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A systematic review of the diagnostic classifications of traumatic dental injuries

Feliciano KMPC, de França Caldas Jr. A. A systematic review of the diagnostic classifications of traumatic dental injuries.
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Abstract – A systematic review of the literature was undertaken to evaluate the criteria used for the diagnostic classification of traumatic dental injuries from an epidemiological standpoint. The methodology used was that suggested by the Cochrane Collaboration and the National Health Service. A total of 12 electronic bibliographical databases (BBO, BioMed Central, Blackwell Synergy, Cochrane, DARE, EMBASE, HighWire, LILACS, MEDLINE, PubMed Central, SciELO, SciSearch) and the World Wide Web were searched. There was no attempt to specify the strategy in relation to date, study design, or language. The last search was performed in May 2003. Two reviewers screened each record independently for eligibility by examining titles, abstracts, keywords and using a standardized reference form. Disagreements were resolved through consensus. The final study collection consisted of 164 articles, from 1936 to 2003, and the population sample ranged from 38 to 210 500 patients. 54 distinct classification systems were identified. According to the literature, the most frequently used classification system was that of Andreasen (32%); as regards the type of injury, the uncomplicated crown fracture was the most mentioned lesion (88.5%). Evidence supports the fact that there is no suitable system for establishing the diagnosis of the studied injuries that could be applied to epidemiological surveys.

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In current terminology, the use of the word trauma implies a reasonable severe, non-physiological lesion to any part of the body. Any thermal, chemical or mechanical lesion that affects the dentition should be analyzed as a dental trauma and its effect, as a traumatic dental injury (1).

Violence, traffic accidents and sports activities, have been identified as some of the major causes that contribute to dental trauma and pose a definite public health problem (2). These causes especially emerge as an increasingly significant threat to the dental health of children and adolescents (3–5). Moreover, studies, in many countries, have shown that a remarkable decline of the prevalence and severity of dental caries among children (6–9) has also been pointed as a cause for this relevant public concern throughout the adolescence (10, 11). It has been claimed that the volume represented by dental trauma and its sequelaes within the foreseeable future will probably exceed dental caries and periodontal disease in the young population (12, 13).

Numerous classification systems have been proposed for traumatic dental injuries (14–26). This plethora of classifications has added both contradiction and confusion to the understanding of this issue (2, 27, 28).

In this context, some of these systems are virtually non-applicable in epidemiological studies, because of some particular characteristics, i.e. radiographic examination as part of the clinical examination; diagnosis of root fractures, pulp vitality and sinus tracts. Furthermore, some of them include many broad terms, detailed terms, or very controversial ones. The need to standardize international

registration norms in this field is underlined dramatically by the vast amount of literature. Therefore, the purpose of this present review was to discuss the existing evidence on the diagnostic classification of traumatic dental injuries in the permanent dentition.

Methods

The methodology of this study was an adaptation of that proposed by the Cochrane Collaboration for undertaking, carrying out or commissioning Systematic Reviews of Research on Effectiveness (29) in association with that suggested by the National Health Service (NHS), Centre for Reviews and Dissemination (CDR), University of York (30).

Inclusion criteria

All studies with any proposed classification system on the diagnosis of traumatic dental injuries to the permanent dentition were included.

Sources of research evidence

The sources of research evidence were 12 electronic bibliographical databases (BBO, BioMed Central, Blackwell Synergy, Cochrane, DARE, EMBASE, HighWire, LILACS, MEDLINE, PubMed Central, SciELO, SciSearch) from 1948 to 2003, and the World Wide Web. There was no attempt to specify the strategy in relation to date, study design, or language. The registered dates correspond to those research periods permitted by each electronic database. Several reference lists were hand searched, as well as information available from three university libraries. Additionally experts were contacted for the grey literature. The last search was performed in May 2003.

All studies, even those that had not been published at the time, were recorded and analyzed for eligibility. The literature reviews and some books were included only for recording any possible classification systems.

Study selection and assessment

A funnel process of evaluation was developed in multiple stages. Two reviewers independently screened each publication for eligibility by examining titles, abstracts and keywords. The over inclusion was considered in this stage as to avoid any possible conservative errors. Disagreements were resolved through consensus. Those studies that did not match the inclusion criteria were excluded in this phase. Afterwards, a new collection list was generated and the articles were thoroughly analyzed by the same reviewers. The inclusion criteria were assessed through a standardized form. Subsequently, another collection list was created and the data extraction procedure was performed.

A second standardized form was developed for the assessment of the quality of each study, which resulted in the exclusion of some studies. The reviewers would choose among three answers (yes, undefined/non-applicable, or no) and the sum of all positive answers would determine the inclusion of the study. The answer 'undefined/non-applicable' was considered only in cases in which consensus could not be reached.

The analysis was not masked as regards the authors and the results. The reviewers extracted the relevant data independently and the information was crossed for disagreements, which were resolved through consensus.

Data synthesis and results assessment

All studies were recorded in the Reference Manager software (31). This software provided an identity number (ID), which was considered throughout the review. The final data was synthesized and further assessed.

Results

A total of 116 studies were excluded at the end of the second analysis. Each study was identified and each exclusion reason was detailed. In the final analysis, six articles were excluded because they did not match the quality inclusion criteria.

Provided no attempt was considered to specify the strategy in relation to date, study design or language, 25 studies in different languages (other than Portuguese, English, Italian, Spanish and French) were identified. They are still waiting for translation and will be included in a future article.

Overall, the final study collection consisted of 164 articles, from 1936 to 2003 and the population sample ranged from 38 to 210 500 patients. The last search was performed in May 2003. The grey literature comprised 16 articles. The included, excluded and awaiting study lists are with the authors.

Diagnostic classifications of dental trauma

A significant number of classification systems was identified (total = 54), and some were mentioned or used only once (by the original author). The majority of the revised articles used or mentioned Andreasen's classification (32%), followed by Ellis' (14%) and Garcia-Godoy's (6%). Several studies

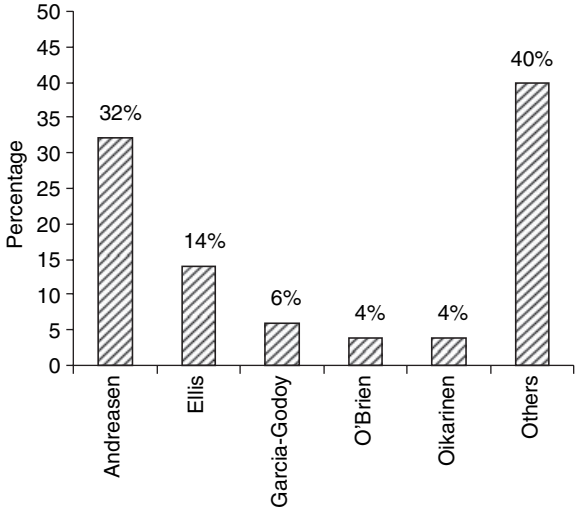

Fig. 1. Distribution of the revised studies according to the main classification systems.

noted the same trend in distribution of O'Brien's and Oikarinen's classifications (4%). The other classification systems accounted for 40% of the studies (Fig. 1).

Discussion

One of the most remarkable and relevant problems regarding Dental Traumatology is the wide range of the existing diagnostic classification systems, and this may pose some relevant problems. In light of this discrepancy, some clinical and epidemiological studies have shown great differences regarding the prevalence and incidence values of diagnostic categories. The question that guided this review arose from this fact.

Only a single search strategy was developed and it was adapted to each specific database. No strategy restriction was considered for searching the studies from 1948. For the ones carried out before 1948, the searching process was performed through the references found electronically. Additionally, postal and electronic communications were sent to researchers to reach the grey literature and to seek their assistance in its assessment.

This review started on March 2002 and lasted 15 months. Original articles were identified and assessed in five different languages (Portuguese, English, Italian, Spanish and French); two reviewers were responsible for the study analysis, which is recommended by the Cochrane Collaboration; an extensive electronic search was developed (twelve electronic databases); rigid patterns were followed in the qualitative analysis process. These criteria are relevant for the final quality of any systematic review.

Diagnostic classifications of dental trauma

Many authors assessed the traumatic dental injuries under different perspectives and according to a wide variety of factors, such as etiology, anatomy, pathology and treatment (14, 15, 20, 32–35). Some researchers used a formal classification system (17, 36, 37), while others tried to create new systems or to modify the existed ones (33, 35, 38–40). These authors attempted to simplify the discussion about the diagnosis of dental trauma and were very well intentioned. However, according to Bakland (39) and Fountain, Camp (37), they resulted in some confusing systems of categories and subcategories with no connection among them and no universal acceptance of their classifications.

In 1962, Ellis (16) recommended a simplified classification system, based on a numerical and anatomic structure. Even though it defines a wide range of lesions, it allows a subjective interpretation, through the use of broad terms such as simple and extensive.

According to Andreasen (41), in 1972, dental injuries were classified as complicated and uncomplicated. This generalized system may lead researchers to confusing and inappropriate conclusions. The author explained that a justifiable reason for allotting these injuries into two main groups was the applicability in studies with a clinical therapeutic approach. This system comprises 19 categories, including injuries to the hard dental tissue and the pulp, to the supporting bone, to gingiva or oral mucosa.

The most remarkable difference between the systems suggested by Andreasen in 1970 (17) and 1972 (41) is the inclusion of infractions or incomplete fractures. When comparing the 1972's (41) and 1994's (42), the latter specifies the bone fractures and emphasizes the diagnosis of uncomplicated crown fractures and entitles these injuries as enamel and enamel-dentin fractures.

Virtually, the WHO (World Health Organization) system is the same as that recommended by Andreasen. The injuries descriptions are associated to the ICD (Application of the International Classification of Disease) codes with the necessary changes.

The newest and most specific version of the ICD to Dentistry is the third edition of the ICD-DA (Application of the International Classification of Disease to Dentistry and Stomatology), which is derived from the 10th revision of the ICD-10. It provides a coherent system for coding and classifying data on oral and dental disorders, particularly when electronic or mechanical means of retrieval and analysis are used. It has been subdivided and expanded to include a fifth character to focus the attention of oral health personnel on the need for

detailed diagnosis for each patient, to allow standardized recording of all diagnoses, and to facilitate comparison data at an international level. This system is valuable to a wide variety of users, from governments collecting basic data to individual researchers, practitioners, and lecturers who require a convenient method for indexing their records and teaching material.

The classification suggested by García-Godoy (20) is also a deviation of the WHO's (19). Nevertheless, the former separates the dental fractures in those with or without cementum involvement. Broad terms, such as those used by Andreasen (41), are not included in this classification (e.g. complicated and uncomplicated fractures). There are no groups for subluxations, alveolar injuries, mandibular or maxillary fractures. The luxations are considered in cases with loosening but with no displacement.

The system proposed by Spinas and Piroddi (43), in 1998, identifies 86 class B-elements (42 with pulpal involvement), 60 class C-elements (35 with pulpal involvement), in the enamel-dentin fractures group. In the same group, Andreasen and Andreasen (42) found 83 complicated fractures in 156 enamel injuries. A basic comparison among the first classification, Ellis' (16) and Andreasen's (41), allows the following conclusions:

Ellis' class I = Spinas and Piroddi's class A;

Ellis' class II = Spinas and Piroddi's class B and C;

Andreasen's class III = Spinas and Piroddi's class B and C;

Ellis' class III = Spinas and Piroddi's class B1 and C1;

Andreasen's class IV = Spinas and Piroddi's class B1 and C1.

From these mentioned findings and conclusions, it is possible to note that the different proposed groups, cited by those authors, would be traditionally grouped as enamel-dentin fractures.

Those researchers, who presented either an excessively generalized or apparently incomplete classification system, may have been influenced by Andreasen, when focusing his ideal characteristics (comprehensive, generalized and complete studies).

Some of the studied systems are not applicable to epidemiological studies, as it would provide an incorrect diagnosis, and therefore, potentially incorrect or inappropriate therapeutic decisions. Some of the reasons are listed below:

- Radiographic examination for the diagnosis of root fractures (15–23, 33, 35, 41, 42, 44–56);
- Root condition assessment (23, 48, 57, 58);
- Pulp vitality assessment (14, 16, 46, 48, 58–60);
- Fistulous tract (24, 61);
- Diagnosis of bone fractures (17, 19, 23, 35, 41, 42, 49, 60, 62–64);
- Too many detailed terms for the diagnosis (14, 20, 23, 35, 42, 52, 53, 55, 56);
- Too many wide or subjective terms for the diagnosis: considerable (15, 48); simple, extensive (46); complicated, uncomplicated (41, 54); minimum exposure (48); certain mobility (48); other lesions (17, 19, 49, 50);
- Incomplete systems (59, 63, 65, 66);
- Extremely complex systems (60).

Some authors included therapeutic procedures in their classification systems. It would be of great importance when considering the treatment costs of traumatic dental researches from an epidemiologic approach (24–26, 65–67).

Most of the revised studies followed a transversal design (27, 59, 68–72), and this kind of study design provides some disadvantages, as follows:

- Sub notification of certain lesions, such as, concussions, subluxations, luxations, alveolar fractures and soft tissue injuries – these lesions may not be evident at clinical examination;
- No signs and symptoms at clinical examination;
- Patient's inaccurate data precision, concerning the way the lesions happened, especially at the pedodontics' age (72–74).

Prospective or cohort studies also provide some disadvantages, as they would only be registered in case the patient seeks dental treatment. It rarely happens in cases of uncomplicated crown fractures, as they are not painful (72).

Most studies were based on special groups comprising subpopulations exclusively, as scholars (27, 75–77); children attended at pediatric services (62) or emergency patients (49, 78).

It is conceivable that the retrospective aspect does not allow the same diagnostic and therapeutic precision as the prospective ones. The ideal would be a 1-year longitudinal study, once it would include the seasonal changes all over the year (79).

Chronologically, it has been observed a great improvement, according to the quality assessment of the included researches.

Conclusions

Based on the literature, to the permanent dentition, the obtained results of this present study may lead to the following conclusions:

- Most classification systems are not applicable to epidemiological studies;
- Ellis' classification system, as not yet published, is the most suitable, once it follows the hierarchical structure, proposed by the WHO, as regards the ideal properties of standardization. However, for epidemiological purposes, some changes may be needed.

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