PEDIATRIC DENTISTRY/Copyright © 1982 by
The American Academy of Pedodontics/Vol. 4, No. 1

Periodontal epidemiological indices for children and adolescents: II. Evaluation of oral hygiene; III. Clinical applications

Stephen H. Y. Wei, DDS, MS, MDS
Niklaus P. Lang, DDS, MS, Dr. Med Dent

Part I of this series, Gingival and periodental health assessments, was published in the December 1981 issue (3:353-360).

In Part I of this publication the index systems used to evaluate gingival health and disease as well as the epidemiological methods to assess the periodontal conditions have been presented. This paper will present the most commonly used methods to evaluate the oral hygiene status of patients and populations. Furthermore, miscellaneous parameters used in epidemiological studies on periodontal disease are discussed.

Oral Hygiene Index (OHI — Greene and Vermillion[6,7])

Originally the oral hygiene index included a measurement of twelve tooth surfaces,[6] subsequently reduced to six tooth surfaces, it is now known as the "Simplified Oral Hygiene Index" or OHI-S.[7] The amount of debris measured in the OHI-S are on the labial surfaces of teeth numbers 11, 16, 26, 31, and the lingual surfaces of 36, and 46. The index is composed of two components, one describing the soft and one the calcified deposits present. Most dentists use only one component of the OHI-S, the debris index simplified (DI-S), and have not used the calculus index (CI-S) to any significant extent. The criteria for the DI-S assigning scores of 0-3 are:

0 = No debris or stain present,
1 = Soft debris covering not more than one-third of the tooth surface being examined or the presence of extrinsic stains without debris regardless of surface area covered,
2 = Soft debris covering more than one-third but not more than two-thirds of the exposed tooth surface,
3 = Soft debris covering more than two-thirds of the exposed tooth surface.

The DI-S score is obtained by the sum of the debris score for all teeth, divided by the number of surfaces scored. At least two of the possible six surfaces must have been included in order to calculate the score, and adjacent teeth may be substituted for the selected teeth if they are missing. Furthermore, to give clinical relevence to the index, the oral cleanliness is considered; "good" if the DI-S score is between 0.3 - 0.6; as "fair" when it is 0.7 - 1.8; or "poor" when the score is between 1.9 to 3.0. This relatively simple assessment is also reasonably reproducible.

Plaque Index (PlI, Ramfjord[34,35])

The six selected teeth of the PDI are used by Ramfjord for a plaque index as well. The teeth are stained with a disclosing solution and the plaque accumulation is scored on a scale of P0-P3.

P0 = No plaque present
P1 = Plaque present on some but not on all of the interproximal and gingival surfaces of the tooth
P2 = Plaque present on all interproximal and gingival surfaces, but covering less than one-half of entire clinical crown
P3 = Plaque extending over all interproximal and gingival surfaces covering more than one-half of the entire clinical crown

This index also takes into consideration the occlusal extension of disclosed plaque.

Plaque Score (PS) (Schick and Ash[39])

These investigators used a score range of 0 to 3 for measuring the amount of plaque on the clinical crown surfaces; however, the interproximal areas are not scored. Six teeth are used and the scoring is confined to the gingival part of the facial and lingual surfaces of the selected teeth. The scores for each tooth are summed to obtain the dental plaque accumulation for each subject. This score is divided by the maximum

possible score, that is, three times the number of teeth. This score is then converted to a percentage for each individual.

Plaque Index (Quigley and Hein[40])

This index represents another system evaluating occlusal extension of dental plaque. The labial surfaces of the anterior teeth are divided into four segments. The amount of plaque is determined with disclosing solution and a range of scores of 0-5 is assigned. The average amount of plaque per tooth surface per person is then computed.

A modification of this Quigley-Hein plaque index was used by Turesky.[41] He included both the facial and lingual surfaces of all teeth. The score per person is derived by a sum of the plaque scores divided by the number of surfaces examined.

Plaque Index (PlI, Silness and Löe[42])

The Plaque Index System by Silness and Löe, PlI, uses the same teeth and "scoring units" as the gingival index (GI) by Löe and Silness; that is, the distal-facial, facial, mesial-facial, and lingual surfaces of each tooth. As opposed to most other plaque indices, this system evaluates the thickness of plaque growth at the gingival margin of the teeth. Occlusal extension of plaque is only incorporated in the evaulation indirectly; there is a strong correlation of the plaque growth assessed at the gingival margin (thickness) and assessed by coronal growth. All or selected teeth may be used and no disclosing solution is needed. The criteria for the PlI range from 0-3 as shown below:

0 = No plaque in the gingival area.
1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may only be recognized by running a probe across the tooth surface, not visible by the naked eye.
2 = Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen by the naked eye.
3 = Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

It is important that compressed air be used to dry the tooth surfaces prior to the evaluation of the unstained plaque deposits.

Plaque Control Record (O'Leary, Drake & Naylor)[43]

A very simple and therefore reliable method for evaluating oral hygiene procedures was proposed by O'Leary and coworkers.[43] On an all or none basis, the disclosed plaque accumulations on all teeth are scored. The number of positively scored units is divided by the total number of tooth surfaces evaluated, and the result is multiplied by 100 to express the index as a percentage. With this method the topographical distribution of plaque throughout the dentition can be assessed easily. Repeated scorings of that nature facilitate the evaulation of the efficacy of oral hygiene programs in daily practice (Figure 1).

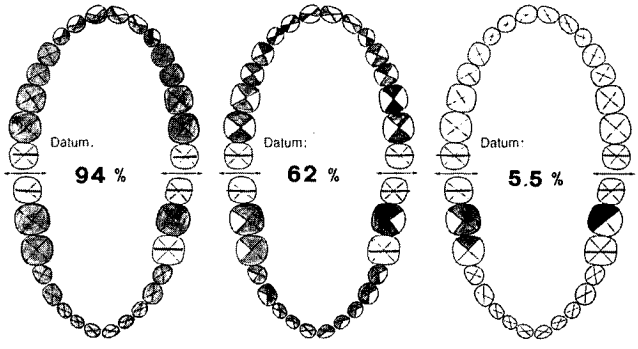

Figure 1. Topographical distribution of plaque scored repeatedly by using the method of O'Leary, et al.[43]

Patient Hygiene Performance Index (PHP, Podshadley and Haley[44])

This index was developed to evaluate patients' hygiene performance following toothbrush instructions. It uses the same six tooth surfaces as in the OHI-S but divides each tooth surface into nine principal areas as shown in Figure 2. Within each surface area the debris is scored on a yes or no basis, where if any debris is present, a score of one is assigned, and where a surface is free of debris a score of 0 is given. The PHP score is the total of the score for each surface divided by the number of tooth surfaces examined.

Like some other indices it has also been modified by other workers. Martens and Meskin[45] utilized the same five surfaces as devised by Podshadley and Haley, but labeled them specifically as A, B, C, D, and E, so that the location of the plaque would also be recorded. This would give a clearer indication of the effectiveness of oral hygiene measures in a longitudinal study.

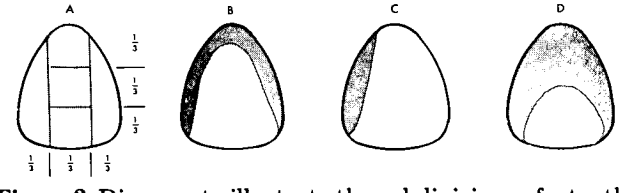

Figure 2. Diagram to illustrate the subdivisions of a tooth used in the PHP method, with examples of scoring by this method: A. Five subdivisions, B. debris score of 3, C. debris score of 1, and D. debris score of 4.

Table 12. Summary of oral hygiene and plaque indices proposed by various investigators.

Name of Index	Features	Author & Year	Plaque or Debris Scale	References
P1 I	selected teeth tooth is unit	Ramfjord, 1959		32, 33
DI	selected teeth	Greene, Vermillion, 1960	debris	6
OHI	all teeth tooth is unit	Greene, Vermillion, 1960	oral hygiene	6
PS	gingivae of facial and lingual surfaces of 6 teeth	Schick and Ash, 1961	plaque	39
PI	labial surface of anterior teeth	Quigley and Hein, 1962	plaque scale	40
OHI-S	selected teeth, tooth is unit	Greene, Vermillion, 1964	oral hygiene simplified	7
P1 I	selected tooth surfaces of each tooth	Silness and Löe, 1964	plaque	42
PI (debris)	Anterior teeth surfaces more weight on gingival plaque	Glass, 1965	debris	
PHP	Six tooth surfaces divided into subdivisions	Podshadley and Haley, 1968	debris	44
PCR	all teeth four surfaces for each tooth	O'Leary, Drake & Naylor, 1972	plaque	43

Table 12 presents a summary for the indices used to evaluate plaque accumulations.

Calculus

Many of the indices to evaluate the presence of calcified deposits are components of other indices evaluating the oral hygiene status. For example, the simplified calculus index is a component of the OHI-S.

Oral Calculus Index (Greene & Vermillion[6,7])

The oral calculus index scores are assigned according to the following criteria:

0 = No calculus present.
1 = Supragingival calculus covering not more than one-third of the exposed tooth surface being examined.
2 = Supragingival calculus covering more than one-third but not more than two-thirds of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth.
3 = Supragingival calculus covering more than two-thirds of the exposed tooth surface or a continuous heavy bank of subgingival calculus around the cervical portion of the tooth.

Calculus Index (Ramfjord[34,35])

This evaulation also involves the teeth selected by Ramfjord for the PDI, namely numbers 16, 21, 24, 36, 41, and 44. The tooth is the unit and the measurements are obtained on a scale of 0-3.

0 = absence of calculus.
1 = supragingival calculus extending only slightly below the free gingival margin (not more than 1 mm).
2 = moderate amount of supra- and subgingival calculus or subgingival calculus alone.
3 = an abundance of supra- and subgingival calculus.

Calculus Surface Index (Ennever, Sturzenberger, and Radike[47])

This index (CSI) assesses the presence or absence of calculus on the four surfaces of the four mandibular incisors. Each incisor is divided into four scoring units, i.e. one labial, one lingual and two proximal surfaces. Each surface is given a score of 1 for

the presence of calculus or 0 for the absence of calculus. The maximum score of 16 is possible for each subject. The CSI score is the total number of surfaces covered by calculus. An extension of the index is the calculus surface severity index (CSSI), where the CSSI is a measure of the severity ranging from 0, for having no calculus present, to a score of three, where the calculus thickness and width is quantified as shown below.

0 = no calculus present.
1 = calculus observable but less than 0.5 mm in width and/or thickness.
2 = calculus not exceeding 1 mm in width and/or thickness.
3 = calculus exceeding 1 mm in width and or thickness.[48]

Calculus Assessment (Volpe and Manhold[49])

This index was described to evaluate calcified deposits in the area where they are most prevalent. It is well suited for longitudinal studies on supragingival calculus formation. The measurements are taken along the gingival, mesial, and distal borders of the gingival margin of the lower six incisors. The amount of calculus deposit is measured using a periodontal probe, which is placed against the most inferior portion of the visible calculus at the gingival margin; or the measurement may be taken diagonally through the point of the greatest depth (or height) of calculus deposit from the gingival margin. The probe is calibrated so that the smallest unit of measurement is accurate to 0.5 mm. The scores can be tabulated as either a measurement score, where the total of all the scores are divided by the number of measurements, or as tooth score, where the total of all the scores are divided by the number of teeth scored, or a subject score, which is simply the total of all the scores for that person.[49]

Marginal Line Calculus Index (MLC-I Mühlemann and Villa[50])

This index is similar to that of Volpe and Manhold. Only supragingival calculus on the lingual surfaces along the marginal gingivae of the lingual surfaces of the lower incisors are measured. An imaginary axial plane bisects vertically each tooth into a mesial and distal portion. The percentage of enamel surface covered by calculus deposits is then recorded using only the percentages of 0, 12.5, 25, 50, 75, and 100%. When in doubt a higher percentage is assigned. The marginal line calculus index score per tooth is determined by averaging the two half-units for each tooth. The MLC score for each subject is derived by a sum of the scores, divided by the number of teeth examined, and is illustrated in Figure 3.

Volpe[51] gave a comprehensive review of the indices used to measure calculus on teeth in 1974 and tabulated some 17 studies between 1962 to 1972, where quantitation of calculus deposits have been made using essentially the probe method of Volpe and Manhold. In Switzerland, however, the Standardized Foil Technique of Marthaler, Schroeder and Mühlemann[46] have been used in more than ten studies to evaluate various anti-plaque agents.

Standardized Foil Technique (Marthaler, Schroeder and Mühlemann[46])

This technique uses small triangular and round-edged foils punched out of sandblasted polyester sheets. The foils are perforated so that a nylon thread can be used to tie the foil on the lingual surfaces of lower central incisors. The amount of deposits on the contoured strips can be determined by carefully weighing the strip before insertion and then again following removal from the mouth after specific time intervals. Basically, it is a technique to collect supragingival calculus.

A summary of most calculus indices is presented in Table 13.

Radiographic Assessments of Periodontal Destruction

Indices that require radiographic evaluation of bone loss are of a limited use in large scale epidemiological trials. This is due to a number of problems. To minimize distortion when projecting a three-dimensional image onto a two-dimensional plane, a long cone paralleling technique should be used. Also, angulation of the radiographs can affect the accuracy with which measurements of bone loss are obtained. Only in 60% can interproximal defects, in 50% furcation defects, and in 30% lesions of hemisepta fenestrations and dehiscences, be evaluated with accuracy. Furthermore, it is understood that radiographs will not assess bony defects on labial and lingual aspects of root surfaces.[52,53]

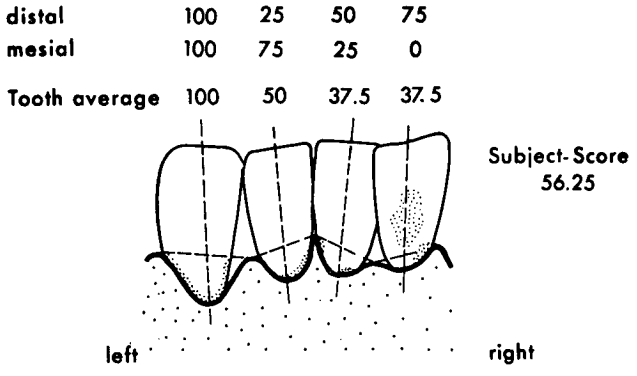

Figure 3. Diagram showing the example of scoring with the MLC-Index of Mühlemann and Villa.[50]

Table 13. Calculus Indices proposed by various investigators.

Name of Index	Tooth or Surfaces	Author & Year	Oral Hygiene/Calculus	Reference
CI	selected teeth tooth is unit	Ramfjord, 1959	calculus	34, 35
CI	selected teeth tooth is unit	Green & Vermillion, 1960	calculus	6, 7
Standardized Foil Technique	lingual surfaces of mandibular central	Marthaler, Schroeder & Mühlemann, 1961	supragingival calculus	46
CSI	mandibular incisors tooth is unit	Ennever, Sturzenberger & Radike, 1961	calculus surface index	47
VM	supragingival lingual surfaces of lower anteriors	Volpe & Manhold, 1962	development of calculus	49
MLC-I	supragingival lingual surfaces of lower incisors in %	Mühlemann & Villa, 1967	marginal line calculus index	50
CSSI	mandibular incisors	Conroy & Sturzenberger, 1968	calculus surface on 4 incisors	48

Several investigators have attempted to improve the accuracy of radiographic measurements by incorporating radiopaque markers such as Hirshfeld points, or the tip of a small Michigan "0" periodontal probes, Michigan "0" eyelet tips, or silver or gutta percha points[54] into the exposed radiographs as a landmark for comparison. All of these techniques tend to be time consuming and difficult, and hence, are to be used only in selected cases. Several evaluation systems for radiographs have been proposed.

1. The index of Miller and Seidler[55] was based on full mouth radiographs.
2. Schei, Waerhaug, Lövdal, and Arno,[56] used ten intraoral radiographs, Bone loss was measured using a plastic ruler; the distance of the length of the root from the cemento-enamel junction minus 1 mm to the apex was divided into ten equal portions, expressing a percentage of bone loss.
3. Gingival bone count (GB, Dunning & Leach)[57] using two posterior bitewing radiographs.
4. Björn and Holmberg[58] project radiographs at a fixed distance onto a screen and the bone height is measured in relation to the total length of the tooth, then expressed in percent loss.
5 Suomi, Plumbo, and Barbano[59] apply a wire grid with 1 mm squares.
6. Marginal bone loss with intraoral radiographs are projected on a specially designed calibrated scale (Björn, Halling and Thyberg[60]).
7. The radiographic index of Sheiham and Striffler[61] is based on 16 intraoral periapical and posterior bitewing films.

Miscellaneous Clinical Indices

There are other indices which do not fall strictly into previous categories such as the retention index of Löe,[62] or the mobility index of Ramjford.[35]

Retention Index (Löe,[62])

This index combines the evaluation of caries, calculus, and gingivitis as well as restorations into a total index. It is supposed to combine all plaque retaining factors. The surface of the tooth is the unit of measurement and all the teeth, or selected teeth, may be included.

The criteria for the retention index system of Löe[62] are as follows:

0 = no caries, no calculus, no imperfect margin of dental restoration in a gingival location;
1 = supragingival cavity, calculus or imperfect margin of dental restoration;
2 = subgingival cavity, calculus or imperfect margin of dental restoration;
3 = large cavity, abundance of calculus or grossly insufficient marginal fit of dental restoration in a supra- and/or subgingival location.

Since it includes all plaque retaining factors in its evaluation, it is well suited for comparative studies in different populations.

Mobility Index (Ramfjord[35])

The mobility of a tooth may reflect the level of periodontal attachment loss, or the influence of traumatic forces on a tooth. Ramfjord has suggested

a mobility index using the following criteria.

M 0 = Physiologic mobility; firm tooth.
M 1 = Slightly increased mobility.
M 2 = Definite to considerable increase in mobility, but no impairment of function.
M 3 = Extreme mobility; a "loose" tooth that cannot be used for normal function.

Other more sophisticated devices such as the microperiodontometer have been developed in order to measure mobility accurate to a hundredth of a millimeter by applying a force of known magnitude. Other appliances use the application of a laser beam.[63] These methods are time consuming and are therefore predominantly used for research purposes.

Most clinicians prefer the use of an index suggested by Laster, et al.[64] The mobility is recorded after the application of lateral or horizontal forces; 0= normal, 1= movement greater than normal, 2=mobility 1mm in lateral direction, 3= mobility greater than 1mm laterally plus rotation and/or axial depression.

III. Clinical applications of indices in children and adolescents

Gjermo[65] suggested that most of the indices or clinical evaluations of periodontal and gingival inflammation may be divided into one of four types, namely: 1) epidemiological surveys on prevalence and incidence, 2) longitudinal experimental studies to evaluate prophylatic and therapeutic measures in populations, 3) clinical trials in small well-controlled experimental groups, and 4) periodontal treatment need evaluation.

1. Epidemiological Surveys on Prevalence and Incidence of Gingival and Periodontal Disease in Children.

The prevalence of gingivitis in children and young adults were tabulated by Carranza.[66] Of the 33 studies that have been reported in the literature between 1925 and 1974, the majority documented that over 80% of the persons show clinical signs of gingivitis. Some studies reported a prevalence of gingivitis as high as 99%. Sheiham[67] found that 99.7% of 11- to 17-year-olds in a population of 756 children in Surrey, England, were affected. The percent of children affected with severe gingivitis in Great Britain and the United States were summarized by Goldman and Cohen.[68] By age 14, 4.6% the children in Great Britain presented with severe gingivitis, whereas in the U.S. at the same age, 1.7% of the children had obvious pocket formation. This represents a very significant number of children who require early prevention and periodontal treatment.

According to Massler,[12,13] the percent of persons with gingivitis increases dramatically from age 5 to age 12 for females, and to age 14 for males. Gingivitis, if left untreated, will continue throughout life and most likely develop into destructive periodontitis.

Loss of periodontal attachment and bone loss have been found in youths in different countries. However, the prevalence varies considerably from study to study.[69] Hull[70] reported that 51% of 14-year-old English children had alveolar bone loss, whereas Blankenstein et al.[71] showed only 1% of children with bone loss in England and Denmark. Davies et al.[72] reported that 19 to 37% of 11- to 12-year-old English children had bone loss.

The prevalence and severity of periodontal disease nationally in U.S. children was reported in 1972 for children aged 6-11 years[73] and in 1974 for youths 12-17 years.[74] In the first study,[73] approximately 7400 children between 6-11 years of age were examined using the PI and the OHI-S. According to this study, an estimated 9.2 million children in the U.S., or about 39% of those 6-11, had either a mild, localized gingivitis or a more advanced form of periodontal disease. Destructive disease with obvious pocket formation was found in 0.8% of the population studied.

The average OHI-S for an estimated 24 million children was 1.44, with the component indices assessing debris DI-S and calculus CI-S being 1.42 and 0.02 respectively.

The prevalence and severity of periodontal disease in adolescents in the U.S. was conducted on a probability sample of 7514 subjects selected to represent the nation's youth between 12-17 years of age.[74] The average PI for all subjects in the age range of 12-17 years was 0.31. The degree of severity increased slightly with increasing age, from 0.27 at age 12 to 0.36 at age 17; there was essentially no sex difference. However, the mean PI for black youths (0.45) was significantly higher than that of all white youths (0.29).

Two surveys of the prevalence and severity of periodontal diseases in children in the state of North Carolina were conducted in 1963 and again in 1977.[4] The PI and the OHI-S were used to assess the periodontal status and plaque accumulations. The study

of 1977 was a replication of the original study conducted in 1960-63. A total of 3454 individuals, or a 94.9% of the representative sample, were reexamined. It was found that there was a significant increase in PI, particularly in nonwhite females, when the two studies were compared. Also, the oral hygiene status was found to be worse in 1977 than in the first study. The investigators concluded that periodontal disease is a childhood problem of increasing significance. Therefore, the dental profession and dental education must emphasize the care of periodontal disease in its earliest incipient stages in order to prevent destructive periodontal disease in adulthood.

2. Longitudinal Experimental Studies To Evaluate Prophylactic or Therapeutic Measures in Population Groups.

It has long been known that experimental gingivitis may be produced in adults by abstaining from oral hygiene measures for 2-3 weeks.[75,76] The gingivitis can be completely eliminated by a program of meticulous plaque removal, professional prophylaxis and/or the use of chemical therapeutic agents. In that respect, the most significant studies in children have been conducted by Lindhe and Axelsson.[77-80] They utilized a program of professional mechanical tooth cleaning using a fluoride polishing paste and professional removal of calculus and subgingival plaque by dental hygienists, with emphasis on the "key risk" surfaces in the interproximal areas. Interproximal cleansing in the premolar and molar areas included the use of a mechanically driven, pointed triangular tip with a speed of 10,000 strokes per minute, using a well-defined program of interproximal cleansing.[81] The professional mechanical tooth cleansing (PMTC) was conducted at frequent intervals (weekly, fort-nightly), supplemented by daily patient home care using a fluoridated dentifrice and dental tape.

In a series of longitudinal clinical trials including adolescents between 10-14 years of age conducted in Karlstad, Lindhe and Axelsson concluded that such a program not only had an effect on caries, but was also effective in almost entirely eliminating gingivitis.[77-80] Reductions in gingivitis and improvement in periodontal health could be similarly achieved in adults.[81]

3. Clinical Trials in Small, Well-Controlled Experimental Groups

In this type of study, a more accurate and detailed parameter, namely gingival exudate, was measured. Löe and Holm-Pedersen[29] sampled crevicular fluid flow as an indicator of gingival inflammation. The fluid could be collected using the extracrevicular sampling method, where the strips were to fit closely to the labial surface of the tooth, extending to the gingival margin and the attached gingivae. In the intracrevicular sampling the strips were carefully guided parallel to the tooth crown and placed at the entrance to the crevice. Extreme care was taken to avoid irritation of the crevicular epithelium. The strips were then stained with a 0.2% solution of ninhydrine and the stained area was measured to the nearest 1/20th of a mm using a magnifying glass.

The gingival exudate generally correlated well with the GI score of Löe and Silness. They found that in the majority of cases where there were normal gingivae (GI score = 0), there was no crevicular flow. Mildly inflammed gingivae regularly showed the presence of fluid, and in moderate to severe gingivitis the flow was increased markedly. When gingival inflammation subsided a correspondent decrease in fluid flow occurred.[82] However, a high correlation with histologic evaluations of gingival inflammation has not yet been established.[83]

Other investigators have studied the various components of the gingival exudate such as the contents of protein, collagenase, and urea.[84-87]

A further research technique for the evaluation of gingival and periodontal inflammation is the use of gingival biopsy samples with special emphasis on the cellular components in the tissues.[88,90] The sulcular content is sampled from strips or paper points placed in the sulcus.[90] Recently, attempts have been made to classify the activity of a pocket using microbiological techniques.[91,92]

4. Periodontal Treatment Need Evaluation

It appears that a system that would rapidly document and quantify the need for periodontal treatment would be very useful in clinical practice. A recent symposium on periodontics has suggested a number of ways that the oral soft tissues may be evaluated properly; the evaluations are relatively simple and clinically relevant.[93]

Maynard et al.[94,95] emphasized the importance of evaluating the mucogingival problems of children with particular attention being paid to differentiating the oral mucous membrane and the attached gingiva. The attached gingivae in the primary dentition is usually wider and less variable than in the permanent dentition, whereas the sulcular depth is shallower in the primary dentition. Periodontists define mucogingival problems as "plastic surgical procedures designed to correct all modified defects in the periodontium, position and amount of gingivae surrounding the teeth."[96] Maynard and others[94,97] suggested that mucogingival problems originated very early in the developing dentition, resulting in developmental aberrations in eruption and deficien-

cies in the thickness of the periodontium. If there is inadequate plaque control superimposed on the inflammatory changes in the gingivae, or if improper toothbrushing habits are used, an aggravated mucogingival problem will be present. However, these claims have never been substantiated by experimental studies.

The severity of gingival inflammation should be recorded carefully using an index such as the sulcular bleeding index (SBI), the gingival bleeding index (GBI), or the papillary bleeding index (PBI). These indices are rapid and can be performed in the dental office for both the primary and permanent dentitions.[98]

The PBI appears to have been tested clinically with much success.[22] A sample form of this index is shown in Figure 4. Similarly, Garnick[98] has suggested a graphic display showing the subject's plaque and gingival index over a period of time. The graphic form would give a rapid visual display of the progress of preventive measures for each patient over time (Figure 5).

A complete periodontal examination must include periodontal probing and radiographic analyses. A clinical chart for recording pocket depth in children and adolescents should be a regular part of a complete oral examination and diagnosis. Furthermore, the use of periodontal probe, preferably a calibrated color-coded type such as the Michigan "0" probe, is essential. In cases of advanced periodontal involvement (e.g. localized juvenile periodontitis), additional evaluations such as a detailed periodontal chart, measurements of alveolar bone loss on radiographs, and culture of the microbial contents of the pockets should be carried out.

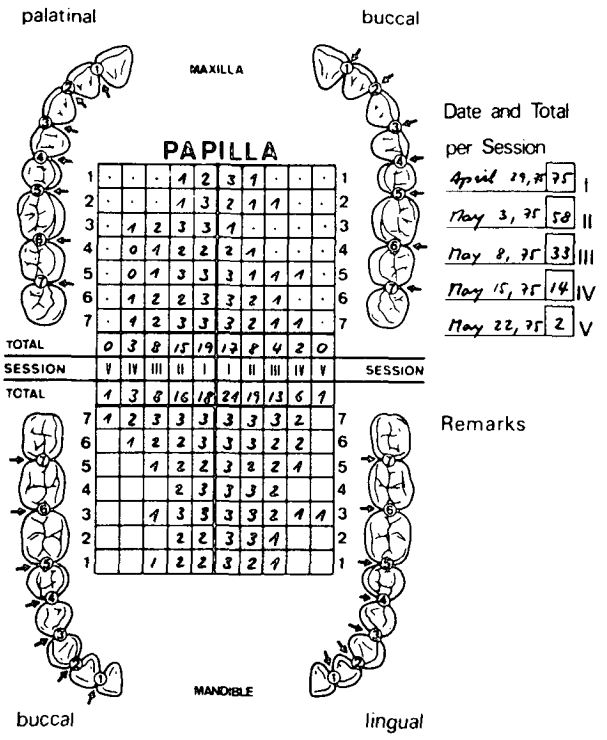

Figure 4. A sample form showing the use of the Papillary Bleeding Index (PBI) of Mühlemann in clinical practice. The progress of gingivitis can be monitored longitudinally as a motivational aid for patient preventive measures.

Conclusion

An abundance of gingival, periodontal, plaque and calculus indices exist in the literature. Some indices, such as the PI or OHIS, are designed primarily for large epidemiological studies, while others may be applied successfully in clinical practice to quantify the status of oral health.

A national survey of the prevalence of gingivitis and periodontitis in children should be replicated since the last one was carried out in the 1960s.

Because of the increasing prevalence of gingivitis and periodontal disease in children and adolescents, pediatric and family dentists should establish a system that will adequately evaluate the oral soft tissues and periodontium so that recommendations for prevention and treatment can be carried out. Pedodontic teaching clinics and private practitioners should use a gingival index (e.g. PBI, SBI, GI or GBI) on all patients. Periodontal probing and charting should be incorporated in the documentation of oral health, and the use of an oral hygiene index such as the OHIS or the PHP index should be utilized universally in plaque control procedures.

Much research needs to be carried out to document the etiology and pathogenesis of periodontitis in children. Attempts should be made to characterize further differences in gingival and periodontal diseases in children as well as in adults, with the goal of achieving optimal periodontal health throughout life.

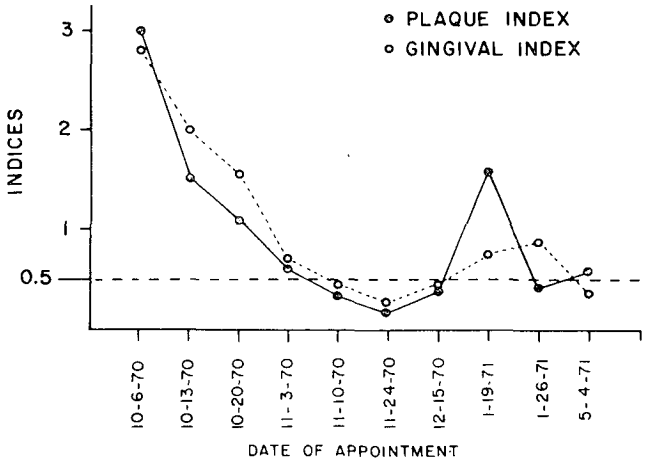

Figure 5. A graphic display of the progress of plaque control utilizing the GI and plaque index over time.[98]

This investigation (Parts I, II, and III) was supported by the Proctor and Gamble Guest Scientist to the American Dental Association Health Foundation Research Institute, awarded to Dr. Stephen H. Y. Wei for 1980-1981.

Dr. Wei is professor and head, department of pedodontics, College of Dentistry, University of Iowa, Iowa City, Iowa 52242. Dr. Lang is professor and chairman, School of Dental Medicine, University of Berne, Freiburgstrasse 7, CH-3010 Berne, Switzerland. Requests for reprints should be sent to Dr. Wei.

Editor's note: References 1-38 are found in Part I of this paper, published in Pediatr Dent 3:353-360, 1981.

39. Shick, Ash. Evaluation of the vertical method of toothbrushing. J Periodont 32:346, 1961.
40. Quigley, G. and Hein, J. Comparative cleansing efficiency of manual and power brushing. JADA 65:26, 1962.
41. Turesky, S., Gilmore, N. D. and Glickman, I. Reduced plaque formation by the chloromethyl analogue of victamine. C J Periodont 41:41, 1970.
42. Silness, J. and Löe, H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. Acta Odont Scand 22:121, 1964.
43. O'Leary, T. J., Drake, R. B., and Naylor, J. E. The plaque control record. J Periodont 43:38, 1972.
44. Podshadley, A. G. and Haley, J. V. A method for evaluating patient hygiene performance by observation of selected tooth surfaces. Publ Health Rep 83:259, 1968.
45. Martens L. V. and Meskin L. H. An innovative technique for assessing oral hygiene. J Dent Child 39:12, 1972.
46. Marthaler, T. M., Schroeder, H. E., and Mühlemann, H. R. A method for the quantitative assessment of plaque and calculus formation. Helv Odont Acta 5:39, 1962.
47. Ennever, J., Sturzenberger, O. P., and Radike, A. W. The calculus surface index method for scoring clinical calculus studies. J Periodont 32:54, 1961.
48. Conroy, C. W. and Sturzenberger, O. P. The rate of calculus formation in adults. J Periodont 39:142, 1968.
49. Volpe, A. R. and Manhold, J. H. A method of evaluating the effectiveness of potential calculus inhibiting agents. N. Y. State Dent J 7:289, 1962.
50. Mühlemann, H. R. and Villa, P. R. The marginal line calculus index. Helv Odont Acta 11:175, 1967.
51. Volpe, A. R. Indices for the measurement of hard tissue deposits in clinical studies of oral hygiene and periodontal disease. J Periodont Res 9: Suppl 14:31, 1974.
52. Rees, T. D., Biggis, N. L. and Collings, C. K. Radiographic interpretations of periodontal osseous lesions. Oral Surg 32:141, 1971.
53. Goldman, H. M. and Stallard, R. E. Limitations of the radiography in the diagnosis of osseous defects in periodontal disease. J Periodont 44:326, 1973.
54. Robinson, P. J. and Vitek, R. M. Periodontal examination. Dent Clin N 24:597, 1980.
55. Miller, S. C. and Seidler, B. B. A correlation between periodontal disease and caries. J Dent Res 19:549, 1940.
56. Schei, O., Waerhaug, J., Lövdal, A., and Arnö, A. Alveolar bone loss as related to oral hygiene and age. J Periodont 30:7, 1959.
57. Dunning, J. M. and Leach, L. B. Gingival-bone count: A method for epidemiological study of periodontal disease. J Dent Res 39:506, 1960.
58. Björn, H. and Holmberg, K. Radiographic determination of periodontal destruction in epidemiological research. Odontol Revy 17:232, 1966.
59. Suomi, et al. A comparative study of radiographs and pocket measurements in periodontal disease evaluation. J. Periodont 39:311, 1968.
60. Björn, H., Halling, A., and Thyberg, H. Radiographic assessment of marginal bone loss. Odont Revy 20:165, 1969.
61. Sheiham, A. and Striffer, D. F. A comparison of four epidemiological methods of assessing periodontal disease. J Periodont Res 5:148, 1970.
62. Löe, H. The Gingival Index, the Plaque Index, and the Retention Index Systems. J Periodontol 38:610, 1967.
63. Ryden, H., Bjelkhagen, H.,and Soder, P. O. The use of laser beams for measuing tooth mobility and tooth movement. J Periodontol 46:421, 1975.
64. Laster, L., Laudenbach, K. W., and Stoller, N. H. An evaluation of clinical tooth mobility measurements. J Periodontol 46:603, 1975.
65. Gjermo, P. Formal discussion following paper of Hazen, S. P. Indices for the measurement of gingival inflammation in clinical studies of oral hygiene and periodontal disease. J Periodont Res 9: Suppl 14:61, 1974.
66. Carranza, F. A. Glickman's Clinical Periodontology, Fifth Edition. W. B. Saunders Co., Philadelphia, 1979, p 319-351.
67. Sheiham, A. The prevalence and severity of periodontal disease in Surrey school children. Dent Pract 19:232, 1969.
68. Goldman, H. M. and Cohen, D. W. Periodontal Therapy, Sixth Ed. C. V. Mosby Co., St. Louis, 1980, p 68.
69. Poulsen, S. Epidemiology and indices of gingival and periodontal disease. Pediatr Dent Suppl 3:88, 1981.
70. Hull, P. S., Hillam, D. G., and Beal, J. F. A radiographic study of the prevalence of chronic periodontitis in 14-year-old English schoolchildren. J Clin Periodontol 2:203, 1975.
71. Blankenstein, R., Murray, J. J., and Lind, O. P. Prevalence of chronic periodontitis in 13- to 15-year-old children: a radiographic study. J Clin Periodontol 5:285, 1978.
72. Davies, P. H. J., Downer, M. C., and Lennon, M. A. Periodontal bone loss in English secondary school children: a longitudinal radiological study. J Clin Periodontol 5:278, 1978.
73. Kelly, J. E. and Sanchez, M. J. Periodontal disease and oral hygiene among children. United States. Data from the National Health Survey. Vital and Health Statistics — Series 11-No. 117. DHEW Publication No. (HSM) 72-1060. National Center for Health Statistics, Rockville, Maryland, 1972.
74. Sanchez, M. J. Periodontal diseases among youths 12-17 years. United States. Data from the National Health Survey, Vital and Health Statistics — Series 11-No. 141. DHEW Publication No. (HRA) 74-1623. National Center for Health Statistics. Rockville, Maryland, 1974.
75. Löe, H., Theilade, E., and Borglum, S. Experimental gingivitis in man. J Periodont 36:171, 1965.
76. Löe, H., Anerud, A., Boysen, H., and Smith, M. The natural history of periodontal disease in man. J Periodont Res 13:550, 1978.
77. Lindhe, J. and Axelsson, P. The effect of controlled oral hygiene and topical fluoride application on caries and gingivitis in Swedish school children. Comm Dent Oral Epidemiol 1:9, 1973.
78. Lindhe, J., Axelsson, P., and Tollskog, G. Effect of proper oral hygiene on gingivitis and dental caries in Swedish school children. Comm Dent Oral Eipdemiol 3:150, 1975.
79. Axelsson, P., Lindhe, J., and Waseby, J. The effect of various plaque control measures on gingivitis and caries in school children. Comm Dent Oral Epidemiol 4:232, 1976.
80. Axelsson, P. Concepts of plaque control. Pediatr Dent, Suppl 3:101, 1981.
81. Axelsson, P. and Lindhe, J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. J Clin Periodontol 5:133, 1978.
82. Siegel, K. L., Mandel, I. D., and Fine, D. The measurement of gingival fluid. J Periodontol 43:682, 1972.
83. Shapiro, L., Goldman, H. M., and Bloom, A. Sulcular exudate flow in gingival inflammation. J Periodontol 50:301, 1979.

84. Golub, L. M., Borden, S. M., and Kleinberg, I. Urea content of gingival crevicular fluid and its relation to periodontal disease in humans. J Periodont Res 6:243, 1971.
85. Golub, L. M. and Kleinberg, I. Gingival crevicular fluid: a new diagnostic aid in managing the periodontal patient. In Oral Science Reviews, No. 8, p. 49-62, (Edited by Melcher, A. H. and Zarb, G. A.). Munksgaard, Copenhagen, 1976.
86. Dombrowski, J. C., Schacterle, G. R., Livne, J. K., et al. A rapid chairside test for the severity of periodontal disease using gingival fluid. J Periodontol 49:391, 1978.
87. Smith, Q. T. Gingival crevicular fluid as a diagnostic aid. Northwest Dent J 56:71, 1977.
88. Rudin, H. J., Overdiek, H. F., and Rateitschak, K. H. Correlation between sulcus fluid rate and clinical histological inflammation of the marginal gingiva. Helv Odont Acta 14:21, 1970.
89. Daneshmand, H. and Wade, A. B. Correlation between gingival fluid measurements and macroscopic and microscopic characteristics of gingival tissues. J Periodont Res 11:35, 1976.
90. Helderman, W. H. and Hoogeneen, C. J. Bacterial enzymes and viable counts in crevices of noninflamed gingiva. J Periodont Res 11:25, 1976.
91. Listgarten, M. A. and Helldén, L. Relative distribution of bacteria at clinically healthy and periodontally diseased sites in humans. J Clin Periodontol 5:115, 1978.
92. Newman, M. G. and Socransky, S. S. Predominent cultivable microbiota in periodontics. J Periodont Res 12:120, 1977.
93. Vandersall, D. C. Periodontics — A decade in review. Dent Clin North Am 24:595, 1980.
94. Maynard, J. G. and Wilson, R. D. Diagnosis and management of mucogingivae problems in children. Dent Clin North Am 24:683, 1980.
95. Maynard, J. G. and Ochsenbein, C. Mucogingival problems, prevalence and therapy in children. J Periodontol 46:543, 1975.
96. Prichard, J. F., Kramer, G., Stahl, S. S., et al. Supplement, Glossary of Terms. J Periodontol 48:17, 1977.
97. Ochsenbein, C. and Maynard, J. G. The problem of attached gingiva in children. J Dent Child 41:263, 1974.
98. Garnick, J. J. Methods of measuring and recording periodontal disease. Dent Clin North Am 24:613, 1980.

Quotable Quote

Capitalizing on people's fears (of food additives, pollution) and hopes (of freedom from disease, increased longevity), a number of individuals and quasi-professional organizations are instrumental in disseminating a wide range of misleading nutrition information. How to recognize these self-styled "nutrition experts" who tend to wear a "cloak of science," reasons for their effectiveness in today's society with its emphasis on back-to-nature, anti-technology, anti-science, and freedom of choice in medical and health matters, the health hazards associated with following anecdotal nutrition claims, and how the First Amendment or freedom of speech protects politically active purveyors of nutrition misinformation, are discussed. "Natural," "organic," and "health" foods, megadoses of vitamins (A, D, E, ascorbic acid) including the limitations of hair analysis, a method of encouraging vitamin and mineral supplementation, and non-vitamins (laetrile or "vitamin B_{17}" and pangamic acid or "vitamin B_{15}"), and antifluoridation messages are among the types of misinformation promoted. Passage of the Proxmire Bill in 1976 removing FDA's legal authority to regulate the sale of over-the-counter vitamin supplements, legalization of laetrile (for patients correctly or incorrectly declared "terminally ill") in several states, government proposals to define the meaningless terms "organic" and "natural," thus lending endorsement to such fakery, and the vigorous opposition to water fluoridation, a safe, economical, and effective means to diminish tooth decay, are examples of the growing success of proponents of nutrition misinformation. With an informed public, the potential danger of anecdotal information replacing scientific findings can be lessened. Several antiquackery organizations are helping the public to distinguish between fact and fiction in nutrition and health matters and are exposing individuals and organizations exploiting nutrition.

From: Dairy Council Digest, "Nutrition misinformation," Volume 52, No. 4, July-August 1981.