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Problems with Current Dental Documentation in Germany

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Abstract

Background: dental documentation is essential for the representation and communication of dental information amongst researchers and practitioners. Dental documentation has to provide the respective means for (a) the representation of the patient status' and (b) the possible actions.

Methods: the consistency of German definitions currently used for dental findings is evaluated by projecting well known examples onto problem axes like "existence of a structure" and "condition of a structure".

Results: it can be shown that current German dental terminology does not support an unambiguous documentation for any situation in dental practice. In some cases, Multiple aspects are merged in several finding statements and make a stringent derivation of the treatment planning difficult.

Conclusions: dental documentation in Germany can in some aspects be improved with respect to (a) precision, (b) expressiveness, (c) simplicity and (d) reproducibility. The main axes of dental documentation are enumerated in preparation of a future top-down approach.

Clinical Implications: an optimised finding scheme can enhance the communication amongst researchers and practitioners and thus is supposed to improve the treatment quality in the long run.

Keywords: Documentation, Findings, Dentistry.

1 CURRENT DEFINITION OF FINDING ACRONYMS

In this article, correlation of a precise documentation for both treatment planning and research will be investigated. For findings play an important role in dental decision-making [1], we will concentrate on this more part of dental documentation. Mainly for the dental findings, it will be investigated whether the current way of documenting finding statements in Germany is appropriate for the comprehensive documentation of dental cases. Later, general criteria for improvement will be derived. A possible improvements for dental documentation in Germany will be described in a separate article.

In literature, dental nomenclatures for dental terms like "acute", "anamnesis" or "fracture" (cf. [2]) are described. They fail - however - to form a global structured approach for dental documentation. Though dental finding schemes are used both in hospitals and practices, one can hardly find according definitions or documentation protocols in scientific literature. For that reason, the finding acronyms can strongly vary between the different institutions.

In [3,4] several improvements for dental documentation have been suggested. However, requirements for the unambiguous representation of dental cases are not discussed. These article rather concentrate on the general process of dental documentation.

The ANSI/ADA Specification No. 1000 for Standard Clinical Data Architecture [5] describes technical specifications of dental communication. A methodology for the finding of dental structures is not included. Nevertheless, the dental documentation has been partitioned within the Third German Investigation on Oral Health (Dritte Deutsche Mundgesundheitsstudie, DMS III, [6]). The section headings of chapter 5 enumerate the fundamental aspects in dental documentation:

- Caries finding
    - Crown Replacement
    - Dental Root
    - Erosion (wedge-shaped defects) – abrasion (attritions)
- Periodontal findings
    - Finding of dental calculus
    - Gingivitis
    - Community Periodontal Index (CPI)
    - Determination of Attachment Loss (AV)
    - Recession / Hyperplasia
- Dental Prosthetic Finding
    - Clinical Proceeding
    - Findings for the Prosthetic Status
- Functional Finding
    - Target Variables

- o Clinical investigation of the Set of Teeth and Questionnaire for Functional symptoms
- o Definition of the variables for the Functional Examination
- o Helkimo-Index
- o Subjective Necessities of Treatment
- Oral Mucous Membrane
  - o Examination Methods
  - o Diagnostic Criteria
  - o Choice of the target diseases
  - o Recording of the localization

Since all of these aspects of dental documentation have been collected over the years, it can be assumed that they include most of the important dental aspects. If this list is supposed to be complete, the question about the appropriate structure and representation of dental documentation arises. To illustrate the expressiveness of current dental documentation, the examination will concentrate on finding statements. Here, the most important axes relate to the following aspects:

- Existence or missing of structures
- Topographical location of existing structures
- Condition of existing structures
- Partial treatments already applied
- Partial treatments planned
- Intention and desired function of the result.

It will be investigated in the first section, how precise each finding statement can represent a partial aspect of the dental domain. Later, the main lacks and the main axes for a top-down structure will be derived.

1.1 Most common finding statements

In this section, the most frequently used finding statements will be listed and described with respect to their usage. In the section below, some typical problems with these statements are discussed.

Table 1: Overview of well known finding statements. The German definitions and their approximate English translation are described (not complete!).

German term	English term	Description
Brückenglied	Pontic	Part of a fixed partial denture construction (replacing a crown and not being fixed at another abutment)

German term	English term	Description
Elongation	Elongation	Prolongation, growing of a tooth outside of the periodontium; mostly because of a missing antagonist. For an impeccable chewing function, the elongated teeth have to be shortened; the missing antagonist has to be replaced.
Erkrankter, erhaltungs-würdiger Zahn	Ill but conservable tooth	A conservative treatment is impossible. The periodontium is ok. Prosthetics is planed.
Erosion	Erosion	Progressive loss of tooth substance by chemical processes [7].
Ersetzter Zahn	Replaced tooth	Artificial replaced tooth.
Fehlender Zahn	Missing tooth	No crown and no root present in the region (gap).
Fraktur	Fracture	Facture of the tooth in the region of the dental crown and/or the root. Fractures of (a) the enamel can be distinguished from (b) fractures uncovering of dentin and (c) complicated fractures with opening of the pulpa, (d) root fractures.
Füllung	Restoration (composite)	Generally composite restoration.
Füllung (Amalgam)	Restoration (amalgam)	Partial crown restoration with amalgam.
Geschiebe	Attachment	Retainer consisting of a metal receptacle and closely fitting part.
Halteelement	Retainer	Any type of device used for the stabilization on or stabilization of prosthesis.
Implantat (dental)	Implant (dental)	Dental implant, prosthetic device of alloplastic material implanted into the oral tissue to provide retention and support for fixed or removable prosthesis [7].
Initialkaries	Initial caries	Reversible early stage caries.
Inlay	Inlay	Fixed infracoronal restoration made outside of a tooth.
Inlay (Keramik)	Inlay (ceramic)	Inlay consisting of ceramic.
Inlay (Metall)	Inlay (metal)	Inlay consisting of metal.
Interdentaler Krater	Interdental crater	Bone loss between two teeth.
Intrusion	Intrusion	Movement of a tooth in an apical direction.
Karies	Caries	Irreversible descaling of the crystalline enamel by the influence of bacterial acid.
Keilförmiger Defekt	Wedge-shaped defect	Wedge-shaped depression.
Keramik-verblendung	Veneer (ceramic)	Ceramic veneers.
Kippung	Tilt	The slope of the dental axis with respect to the occlusal plain lies outside of the normal range.

German term	English term	Description
Krone	Crown	Restoration of a missing tooth structure surrounding part or all of the remaining structure.
Krone Keramik-verblendung	Crown (ceramic)	Crown that uses a metal substructure on which a ceramic veneer is fused.
Krone (Metall)	Crown (metal)	Metal crown replacement mounted on a natural root.
Krone (VMK)	Crown (metal-ceramic)	Metal-ceramic crown replacement mounted on a natural root.
Krone mit Kunststoff-verblendung	Veneer (plastic)	Plastic veneer.
Lückenschluss	Gap closure	Shifting the teeth from distal to mesial closes a gap between two teeth.
Nichterhaltungs-würdiger Zahn	Non-conservable tooth	Tooth has to be extracted.
partieller Lückenschluss	Partial gap-closure	Partial Closure of a gap between two teeth.
Interimsersatz	Interims prosthesis	Removable prosthesis for a limited period of time, after which it is to be replaced by a definitive prosthesis.
Provisorium	Temporary crown or pontic	Provision crown replacement.
Restauration mit Defekt	Restoration with defect	
Rezession	Recession	Declination of the gingiva.
Rotation	Rotation	Rotation of the tooth around his longitudinal axis.
Schlifffacette	Area of attrition	
Stellungs-anomalie	Abnormal position	The tooth is not aligned in the set of teeth.
Strukturanomalie	Abnormal structure	
Teilkrone	Partial crown	Crown surrounding part of the remaining tooth structure.
Teilretention	Partial retention	
Teleskop / Konus	Telescope/cone	Artificial crown constructed to fit on a coping for retaining a removable partial denture.
Überstehender Füllungs- bzw. Kronenrand	Out-sticking edge of a crown or a restoration	Restoration and crown edge do not fit exactly to the surface of the natural tooth.
Verblockung	Blocking	Stiff connection of artificial crowns.
Verfärbung	Discoloration	Change of color.
Versiegelung	Sealing of the fissure	Sealing of the Fissure with composite.

German term	English term	Description
Wurzelkaries	Root caries	Caries at the dental root.
Zahn in Ordnung	Tooth ok	No defects present.
Zahnhalsdefekt	Defect of tooth cervix	Caries or wedge-shaped depression at the tooth collar.
Zahnstein	Calculus	Sediment of mineral substance, mostly a combination of calcium phosphate and saliva mixed with organic tissue remains and microorganisms.
Zerstörter, erhalt-ungswürdiger Zahn	Destroyed but conservable tooth	A conservative treatment is impossible. The periodontium is ok. Prosthetics is planned.

1.2 Projecting the finding statements onto main axes of dental finding

To check whether and how systematic finding definitions shown above have been set up, they will be projected onto the following axes:

- Topography of existing structures
- Conditions of existing structures
- Partial treatments
- Already applied treatments
- Intention and function of partial treatments

Like this, it can be investigated for each of them whether it is used for the representation of dislike aspects of documentation. If dissimilar aspects can be assigned to one finding statement, a separate and thus precise usage is presently impossible (the acronyms have been taken from the standard finding form used in the University Hospital of Heidelberg. They are representative for usage in Germany):

Table 2: Finding statements describing the existence or the missing of a structure. To ease the readability only the English terms will be shown (A = acronym).

A	Term	Description
b	Pontic	Part of a fixed partial denture construction.
e	Replaced tooth	Artificial replaced tooth.
f	Missing tooth	No crown and no root present in the region (gap).
fl	Restoration	Generally restoration.
fk	Restoration (composite)	Composite Restoration.
)(	Gap closure	Shifting the teeth from distal to mesial closes a gap between two teeth.
o	Attachment	Special preparation of the artificial crown for the fixation of the removable denture.
h	Retainer	Metal retainer for the fixation of a removable, partial prosthesis fixed at the anchor teeth and supported gingivally.

A	Term	Description
i	Implant	Dental implant, prosthetic device of alloplastic material implanted into the oral tissue to provide retention and support for fixed or removable prosthesis.
in	Inlay	Fixed infracoronal restoration made outside of a tooth.
im	Inlay (metal)	Inlay consisting of ceramic.
ik	Inlay (ceramic)	Inlay consisting of metal.
m	Veneer (ceramic)	Ceramic veneers of replaced tooth
k	Crown	Crown replacement mounted on a natural root.
kk	Crown (ceramic)	Crown that uses a metal substructure on which a ceramic veneer is fused.
km	Crown (metal)	Metal crown replacement mounted on a natural root.
kv	Crown (metal-ceramic)	Metal-ceramic crown replacement mounted on a natural root.
v	Veneer (plastic)	Plastic veneer.
) (	Partial gap-closure	Partial Closure of a gap between two teeth.
pv	Temporary crown or pontic	Provision crown replacement.
sf	Abrasion	Abrasion resulting from the meeting of two antagonists.
tk	Partial crown	Crown surrounding part of the remaining tooth structure.
t	Telescope/ cone	Artificial crown constructed to fit on a coping for retaining a removable partial denture.
ür	Out-sticking edge of a crown or a restoration	Restoration and crown edge do not fit exactly to the surface of the natural tooth.
vs	Sealing	Sealing of the fissure with composite.

Table 3: Finding statements describing the topography of existing Structures (A = acronym).

A	Term	Description
el	Elongation	Prolongation, growing of a tooth outside of the tooth compartment; mostly because of a missing antagonist. For an impeccable chewing function the elongated teeth have to be shortened; the missing antagonist has to be replaced.
)(	Gap closure	Shifting the teeth from distal to mesial closes a gap between two teeth.
↓	Intrusion	Movement of a tooth in an apical direction.
kp	Tilt	The slope of the dental axis with respect to the occlusal plain lies outside of the normal range.
ro	Rotation	Rotation of the tooth around his longitudinal axis.

A	Term	Description
sa	Abnormal position	The tooth is not aligned in the set of teeth.

Table 4: Finding statements describing conditions of existing Structures (A = acronym).

A	Term	Description
er	Erosion	Partial destruction of the tooth.
fr	Fracture	Fracture of the tooth in the region of the dental crown and/or the root. Fractures of (a) the enamel can be distinguished from (b) fractures uncovering of dentin and (c) complicated fractures with opening of the pulpa, (d) root fractures.
fa	Restoration (amalgam)	Partial crown replacement.
ik	Initial Caries	Reversible early stage caries.
kr	Interdental crater	Bone loss between two teeth.
c	Caries	Irreversible descaling of the crystalline enamel by the influence of bacterial acid
dk	Wedge-shaped defect	
x	Non-conservable tooth	Tooth does not show any vitality and has to be extracted.
rd	Restoration with Defect	
re	Recession	Declination of the gingival.
sf	Abrasion	Abrasion resulting from the meeting of two antagonists.
sa	Abnormal Structure	
ür	Out-sticking edge of a crown or a restoration	Restoration and crown edge do not fit exactly to the surface of the natural tooth.
vf	Discoloration	Change of colour.
wk	Root Caries	Caries at the dental root.
ok	Tooth ok	No defects present.
zd	Defect of tooth cervix	Caries or wedge-shaped defect at the tooth cervix.
za	Dental calculus	Sediment of mineral substance, mostly a combination of calcium phosphate and saliva mixed with organic tissue remains and microorganisms.

A	Term	Description
w	Destroyed but conservable tooth	A conservative treatment is impossible. The periodontium is ok. Prosthetics is planned.

Table 5: Finding statements describing applied treatments (A = acronym).

A	Term	Description
x	Non-conservable tooth	Tooth has to be extracted.
za	Dental calculus	Sediment of mineral substance, mostly a combination of calcium phosphate and saliva mixed with organic tissue remains and microorganisms.

Table 6: Finding statements describing intention and function of partial treatments (A = acronym).

A	Term	Explanation
	Blocking	Stiff connection of artificial crowns.

In this section, the findings statements have been projected onto several axes. As most of the acronyms can be found on different axes, they represent multiple aspects. Like this, it can be shown that most of the finding statements contain versatile and complex information. With other words, most of the finding statements cannot be expressed by one specific argument as various aspects are bound to it at the same time.

2 DOCUMENTATION IN DENTAL PRACTICE

In the following, the practical usage and the respective expressiveness of the finding statements will be examined with the help of sample cases. Here, practical problems of their application will be discussed.

2.1 Examples for the difficulties during the finding process

Within the AIDA-project [8,9], several hundred real-life cases have been investigated for the definition of planning rules for prosthetics. During this modelling, problems have been found with respect to the documentation. Several problems have shown up, where only the simple ones will be described in the following.

Gap closure

By documenting a gap closure it two aspects are mixed-up: (a) the missing of a structure and (b) the position of neighbour teeth. Usually, it is not specified how large the gap is and whether a replaced tooth is needed or wanted.

Constructions of fixed partial denture

The documentation does not properly distinguish between a normal crown and a retainer. In the following sample situation it cannot be reconstructed whether the solution represents two bridge constructions or one construction.

```
BA B  BA BA B  B  BA
18 17 16 15 14 13 12 11 | 21 22 23 24 25 26 27 28
-------------------------------------------------
48 47 46 45 44 43 42 41 | 31 32 33 34 35 36 37 38
```

This could be clarified if the connection between 16 and 15 was documented. Another solution could to note the extension of the fixed partial denture. Like this, the connections between the two elements of the construction (crown replacement) could easily be determined.

Interims replacement vs. final replaced tooth

The acronym "E" specifies both an *interims replacement* and a *final crown replacement*. In contrast to the latter, an interims replacement is equivalent to the non-existence of an adequate final structure.

As shown above, a clear distinction between (a) the characteristics, (b) the location, (c) the planned measures and (d) the intended aims cannot appropriately be expressed on the basis of the existing finding scheme. Hence, the definitions have to be revised to result in an unambiguous representation of the patient's status.

2.2 Necessity of separation between actual and intended states

If dental documentation does not strictly distinguish between (a) the current state of the patient and (b) his intended state after treatment, the comprehension of the dental decision-making is complicated.

It seems to be useful to clarify the following questions in the future:

- How can the finding statements and their acronyms be improved for an unambiguous description of dental problems?
- Which partners (e.g. health services) have to be involved for a re-definition of the finding statements?
- How and to what extent can new finding statements be manifested and spread?
- An answer will be given for the first question.

In the next section, fundamental criteria for the improvement of dental documentation will be given. Due to the complexity of dental documentation, a new top-down approach has to be described in a separate article.

3 ENHANCED STRUCTURE FOR DENTAL DOCUMENTATION

According to Leiner et al. [10] (a) objects and (b) their properties can be distinguished. Hence, a multi-axial classification should be defined for the specification of the objects and their characteristics.

The current International Classification of Diseases (ICD-10) is mainly used for financial or organisational purposes. The Medical Subject Headings (MeSH, [11]) provide a terminology for the representation of medical concepts. Unfortunately, these structures are (a) not powerful enough and (b) not well structured to represent the patient's dental status in detail. Accordingly, it will be shown exemplarily in the following how the finding statements can be structured for an unambiguous representation of dental situations and respective solutions.

3.1 Main axes of dental documentation

A re-definition of the dental finding statements and their acronyms takes a lot of effort to make them applicable in the practice. Hence, only the main criteria and axes of a unified dental documentation interest will be shown in the following. Here, informational aspects will not be considered in detail.

The main axes of dental finding

Any dental question can be related to one or more human topology. Hence, (i) the location, (ii) the structure and (iii) the characteristics can be distinguished. Usually, the location and the structure are strongly correlated. However, in certain situations the location might vary (e.g. a tooth might be shifted). Only in the latter situations, the location has to be added to properly represent the patient's status.

The topological scheme has to be expressive enough to localise all or at least most of the real-life situations with a minimum set of acronyms. With such a "class model", the relations of objects can be visualised based on the object-oriented modelling scheme [12,13]. An according partial approach for the relations of the jaw structures is shown in figure 1.

Fehler! Es ist nicht möglich, durch die Bearbeitung von Feldfunktionen Objekte zu erstellen.

Figure 1: Part of the class diagram visualised based on the UML modelling scheme [12,13].

Characteristics of dental diseases

According to MeSH [14] the stomatognathic diseases are distinguished as follows:

- Jaw Diseases
- Mouth Diseases
- Pharyngeal Diseases
- Stomatognathic System Abnormalities
- Temporomandibular Joint Disorders
- Tooth Diseases

In the MeSH-terminology, various aspects like *structure*, *location*, *type of disease* and *characteristics* are combined. Hence, the MeSH-classification can be used for analysis but it is not well suited for the structured representation of characteristics.

For each of the axes mentioned above the finding scheme should be specified more in detail. Reversibly, the individual finding can be composed on the basis of these *fundamental finding axes*. Here, syntactical rules for the composition of multi-axial classifications can ease (a) the process of documentation and (b) reduce the amount of acronym necessary; like this it can (c) help reducing mistakes in data entry (cf. the GALEN-project, [15,16]).

   If a redefinition of the dental documentation is realised, an internationalisation of the standard should be considered. Like this, other differences – like the region codes – could easily be adapted for a better exchange between researchers and practitioners.

3.2 Representation of dental documentation

The axes of description enumerated above can be used for the construction of a multi-axial nomenclature or even a multi-axial classification. In the following, examples will be given, how to compose the partial statements e.g. to one dental finding.

   Most of the findings can have different extensions and occur at several locations. For that reason, it is useful to emphasise the point of view of the *findings* rather than the one of the *locations* in dentistry. In other words, the different locations of a specific finding are enumerated rather than the different findings of a location. For a specific finding this could look as follows:

- `{type_of_finding}({location/type_of_structure})`

A sample for an individual finding has to be given: caries at the crown in region 025 and caries at the root of region 026 can be represented as

- `caries(025/25/crown)`
- `caries(026/26/root)`

It has to be emphasised, that the affected structures still have to be specified in more detail to be able to derive an individual treatment alternative and the respective treatment plan from the patient's finding statements, (e.g. concerned surfaces).

3.3 <u>Necessity of new finding acronyms</u>

To make such a representation of findings possible new definitions of the finding acronyms have to be established. The existing finding statements have to be translated into a new scheme in order to make an unambiguous representation possible. E.g. new finding statements should be set up to distinguish (a) an interims replacement ("e") and (b) an artificial crown, that is not used as a bridge abutment („k").

4 SUMMARY AND PROSPECTS

Several problems of current dental documentation have been discovered. Most of the finding statements represent multiple findings within one statement. Accordingly, the current German finding scheme does not allow an optimal representation for the full range of dental cases. Moreover, for specific situations it could be shown that specific constellations cannot be distinguished based on the standard documentation.

A revision of the representation scheme for dental finding statements can help to improve the representation of (a) the interaction between the patient's status before treatment, (b) the intended state after planning and (c) the state after the treatment. It can help reducing (i) ambiguity of dental documentation and (ii) the size of a patient record. This approach should be brought into consistency with existing approaches for medical documentation.

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