns transparent), and the edges of the cervical crown are thin and convergent

Note 1 to entry: Stage C7 is analogous to the stage at which crown development is complete.

3.2 Root developmental stages (see Annex A)

3.2.1
stage R1
root development stage at which the outline of the whole crown is complete and divergent spicules of the root outline extending from the cervical crown edges have just begun to form

Note 1 to entry: Stage R1 is analogous to the stage at which the root begins formation.

3.2.2
stage R2
root development stage at which part of the root equivalent up to half the height of the crown (from highest cusp/incisal edge to cementoenamel junction) is developed, the root edges are divergent (dentine walls get thinner towards the root end), making the pulp wider thus giving the illusion that the apical root walls are going outwards)

Note 1 to entry: Stage R2 is analogous to the stage at which the root is one-quarter developed.

Note 2 to entry: Stage R2 is analogue to first sign of the root furcation area being visible in posterior teeth.

3.2.3
stage R3
root development stage at which the root has developed up to the complete height of the crown (from the highest cusp/incisal edge to the cementoenamel junction), and the root edges are divergent

Note 1 to entry: Stage R3 is analogous to the stage at which the root is one-half developed.

3.2.4
stage R4
root development stage at which the root is longer than the height of the crown (from highest cusp/incisal edge to cementoenamel junction) and root edges are divergent

Note 1 to entry: Stage R4 is analogous to the stage at which the root is three-quarters developed.

3.2.5
stage R5
root development stage at which the whole outline of the tooth (crown and root) is complete and the root edges are parallel

Note 1 to entry: Stage R5 is analogous to the stage at which the root is entirely developed.

3.3 Apex developmental stages (see Annex A)

3.3.1
stage A1
apex developmental stage at which the outline of the whole tooth (crown and root) is complete, the root edges are convergent (bullet-shaped) and the tooth appears complete but with wide, apical periodontal ligament space

Note 1 to entry: Stage A1 is analogous to the stage at which the apex is half-closed.

3.3.2
stage A2
apex developmental stage at which the outline of the whole tooth (crown and root) is complete, root edges are convergent (bullet-shaped) and there is a uniform periodontal ligament space around the entire root

Note 1 to entry: Stage A2 is analogous to the stage at which the apex is completely closed.

4 Structure of the code

In order to allow for human readability of the codes, a letter-number coding system is utilized; the letter represents the part of the tooth (crown, root and apex). The number represents the stage of development of the tooth part.

5 Designation of tooth developmental stages

5.1 The designation of tooth development stages from dental radiographic images is based on the terms defined in Clause 3. The images and drawings in Table A.1 for multi-rooted teeth and Table A.2 for single-rooted teeth are intended strictly for informative purposes.

5.2 Based on the ideal tooth form, developmental stages refer to the amount of tooth developed rather than its relation to the undeveloped part.

5.3 A tooth is considered to be at a particular developmental stage until any element from the next stage is present. When there are different developmental stages present on separate roots involving the same tooth, then the less mature, developing root stage is chosen over the more mature stage.

Annex A
(informative)

Tables of tooth development

Table A.1 — Tooth developmental stages for multi-rooted teeth

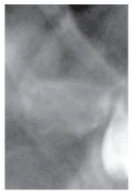
Stage	Mandible		Maxilla		Significant findings
stage C0	None	None	None	None	Non-appearance
stage C1					Bud is present, but no evidence of mineralisation.
stage C2					Developed enamel is minute. Isolated cusp tips can be seen as small, isolated triangles with gaps in between.
stage C3					Cusps are connected but with a gap in the middle (ring-shaped). The amount of enamel visible is minute (thin band).
stage C4					The amount of enamel visible is thick and continuous, the dentine has not formed yet, and the outline of the occlusal surface is complete.
stage C5					Part of the dentine can be seen as a thin band and the pulp is absent. Crown is half developed.
stage C6					A thick layer of dentine can be seen, the pulp chamber can be seen, the pulp roof outline is not yet defined (straight line) and the crown edges are divergent.

Table A.1 *(continued)*

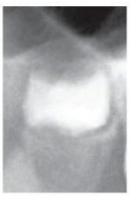
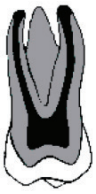
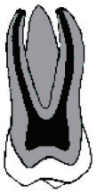
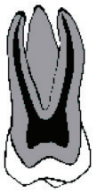
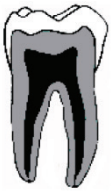
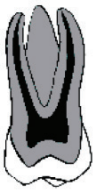
Stage	Mandible		Maxilla		Significant findings
stage C7					Outline of the crown is complete, the pulp roof well defined (open umbrella shape with the dentine convexity in the middle and the pulp horns transparent), and the edges of the cervical part of the crown are thin and convergent.
stage R1					Outline of the crown is complete and divergent spicules of the root outline extending from the cervical crown edges have just begun to form.
stage R2					Root development is up to half the crown height. Divergent root edges are present. Bifurcation area is visible.
stage R3					The root is developed up to the complete height of the crown and the root edges are divergent.
stage R4					Root development is longer than the height of the crown. Divergent root edges.
stage R5					Outline of the tooth (crown and root) is complete. Parallel root edges.
stage A1					Outline of the tooth (crown and root) is complete. Convergent root edges. Wide periodontal ligament space at the apex.
stage A2					Outline of the tooth (crown and root) is complete. Convergent root edges. Uniform periodontal ligament space around entire root.

Table A.2 — Tooth developmental stages for single-rooted teeth

Stage	Mandible		Maxilla		Significant findings
stage C0	None	None	None	None	Non-appearance
stage C1					Bud is present, but there is no evidence of mineralisation.
stage C2					Developed enamel is minute. The incisal/occlusal edge can be seen as an incomplete outline.
stage C3					An incisal/occlusal edge with added mesial and distal angles can be seen. The amount of enamel visible is minute (thin band).
stage C4					The amount of enamel visible is thick and continuous, the dentine has not formed yet, and the outline of the incisal/ occlusal edge is complete.
stage C5					Part of the dentine can be seen as a thin band, and the pulp is absent. Crown is half developed.
stage C6					A thick layer of dentine can be seen, the pulp chamber can be seen, the pulp roof outline is not yet defined (straight line), and the crown edges are divergent.
stage C7					Outline of the crown is complete, the pulp roof well defined (closed umbrella shape anterior teeth/ open umbrella shape posterior teeth), and the edges of the cervical part of the crown are thin and convergent.
stage R1					Outline of the crown is complete and divergent spicules of the root outline extending from the cervical crown edges have just begun to form.

Table A.2 *(continued)*

Stage	Mandible		Maxilla		Significant findings
stage R2					The root is developed up to half the height of the crown. The root edges are divergent making the pulp wider and giving the illusion that the apical walls are going outward.
stage R3					The root is developed up to the complete height of the crown and the root edges are divergent.
stage R4					Root development is longer than the height of the crown. Divergent root edges.
stage R5					Outline of the tooth (crown and root) is complete. Parallel root edges.
stage A1					Outline of the tooth (crown and root) is complete. Convergent root edges. Wide periodontal ligament space at the apex.
stage A2					Outline of the tooth (crown and root) is complete. Convergent root edges. Uniform periodontal ligament space around entire root.

Bibliography

[1] ISO 3950, *Dentistry — Designation system for teeth and areas of the oral cavity*

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