The recording methods used to investigate the epidemiology of early periodontitis
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Abstract
Based on the prevailing understanding of the distribution and etiology of periodontal disease, different methods have been introduced to evaluate periodontitis in epidemiological and clinical situations. This article discusses the recording methods used to investigate the epidemiology of early periodontitis.

Key Words: Adolescents; Epidemiology; Periodontitis

Many different methods have been used to assess the epidemiological features of periodontitis among adolescents including periodontal indices like the Community Periodontal Index of Treatment Needs (1), the radiographic evaluation of the bone level with bitewing (2), panoramic (3); periapical (4); or poorly defined radiographic techniques (5), and recordings of clinical attachment level (6). Additionally, many studies of periodontitis in adolescents exist in which different methods have been combined in a screening-like fashion (7) and in many studies the exact methods used remain poorly explicated (8).

The use of periodontal indices for the recording of periodontitis has a background in a period where simple data collection; limitations in analysis, understanding and reporting of findings were compulsory features of the methods used. Their use is also founded in a disease paradigm which holds that gingivitis is the preliminary lesion to periodontitis (9). Hence, most indices merge signs of gingivitis and periodontitis, just as their use accepts a generalized distribution of periodontal signs and symptoms across teeth in the mouth and across subjects in a population. The tooth-based recordings are combined as mouth means and group means which cover the variation in the distribution of periodontal symptoms across teeth and subjects (9).

The Community Periodontal Index of Treatment Needs [CPITN] (10) was developed in 1982. Though originally intended for the quantification of periodontal treatment needs in populations, the CPITN has been broadly used for epidemiological purposes. A look at the WHO report (1), which contains CPITN data for 15-19 year old subjects, reveals enormous variation of between and within countries, however, these studies have not shed much light on the prevalence, extent and severity of periodontitis among adolescents because it reflects a periodontal disease paradigm, which is no longer considered sustainable (9).

The use of radiographs to assess the bone support of the teeth provides a permanent record. However, radiographs are two-dimensional representations of complex three-dimensional structures, which makes the radiographs very susceptible to angulation errors and often difficult to interpret, since anatomical structures such as tooth roots and cortical plates may overlie lesions in the trabecular bone. The assessment of the bone level is usually restricted to the interproximal sites due to the lack of accuracy and precision of the estimates obtained at the buccal and lingual sites owing to the overlapping of the tooth structures and two bone plates. Moreover, radiographs are vulnerable to differences in exposure time, voltage, and film-developing processes, all of which may lead to a ‘burn out’ of the alveolar crest in the absence of bone loss (11). Subjects are exposed to ionizing radiation, and while many studies do not provide the information, the readability of the radiographs is frequently reduced due to technical errors. Even though panoramic radiographs have advantages over periapical and bitewing radiographs in the broad anatomic region imaged, they also have important weaknesses in that they require special equipment and have a lower precision and resolution than the intra-oral radiographs. Bitewing radiographs have smaller angulation errors than those associated with the use of periapical radiographs (12) and therefore most radiographic epidemiological studies of periodontitis among adolescents are based on this technique. The bitewing radiographs are restricted to the molar-premolar area, and they have reduced “ability …to cover extensive bone loss”(13).

Clinical attachment level (CAL) recordings are intended to estimate the extent of lost fibrous attachment to the teeth, defined as the root surface area outlined by the cemento-enamel junction (CEJ) and the most apically positioned cells of the junctional epithelium. From a theoretical angle, the lost fibrous attachment area is the best measure of the presence and extent of
periodontal destruction. However, clinical attachment level measurements are linear estimates, and they can only approximate this area. CAL requires the identification of two anatomical landmarks, the cemento-enamel junction (CEJ) and the apical termination of the junctional epithelium. A full mouth assessment of clinical attachment levels at all teeth present in the mouth among adolescents is rare (14), and the vast majority of studies have employed some form of partial recordings. This is because one way of reducing the work-load linked with clinical measurements in epidemiological studies is to reduce the number of teeth and sites recorded (15). Nonetheless, there is no consensus on which teeth or sites should be included for examination in studies of CAL among adolescents, and the selection of teeth and sites therefore varies considerably across studies. The number of teeth recorded may vary between 1 and 32, and the number of sites recorded per tooth may vary between 1 and 6 (mesio-buccal; mid-buccal; disto-buccal; mesio-lingual/palatal; mid-lingual/palatal; and disto-lingual/palatal) (15).

The use of partial recordings tends to underestimate the prevalence of clinical attachment levels relative to the full mouth results (16) and this can be found even among adolescents. Obviously, the inclusion of fewer teeth and/or sites in the examination decreases the possibilities of finding CAL at the subject level. The magnitude of the underestimation depends on the underlying true prevalence and the distribution of CAL in the study population.

The direction and magnitude of the bias introduced in the extent estimates will vary depending of the magnitude of the underlying full mouth extent of CAL in the population; the teeth and sites selected for examination; and the nature of the statistics used to express extent.

Many studies among adolescents have been conducted in which the data have been analyzed according to the concept that different periodontitis entities exist which is clearly distinguishable on the basis of the intra-oral distribution of CAL. For example, Albandar et al., defined localized early onset periodontitis as the presence of CAL $\geq$ 3 mm in at least 4 teeth including two or fewer canines, premolars and 2nd molars (17), and early onset periodontitis as the presence of $\geq$ 4 mm attachment loss at the approximal surfaces of one or more teeth”(18), while Löe & Brown (19) defined localized juvenile periodontitis as the presence of CAL $\geq$ 3 mm in at least 1 first molar and at least 1 incisor or second molar, and 2 or fewer cuspids or premolars. Other conditions that have been defined in terms of particular combinations of clinical attachment loss findings include localized and generalized periodontosis; generalized juvenile periodontitis; incidental loss of periodontal attachment; generalized early onset periodontitis; and incidental early onset periodontitis (20).

Clearly, the use of numerous definitions adds to the crowd of methods used to report CAL findings; and is a further limitation to attempts to compare findings across study groups. We specifically investigated the impact of the use of four different disease definitions for the results obtained (21) and showed that the use of different disease definitions for periodontitis in adolescents based on CAL recordings leads to the identification of different subjects from the same dataset (21).

Some investigators contend that CAL may result from reasons other than periodontitis. Clerhugh et al., (22) showed that mid-buccal CAL among adolescents may be associated with tooth brushing practices, and the authors therefore recommended the exclusion of buccal sites in epidemiological studies of early periodontitis. Accordingly, in a review of periodontal disease in children and adolescents, Jenkins & Papapanou (23) excluded mid-buccal attachment loss from comparisons of studies under the assumption “that buccal surface lesions in young people are frequently linked with traumatic tooth brushing practices and good oral cleanliness rather than plaque-associated destruction”(23).

While it is clearly conceivable to have a definition of periodontitis that specifies periodontitis as loss of attachment in the presence of plaque deposits, it is highly questionable whether such an approach is helpful. In the context of periodontitis among adolescents the suggested definition may seem vague in view of the much-cited observation that “the amount of periodontal destruction observed is not commensurate with the amount of local irritants”(24). Moreover, infections need not be accompanied by the accumulation of gross plaque deposits, and this raises the question how infection may be excluded as a co-factor for the loss of attachment observed in seemingly clean mid-buccal surfaces. As an example, Källestål et al., (25) studied a population with high oral hygiene standards and found that mid-buccal surfaces accounted for most attachment loss, and “in a majority of the individuals with AL [CAL], only the buccal [mid-buccal] surfaces were affected”(25). The investigators identified a group
of individuals with mid-buccal/lingual attachment loss and another with interproximal attachment loss, and found that the former had better oral hygiene conditions and more frequent tooth brushing than did subjects with interproximal attachment loss (26). Källestål & Uhlin (27) investigated potential factors associated with the loss of buccal attachment and found that “thin alveolar tissue, narrow width of the attached gingival and presence of teeth with buccal displacement” were associated factors, while several dimensions of tooth brushing. This speaks against tooth brushing as such being a central factor, and does not exclude a key etiological role for oral microorganisms.

Taken together these findings indicate that the epidemiological findings may not change very much whether all sites or only interproximal sites are considered, and there is therefore no reason to exclude certain sites based on a presumed different etiology of attachment loss in such sites.

In many studies of periodontitis among young subjects, different recording methods have been used hierarchically to the study groups in order to identify cases of periodontosis (28), juvenile periodontitis (29), and more recently aggressive periodontitis (8) in a screening-like way. As an example Van der Velden et al., (29) investigated a large sample of schoolchildren in Amsterdam and in those “sites showing a probing pocket depth of 5 mm or more” (29), CAL “was determined” (29). The use of these criteria therefore resulted in identification of sites presenting with probing pocket depth ≥ 5 mm and CAL ≥ 1 mm. Nevertheless, the combination of recording methods in a hierarchical manner necessarily adopts that subjects, who are negative with the first recording method applied, will also be so with the second recording method. Considering the above-mentioned example, it is thus assumed that CAL in the absence of a pocket depth ≥ 5 mm either does not occur or is uninteresting. Certainly a problem arises when the paper reports the prevalence of CAL to be “about 5%” (29) when it would have been more correct to state that about 5% of the population presented with CAL in the presence of a probing pocket depth ≥ 5 mm in the same site (29). This screening-like methodology may give rise to serious underestimation of the underlying prevalence of CAL. As an example, Baelum et al., (14) found that 7% of the sites with shallow pockets – which amounts to the vast majority of all sites – did indeed have attachment loss among young Kenyans. Observations by Källestål et al., (25) among Swedish adolescents corroborate this, as clinical attachment levels ≥ 2 mm could be found among subjects with minimal (0-2mm) probing pocket depth (26). Similar results indicating that the occurrence of deeper pockets may seriously underestimate the occurrence of CAL have been presented by Carlos et al., (30), Aucott & Ashley (31), and Agerholm & Ashley (32).

The fact that radiographic assessment of the alveolar bone level is restricted to interproximal surfaces while clinical attachment level measurements are applicable also to other types of surfaces is a clear indication that the two recording methods might yield different results. This is substantiated by the results of studies that have compared radiographic recordings with clinical attachment level recording in the same sites among adolescents. As an example, Mann et al., (33), investigated the relationship between CAL and radiographic signs of bone loss assessed in bite wing radiographs among students aged 12-16 years and found poor agreement between the methods. (33) Among adults aged 28-64 years, Machtei et al., showed “an overall good correlation between attachment and bone height measurements” (34-36). However, this conclusion was based on the observation that the mean individual clinical attachment level showed a correlation of 0.73 (r) with the individual mean radiographic bone height.

First, it is doubtful whether a correlation of 0.73 between two methods that purport to assess the same underlying condition, namely periodontal destruction reflects a good correlation. Hence, a correlation coefficient of 0.73 means that only about 50% (r² = 0.73²) of the variation in one measure may be explained by variation in the other. Moreover, the coefficient is inherently unable to express a systematic difference between the two methods and indeed the results presented by Machtei et al., (34) indicated an average systematic difference of 0.9 mm between the mean individual clinical attachment level and the mean individual radiographic bone height (34).

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References


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