

**Oral Health Surveys
of the
National Institute of Dental Research**

Diagnostic Criteria and Procedures

Epidemiology and Oral Disease Prevention Program
National Institute of Dental Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
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Acknowledgments

The editors of this manual were Dr. James P. Carlos and Janet A. Brunelle. To them and all others who participated, the Institute extends its appreciation.

A handwritten signature in black ink that reads "Harald Loe". The signature is written in a cursive, flowing style.

Harald Loe, D.D.S.

Director

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INTRODUCTION

This manual describes the methods and diagnostic criteria used by the National Institute of Dental Research for epidemiological studies of oral diseases, especially for descriptive population surveys.

Most of the indices of oral diseases described were originally proposed by others but have been extensively field-tested by NIDR staff and consultants and, in many cases, have been modified to improve examiner consistency and reproducibility and reduce examination time. We acknowledge the extensive contributions of the many current and former NIDR staff and consultants who have participated in the planning, drafting and testing of these methods and criteria.

It should be noted that the diagnostic criteria used are intentionally conservative; to maximize examiner consistency the general rule is that when a choice exists between two possible diagnoses, the less severe possibility is recorded. Thus, for example, frank evidence of cavitation must be present before a tooth surface is considered "decayed," periodontal probing measurements are always rounded downward, etc.

If the results of an oral health survey are to be extrapolated to larger populations, as is usually the case, the subjects examined must be statistically representative of the population of interest. This is to say that subjects must be selected by a valid sampling technique with known probability. Unless this is done, it is impossible to calculate how closely estimates of disease prevalence derived from the survey may approximate the true prevalence in the parent population. Sampling methodology can be complex, and an experienced sampling statistician is an essential collaborator in any epidemiologic survey.

Finally, the importance of thorough training and calibration of examiners cannot be overemphasized. For this reason, a section on examiner calibration and on the appropriate methods of measuring and interpreting inter- and intra-examiner reliability of diagnoses is included in the manual.

Proper sampling design and examiner calibration, together with close adherence to the methods and criteria described in this manual, should result in survey data which are directly comparable to those reported by the NIDR.



CORONAL CARIES

The DMFS Index

Introduction

The DMFT Index was originally described in 1938.¹ The variant used by the NIDR is the DMFS Index, which is the sum of the number of Decayed, Missing or Filled permanent tooth Surfaces, and is thus a summary of cumulative caries experience. The index is calculated for each subject, and averaged over subsets of the population.

The most important factor in obtaining high quality data using the DMFS index is that it be applied in a manner that is consistent among different examiners. The achievement of a high level of consistency requires that every examiner be thoroughly familiar with a uniform set of diagnostic criteria. These include criteria for diagnosing caries, for determining whether lesions or restorations involve multiple tooth surfaces, for determining the status of eruption of teeth, and for determining the conditions for which certain teeth should be excluded from the analysis.

Examination Procedure

In conducting the examination, an effort should be made to examine each subject in the same manner. An examiner should avoid the temptation to examine more thoroughly a subject who appears to be highly susceptible to caries. The examination sequence should follow the sequence shown on the data forms. The forms are arranged by quadrants; the examiner starts with the upper left central incisor and continues distally through the second molar in the same quadrant. The same sequence is followed for the upper right, lower left, and lower right quadrants, in that order.

It is also necessary to develop a systematic approach to examining each tooth. The suggested approach (following the sequence on the NIDR data forms) is to examine surfaces in the following order: lingual, labial, mesial, and distal for anterior teeth and occlusal, lingual, buccal, mesial, and distal for posterior teeth. It is not advisable to call out individual surface diagnostic codes as each tooth surface is examined, as this can be confusing to the recorder. It is better for the examiner to mentally accumulate surface diagnoses for a given tooth until all surfaces have been examined before dictating the diagnostic codes to the recorder.

¹Klein H, Palmer CE, and Knutson JW: Studies on Dental Caries. *Public Health Reports* 53:751-765, 1938.

Coronal Caries Scoring System

<u>Tooth Status</u>	<u>Diagnostic Code</u>
Sound (no caries or restorations)	S
Full Crown Coverage	C
Unerupted	U
Missing (caries/periodontal diseases)	E
Missing (orthodontic or non-disease reasons)	M
Exclusion (tooth or root cannot be scored)	Y
Deciduous (sound)	D*

<u>Surface</u>	<u>Diagnostic Code</u>	
	<u>Caries</u>	<u>Filled</u>
Occlusal	X**	5**
Lingual	0	6
Buccal	1	7
Mesial	2	8
Distal	3	9

- * When deciduous surface has caries or restoration, indicate "D" as well as surface codes X-3, 5-9 to differentiate from permanent surface codes.
- ** Not applicable to anterior teeth

Decayed Tooth Surfaces (The "D" component of the index)

Advanced lesions are detected as gross cavitation and thus present few problems in diagnosis. Early lesions, on the other hand, are more difficult to diagnose consistently. Early lesions may be subdivided into three categories according to location, each with the following special diagnostic consideration:

- Pits and fissures on occlusal, buccal and lingual surfaces: These areas are diagnosed as carious when the explorer catches after insertion with moderate, firm pressure and when the catch is accompanied by one or both of the following signs of caries:
 - (1) Softness at the base of the area.
 - (2) Opacity adjacent to the area providing evidence of undermining or demineralization.

In other words, a deep pit or fissure in which the explorer catches is not in itself sufficient evidence of decay; it must be accompanied by at least one of the above signs.

- Smooth areas on buccal (labial) or lingual surfaces: These areas are carious if they are decalcified or if there is a white spot as evidence of subsurface demineralization and if the area is found to be soft by:
 - (1) Penetration with the explorer, or
 - (2) Scraping away the enamel with the explorer.

These areas should be diagnosed as sound when there is only visual evidence of demineralization.

- Proximal surfaces: For areas accessible to direct visual and tactile examination, as when there is no adjacent tooth, the criteria are the same as those for smooth areas on buccal or lingual surfaces. For areas not available to direct examination, other criteria must be applied. In anterior teeth, transillumination can serve as a useful aid in discovering proximal lesions. Transillumination is achieved by placing a mirror lingually and positioning the examining light so that it passes through the teeth and reflects into the mirror. If a characteristic shadow or loss of translucency is seen on the proximal surface, then this is indicative of caries on the surface. Ideally, the actual diagnosis should be confirmed by detecting a break in the enamel surface with the explorer; however, clear visualization of a lesion by transillumination can justify a positive diagnosis. In posterior teeth, however, visual evidence alone, such as undermining under a marginal ridge, is not sufficient proof for diagnosing a proximal lesion. A positive diagnosis is made only if a break in the enamel surface can be detected with the explorer.

Missing Tooth Surfaces (the "M" component of the index)

This component usually includes only those permanent teeth which have been extracted as a result of caries. It is essential to distinguish between teeth extracted because of caries and those extracted or missing for other reasons. The code "E" is used to indicate teeth extracted because of caries, and a different code "M" for teeth missing due to trauma, orthodontic treatment, or other non-disease related causes. Unerupted or congenitally missing teeth (code "U") must also be correctly identified.

However, in older subjects, it is difficult to distinguish between teeth extracted due to caries and those extracted for periodontal reasons. In populations where teeth missing because of periodontal disease may be common, to include such teeth in the "M" component of the DMFS Index would overestimate total caries experience. Therefore, many investigators ignore missing teeth in these circumstances, and report caries experience only as DFS (Decayed and Filled Surfaces) only. Once again, the result is to err on the side of conservatism. In this circumstance, all teeth missing because of disease are coded "E" and teeth missing due to other reasons are coded "M".

Filled Tooth Surfaces (the "F" component of the index)

The "F" component represents a tooth surface that has been filled with either a permanent or a temporary restoration as a result of caries involvement. Here also it is necessary to distinguish between surfaces restored for caries and those restored for other reasons, such as trauma, hypoplasia or malformation.

Guidelines for Diagnosing Coronal Caries

The following conventions have been adopted in the interest of achieving diagnostic consistency:

- Third molars are not scored. When examining second molars it is important to be aware that a drifted third molar may occupy the space of a missing second molar. In such cases, the diagnosis and score must relate to the status of the missing second molar, not the third molar. If the second molar, for example, was extracted due to caries and the space is now occupied by a sound third molar, the second molar is scored as extracted (E) and the third molar is not scored.
- If both a deciduous and a permanent tooth occupy the same tooth space, only the permanent tooth is scored.
- A tooth is considered to be in eruption when any part of its crown projects through the gum. This criterion is easier to standardize than one based on a more advanced stage of eruption.

- In the case of supernumerary teeth, only one tooth is scored for the tooth space. The examiner must decide which tooth is the "legitimate" occupant of the space.
- Incisal edges of anterior teeth are not considered to be separate surfaces. If a lesion or restoration is confined solely to the incisal edge, its score should be assigned to the nearest adjacent surface. Thus, anterior teeth have only four scorable surfaces (mesial, distal, labial, and lingual). The inclusion of the occlusal surface for posterior teeth gives those teeth five surfaces. Therefore, a total of 128 surfaces are examined and diagnosed for each subject.
- When a caries lesion extends beyond the line angle onto another surface, the other surface is also scored as affected. However, a proximal filling on an anterior tooth is not considered to involve the adjacent labial or lingual surface unless it extends at least one-third of the distance across the labial or lingual surface. The reason for this criterion is that tooth structure on adjacent surfaces must often be removed to provide access for the restoration of a proximal lesion on anterior teeth. Also, to guard against a similar possibility for overestimating the amount of disease in posterior teeth, a proximal restoration should extend at least a millimeter past the line angle before it is considered to involve the adjacent buccal or lingual surface.
- If a permanent tooth has a full crown restoration placed because of caries, the tooth will be coded as "C," which represents the maximum number of surfaces for the tooth type, i.e., four surfaces on anterior teeth and five surfaces on posterior teeth. By convention, all crowns on posterior teeth, including abutment teeth for fixed or removable prostheses, are considered to have been placed as a result of caries. On anterior teeth, however, the examiner should make a determination of the reason for crown placement. If the crown was placed for any reason other than caries, such as fracture, malformation or esthetics, the tooth is coded "Y." This rule applies only to those anterior teeth with full crowns or jackets. If a tooth has been restored with less than full coverage, all surfaces not involved should be scored in the usual manner.
- Teeth that are banded or bracketed for orthodontic treatment are examined in the usual manner and all visible surfaces are scored.
- Certain teeth, notably first bicuspid, may have been extracted as part of orthodontic treatment. These teeth are coded "M" and will be excluded from the DMFS analysis. The examiner must make the determination that the teeth were in fact extracted for orthodontic reasons, although this is not usually difficult because of the typically symmetric pattern of these extractions. For the sake of uniformity, all orthodontically extracted bicuspid are scored as first bicuspid. Teeth other than bicuspid may also be extracted for orthodontic reasons. In many cases the subject will have good recall of the reason for the extractions, and can help in making the correct determination.

ILLUSTRATIONS OF DMFS ASSESSMENT OF CORONAL CARIES

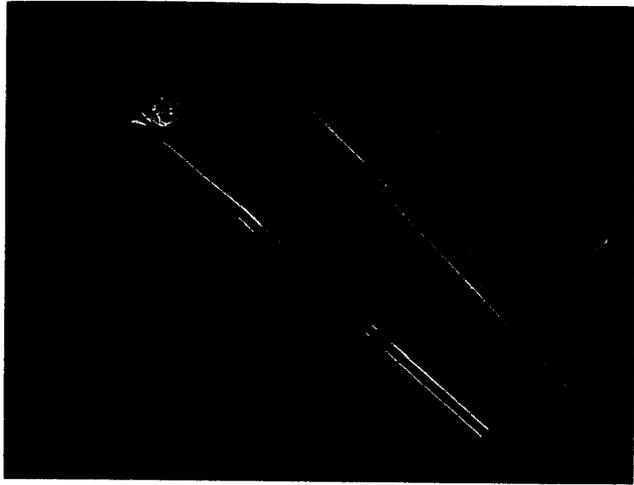
- 1) Subjects should be examined with a sharp, #23, sickle-shaped explorer and unmarred, nonmagnifying, front surface mirror. Ideally the teeth should be dried before examining each quadrant.**

- 2) The recorder should be positioned within easy hearing distance of the examiner. The portable chair should be set at a height that is comfortable and compatible with the height of the stool. Instruments and other necessary material are placed on a table within easy reach of the examiner.**

- 3) If the light is properly placed, subtle adjustments of the mouth mirror should allow for transillumination of approximal surfaces of anterior teeth from the lingual. This technique is used only on anterior teeth.**

- 4) Caries is present in the pits and fissures of the occlusal surfaces of the molar and the bicuspid. Each of these teeth surfaces would receive a score of "X." The buccal surface of the molar would be scored "1" if caries is confirmed with the explorer. It appears that undermining is present on the mesial surface of the first molar; however, the status of this surface must be confirmed with the explorer.**

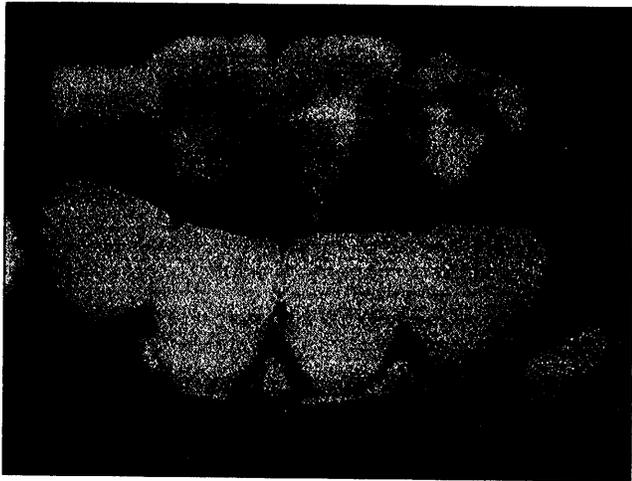
- 5) The second bicuspid has a large caries lesion that extends at least one millimeter beyond the line angle onto the buccal surface. The tooth would be scored "X,1,3" to indicate involvement of the occlusal, buccal and distal surfaces.**



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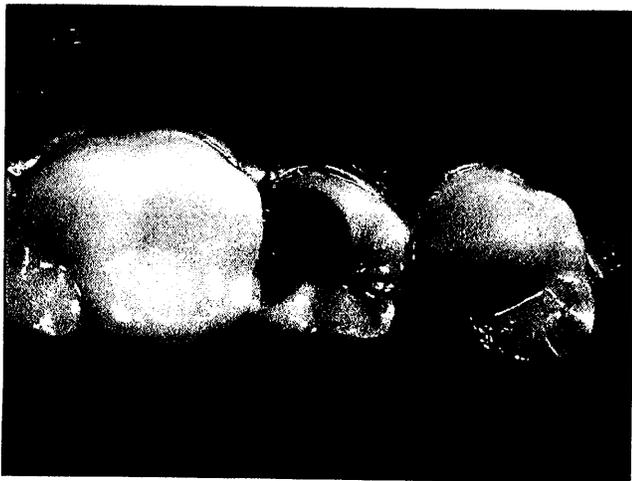
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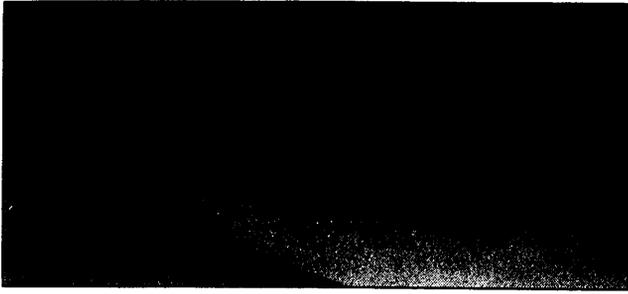
- 11) Only the roots are remaining for the first bicuspid and first permanent molar. A shell of the second bicuspid is present. These teeth would be scored as all surfaces carious (X,0,1,2,3).

- 12) The distal and occlusal surfaces of the first bicuspid and the occlusal surface of the first molar have been restored. The first bicuspid would be scored "5,9" and the first molar would be scored "5." The second bicuspid would be scored "S," indicating that all surfaces are sound.

- 13) The first primary molar would be scored "D5,8,9" to account for the three-surface restoration. In the second primary molar, the occlusal restoration would be ignored and the tooth would be scored "D X."

- 14) Composite restorations can be seen on the upper lateral incisor and cuspid. The mesial and distal of the lateral would be scored "8" and "9," respectively, and the mesial of the cuspid would be scored "8." The labial surfaces are not scored because the restoration does not extend one-third of the distance across the surface.

- 15) If the restoration on the central incisor had been placed because of caries, it would be scored as "6,7,8" indicating involvement of the lingual, labial and mesial surfaces. (There is no score for incisal surfaces.) If it had been placed only to restore a fracture, the filling would be ignored and the tooth scored as sound (S).



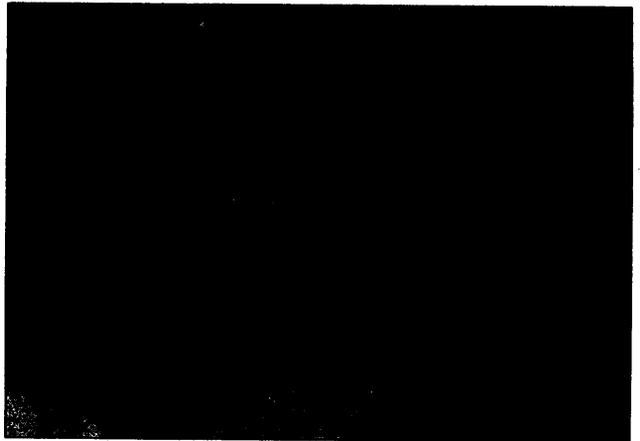
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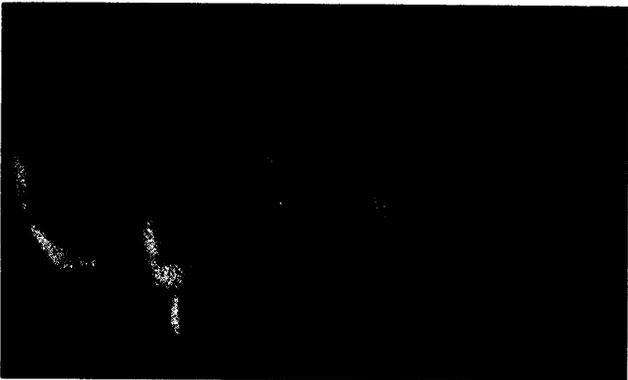
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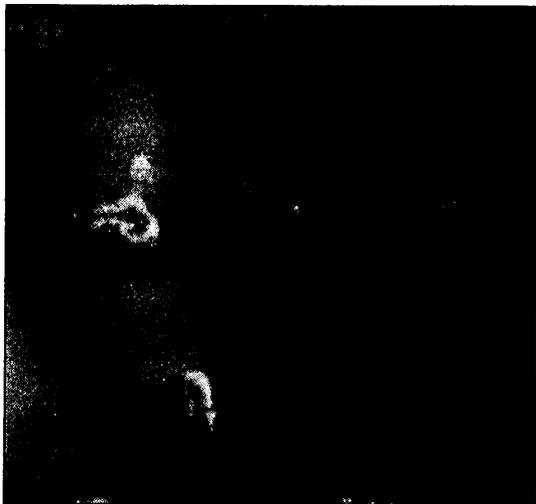
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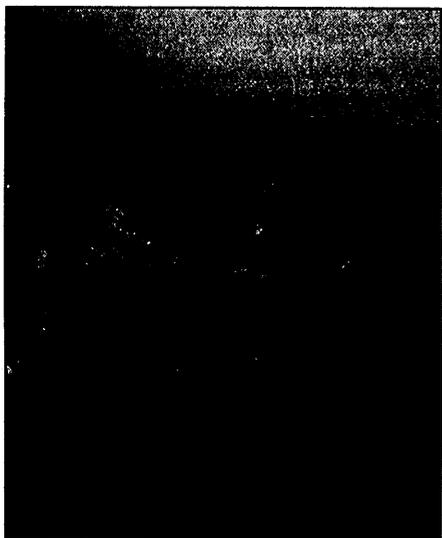
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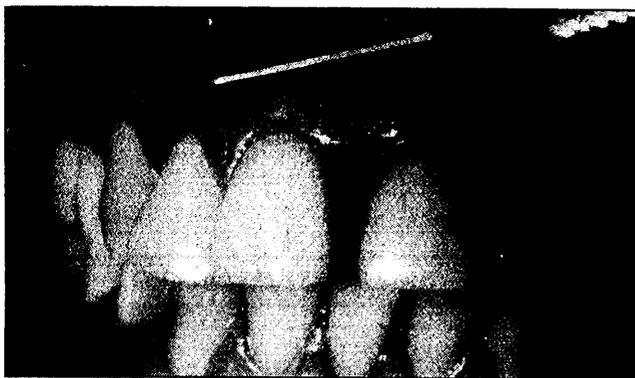
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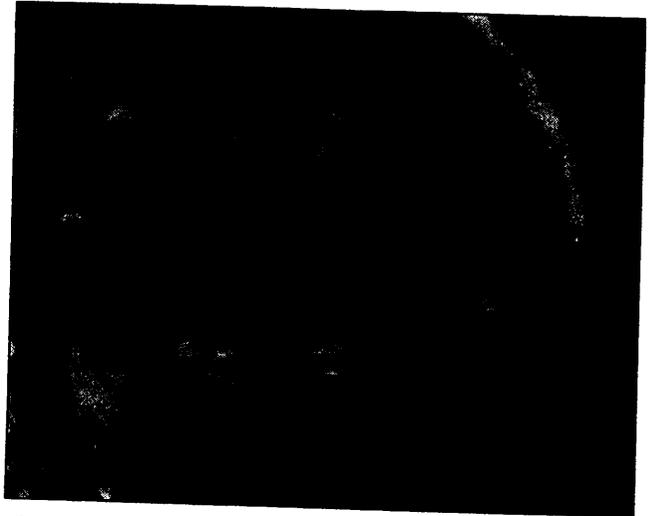
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- 16) The upper first molar has a large restoration involving the occlusal, lingual, buccal and mesial surfaces (5,6,7,8). Even though two restorations are present on the buccal surface of the lower molar, a single score of "7" would be given, unless obvious caries exists. Then, the caries would take precedence and the surface would be scored "1."
- 17) Fractured amalgams are present in the first and second molars. If caries were not detected, each tooth would be scored "5,8," as though the restorations were still intact. If caries were found in the approximal areas where the restorations are missing, the teeth would be scored as "2,5."
- 18) A distal-occlusal restoration with a hairline fracture is present in the bicuspid. This tooth would be scored "5,9" as if no fracture were present, unless obvious caries was detected.
- 19) The mesial surfaces of both bicuspids have restorations as well as obvious caries. The caries would take precedence and these surfaces would be given a score of "2."
- 20) The reason for the crown on the central incisor must be determined. If it were placed because of caries, the tooth would be scored "C." A score of "Y" would be assigned if the crown were placed to restore a fracture, or for other non-disease related reasons.

- 21) Each of the crowned molars would receive a score of "C." Depending on the extent of coverage on the bicuspids, all surfaces except the buccal would be scored (5,6,8,9).
- 22) The lower molar was extracted because of caries and would receive a score of "E." If the tooth had been extracted for a non-disease related reason, a score of "M" would be given.
- 23) The missing teeth were extracted because of periodontal disease. They would be scored the same as for caries (E).
- 24) Hypoplastic teeth are scored as sound (S) unless caries or a restoration is present. In case of a restoration, a judgment must be made as to whether a restoration was placed because of caries or for esthetic reasons. In the latter case, the restoration would not be scored.
- 25) Temporary restorations are scored in the same manner as permanent restorations.



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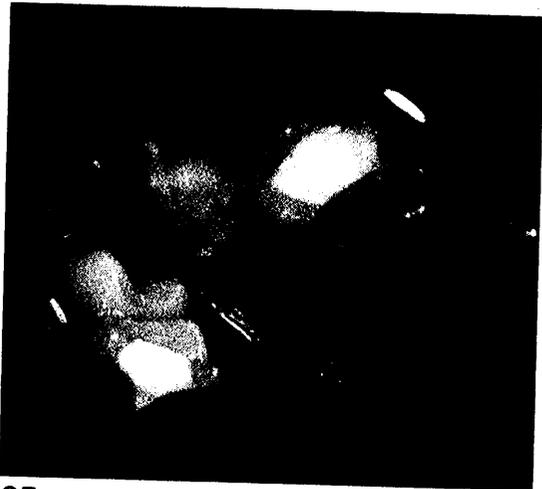
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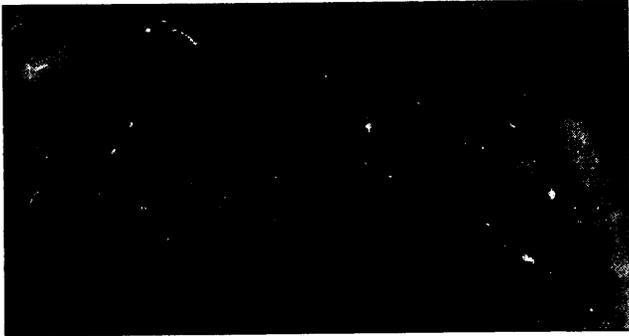
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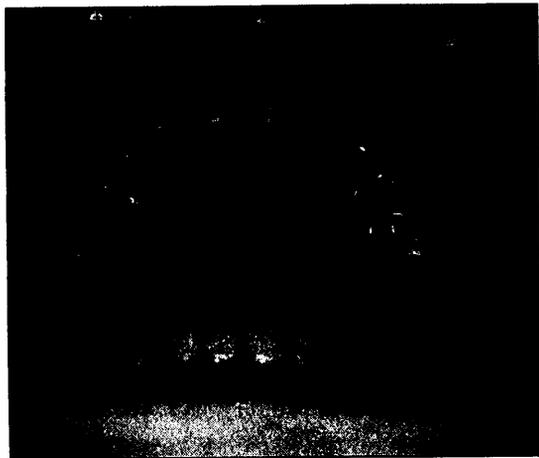
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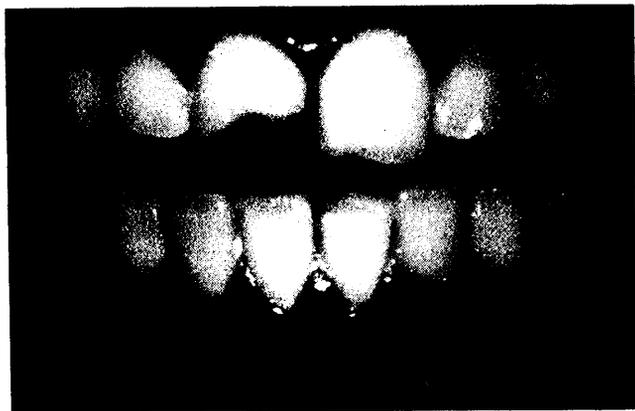
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- 26) Composite restorations, or sealants used as filling material, are scored in the same manner as any other restoration.
- 27) In the absence of caries or restorations, a surface containing a dental sealant would be scored as sound (S). The sealant would be assigned a code of "A," or in the case of permanent molars, where two sites are present, an "A1" or "A2."
- 28) A score of "C" is given to all full crowns placed on posterior teeth, including abutments. On anterior teeth, the score could be either a "C" or "Y," depending on the reason the crowns were placed.
- 29) Orthodontically banded teeth are scored as usual on all surfaces visible. If the upper lateral incisors are thought to be congenitally missing, they are scored as unerupted permanent teeth (U).
- 30) Unrestored fractured teeth are scored as usual on all surfaces. If a full crown had been placed to restore the fracture, the tooth would be scored "Y." If only the fractured area had been restored, the restoration would be ignored and all other visible areas would be scored as usual.



ROOT CARIES

An examination for root caries is done only in surveys of adult or elderly populations.

Root caries is summarized by the DFS Index (Decayed and Filled Permanent Root Surfaces), missing teeth being ignored. By convention, each tooth is considered to have 4 root surfaces: mesial, buccal (labial), distal and lingual.

The sequence of examination is exactly the same as for coronal caries. All exposed portions of a tooth's root surface should be carefully examined. The most difficult areas to examine are approximal surfaces in posterior teeth, particularly those that contain restorations. Subgingival inspection is not recommended because few lesions are confined subgingivally and it may produce bleeding.

The tooth and surface codes for root caries are identical to those for coronal caries with the exception of the "R" score, which is equivalent to the "S" score for coronal caries, indicating a tooth for which all root surfaces are sound.

Root Caries Scoring System

<u>Tooth Status</u>	<u>Diagnostic Code</u>
Sound (no caries or restorations)	R
Unerupted	U
Missing (for any reason)	M
Exclusion (tooth or roots cannot be scored)	Y

<u>Surface</u>	<u>Diagnostic Code</u>	
	<u>Caries</u>	<u>Filled</u>
Lingual	0	6
Buccal (Labial)	1	7
Mesial	2	8
Distal	3	9

The diagnosis of root caries requires the examiner to:

- Distinguish between caries and abrasion/erosion
- Decide whether a lesion originated on the root or the crown of the tooth, when both areas are involved
- Decide how many surfaces to score carious (or filled)

Guidelines for Diagnosing Root Caries

The following conventions and notes have been adopted to promote consistency of diagnoses.

- In some incipient lesion the carious area of the root surface may merely be discolored without cavitation, but the area will be soft to exploration. Cavitation with jagged margins and a roughened, but soft floor or base usually occurs in advanced lesions. Normal cementum is softer than enamel, and frequently will yield to pressure from the tip of an explorer. Areas of root caries, however, are softer than surrounding cementum; therefore, it is possible to differentiate sound cementum from carious cementum based on tactile sense. In the presence of root caries, an explorer penetrates the tissue but usually can be removed easily. However, if the explorer penetrates but resists withdrawal or "sticks," the surface is usually sound cementum.
- Areas of abrasion or erosion in root surfaces rarely become carious because they are generally kept clean and are free of plaque. Root caries frequently occurs beneath plaque, but rarely beneath calculus. Accumulations of plaque which obstruct the examination procedure should be removed. Surfaces covered entirely by calculus are considered sound.
- Whenever both a coronal and root surface is affected by a single caries lesion that extends at least 1 mm past the CEJ in both cervical-incisal and cervical-apical directions, both surfaces should be scored as decayed. However, for a lesion affecting both crown and root surfaces that does not meet respective 1 mm extent of involvement, the surface on the side of the CEJ that involves more than 50 percent of the area of the lesion should be scored. When it is impossible to apply the "> 50% rule," i.e., when both coronal and root surfaces appear equally affected, both surfaces should be scored "decayed." For restorations, the same rules apply.
- Because of the constricted anatomy of the root surfaces of lower incisors, few lesions will be confined solely to the lingual surface--only small lesions at the midpoint. Most lingual lesions will also affect the adjacent mesial and/or distal

root surfaces. However, lesions of the mesial and distal surfaces which extend lingually but do not reach the midline are only scored as interproximal lesions.

- On all other teeth, when root caries appears to wrap around the line angle of the root, the more involved surface is considered the primary site of the lesion and is scored carious, whereas the adjoining surface is only scored as carious when the lesion clearly extends at least 1 mm past the line angle.
- Defective margins of fillings should be checked with an explorer for recurrent decay. The criterion for scoring "decayed and filled" root surfaces is the same as for coronal surfaces, that is, decay takes precedence over a filling. Full crown coverage is considered to have been placed for coronal caries even if the margin of the crown extends onto the root surface. Thus, a root surface with a crown margin free of recurrent decay should be scored sound or "R" (no caries or restorations).

ILLUSTRATIONS OF DFS ASSESSMENT OF ROOT CARIES

1) No apparent recession

Each tooth in the quadrant, excluding third molars, is checked for root caries in the same sequence that was utilized for coronal caries. If no recession were found on the root surfaces of a tooth, a call of "R" would be made indicating a sound root. Knowledge of the curvature of the CEJ for each tooth type is essential for the determination of recession.

2) Presence of plaque and soft accumulations

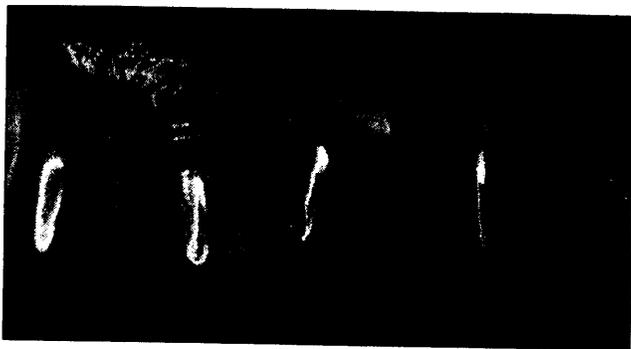
Soft debris is visible on the upper and lower anterior teeth. Because root caries is often found under plaque, the examiner should remove any soft debris that hinders the visual and tactile examination of the root surface. Soft debris should be removed with a gauze square.

3) Presence of calculus

Calculus is present at the cervical area of the lower cuspid and bicuspid. Because root caries seldom occurs beneath calculus, the underlying surface is presumed to be sound.

4) Mild recession

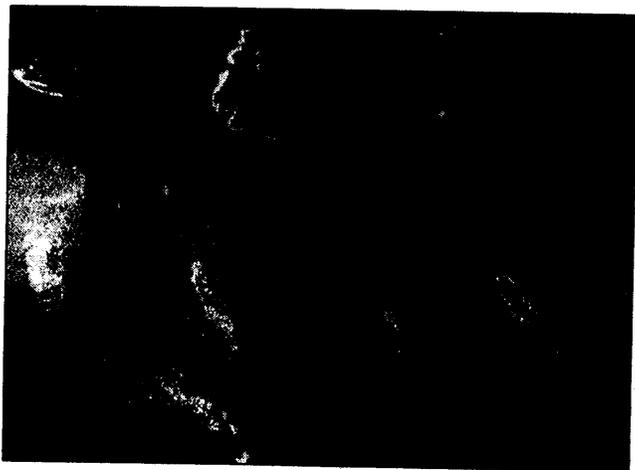
Even with minimal recession of the gingival tissues, the cementum of root surfaces becomes susceptible to caries. All surfaces, therefore, with any exposed cementum should carefully be examined. The labial surfaces of the cuspid and first bicuspid show mild recession. If no caries was detected in these teeth, they would each be scored "R."



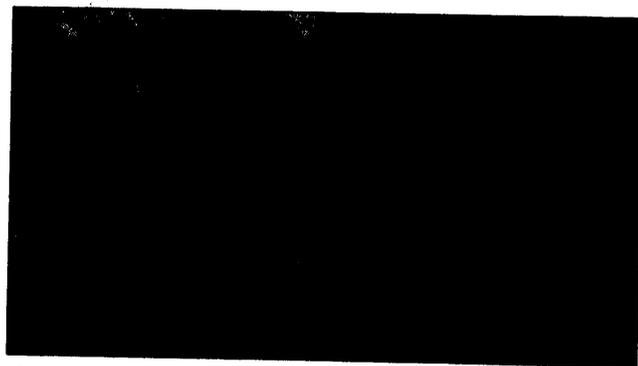
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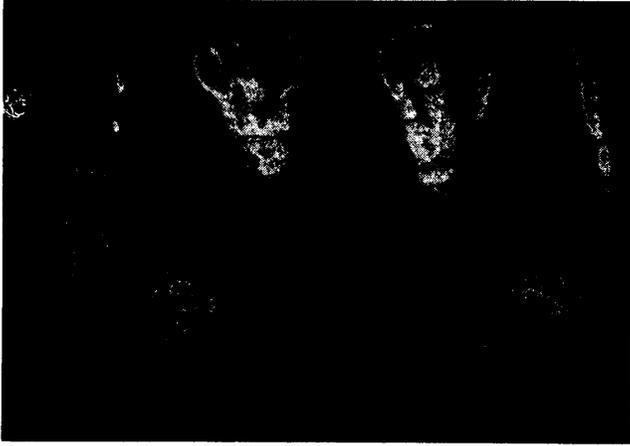
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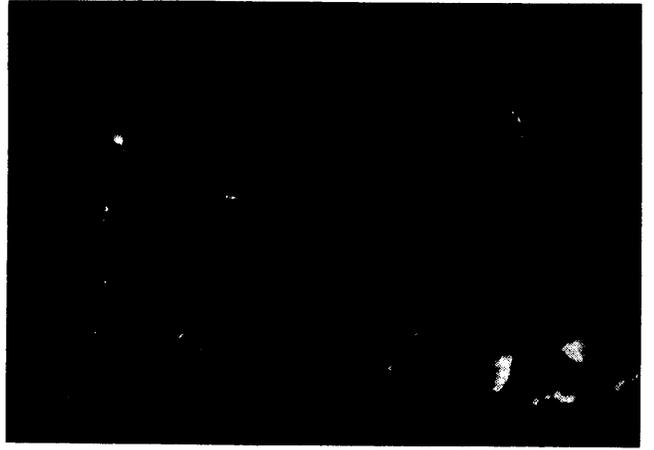
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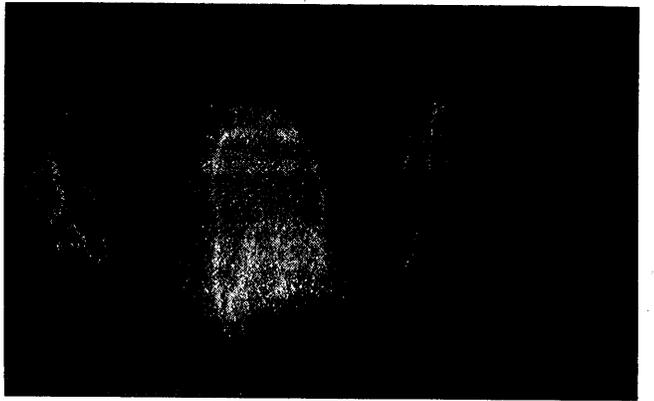
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5) **Advanced recession**

Recession is present on the labial and mesial surfaces of the lower central incisors. Calculus is also present. If no caries was detected, each of the incisors would be scored "R."

6) **Abrasion and recession**

The labial surfaces of the anterior teeth and the buccal surface of the bicuspid both show abrasion and recession. Even though the areas of abrasion are usually caries free, the examiner should carefully check such areas. If no caries or restorations were present on these teeth, each would be scored "R."

7) **Initial root lesion**

A small round discoloration can be observed in the cervical area of the labial surface of the lower cuspid. If upon exploration, the area is determined to be carious, a scorer of "1" would be given.

8) **Initial root lesions**

Note the pinpoint lacy effect of the discolorations along the CEJ of the labial surfaces of the patient's upper right central and lateral incisors. If these areas are found to be carious and if the lesions continue on to the mesial and distal surfaces, a score of "1, 2 and 3" would be given for each of these teeth.

9) **Small root lesions**

Three stages of lesions can be noted on the rotated second bicuspid. A questionable white spot, a small pinpoint lesion and a more advanced black lesion. Even if the examiner were to determine that all three areas were carious, a single score of "3" would be given to indicate caries present on the distal surface.

10) Advanced root lesions

More advanced lesions can be observed on the upper lateral incisors and lower cuspids. Because the lesions extend 1 mm or more past the CEJ onto both crown and root surfaces, both crown and root surfaces of each tooth should be scored "1."

11) Advanced root lesions

Several stages of the development of root lesions are shown. The irregular progressive destruction of advanced root lesions often affects the crown causing cervical undermining of the enamel. However, only the crowns of the patient's right cuspid and left first bicuspid are clearly involved. Black lesions usually indicate a remission in caries activity. Small circular brown lesions have developed apically next to the receding gingiva. All visible root surfaces would be scored as carious, "1, 2, and 3."

12) Root restorations

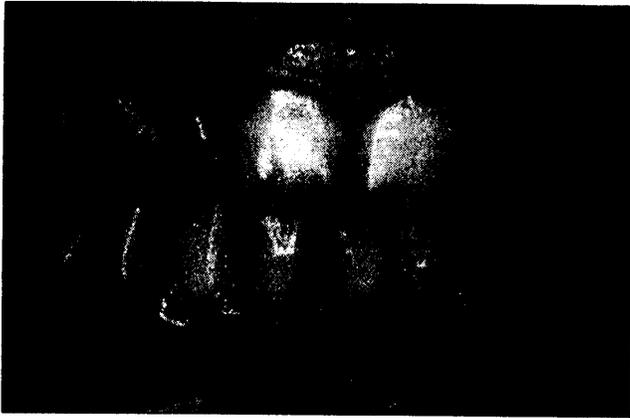
Several teeth with gold foil cervical restorations can be observed. In order to make the appropriate diagnosis for these teeth, it is necessary to locate the CEJ. Restorations that extend 1 mm or more both incisally and apically past the CEJ would be scored as involving both crown and root surfaces. Accordingly, for all restorations with the exception of those in the patient's upper left central and lateral incisors, the crown and root surfaces would each be scored a "7." Because the crown portion of the restorations on the patient's upper left central and lateral incisors do not extend incisally 1 mm past the CEJ and do not involve more than 50 percent of the area of the restoration only the root surface is scored a "7."

13) Root restorations

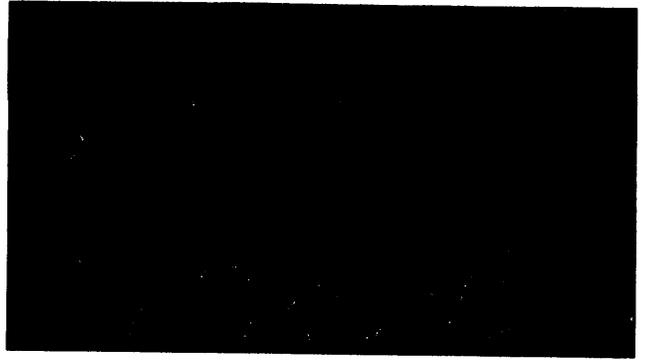
Crowns are considered to be placed for coronal caries even if the crown extends onto a root surface. Exposed root surface adjacent to the crowns on the abutment teeth should be examined. If no lesions or restorations are present, a single score of "R" would be made for the root surfaces.

14) Recurrent decay

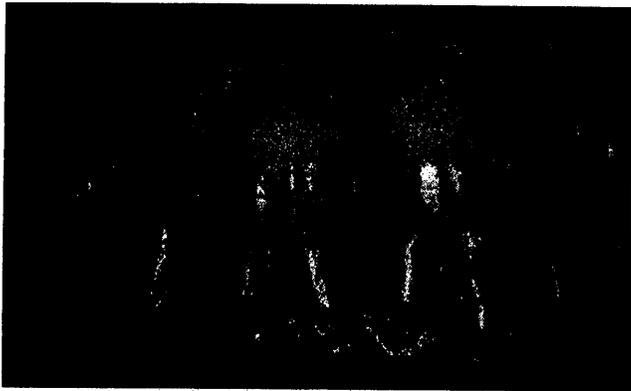
Note the two areas of recurrent decay associated with the cervical restoration on the buccal surface of the upper cuspid. Because both recurrent lesions and restoration appear to be confined to the crown, the root would be called an "R" and the buccal surface on the crown scored "1."



10



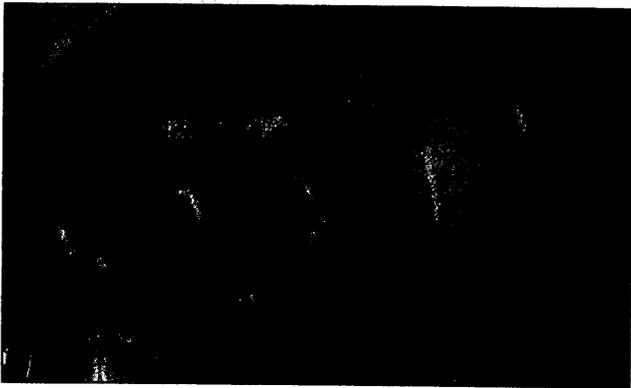
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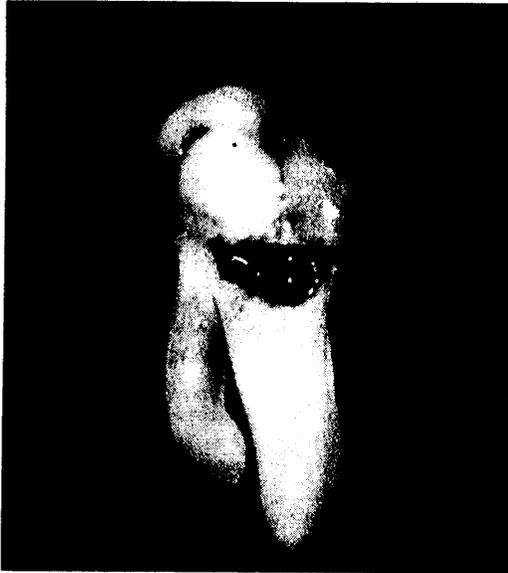
12



13



14



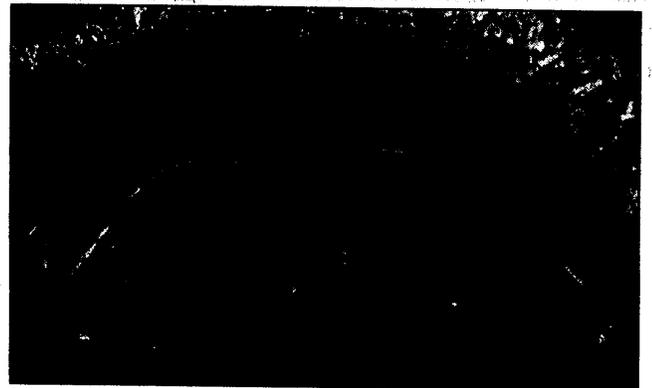
15



16



17



18

15) Surface-specific scoring

This extracted molar shows caries (red dye) on the lingual surface. Irrespective of the number of roots, the tooth is considered to have four surfaces. The mesial and distal surfaces are not involved. A single score of "0" would be made.

16) Surface-specific scoring

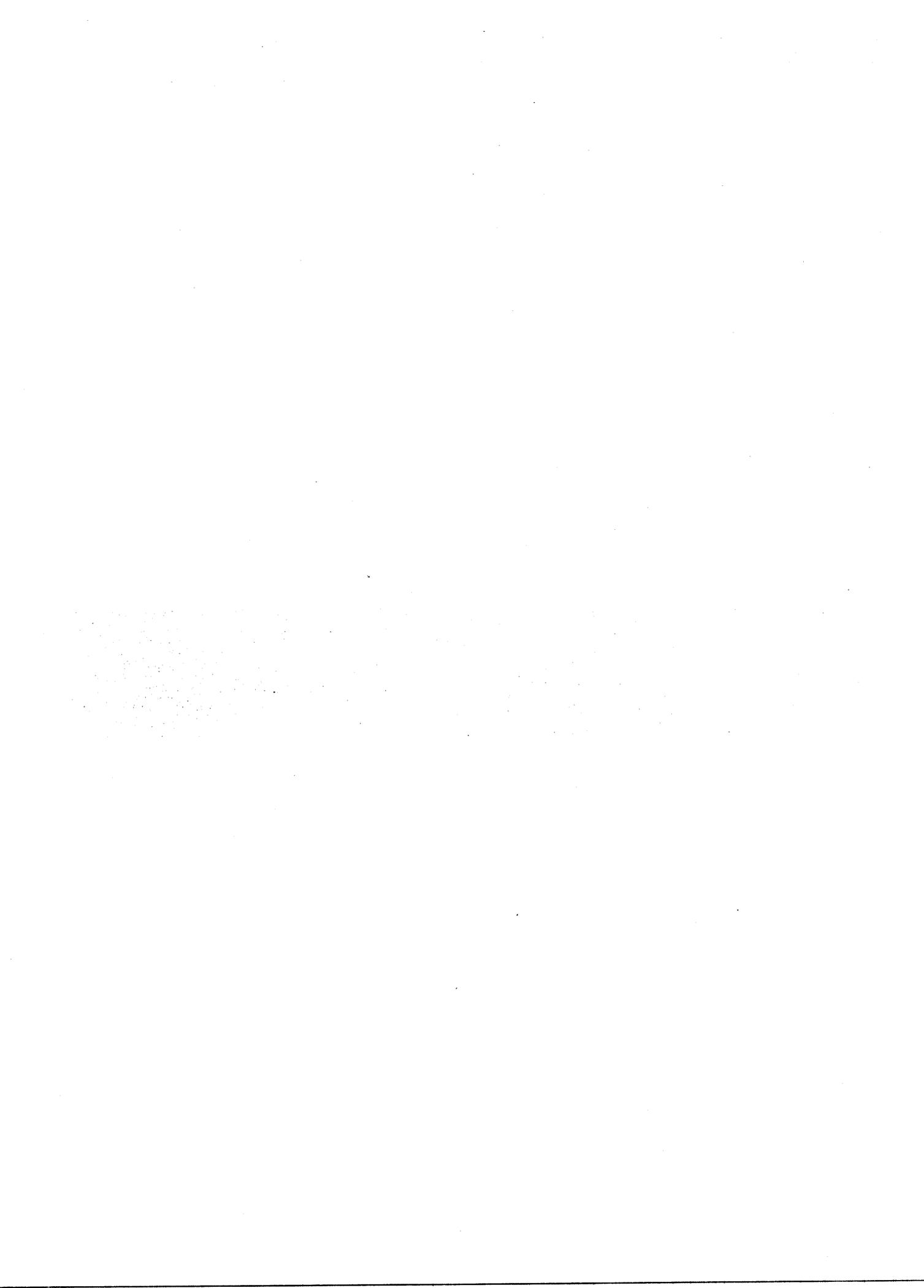
Caries is present on the lingual surface of the central incisor. If the lesion were judged to clearly extend past the line angle by more than 1 mm, then the distal surface would also be considered involved (score "0,3").

17) Surface-specific scoring

Several interproximal and cervical lesions can be observed. On the lower anterior teeth, mesial and distal lesions which extend lingually but do not reach the midline are scored only as interproximal lesions. Thus, the lower left cuspid is scored as lingual decay "0," the lateral incisor as distal decay "3," and the central incisor is scored as mesial and distal decay "2, 3." The area on the distal of the lower right central incisor would receive a "3" if determined to be carious.

18) Surface-specific scoring

The same dentition as in 17 can be seen after restoration. The patient's left cuspid would be scored as a "6," the left lateral and central would both be scored as "8, 9." The right central would be scored "R" if no decay is detected.



DENTAL FLUOROSIS

Introduction

Dental fluorosis is a hypomineralization of tooth enamel and dentine that results from consuming excessive amounts of fluoride during the period of tooth development. Both primary and permanent teeth may have fluorosis, although the former generally are affected to a lesser extent. The degree of fluorosis can range from barely noticeable whitish opacities to confluent pitting of the enamel surface and unsightly dark brown staining, depending upon the amount of fluoride and duration of exposure during tooth development.

Classification and Scoring

The criteria for classifying and scoring dental fluorosis are derived from the system described by Dean in 1942.² Each tooth is examined and assigned to one of six categories according to its degree of fluorosis. Classification of a person is based on the two teeth most affected by fluorosis. If the two teeth are not equally affected, the classification given is that of the less involved tooth. The criteria and the corresponding scores are as follows (see illustrations):

²Dean HT: The Investigation of Physiological Effects by the Epidemiological Method. In: *Fluorine and Dental Health*, F. R. Moulton, (Ed.), AAAS, Pub. No. 19, Washington, DC, pp. 23-31, 1942.

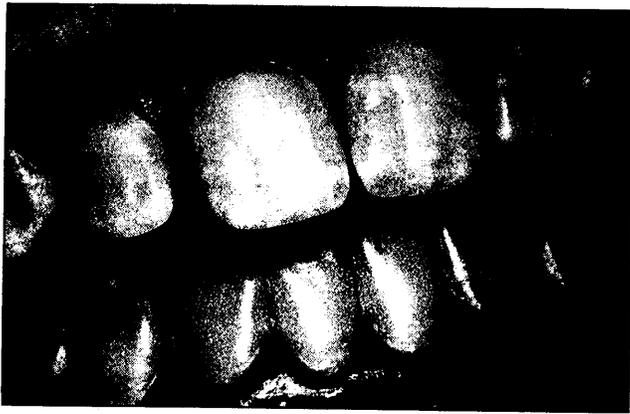
<u>Classification (Score)</u>	<u>Criteria</u>
Normal (0)	The enamel presents the usual translucent semivitriform type of structure. The surface is smooth, glossy, and usually of a pale creamy white color.
Questionable (0.5)	The enamel shows slight aberrations from the translucency of normal enamel, ranging from a few white flecks to occasional white spots. This classification is utilized in those instances where a definite diagnosis of the very mild form of fluorosis is not warranted and a classification of "normal" is not justified. Included in this category are teeth that show no more than 1-2 mm of white opacity at the cusp tips of posterior teeth or incisal edges of anterior teeth.
Very Mild (1)	Small, opaque, paper white areas scattered irregularly over the enamel but involving less than 25 percent of the total surface area.
Mild (2)	The white opaque areas are more extensive but involve less than 50 percent of the total surface area.
Moderate (3)	At least 50 percent of the total surface area is affected. Surfaces subject to attrition often show wear and brown stains may be present.
Severe (4)	The entire surface area is usually affected. The diagnostic sign required for this classification is discrete or confluent pitting of the enamel. With marked confluent pitting, the tooth often presents a corroded-like appearance. Brown stains of intact enamel are often present.



Normal (0)



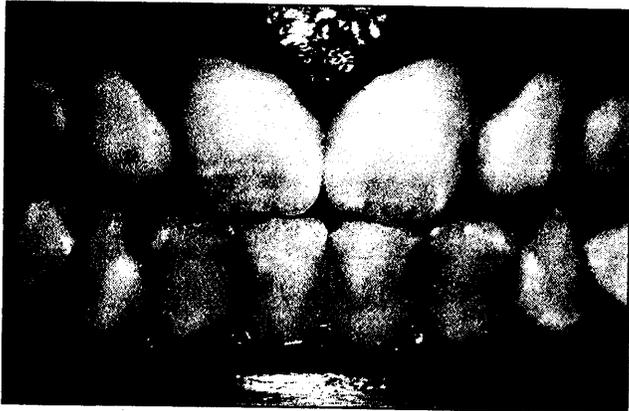
Questionable (0.5)



Very Mild (1)



Mild (2)



Moderate (3)



Severe (4)

Community Fluorosis Index

A Community Fluorosis Index. This is simply the arithmetic mean of the fluorosis scores assigned to each individual in the group of interest. In the opinion of Dean, Community Fluorosis Index scores of 0.6 or higher indicate a situation which "constitutes a public health problem."

Public Health Significance of Community Fluorosis Index³

Community Fluorosis Index	Public Health Significance
0.0 - 0.4	Negative
0.4 - 0.6	Borderline
0.6 - 1.0	Slight
1.0 - 2.0	Medium
2.0 - 3.0	Marked
3.0 - 4.0	Very Marked

Special Diagnostic Considerations

- Only fully erupted permanent teeth are scored, using a good source of artificial light. The teeth are not air-dried before scoring.
- The examiner should follow the same sequence in the mouth as for the DMFS examination. A single diagnosis is made for each tooth (or tooth space).
- A tooth is not scored if one-half or more of the visible enamel area is replaced with a restoration or is destroyed by caries or covered with an orthodontic band. For posterior teeth the visible enamel is composed of the buccal and lingual surfaces, extending from embrasure to embrasure, and the occlusal surface. For the anterior teeth, the visible area is composed of the labial and lingual surfaces, extending from embrasure to embrasure.
- Fluorosis in the milder classifications may be confined to particular areas of the enamel, or may occur irregularly over the entire enamel surface. The area affected is derived by visually coalescing all areas of fluorosis and relating that area to the total area of all visible enamel.

³Dean HT. Epidemiological Studies in the United States. In: Dental Caries and Fluorine, F. R. Moulton (Ed.), AAAS, Science Press, AAAS, Lancaster, 1946.

- Staining of intact enamel is not a diagnostic criterion specific to any of the classifications and is not taken into consideration in scoring a tooth.
- A pit is defined as a discrete, focal loss of outermost enamel. Initially, the enamel wall is usually intact. With wear, however, the enamel wall can be abraded away, so that often only part of the wall can be detected. The pitted area is usually stained or demonstrates a different color compared with the surrounding intact enamel.
- Confluent pitting of the enamel results from the coalescence of two or more discrete pits. The walls of pits at the occlusal or incisal edges can be abraded, so that only the walls on the gingival aspect remain intact, often leading to an irregular "ledging" effect. In some cases, confluent pitting may advance to a point where such large areas of enamel are corroded that the anatomy of the tooth is altered.

Differentiating Between Fluorosis and Nonfluoride Opacities

Opacities occurring in enamel may be due to a multitude of etiological factors in addition to excessive fluoride intake. In studies of fluorosis it is necessary to distinguish between fluoride and nonfluoride enamel changes. This distinction is generally most difficult when examining for the milder forms of fluorosis. To aid the examiner in making an appropriate decision, the following set of criteria were developed by Russell:

The Differential Diagnosis of F and Non-fluoride Enamel Opacities⁴

<u>Characteristic</u>	<u>Milder Forms of Fluorosis</u>	<u>Non-fluoride Enamel Opacities</u>
Area affected	Usually seen on or near tips of cusps or incisal edges.	Usually centered on smooth surface; may affect entire crown.
Shape of lesion	Resembles line shading in pencil sketch; lines follow incremental lines in enamel, form irregular caps on cusps.	Often round or oval.
Demarcation	Shades off imperceptibly into surrounding normal enamel.	Clearly differentiated from adjacent normal enamel.
Color	Slightly more opaque than normal enamel; "paper-white." Incisal edges, tips of cusps may have frosted appearance. Does not show stain at time of eruption (in these milder degrees, rarely at any time).	Usually pigmented at time of eruption; often creamy yellow to dark reddish-orange.
Gross hypoplasia	None. Pitting of enamel does not occur in the milder forms. Enamel surface has glazed appearance, is smooth to point of explorer.	Absent to severe. Enamel surface may seem etched, be rough to explorer.
Detection	Often invisible under strong light; most easily detected by line of sight tangential to tooth crown.	Seen most easily under strong light on line of sight perpendicular to tooth surface.

⁴Russell, AL: The Differential Diagnosis of Fluoride and Non-fluoride Enamel Opacities. *Pub Health Dent* 21:143-146, 1961.

PERIODONTAL ASSESSMENT

Introduction

The periodontal status of subjects is assessed by clinical evidence of gingival bleeding, presence of supra- and sub-gingival calculus, and the presence, extent and severity of periodontal attachment loss. Usually a half-mouth examination is done. One maxillary and one mandibular quadrant is selected for examination at random (for example, by the toss of a coin). Available evidence suggests that, on a population basis, periodontal lesions tend to be symmetrically distributed within each arch; thus a half-mouth design affords maximum efficiency while sacrificing little significant information.

The periodontal tissues around all permanent teeth (excluding third molars) which have erupted to the plane of occlusion are examined in the selected quadrants. Both quadrants are assessed first for gingival bleeding, then for calculus, and finally, for periodontal attachment loss.

Two sites, buccal and mesial, are examined at each tooth beginning with the most posterior tooth in the quadrant and progressing toward the midline (e.g. from the second molar to the central incisor). Although the examination of only two sites per tooth may result in a slight underestimate of the prevalence and severity of periodontal destruction, distal and lingual sites are not examined because the level of intra- and inter-examiner reproducibility of attachment loss measurements is unacceptably low in epidemiologic surveys.

The instruments and supplies required for the periodontal status assessment are gauze or a compressed air source, intra-oral illumination, a mouth mirror, a periodontal probe, a #17 explorer, and a Columbia #13-14 curette.

A special periodontal probe⁵ is used by the NIDR. This probe is yellow-banded for maximum visibility under fiber-optic examining lights. It is graduated at 2, 4, 6, 8, 10, and 12 millimeters and has a point diameter of 0.38 mm.

The curette (#13-14) is used only occasionally for removal of obstructing calculus but should always be available during the periodontal examination. The specific clinical criteria and other points which are unique to each of the periodontal assessments are discussed in the following:

⁵Periodontal probe #2-12 by the American Dental Manufacturing Co., available from G.C. International Corporation, 7830 East Redfield Road, Suite 12. Scottsdale, AZ 85258.

Gingival Assessment

The gingival assessment is made using a modification of the Gingival Index proposed by Løe and Silness.⁶ The teeth should be dried with air (or gently dried with gauze) before beginning the examination of each quadrant. The periodontal probe is inserted no more than 2 mm into the gingival sulcus, just distal to the midpoint of the buccal surface of the most posterior tooth, and then moved gently into the mesial interproximal area. Care must be taken to minimize pressure on the gingival tissue. This "sweeping" motion of the probe is continued in the same manner for each fully erupted permanent tooth in the quadrant until the central incisor is reached. The bleeding points in that quadrant are then scored. A score of 0 or 1 (or "Y") is made for each buccal and mesial site, beginning with the second molar and continuing to the central incisor.

Gingival Scoring System

- 0 = No bleeding
- 1 = Bleeding
- Y = Cannot be assessed
(Missing, partially erupted or deciduous)

Calculus Assessment

The teeth are thoroughly dried with air or gauze before beginning the examination of each quadrant. The buccal and mesial aspects of each tooth are examined for the presence of supragingival⁷ and subgingival calculus using either the NIDR probe or a #17 explorer. When the #17 explorer is used, care should be taken to keep the tip in contact with the tooth surface so as to avoid tissue damage.

Calculus Scoring System

- 0 = No calculus
- 1 = Supragingival calculus but no subgingival calculus
- 2 = Subgingival calculus, or subgingiva and supragingival calculus
- Y = Cannot be assessed (a site code) (missing, partially erupted or deciduous)
- NS = No score (a quadrant code)

⁶Løe H and Silness J: Periodontal Disease in Pregnancy: I. Prevalence and Severity. *Acta Odontol Scandinavica* 21:533-551, 1963.

⁷Supragingival calculus includes calculus located on the exposed crown and root of the tooth which extends not more than 1 mm below the free gingival margin (FGM).

Subgingival calculus takes precedence. That is, if subgingival calculus is detected at a site, a score of "2" is immediately assigned, and the site is not examined further for supragingival calculus. Therefore, the examiner should probe first for subgingival calculus at each site. If none is detected, then the site should be examined further for supragingival calculus.

Attachment Level Assessment

Attachment level is measured using the method described by Ramfjord.⁸ The level of periodontal attachment is the distance from the cemento-enamel junction (CEJ) to the bottom of the gingival sulcus. Apical migration of the level of attachment ("loss of attachment") is evidence of destructive periodontal disease. Estimation of the level of attachment requires that observations be made from a fixed point, and the cemento-enamel junction serves as this reference point.

The periodontal attachment level assessment is made for the same maxillary and mandibular quadrant, and at the same buccal and mesial sites, as the gingival bleeding and calculus assessments. Only teeth in full eruption (excluding third molars) are measured. The distance from the free gingival margin (FGM) to the CEJ and the distance from the free gingival margin to the bottom of the sulcus ("pocket depth") are measured using the periodontal probe. Measurements are rounded downward to the nearest whole millimeter before they are recorded.

The probe should be held with a light grasp and pointed toward the apex of the tooth or the central axis of multirrooted teeth. It is inserted from the buccal aspect to measure both the buccal and mesial sites. At the interproximal (mesial) site, the probe should be kept parallel to the long axis of the tooth and as close to the contact point as possible, even if the adjacent tooth is missing. For molars, the buccal measurements are always made at the midpoint of the mesial root.

Generally, there are four situations encountered in the measurement of attachment level. Where the gingival margin has receded and the CEJ is exposed, the distance from the CEJ to the gingival margin is scored as a negative value, and pocket depth is scored as usual (non-negative). When the epithelial attachment is located at the cemento-enamel junction, the first and second measurements are identical and non-negative. When the free gingival margin is at the CEJ, the first measurement is zero. Pocket depth may also be zero or positive. Finally, where there is pocketing without evidence of gingival recession (i.e. the epithelial attachment is below the CEJ, and the free gingival margin is above), both measurements will be non-negative. The level of attachment is later calculated by subtracting the recorded distance from the FGM to CEJ from the distance FGM to base of sulcus.

⁸Ramfjord SP: Indices for Prevalence and Incidence of Periodontal Disease. *J Periodontol* 30:51-59, 1959.

Special Considerations:

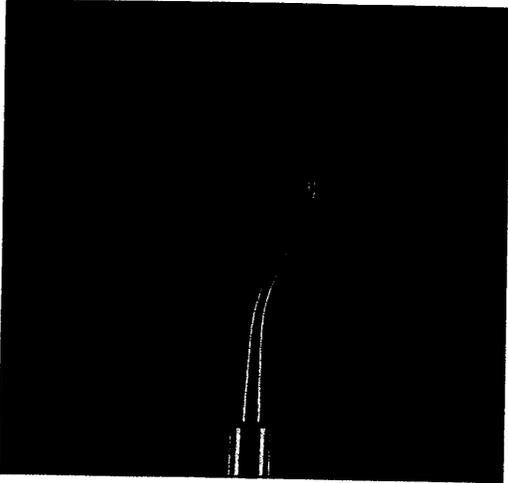
- **Calculus at the mesial or buccal sites which obscures the CEJ or interferes with the correct placement of the probe should be removed using the curette.**
- **When the margin of a restoration obscures the CEJ, the position of the CEJ should be estimated, using adjacent landmarks and dental anatomy. When the CEJ cannot be estimated, the examiner should code "Y" to exclude the site.**
- **When a tooth is missing, both tooth sites are scored "Y." On the recording form, missing teeth should coincide for both the periodontal and caries assessments.**
- **Mobile teeth should be examined with care. The CEJ should be estimated, if possible.**
- **Orthodontically banded teeth, splinted teeth, and hemisected teeth are considered on an individual basis and should be examined, if possible.**
- **Partially erupted teeth and root tips are excluded. It is necessary to have at least a partial clinical crown, including the CEJ, present for the periodontal assessment. The code of "Y" should be used for the mesial and buccal sites of the excluded tooth. If an entire quadrant cannot be scored, the single quadrant code of "NS" (no score) should be given.**



ILLUSTRATIONS OF GINGIVAL ASSESSMENT

- 1) The NIDR probe (#2-12) is the instrument used for the gingival assessment. The probe is placed in the gingival sulcus just distal to the midpoint of the buccal surface at a depth not to exceed 2 mm (the beginning of the first yellow band on the NIDR probe). The teeth are scored beginning with the most posterior tooth and moving towards the midline.
- 2) At this site, it was possible to place the probe almost 2 mm into the sulcus. In some subjects the gingiva will be so tight that only the tip of the probe will fit into the sulcus.
- 3) After the probe is placed in the sulcus on the buccal site, it is carefully "swept" into the mesial interproximal area. During this procedure the probe is gently placed against the tissue rather than against the tooth surface. When all teeth in the quadrant have been probed in this manner, the entire quadrant is immediately examined for bleeding points at the buccal and mesial sites of each tooth.
- 4) For the sites visible here, the following diagnostic codes would be assigned:

bicuspid	buccal 0	mesial 0
cuspid	buccal 0	mesial 0
lateral incisor	buccal 0	mesial 1
central incisor	buccal 1	mesial 1
- 5) This subject has chronic periodontal destruction. The examiner should be aware that bleeding points may not always be present with advanced disease states.
- 6) Several periodontal diseases can be noted in the this illustration including severe inflammation. Although the examiner may be tempted to use the "no score" code for this dentition, the exam should proceed in the usual manner. If necessary, the "Y" code may be used for individual teeth that cannot be assessed.



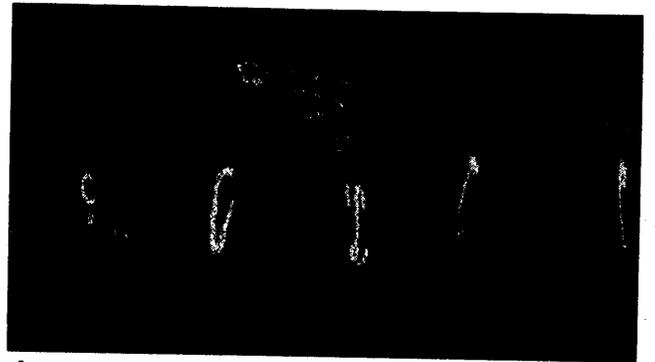
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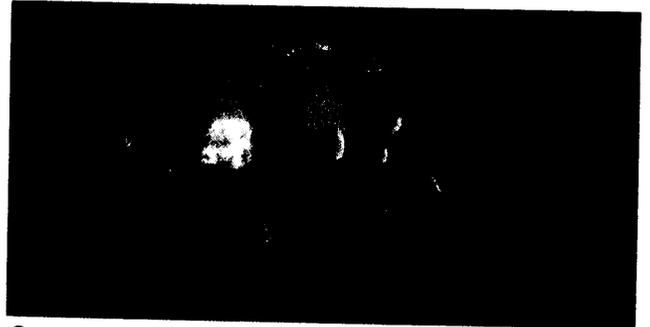
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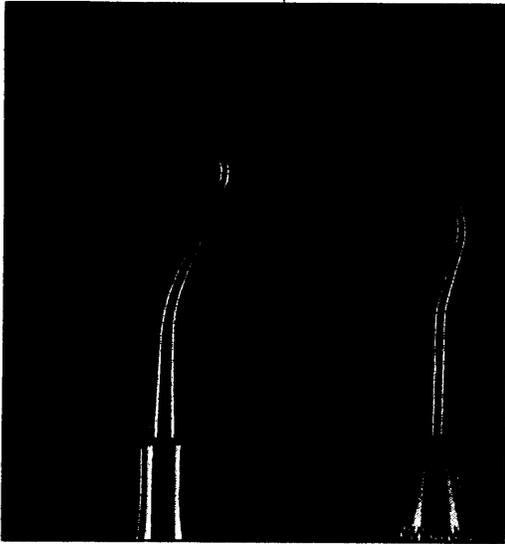
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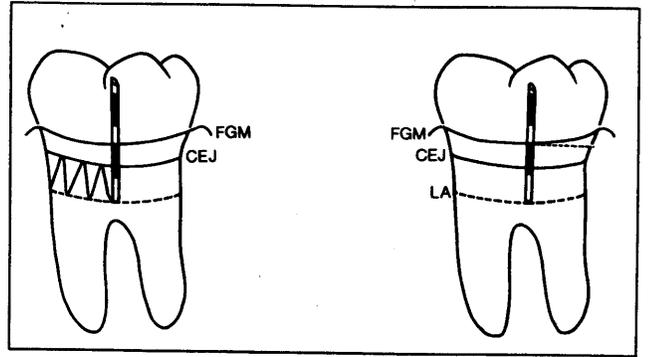
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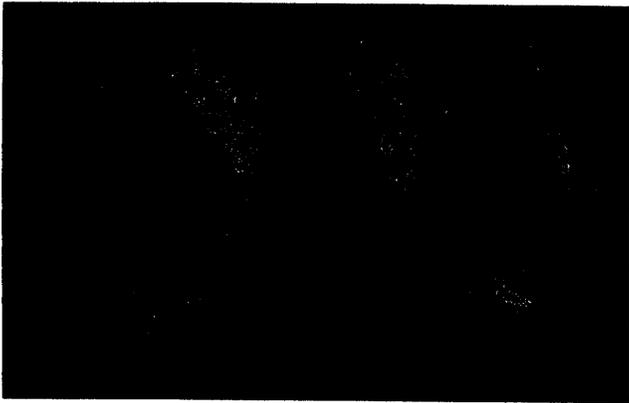
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ILLUSTRATIONS OF CALCULUS ASSESSMENT

- 1) The instruments for the calculus assessment are the NIDR periodontal probe or the #17 explorer.

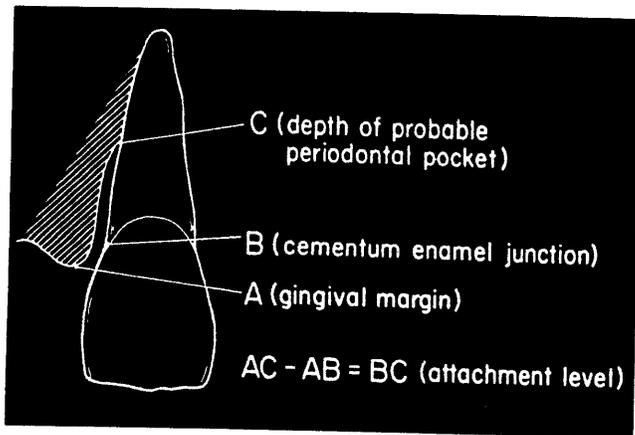
- 2) The instruments should be used as indicated in the illustration--gently explore the tooth surface from the bottom of the gingival crevice, moving in a coronal direction. The examiner will start just distal to the midpoint of the buccal surface and move into the mesial interproximal area.

- 3) Supragingival calculus includes calculus located on the exposed root of the tooth and extends up to 1 mm below the gingival margin. Calculus is observed and felt with the instrument on the coronal and root surface at the buccal site of the mandibular right central incisor. This site would be recorded as "1" unless subgingival calculus was also detected in which case it would be scored "2."

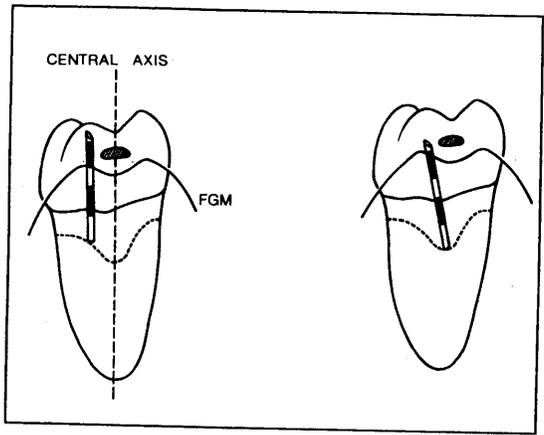
- 4) Subgingival calculus is felt with the instrument at the buccal sites of the mandibular left cuspid and bicuspid. Although supragingival calculus is also evident, this is ignored and each site is scored "2."

ILLUSTRATIONS OF PERIODONTAL DESTRUCTION ASSESSMENT

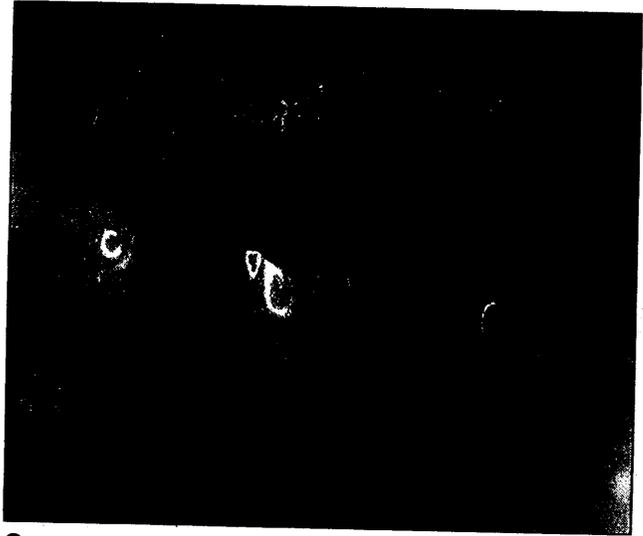
- 1) The distance from the gingival margin (A) to the CEJ (B) and the distance from the gingival margin (A) to the bottom of the gingival crevice or pocket (C) is measured at the mesial and buccal sites of each tooth. The distance from the CEJ to the bottom of the pocket (BC), which represents the level of attachment, is determined by subtracting the first measurement (AB) from the second (AC).
- 2) The probe is positioned at the mesial site parallel to the long axis of the tooth and close to the contact point, as is illustrated on the left tooth. The illustration to the right shows an incorrectly angulated probe, which will result in inconsistent measurements.
- 3) The probe is positioned at the midpoint of the mesiobuccal root of the mandibular molar. The gingival margin is apical to the CEJ, therefore the first measurement is "minus 2 mm."
- 4) The probe tip is at the base of the sulcus. The gingival margin is approximately at the 1.5 mm distance on the probe; however, as all measurements are rounded down, sulcus depth is recorded as 1 mm.
- 5) The tip of the probe is placed in contact with the buccal surface of the central incisor. The buccal probing depth = 1 mm. (Note color on probe.)
- 6) The gingival margin of the upper left cuspid has migrated apically and the cementum is exposed (gingival recession). Therefore, the distance from the cemento-enamel junction to the gingival margin is recorded as a negative value. The distance from the free gingival margin to the bottom of the sulcus ("pocket depth") is always a non-negative number. The location of the CEJ on the maxillary central incisor is obscured because of a crown. In addition, composite and amalgam restorations hinder identification of the CEJ on other teeth. When the CEJ is obscured, the location of the CEJ is estimated using adjacent anatomical landmarks.



1



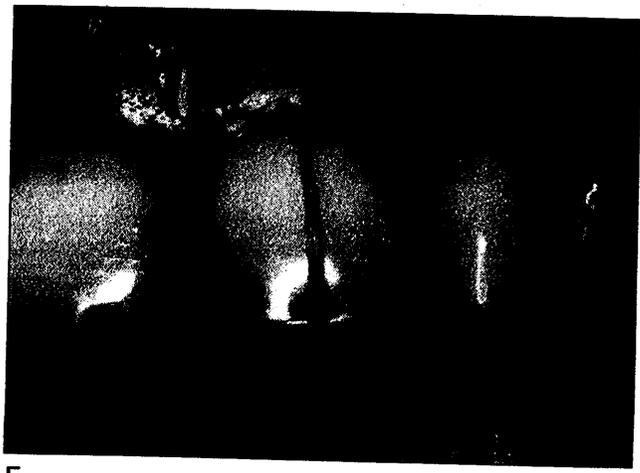
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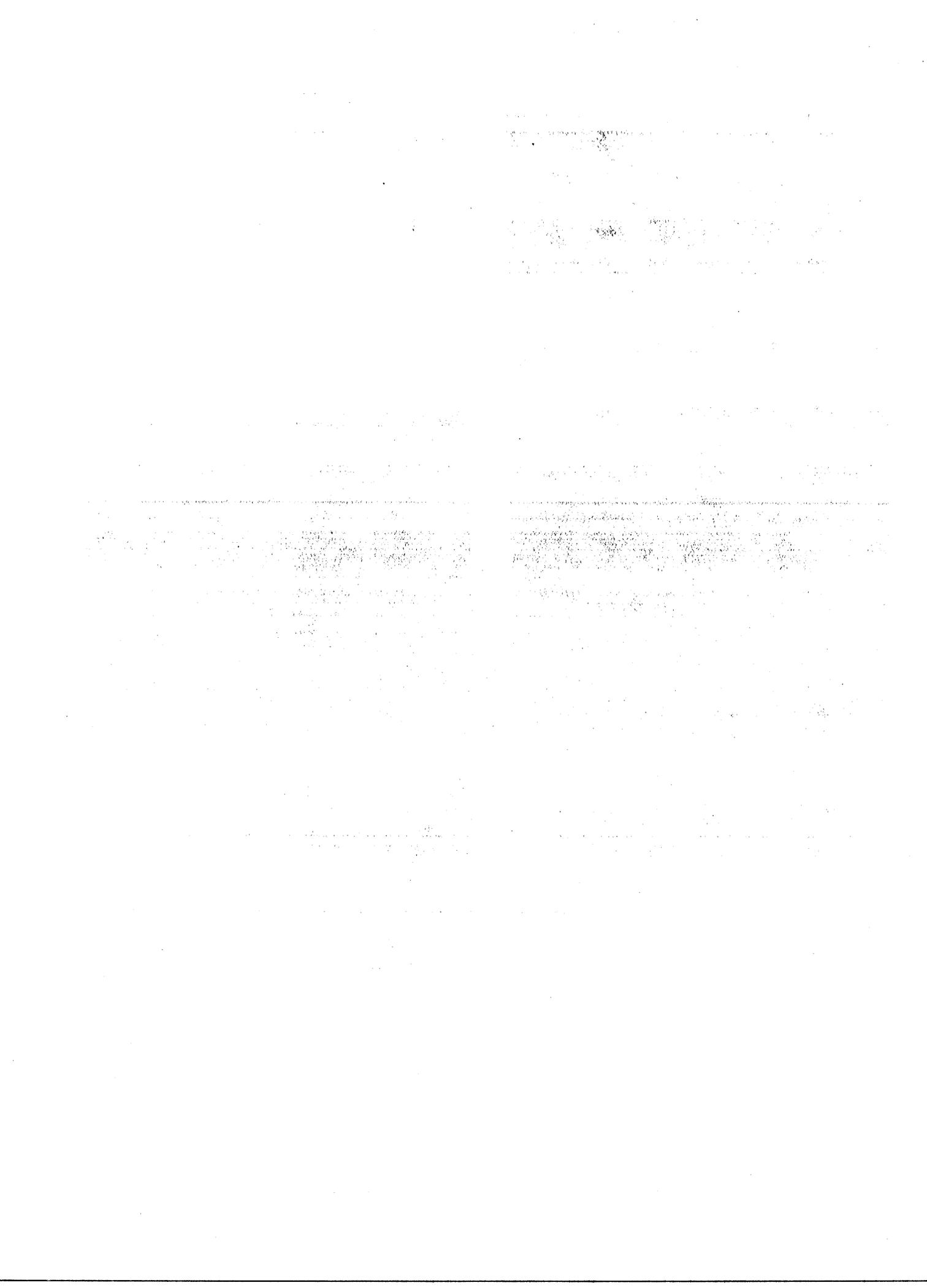
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6



ORAL SOFT TISSUE LESIONS

This section presents a procedure for identifying and documenting oral soft tissue conditions in epidemiologic surveys of school-aged children. Because the range of oral mucosal pathologies is broad and may vary widely among populations groups, it is not possible to assess the prevalence of these conditions by use of a single epidemiologic index. Rather, the examiners must be trained to recognize the clinical characteristics of each condition of interest in the survey, as well as other conditions that may present problems in differential diagnosis.

The approach presented here was developed with the needs of children and adolescents in mind and was applied in the NIDR National Survey of Oral Health in U.S. School Children, 1986-87, with special consideration given to the detection of mucosal pathology resulting from the use of smokeless tobacco. In that survey, a questionnaire on the use of tobacco and alcohol was also administered. In addition diagnostic criteria described in this section are also being used in the current Health and Nutrition Examination Survey (NHANES III) conducted by the National Center for Health Statistics. Since the NHANES III addresses populations of all ages, a much broader range of soft tissue conditions are included, with a focus on cancer, pre-cancer, and conditions predisposing to cancer, as well as pathologies related to denture-wearing and tobacco use.

The assessment of oral mucosal conditions includes both the questioning of the subject and the clinical examination of the soft tissues.

Questions:

Prior to examining the tissues, each subject is asked two questions to determine the prior history of recurrent aphthous ulcers and *herpes labialis*. In conjunction with each question, a photograph of a typical lesion is shown to the subject. Appropriate responses include "yes," "no," and "don't know."

1. Have you ever had "cold sores" or "fever blisters" on your lips?
2. Have you ever had "canker sores" or other recurring ulcer or sores inside your mouth?

The responses to these questions are recorded on the Dental Caries Examination form.

Examination:

Equipment and Supplies

- 2 mouth mirrors
- 2 (2" x 2") gauze squares

Examination Procedures⁹

The examination procedure, which follows that developed by the World Health Organization, includes a systematic assessment of the lips, labial mucosa and sulcus, commissures, buccal mucosa and sulcus, gingiva and alveolar ridges, tongue, floor of the mouth, and hard and soft palate.

- a. Begin examination by observing the lips, both with the mouth closed and opened. Note the color, texture and any surface abnormalities of the upper and lower vermilion borders.
- b. With the mouth partially open, visually examine the labial mucosa and sulcus of:
 - 1) the maxillary vestibule and frenulum, and
 - 2) the mandibular vestibule.

Observe the color and any swelling of the vestibular mucosa and gingiva.

- c. Using the two mouth mirrors as retractors and with the mouth open wide, examine first the right, then the left buccal mucosa extending from the labial commissures and back to the anterior tonsillar pillar. Note any change in pigmentation, color, texture and mobility of the mucosa. Make sure that the commissures are examined carefully and are not covered by the mouth mirrors during retraction of the cheek.
- d. Next, examine the gingiva and alveolar ridges.
 - 1) Buccal and labial aspects

Start with the right maxillary posterior gingiva and alveolar ridge and move around the arch to the left posterior gingiva. Continue with the left mandibular posterior gingiva and alveolar ridge and move around the arch to the right posterior gingiva.
 - 2) Palatal and lingual aspects

Same as above except on the palatal for the maxillary (right to left) examination and on the lingual for the mandibular (left to right) examination.

⁹Abstracted from the World Health Organization's *Guide to Epidemiology and Diagnosis of Oral Mucosal Diseases and Conditions* (reprinted in *Comm Dent Oral Epidem*, 8:1-26, 1980).

- e. With the tongue at rest and mouth partially open, inspect the dorsum of the tongue for any swelling, ulceration, coating or variation in size, color or texture. Also note any change in the pattern of the papillae covering the surface of the tongue and examine the top and the tip of the tongue. The subject should then protrude the tongue and the examiner should note any abnormality of mobility. With the aid of mouth mirrors, inspect the margins of the tongue. Grasping the tip of the tongue with a piece of gauze will assist full protrusion and will aid examination of the margins. Then observe the ventral surface.
- f. With the tongue still elevated, inspect the floor of the mouth for swellings or other abnormalities.
- g. With the mouth wide open and the subject's head tilted backwards, gently depress the base of the tongue with a mouth mirror. First inspect the hard, and then the soft palate.

Mucosal or facial tissues that seem to be abnormal should be palpated.

The following conditions do not appear on the recording form. They are described in the Field Reference Guide (which follows this section) because they may be frequently observed and because familiarity with their clinical appearance will aid the examiner in making differential diagnoses of other conditions.

- a) amalgam tattoo
- b) cheek and lip biting
- c) Fordyce granules
- d) focal epithelial hyperplasia

Selected photographs depicting aspects of the clinical criteria of the following lesions with narratives are included elsewhere in this manual.

- Acute necrotizing ulcerative gingivitis
- Candidiasis
- Geographic tongue
- Gingival hyperplasia
- Herpes labialis
- Herpetic gingivostomatitis
- Mucocele
- Recurrent aphthous ulcerations
- Smokeless tobacco-associated lesions (degree 1-3)
- Tumor (nonspecific)
- Ulcerations (nonspecific)
- Verruca vulgaris
- Unknown
- Other

Periapical abscesses with fistulization may be seen in children. These lesions are not of mucosal origin and need not be recorded on the data form. Extensive white mucosal lesions can result from the placement of an aspirin tablet on the mucosa in an attempt to alleviate dental pain. Patient's recall of aspirin placement is the key to diagnosis. The whitish necrotic surface epithelium seen in the early stages will eventually slough away to leave an ulcerated base.



ILLUSTRATIONS OF SOFT TISSUE LESIONS¹⁰

- 1) The photograph shows a Degree 1 lesion in the buccal vestibule, extending into the mucosa. There is superficial wrinkling and a slight whitish color change.

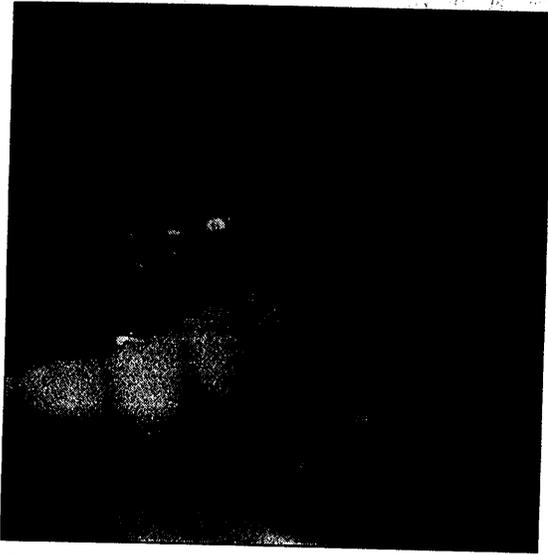
- 2) This Degree 2 smokeless tobacco-associated lesion extends from the buccal vestibule well into the buccal mucosa. Both wrinkling and color change are clearly visible.

- 3) In this photograph the buccal vestibule presents a classic Degree 3 smokeless tobacco-associated lesion.

- 4) Furrows with thickening can also be seen in this photograph of a Degree 3 smokeless tobacco-associated lesion.

¹⁰Pindborg JJ: *Atlas of Diseases of the Oral Mucosa*, Fourth Edition, Munksgaard, Copenhagen, 1985.

Smokeless Tobacco Lesions

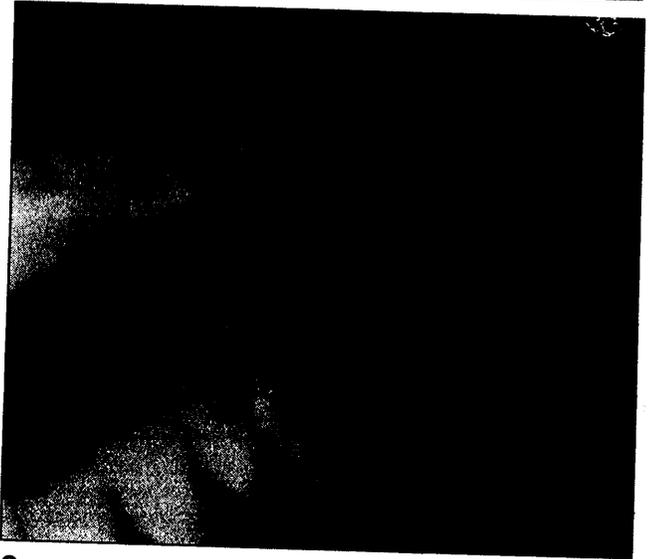


1

Degree 1 lesions:

Clinical characteristics:

- Wrinkles are fine, superficial and close together
- Color changes, if any, are usually subtle
- Lesions tend to disappear when mucosa is stretched



2

Degree 2 lesions:

Clinical characteristics:

- Wrinkles are more distinct and linear than in Degree 1 lesions
- Wrinkles may disappear when mucosa is stretched, but color change remains



3

Degree 3 lesions:

Clinical characteristics:

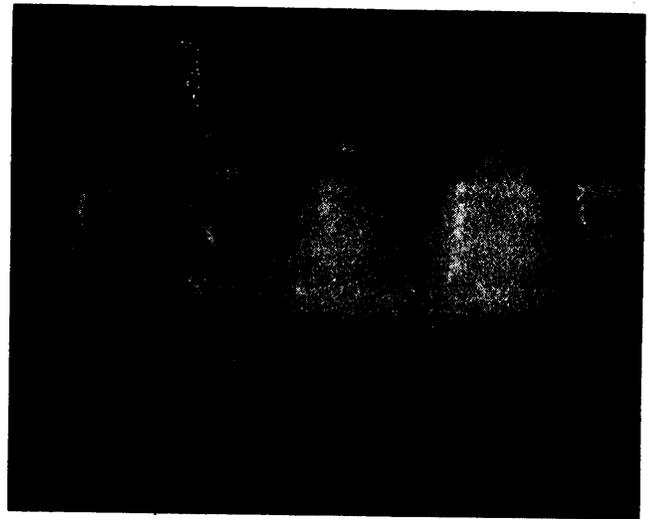
- Often appear as broad bands of whitish, thickened mucosa separated by furrows of normal or reddish color
- Thickened mucosa and furrows remain visible even when tissue is stretched



4



5



6

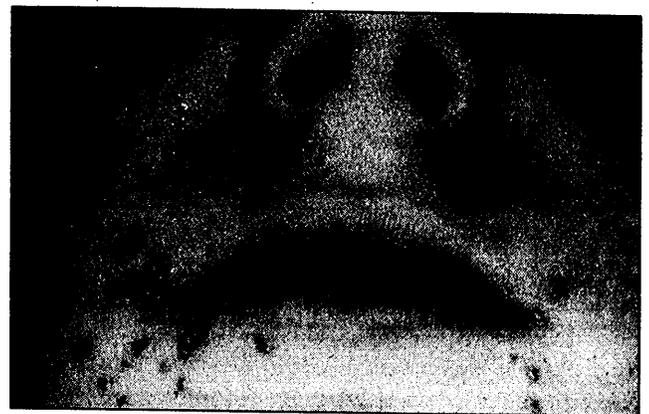
Recurrent Aphthous Ulcerations

Clinical characteristics:

- Well-defined grayish-white ulcer(s)
- Ulcers surrounded by red halo
- Pain
- Duration: 10-21 days
- History of recurrence



7



8

Herpes Labialis (Secondary herpes)

Clinical characteristics:

- Yellowish vesicle(s) or crust(s)
- Found on the vermillion border or adjacent skin
- Duration: less than three weeks
- History of recurrence

- 5) This photograph depicts an aphthous ulcer with the typical clinical appearance. The ulcer is well defined and the red halo is clearly evident.

- 6) The aphthous ulcer in this photograph appears on the gingiva, a less common site for this condition. Although both of these photographs are examples of single ulcers, as many as 5-10 lesions may occur in the mouth at the same time. To confirm the diagnosis of recurrent aphthous ulcers, the subject should be questioned for a history of previous lesions.

- 7) In this example, *Herpes labialis* presents as a crusted lesion on the upper lip with an erythematous background. Typically, the labial mucosa is not involved.

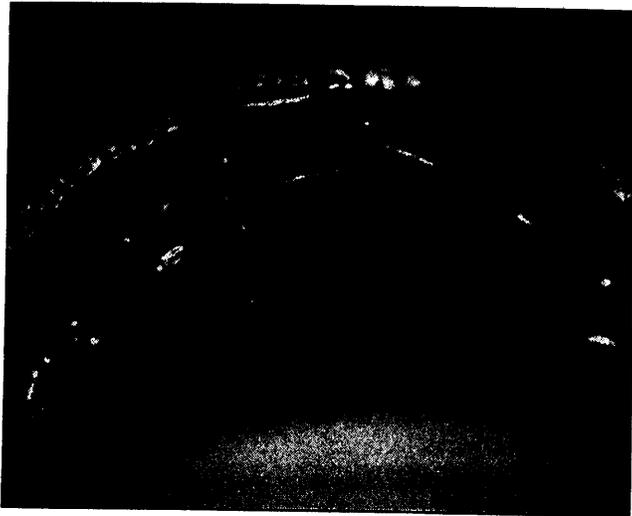
- 8) The child in this photograph presents with red crusts which are on the lips as well as the adjacent skin. To confirm the diagnosis of *Herpes labialis*, the subject should be questioned for a history of recurring lesions.

- 9) This photograph shows a child affected by herpetic gingivostomatitis. There is severe inflammation affecting both marginal and attached gingiva, which have a characteristic fiery red color and swollen appearance. The gingival margin is covered by a whitish serofibrinous exudate. In early stages, the condition may appear as marked gingivitis with yellowish vesicles on the mucosa. Because lesions are usually accompanied by pain, malaise and fever, children with primary herpes infection are often kept out of school.

Any ulceration of the lip or oral mucosa that cannot be attributed to one of the conditions listed on the recording form should be recorded as a nonspecific ulcer. These may include ulcers due to trauma as well as those for which a cause cannot be identified.

- 10) This photograph shows a large traumatic ulcer on the tongue, with extremely inflamed margins. The tongue is a common site for traumatic ulcers, which may have a variety of clinical presentations.

- 11) A common cause of gingival ulceration is toothbrush abrasion, as seen in this photograph. Characteristic of this lesion is the linear pattern of the ulceration, which results from vigorous horizontal brushing. With ulcers of this type, the interdental papillae often remain unaffected. This condition is recorded as a nonspecific ulcer.

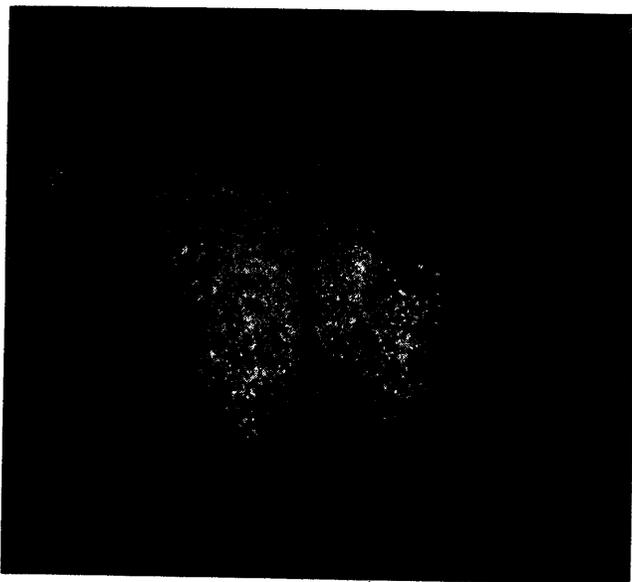


Herpetic Gingivostomatitis (Primary herpes)
Clinical characteristics:

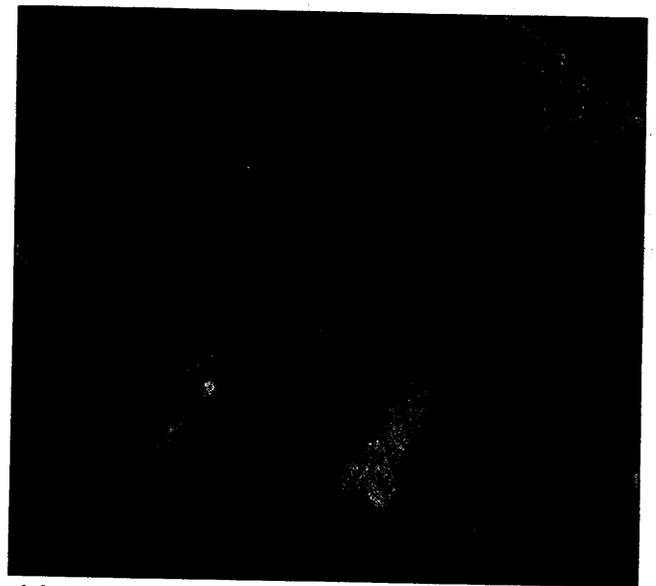
- Severe gingival inflammation
- Whitish serofibrinous exudate
- Vesicles and/or shallow ulcers
- Pain, malaise, fever

9

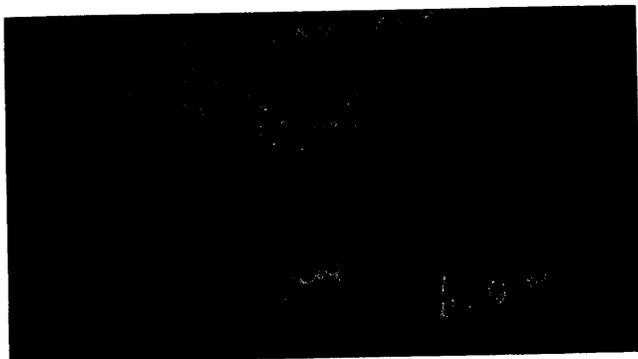
Ulcers (non-specific)



10
Traumatic Ulcer



11
Toothbrush Abrasion

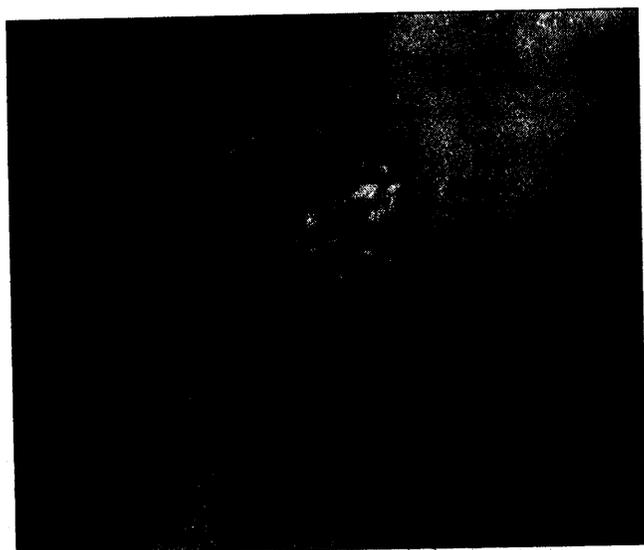


12

Mucocele

Clinical characteristics:

- Well-defined fluid-filled submucosal swelling
- Normal, pink or bluish in color
- Commonly found on labial mucosa and floor of the mouth (ranula)

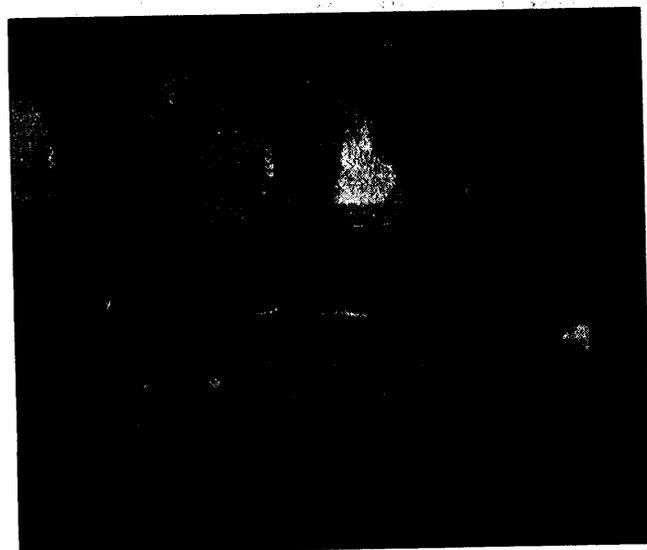


13

Verruca Vulgaris

Clinical characteristics:

- Sessile or pedunculated growth
- Papillomatous surface
- Color ranges from normal to pink or whitish
- Common location is the labial commissure



14

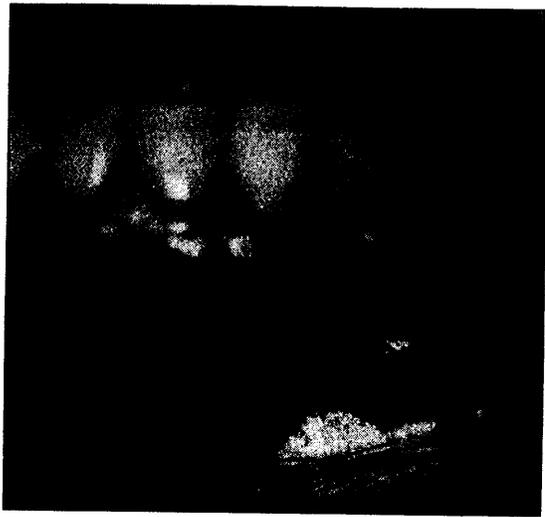
Gingival Hyperplasia

Clinical characteristics:

- Enlarged gingiva and interdental papillae
- Condition is usually generalized
- Surface may be stippled or glazed
- Color can range from normal to pink or red (if inflamed)

- 12) In this example of a mucocele, the lesion appears in the mucosa of the lower lip. When found on the floor of the mouth, the mucocele is also called a "ranula."
- 13) This example shows a whitish, sessile verrucous lesion on the labial commissure, with the characteristic wart-like surface appearance. *Verruca vulgaris* can also be found on the labial mucosa, gingiva, tongue, and palate. More than one lesion may be present.
- 14) Gingival hyperplasia is a fairly common side effect of systemic therapy with certain drugs. This photograph shows the best-known form of this condition, the so-called "hydantoin" or "Dilantin" hyperplasia, which occurs as the result of medication used to control epilepsy. In more severe cases the entire crown is sometimes covered. Color may be normal, as in this example, or reddish if inflammation is present. In addition to the types shown, idiopathic and familial forms of gingival hyperplasia may also be seen. Although the presentation may vary with etiology, no attempt should be made to distinguish between the types. All types are recorded as gingival hyperplasia.

Tumors (non-specific)



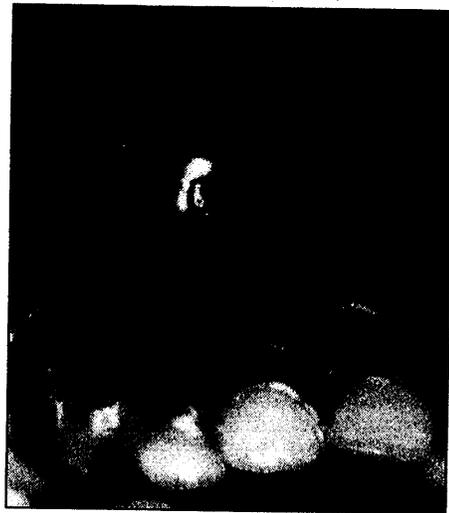
15
Fibroma



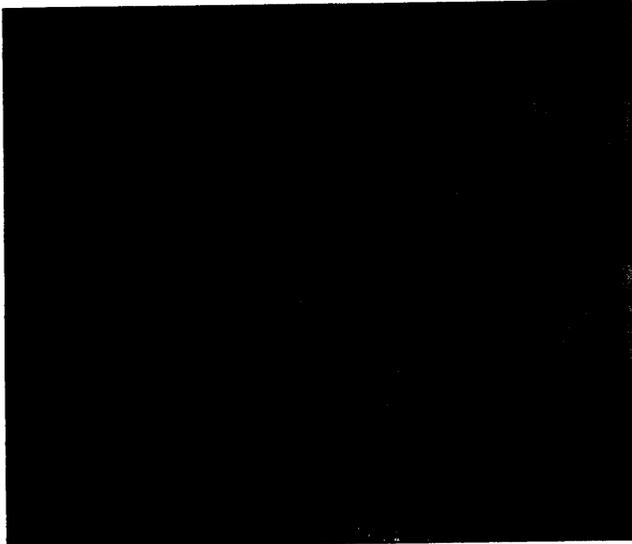
16
Peripheral Giant Cell Granuloma



17
Hemangioma



18
Lymphangioma



19

Acute Necrotizing Ulcerative Gingivitis (ANUG)

Clinical characteristics:

- "Punched-out" papillae
- Pseudomembranous exudate
- Bleeding upon palpation
- Pain
- Malodor

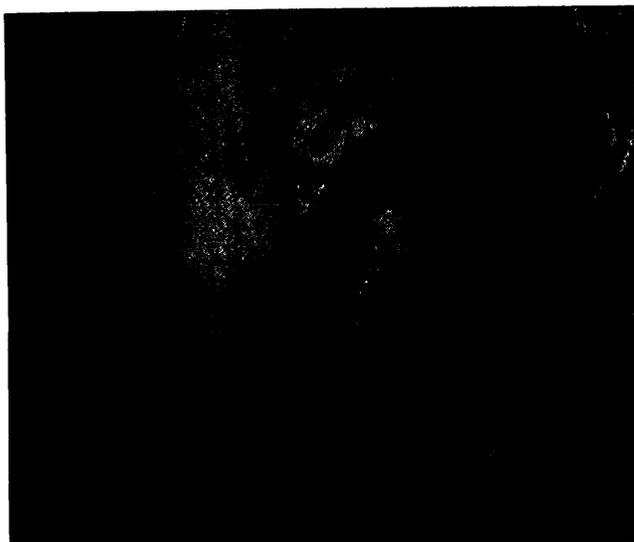


20

Geographic Tongue

Clinical characteristics:

- Localized absence of filiform papillae
- Affected areas are irregularly shaped
- Areas change in shape and location over time
- Usually asymptomatic



21

Candidiasis (acute pseudomembranous type)

Clinical characteristics:

- Creamy white patches on mucosal surface
- Can be wiped off, leaving a red, bleeding surface

- 19) In this example of acute necrotizing ulcerative gingivitis (ANUG), the anterior gingival tissue is severely affected, showing the characteristic loss of tissue from the interdental papillae and the grayish yellow pseudomembrane overlying a bleeding surface.
- 20) This photograph shows a characteristic lesion of geographic tongue, with absence of filiform papillae on the right side of the tongue. These well-defined, irregularly-shaped areas show some reddening at the periphery.
- 21) Oral candidiasis occurs in a variety of clinical presentations, including both acute and chronic types. It is not common in children but may be seen occasionally. The case shown in this photograph is the acute pseudomembranous type, the only type of candidiasis likely to occur in children. Candidiasis is often associated with an immuno-compromised condition or antibiotic treatment.



FIELD REFERENCE GUIDE TO DIAGNOSIS

The guide lists the lesions alphabetically and summarizes the clinical presentation, common locations, associated symptoms, differential diagnosis, etiology, and other names of each condition, along with guidelines for referral if such a lesion is found upon examination. It not only contains lesions of primary interest but also those which should be considered for differential diagnosis.

ACUTE NECROTIZING ULCERATIVE GINGIVITIS (ANUG)

Clinical presentation: Necrotic areas at tip of interdental papillae ("punched-out" papillae) covered by grayish yellow pseudomembranes which can be readily removed exposing bleeding surfaces

Common locations: Free gingival margin, interdental papilla

Symptoms: Tenderness, oral malodor

Differential diagnosis: Herpetic gingivostomatitis, acute streptococcal gingivostomatitis. (These conditions are not associated with loss of tissue and oral odor.)

Etiology: Uncertain, but probably fusiform bacillus and *Borrelia vincenti*

Other names: Trench mouth, Vincent's infection

Referral: Refer for treatment

AMALGAM TATTOO

Clinical presentation: Fairly well-defined non-elevated blue, black or slate-gray pigmented area

Common locations: Gingiva, alveolar mucosa, buccal mucosa

Symptoms: None

Differential diagnosis: Melanotic macules, racial pigmentation, nevi, other foreign bodies (Malignant melanoma is usually an elevated lesion and is extremely rare in children.)

Etiology: Embedded particles of dental amalgam

Referral: Unnecessary

CANDIDIASIS (Acute pseudomembranous type)

Clinical presentation: Creamy white or grayish patches or nodules which can be easily rubbed off, leaving an erythematous or bleeding surface

Common locations: Tongue, palate, buccal mucosa

Symptoms: A burning sensation or tenderness is occasionally present

Differential diagnosis: Leukoplakia, coated tongue, aspirin burn (However, these lesions cannot be wiped away.)

Etiology: Infection with *Candida albicans*

Other names: Thrush, moniliasis, candidosis

Referral: Refer for treatment

CHEEK/LIP BITING

Clinical presentation: The mucosa shows a rough, gray-white macerated surface with irregular, flaky desquamation. The lesion is diffusely outlined and is situated where self-infliction by chewing is possible.

Common locations: Buccal or labial mucosa or vermilion border

Symptoms: Tenderness if ulcerated or inflamed

Etiology: Self-inflicted trauma

Differential diagnosis: Aspirin burn, leukoplakia, white sponge nevus

Referral: Refer severe cases

FOCAL EPITHELIAL HYPERPLASIA

Clinical presentation: These multiple nodular lesions are slightly elevated, sessile and soft. The surface is usually finely stippled or slightly keratotic, with a color like that of the surrounding mucosa. Nodules are typically 1-5 mm in diameter. When the mucosa is stretched, the lesions may disappear. In the United States this condition is seen almost exclusively in American Indians and Eskimos.

Common locations: Labial or buccal mucosa, vermilion border, commissures, tongue

Symptoms: None

Etiology: Human papilloma virus

Differential diagnosis: Multiple fibromas, warts, or papillomas

Other names: Heck's disease

Referral: Not necessary

GEOGRAPHIC TONGUE

Clinical presentation: Usually appears as one or more well-defined, irregularly shaped areas of the tongue with absence of filiform papillae. These areas are typically red, with white or yellowish, slightly elevated serpiginous margins. The configuration of the affected areas changes over time.

Common location: Dorsum of tongue

Symptoms: None, unless secondarily infected with candida

Differential diagnosis: Candidiasis, Vitamin B deficiency

Etiology: Unknown

Other names: Wandering rash, benign migratory glossitis

Referral: Not necessary

GINGIVAL HYPERPLASIA

Clinical presentation: Presentation may vary with the etiology, but no attempt should be made to distinguish between the various types. All types exhibit enlarged gingiva and interdental papillae, which may have either a stippled or glazed appearance. In severe cases, clinical crowns may be covered by a solid mass of firm hyperplastic tissue, with marked pseudopockets.

Symptoms: Usually asymptomatic

Differential diagnosis: Leukemia-induced gingivitis

Etiology: Variable. Drug-induced, idiopathic, and familial types exist

Referral: Refer for evaluation

HERPES LABIALIS

Clinical presentation: Yellowish vesicle(s) or crust(s) which may present on an erythematous background

Common locations: Vermilion border of the lip or adjacent skin, but not involving the labial mucosa

Symptoms: May be preceded by itching in affected area. Past history of recurrence. Healing time of previous lesions less than three weeks.

Differential diagnosis: Impetigo, chicken pox

Etiology: Herpes simplex virus, Type I

Other names: Fever blisters, cold sores, secondary herpes

Referral: Refer for palliative treatment if needed

HERPETIC GINGIVOSTOMATITIS

Clinical presentation: Gingivitis affecting marginal and attached gingiva, characterized by fiery red, swollen appearance. Gingival margin is often covered by a serofibrinous exudate. In early stages the condition may present as marked gingivitis with small yellowish vesicles on the oral mucosa. Later, shallow, ragged ulcers covered by a gray membrane and surrounded by a red halo may appear throughout the oral mucosa. Crusts may be present on the vermilion border.

Common locations: Gingiva, palate, labial and buccal mucosa, lips

Symptoms: Pain, general malaise, fever, lymphadenopathy

Differential diagnosis: See "Acute Necrotizing Ulcerative Gingivitis"

Etiology: Herpes simplex virus, Type I

Other names: Primary herpes

Referral: Refer for evaluation

MUCOCELE

Clinical presentation: A well-defined fluid-filled swelling which may be soft, firm or fluctuant. Size of the swelling may vary with degree of salivary stimulation. Color may range from normal to pink or bluish.

Common locations: Labial mucosa, floor of mouth

Symptoms: Painless

Differential diagnosis: Salivary gland tumors

Etiology: Rupture of minor salivary gland ducts

Other names: Called "ranula" if located in the floor of the mouth

Referral: Refer for evaluation

RECURRENT APHTHOUS ULCERATIONS

Clinical presentation: Small, well-defined gray-white or yellowish round ulcerations surrounded by red halo. A red macule or small papule is seen in early stages. The number of lesions varies from one to five or more.

Common locations: Labial or buccal mucosa, tongue

Symptoms: Burning sensation with early stages of lesion; pain may be intense with established ulcers. History of previous lesions and healing time of previous lesions has not exceeded three weeks.

Differential diagnosis: May resemble other ulcerative conditions

Etiology: Unknown

Other names: Canker sores

Referral: Refer for palliative treatment if needed

SMOKELESS TOBACCO-ASSOCIATED LESIONS

Clinical presentation: There is slight to heavy wrinkling of the mucosa with or without whitish or yellowish to brown discoloration, and with or without obvious thickening. The location of the lesion is the site of regular placement of snuff or tobacco. These lesions can be classified into three degrees of severity, as described by Greer *et al.*¹¹

Degree 1 lesions: Slight, superficial wrinkling of the mucosa. Color of the mucosa may range from normal to pale white or gray. Mucosa does not appear to be thickened. Wrinkles are fine, superficial and close together. Color changes, if any, are usually subtle. Lesions tend to disappear when mucosa is stretched.

Degree 2 lesions: Distinct whitish, grayish or occasionally reddish color change. Wrinkling is obvious, but there is no thickening of the mucosa. Wrinkles are more distinct and linear than in Degree 1 lesions. Wrinkles may disappear when mucosa is stretched, but color change remains.

Degree 3 lesions: Mucosa is obviously thickened, with distinct whitish or grayish color change. Deep furrows are present within thickened areas. Often appears as broad bands of whitish, thickened mucosa separated by furrows of normal or reddish color. Thickened mucosa and furrows remain visible even when tissue is stretched.

Common locations: Buccal and labial vestibules

Symptoms: Usually asymptomatic

Differential diagnosis: Aspirin burn, cheek bite, leukoedema

Etiology: Local reaction to smokeless tobacco

Other names: Snuff-dippers lesion

Referral: Refer for evaluation

¹¹Greer RO Jr and Poulson TC: Oral Tissue Alterations Associated with the Use of Smokeless Tobacco by Teenagers. *Oral Surg* 56:275-284, 1983.

TUMORS, NONSPECIFIC

Oral tumors in children are not common, but the range of reported tumor types and clinical presentations is large, and definitive diagnosis often depends on histopathological examination. For this reason, any exophytic growths not specifically listed on the recording form will be recorded as nonspecific tumors. These may present in a range of locations, colors, and surface morphologies. Common examples in school-age children are fibromas, hemangiomas, lymphangiomas and a variety of tumors of the gingiva grouped under the term "epulis."

Some typical clinical presentations are described below:

Fibroma - Firm, well-defined sessile or pedunculated lesion covered by mucosa of normal color and appearance

Hemangioma - Typically a submucosal swelling with a reddish, bluish or purple color and a vascular appearance

Lymphangioma - Submucosal swelling with a whitish or yellowish color. The surface appearance may be irregularly nodular. The tongue is a common site.

Peripheral Giant Cell Granuloma - Well-defined, soft swelling of the gingiva with a bluish or purple color

Referral: All tumors should be referred for diagnosis and treatment.

ULCER, NONSPECIFIC

Any ulceration of the lip or oral mucosa that cannot be attributed to one of the conditions listed on the recording form should be recorded as a nonspecific ulcer. These may include ulcers due to trauma as well as those for which a cause cannot be identified.

Some typical clinical presentations are described below:

Toothbrushing-induced ulcerations - Loss of marginal gingival epithelium in a linear pattern consistent with the direction of forceful horizontal toothbrushing. Tips of interdental papillae are usually unaffected.

Traumatic ulcerations - Mildly or moderately painful ulceration of the oral mucosa or the lips. Site of the lesion can be related to the source of trauma, either at examination or from patient's history.

Referral: Refer severe or painful cases for evaluation and care

VERRUCA VULGARIS

Clinical presentation: Whitish or pinkish pedunculated or sessile growth with papillomatous surface

Common locations: Lips (commissures), labial mucosa, gingiva, tongue, palate

Symptoms: May see warts on fingers

Differential diagnosis: Papillomas, focal epithelial hyperplasia

Etiology: Human papilloma virus

Referral: Refer for evaluation

DATA RECORDING SYSTEM

The data system used for NIDR surveys was designed to produce detailed analyses of the collected data with minimal time lapse between field examination and final output of results. At the time of the dental examination, information is recorded on specially designed mark-read forms. When received at the NIDR, these forms are scanned by a 7001 Sentry Optical Mark Reader which sends the recorded data directly into computer storage ready for immediate data editing and analysis.

On the following pages are descriptions of the various parts of the data forms, directions for their use and the order of examination for the various dental indices measured in epidemiologic surveys.

The dental examiner examines each eligible person and "calls" out the diagnostic codes for the various indices to the dental recorder who records the examiner's observations on the appropriate Dental Data Forms.

The recorder should never guess at a call or try to remember it and record it later. The recorder should not hesitate to ask the examiner to go slower or to repeat a call. Accuracy is very important. All of the recording procedures are done by the recorder, but the examiner is expected to help edit the forms.

Recording on the Dental Data Forms

It is crucial that Data Forms be handled with care at all times. The following rules must be followed:

- Do not put ID labels on the Data Forms unless the forms have been specially designed for labels. Labels might cause the forms to jam the scanning machine.
- Do not fold or bend the Data Forms. Do not use metal paper clips, staples, a rubber band, or a clip board to hold the forms together. Forms which are wrinkled, folded, torn, or smudged cannot be read by the scanning machine and will result in substantial delays in processing time.
- Do not write or mark on a page if there is another Data Form underneath. A pencil can make indentations on the page underneath, and the optical scanning equipment may read the indentation as an observation. On two-part forms, before making any marks on page 1, fold back page 2 (Do not separate page 1 from page 2).
- All information must be entered on the Dental Data Forms with #2 black lead pencils. When making an entry, the circle must be completely filled in. When filling in the spaces, use up and down strokes rather than side-to-side.

- If an incorrect entry is made, erase it completely. No extraneous marks should be made on the form at any time.

Examples

INCORRECT MARKS		CORRECT MARKS
0 0 0 0 0 0 0 0 0		● 0 0 0 0 ● 0 ● 0

- Begin by printing information in the upper right corner of the Dental Caries Form. Write in the participant's name, the date, age, sex and the participant's identification number. This is usually done ahead of time by the person scheduling individuals for exams, and is re-checked at time of exam by the data recorder.
- Write in the Examiner's number and the Recorder's number. Each Examiner and Recorder should be assigned a unique ID.
- Mark the appropriate circles for the participant's ID in the upper portion of the form (beginning with region and ending with the person's ID).
- If the exam is a "replicate" exam, mark in the circle after "REP" for replicate. If the exam is not a replicate exam, leave the circle beside "REP" blank.
- Mark in the circles for the participant's age, sex, race and grade where appropriate. These are usually obtained from the consent form and confirmed with the participant.
- Mark the circles for the Examiner's number and Recorder's number.
- On all other forms, print the participant's name and mark in the participant's age, sex and identification number.
- Occasionally an Examiner may decide that the examination should not be conducted. In this situation the Examiner will call out "No Exam," and the "NO EXAM" circles at the top of the pages must be marked in. The "NO EXAM" circle at the top of page 1 should also be marked whenever the examination is started but not finished. Whenever the "NO EXAM" circle is marked on page 1, the "NO EXAM" circle must also be marked on all other pages. There is usually room in the margin or right side to write the reason the exam was not conducted. If the participant does not receive an exam and no make-up exam is scheduled, draw a diagonal line across the entire Data Form.

Sequence of Dental Exam Procedures

The following summarizes the recommended sequence of the dental examination:

- Oral Mucosal Tissue Examination (Red Form). Use a separate red form for each separate lesion an examinee has.
- Dental Caries Examination (Green Form)
 - Coronal Caries (grades K-12)
 - Sealants (grades K-12)
 - Fluorosis (grades 2-12 only)
 - Root Caries (adults only)
- Periodontal Examination (Blue Form - grades 8-12)
 - Gingival assessment
 - Calculus Assessment
 - Loss of Attachment

ORAL MUCOSAL TISSUE EXAMINATION

If the examiner identifies one or more oral lesions or conditions in the participant's mouth, the examiner will tell the recorder to prepare the Oral Mucosal Tissue Examination Form (Red Form). Each form is used for one lesion only. If more than one lesion or condition is detected, additional forms must be used. For suspected smokeless tobacco-induced lesions, each individual lesion in a subject was considered a separate lesion and recorded on a separate form.

The form has three major components: diagram for specifying the location of the lesion; a section for the clinical diagnosis; and a section to clinically describe the lesion. In addition, the referral of the subject can be indicated.

The following sections should be completed by the recorder:

- **Top of the Form:** Record the participant's first and last names, ID number, and the date (month, day, and year). Fill in the appropriate circles for the ID number, age, and sex.
- **Location of Lesion or Condition.** The examiner tells the recorder where the lesion or condition is located in the mouth. The recorder fills in the circle(s) on the diagrams in the area(s) which is closest to where the examiner identified the lesion. At least one location must be marked, and it is possible to mark more than one location.

- **Clinical Diagnosis.** The examiner tells the recorder which clinical diagnosis to mark, and the recorder marks the appropriate circle. At least one circle must be marked, and only one diagnosis can be marked on a form. If the examiner dictates a diagnosis which is not listed, the recorder fills in the circle for "Other" and writes the name of the condition on the designated line. (Many dental terms are very technical; therefore, if the recorder is unsure of the spelling of the condition, she/he should be sure to ask the examiner.) When a clinical diagnosis cannot be made, the recorder marks the circle for "Unknown" and completes the Clinical Description portion on the back of the form according to the examiner's directions. The Clinical Description section is only completed if a diagnosis is not coded on the form.
- **Clinical Description.** This section is completed only if the examiner could not make a specific clinical diagnosis based on the examination, or if any of the following conditions (marked "CD") are found: candidiasis, erythroplakia, leukoplakia, lichen planus, tumors, ulcers, and unknown lesions. The examiner indicates which condition to check for each line of the Clinical Description. The examiner may wish to look at the form directly and call off the number of the circle to be marked. Otherwise, the recorder may prompt with the category of each line. Only one mark per line is possible except for "color" which allows for multiple marks. Spaces after "Other" should be filled as necessary.
- **Referral.** Subjects should be referred to a dentist or dental specialist for all lesions identified on the recording form, except for geographic tongue, recurrent aphthous ulcerations and recurrent *herpes labialis*. Subjects with lesions that are painful, and which in the examiner's judgment require treatment, should also be referred.
- **Comments.** This space permits the examiner to record potential diagnosis and describe aspects of the lesion which would be of use for referral.

DENTAL CARIES EXAMINATION

Coronal Caries

The examiner conducts the entire coronal caries examination first, beginning with the central incisor in the upper left quadrant, working toward the back of the mouth and ending with the 2nd molar. The examiner then repeats the procedure for the upper right, lower left, and lower right quadrants, always starting with the central incisor and ending with the second molar. The examiner "calls" the diagnostic code for each tooth and the recorder will simply mark in the circle or circles containing the code. The examiner proceeds to diagnose the status of each tooth surface for each of the 28 permanent teeth excluding third molars. The recorder fills in the appropriate circles beginning with the first box on the left-hand side of the form and proceeding across the row. Each of the boxes on the data form represents a tooth. Within each box there is space to record information about the condition of each surface on the

tooth. The names of the teeth are at the bottom of the form. Notice the top two rows in a box. They are marked:

- S = Sound (no decay or filling on any surface)
- C = Full crown coverage
- U = Unerupted tooth
- E = Extracted for disease (caries or periodontal)
- M = Missing (orthodontic or non-disease)
- Y = Exclusion (tooth cannot be examined)
- D = Deciduous or "baby tooth"

The above codes characterize a whole tooth condition. These are referred to as "tooth calls."

If the tooth is permanent with no decay or filling on any surface, the examiner calls "S." The recorder fills in the appropriate space on the top row of the first box. If the tooth is characterized by one of the other "tooth calls," the examiner calls out the appropriate letter and the recorder fills the appropriate circle in the top row of the box.

The "D" on the second row must be marked for all deciduous teeth. In addition, the surface condition is marked if carious or filled surfaces are involved. However, for permanent teeth, the "S" is marked only if the tooth is present and all surfaces are sound.

Below the row of tooth calls there are three rows of numbers. Above these are the abbreviations for the surfaces of the tooth. With the exception of the incisors and cuspids, each tooth has five surfaces. Incisors and cuspids do not have occlusal surfaces. These surfaces are:

- O = Occlusal - top or biting surface
- L = Lingual - surface toward the tongue
- B = Buccal - surface outside, toward the facial surface
- M = Mesial - surface between teeth (side surface) facing toward front of mouth
- D = Distal - the side of the tooth facing the back of the mouth

The first row of numbers (X), 0, 1, 2, 3 will be used to record decay on one of the tooth surfaces. The second row of numbers (5), 6, 7, 8, 9 is used to record filled surfaces.

For caries:

- X = Occlusal
- 0 = Lingual
- 1 = Buccal
- 2 = Mesial
- 3 = Distal

For filled surfaces:

- 5 = Occlusal
- 6 = Lingual
- 7 = Buccal
- 8 = Mesial
- 9 = Distal

If the tooth is permanent with decay on one or more surfaces the examiner calls the number(s) which, on the data form, correspond(s) to the surface(s) having decay. For example, if the examiner calls X, 0, 1, 2 or 3, it means that there is decay on the surfaces of the tooth represented by those numbers. The recorder fills the appropriate spaces on the Data Form. If the examiner calls 5, 6, 7, 8 or 9, it means that there is a filling on the surface(s) represented by the number(s) called. This process continues for each tooth in the mouth.

Note: In the event of multiple calls for a tooth surface, the order of precedence is decayed and then filled. Usually only one entry is to be made for each tooth surface.

Sealants

There is an "A" in each box for the bicuspid and molars and the upper laterals. The examiner will call an "A" if a sealant is present on either permanent or primary teeth. This call will be in addition to the other tooth calls. Some tooth boxes contain two A's. The examiner will indicate which one to mark by saying A1 or A2. A1 is the first A starting at the left and is positioned under the occlusal column.

Fluorosis Recording Procedures

The fluorosis exams are usually done on students in grades 2 - 12. The scores for fluorosis are:

- Y = Tooth cannot be scored for fluorosis (eg., missing or crowned)
- 0 = Normal
- .5 = Questionable
- 1 = Very mild
- 2 = Mild
- 3 = Moderate
- 4 = Severe

There should be one fluorosis code for each tooth. If the examiner could not do a fluorosis exam, mark "No FI Exam" on the right side of the form.

Root Caries

The exam for root caries is conducted in the same order as that for coronal caries, beginning with the central incisor in the upper left quadrant and ending with the 2nd molar in the upper left quadrant. The recorder marks in the appropriate circles in the root caries area. The shaded area for recording root caries is designed in the

same way as for coronal caries. The codes "R," "Y," and "M" appear at the top of the shaded area and are codes for the overall condition of the roots:

R = Roots for the entire tooth are sound

M = Not present

Y = Exclusion (root cannot be scored)

If "R" or "Y" is marked, no other mark in the root index can be made for that tooth. Surface calls are the same as for coronal except there is no occlusal surface indicated.

In some situations, "E," "M" (missing tooth), or "U" (unerupted tooth) will have been previously marked for the tooth during the coronal caries exam. During the root caries exam, the examiner will call "M" for all missing teeth and the recorder should make sure that the "E," "M," or "U" was previously marked on the coronal examination section. If the examiner called "E," "M," or "U" during the coronal assessment and "R" or "Y" during the root exam, bring this discrepancy to his/her attention immediately.

PERIODONTAL EXAMINATION

The Periodontal Examination Form includes gingival assessment, calculus assessment, and measurements for loss of attachment for two randomly selected quadrants. If the examiner indicates that the periodontal exam cannot be conducted, the recorder fills in the "Exam Inc" circle in the upper corner of the Loss of Attachment area of the form.

Gingival Assessment

The examiner begins the periodontal exam by conducting the gingival assessment of all teeth, excluding the third molars. The circles for scoring gingival assessment are located in the upper left portion of the form. Names of teeth are listed in the middle of that section (2nd molar, 1st molar, 2nd bicuspid, 1st bicuspid, cuspid, lateral, central). Unlike the caries exams which started with the central incisor and ended with the 2nd molar, the periodontal exams begin at the back of the quadrant with the 2nd molar and ends in the front with the central incisor. The codes are as follows:

Y = A gingival assessment for a particular
tooth site cannot be scored

0 = No bleeding

1 = Bleeding

One score must be called for each tooth site (two sites per tooth) and only a "Y" or a "0" or a "1" may be called. The examiner begins the gingival assessment with the second molar in the upper quadrant. The recorder marks the circles containing the codes. When the examiner has completed the exam for the designated upper quadrant, she/he examines the designated lower quadrant.

There is a circle labeled "NS" for "no score" at the top of the gingival assessment section for each quadrant. In cases where the gingival assessment cannot be made for one or more quadrants, the examiner calls "No score for upper quadrant" and/or "No score for lower quadrant." The recorder fills in the "NS" circle(s). If "NS" is marked, all other circles for the quadrant must be left blank.

Calculus Assessment

The circles for scoring the calculus assessment are located in the upper right section of the periodontal examination form. The buccal and mesiobuccal sites of each tooth are examined. The examiner conducts the calculus assessment in the same order as the gingival assessment. The recorder fills in the circles containing the codes that are called. The codes are as follows:

- Y = Cannot be assessed
- 0 = Absence of calculus
- 1 = Supragingival calculus but no subgingival calculus present
- 2 = Supragingival and subgingival calculus or subgingival calculus only

There are also "NS" (no score) circles for each quadrant to mark if the quadrant cannot be assessed for calculus. If "NS" is marked, all other circles for a quadrant must be left blank.

Loss of Attachment

The area for scoring loss of attachment is located on the lower half of the periodontal examination form. The names of the teeth in a quadrant are listed at the middle or bottom of the section beginning with the 2nd molar and ending with the central incisor. First scores for the teeth in the selected upper quadrant are recorded, followed by scores for the teeth in the selected lower quadrant.

Buccal and mesiobuccal sites of each tooth are examined. Scores are assigned for both tooth sites.

There are "No Score" circles at the top left portion of the form to indicate the quadrant(s) which cannot be assessed. If an entire quadrant cannot be examined for

loss of attachment, the examiner calls out "no score" for the quadrant and the recorder marks in the "No Score" circle corresponding to that quadrant:

UL = Upper left quadrant
UR = Upper right quadrant
LL = Lower left quadrant
LR = Lower right quadrant

If "No Score" is marked, all other circles for that quadrant must be left blank.

There is a "Y" code (cannot be assessed) for each surface of each tooth. If a surface cannot be assessed, the examiner calls out "Y," and the recorder marks the circle containing "Y" for that surface. Whenever a "Y" code is marked, the two columns of numbers for that surface must be blank. The missing teeth should be the same as those called in the caries exam.

During the loss of attachment assessment, the examiner will first measure the millimeters from the free gingival margin (FGM) to the cementoenamel junction (CEJ) and will call out the number of millimeters (from 0 to 12). The recorder marks this number in the first column. If this measurement is a negative number, the examiner calls "minus" followed by the number. The recorder marks in the circle with the minus sign and then enters the number in the same column. The examiner then measures the distance from the FGM to the bottom of the pocket, and the recorder marks that number in the second column for that surface of the tooth.

Editing the Dental Data Forms

After the examination, the recorder and examiner must edit the Data Forms while the examinee is still in the dental chair. If data are missing or inconsistent, or if the forms are incorrectly filled out, the form should be corrected. After the edit has been completed, the recorder should immediately file the completed Data Forms in a temporary file to avoid damage to the forms.

Edit Check List

The following edit checks must be conducted on each Dental Data Form:

- Incomplete or light marks must be completed or darkened with No. 2 black lead pencil.
- Extraneous marks must be completely erased.
- Filled in circles for identification must correspond exactly with the written information at the top of the forms.
- Name, ID, Date, Age, Sex: Check to be sure that these items are consistent on every form used for that SP.

- Check for the missing data.
- Make certain that missing teeth correspond exactly for all assessments.

The Dental Caries Examination Form must have the following items edited:

- If the Coronal Assessment indicates a missing tooth ("E," "M," or "U"), then most other indices must be missing ("Y") for that tooth also. It is extremely important that these teeth are in exact correspondence for all assessments.
- In the Coronal Caries Assessment, if a tooth code "C," "U," "E," "M," "MR" or "Y" is scored, all other marks for the tooth in the box must be blank. For tooth code "S," the only other score that can be marked for that tooth is "A."
- Dental Caries Assessment. Check for multiple marks on the same line in the first row of the tooth box and each column of surface codes. There should be none.

The Periodontal Exam Form must have the following items edited:

- Missing Teeth: If "U," "E," or "M" is marked for any tooth on the caries form, a "Y" must be entered for that tooth on all periodontal assessments.
- Loss of Attachment: If "Y" is scored for a surface in a periodontal assessment, no other mark can be made for the surface of the tooth in that assessment.

The Oral Mucosal Exam Form must have the following items edited:

- Location. One or more marks must be made on either or both diagrams.
- Clinical Diagnosis. A separate form must be filled out for each condition present on an examinee, and only one circle per form must be marked. If "Other" is marked, there must be a diagnosis written on the designated line(s).
- Clinical Description. This section must be completed if candidiasis, erythroplakia, leukoplakia, lichen planus, tumor (nonspecific), ulcer (nonspecific), or "unknown" was marked in the Clinical Diagnosis section. These conditions are identified with CD on the Oral Mucosal Examination Form. One circle must be marked for each of the eight items listed. For some items, more than one circle can be marked.

EXAMINER CALIBRATION AND EXAMINER RELIABILITY

The quality of the data from population surveys of oral health depends critically upon the ability of the clinical examiners to apply the diagnostic criteria and to do so consistently over time ("intra-examiner reliability"). In addition, the logistics of most surveys will dictate the use of multiple examiners, and the extent to which their diagnoses are mutually consistent ("inter-examiner reliability") is also a major concern. We define "examiner calibration" as the training process which attempts to develop very high levels of both intra- and inter-examiner reliability. The mechanics of the process are outlined briefly in this section. It is assumed that the examiners have already studied and discussed the various diagnostic criteria, have applied them in "practice" examinations, and have discussed and resolved any major disagreements in diagnoses.

Data Collection

To assess intra- and inter-examiner reliability, before the survey begins each examiner applies the various diagnostic indices to a panel of subjects who are representative, in every way possible, of those who will be surveyed. The examinations are then repeated ("replicated") after some interval of time. The interval is chosen such that it would be unlikely that any change in the true disease status had occurred, but also unlikely that the examiners could recall their original diagnoses (and thus introduce bias). Intervals of from one day to one week are typically used. The conditions of the replicate examinations with regard to equipment, instruments, lighting, etc. should approximate those planned for the actual survey. Ideally, the survey data recorders should be used.

There are no statistical guidelines regarding the number of subjects for the replicate examination panel. The important consideration is that these subjects present a range of oral conditions similar to that which will be encountered in the actual survey--otherwise estimates of examiner reliability may be badly misleading. In practice, 20-30 well-chosen subjects will usually suffice.

Analysis of Data for Examiner Reliability

A full explanation of the statistical techniques and computational methods involved in the analysis of examiner reliability can be found in standard texts and in the references cited below. However, those not already familiar with these methods are strongly urged to consult a biostatistician to assist with these analyses.

The analytical intent is to assess the degree of consistency of two sets of diagnoses of the same subjects, whose actual disease status has not changed. To assess intra-examiner reliability, the data used are those from replicate examinations of a panel of subjects by the same examiner. To measure inter-examiner reliability, the results of exams of the panel by all possible pairs of examiners can be contrasted. However, it is usually simpler to designate one examiner as the "reference examiner," and to compare the performance of each of the other examiners to the reference data

set. Typically, the "reference examiner" is the most experienced examiner involved; the analyses implicitly regard his or her diagnoses as "correct."

Intra- and inter-examiner reliability can be assessed using either individual subject scores (for example, DMFS per person) or on a surface-by-surface or site-specific basis. Usually it is instructive to do both. To analyze agreement among sets of scores, an analysis of variance model is used which separates variation among the subjects examined from that due to differences among the examiners.¹² The level of reliability between any two examiners (or of an examiner with himself) is measured by the intraclass correlation coefficient,¹³ which takes the form

$$\rho = \frac{\text{variation among subjects}}{\text{variation among subjects} + \text{variation among examiners} + \text{random error}}$$

The value of the coefficient can range from 0.0 - 1.0. Values of the coefficient of 0.75 or greater are considered acceptable, and those of 0.85 or greater indicate very good examiner reliability.

To analyze reliability on a surface-by-surface (or site-by-site) basis, the data from two examiners (or two exams by the same examiner) are cross-tabulated in a two-way table. Figure 1 is an example for data from a DMFS examination.

Fig. 1. Frequency of Surface-specific Diagnoses from Two Examinations for Coronal Dental Caries

<u>Examiner A</u>	<u>Reference Examiner</u>					Total
	Unerupted	Sound	Caries	Filled	Missing	
Unerupted						
Sound						
Caries						
Filled						
Missing						
Total						

¹²Scheffé H: *The Analysis of Variance*. Wiley & Sons, New York, 1959.

¹³Shrout PE and Fleiss JL: Intraclass Correlation: Uses in Assessing Rater Reliability. *Psychological Bulletin* 86:420-428, 1979.

Reliability is measured by a statistic called kappa.¹⁴ Kappa takes into account the fact that a certain level of agreement between examiners will occur purely by chance, and therefore provides a way to measure agreement in excess of this. ("Percent agreement," which is often seen in published reports, includes agreement which is purely due to chance. It may be a misleading indicator of examiner reliability, and should not be used for that purpose.) Kappa takes the form

$$K = \frac{\text{observed agreement} - \text{expected agreement}}{\text{perfect agreement} - \text{expected agreement}}$$

or, when the data are expressed as proportions

$$K = \frac{P_o - P_e}{1 - P_e}$$

where P_o is the percent agreement observed, and P_e is the percent agreement expected by chance.

Values of kappa of 0.50 or greater are considered evidence of adequate examiner reliability for population surveys

In the case of data on dental caries, there is either total agreement or total disagreement in diagnosis for every surface. There may be instances, however, when it is desirable to permit less than perfect agreement among examiners. For example, in assessing examiner reliability in the diagnosis of periodontal attachment loss, measured in millimeters, it may be considered adequate if examiners agree within ± 1 mm at each site. In this situation, a statistic called **weighted kappa**¹⁵ is used. Weighted kappa is an extension of kappa, and provides a way to give "credit" (or "partial credit") for less than perfect agreement in diagnoses.

¹⁴Cohen J: A Coefficient for Agreement for Nominal Scales. *Educational and Psychological Measurement* 20:37-46, 1960.

¹⁵Cohen J: Weighted Kappa: Nominal Scale Agreement with Provision for Scaled Disagreement or Partial Credit. *Psychological Bulletin* 70:213-220, 1968.

It is usual to find that, during the initial assessment of examiner reliability, one or more examiners are consistently over- or under-diagnosing disease, compared to the rest of the group. In almost every instance, this problem can be corrected by a thorough re-discussion of the written diagnostic criteria and photographs, and further chairside demonstration and discussion. The calibration exercise is then repeated until satisfactory reliability is demonstrated. Kappa and weighted kappa also can be used to identify the specific diagnoses or the particular sites within the dentition where examiner disagreement is greatest.¹⁶ This can be very helpful as it indicates where additional training should be concentrated to improve examiner reliability.

¹⁶Kingman A: A Procedure for Evaluating the Reliability of a Gingivitis Index. *J Clinical Periodontology* 13:385-391, 1986.

LOGISTICS AND EQUIPMENT FOR STUDIES

Field conditions and examination sites and facilities differ widely and, to some extent, will dictate the specific clinical protocol for the conduct of examinations. Large surveys will usually require conducting exams in a setting other than a dental clinic, using portable equipment. It may be assumed that the best quality data will be produced where the positioning of subjects and examiners, the lighting and the type and condition of instruments is standardized as much as possible.

Some attention needs to be given to the specific examination site. Minimum requirements include electric outlets for examination lights (and instrument sterilizers), tables and chairs for the data recorders, and freedom from noise or other distractions. If simultaneous examinations are conducted by more than one examiner, examining chairs must be separated enough that data recorders can hear only the correct examiner.

The NIDR maintains a large inventory of equipment and instruments for use in field studies, and these are available on free loan to researchers who are planning oral health surveys. This equipment, plus other necessary supplies, is listed below. To borrow these items, contact the Epidemiology Branch, National Institute of Dental Research. Please allow 8 weeks to process a loan request.

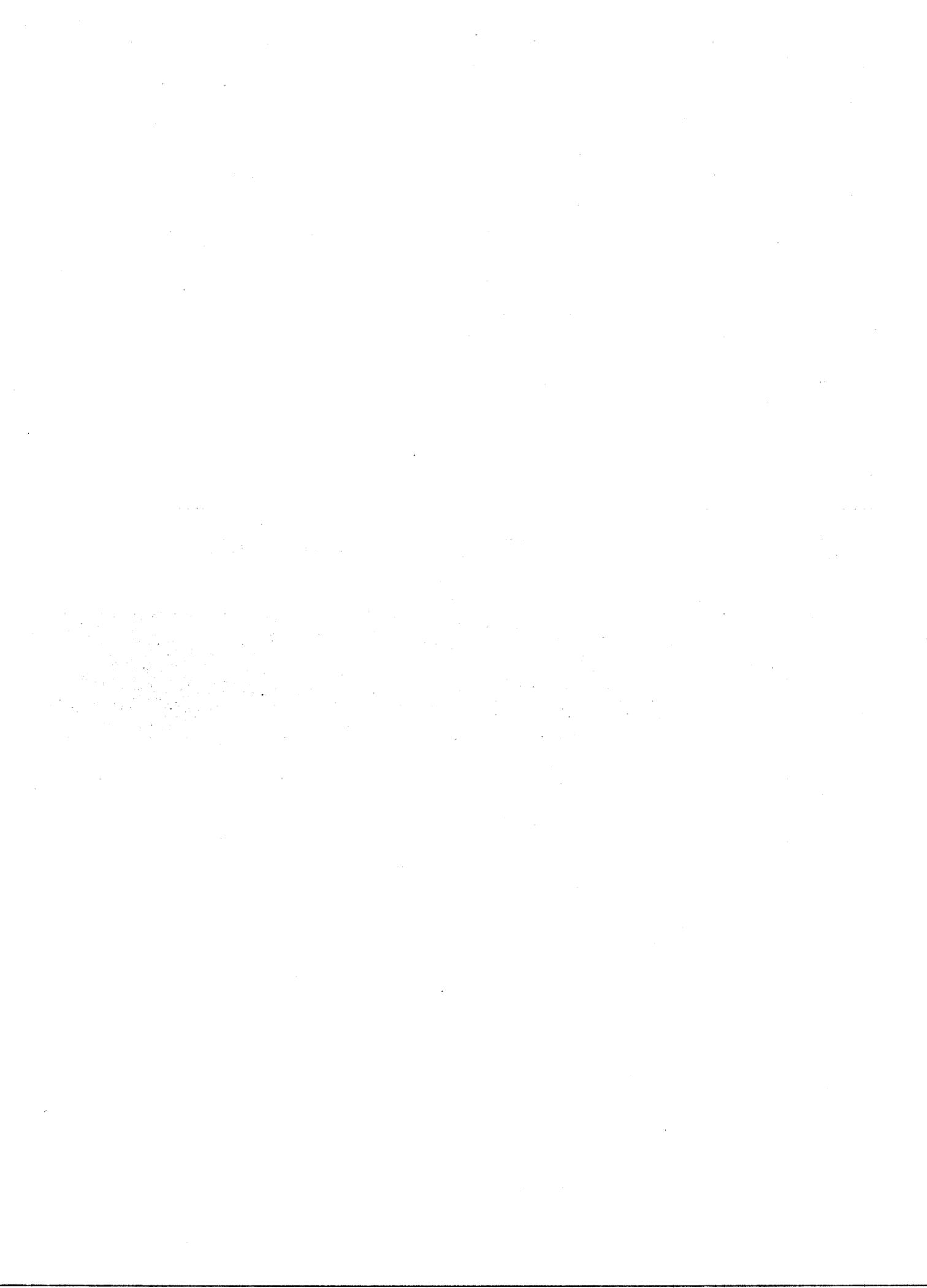
Equipment, Instruments and Supplies

Available on loan from the NIDR:

- Portable dental chairs in carrying cases
- Rolux fiberoptic examining lights in cases
- Examiners' stools
- Chemiclave sterilizers with cases
- Folding tables and chairs
- Dental mirrors with handles
- Dental explorers #23
- Dental explorers #17
- Periodontal probes #2-12
- Curettes #13/14
- Data recording forms

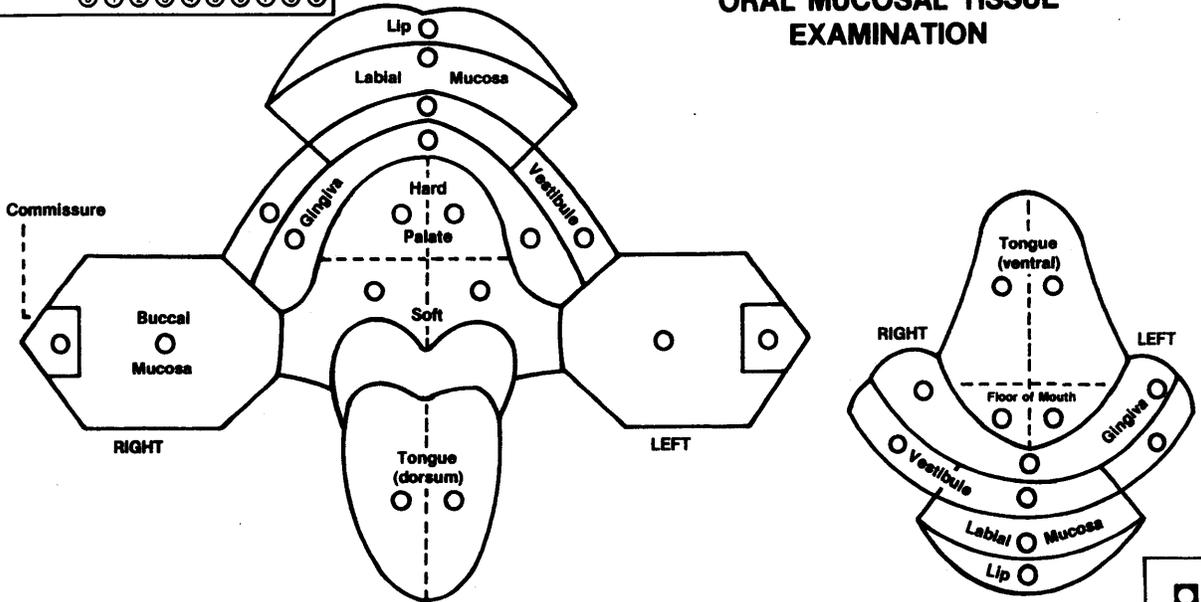
Other required equipment and supplies:

- Gauze 2" x 2" squares
- Surgical gloves and masks
- Hand cleansing system (i.e. water and detergent soap)
- Surface disinfectant
- Prewash system for instruments prior to sterilization (water/soap or a disinfecting liquid, e.g. Cidex)
- Pencils, pens, other office supplies



UR/RU ① ②		NAME	ID NUMBER
SCHOOL ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩		TENS UNITS ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩	DATE
CHILD ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩		<input type="radio"/> Male <input type="radio"/> Female	

ORAL MUCOSAL TISSUE EXAMINATION



- | | | | | |
|--|---|--|--|--------------------------------|
| <input type="radio"/> ACUTE NECROTIZING
ULCERATIVE GINGIVITIS | <input type="radio"/> HERPETIC GINGIVOSTOMATITIS | <input type="radio"/> VERRUCA VULGARIS | SMOKELESS TOBACCO-
ASSOCIATED LESIONS | |
| <input type="radio"/> CANDIDIASIS | <input type="radio"/> MUOCOCELE | <input type="radio"/> UNKNOWN | | <input type="radio"/> DEGREE 1 |
| <input type="radio"/> GEOGRAPHIC TONGUE | <input type="radio"/> RECURRENT APHTHOUS
ULCERATIONS | <input type="radio"/> OTHER (DIAGNOSIS)* | | <input type="radio"/> DEGREE 2 |
| <input type="radio"/> GINGIVAL HYPERPLASIA | <input type="radio"/> TUMOR (non-specific)* | _____ | <input type="radio"/> DEGREE 3 | |
| <input type="radio"/> HERPES LABIALIS | <input type="radio"/> ULCERATIONS (non-specific)* | _____ | | |

1. <input type="radio"/> Single	<input type="radio"/> Multifocal	<input type="radio"/> Generalized
2. Size: Dia/Len ① ② ③ ④ ⑤ ⑥	MM	W ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ MM
3. Surface morphology:	<input type="radio"/> Elevated <input type="radio"/> Vesicle/Bulla <input type="radio"/> Nonelevated <input type="radio"/> Ulcer <input type="radio"/> Other	
4. Color:	<input type="radio"/> Normal <input type="radio"/> White <input type="radio"/> Red <input type="radio"/> Blue <input type="radio"/> Brown/Black <input type="radio"/> Other	
5. Consistency:	<input type="radio"/> Soft <input type="radio"/> Firm <input type="radio"/> Fluid filled <input type="radio"/> N/A <input type="radio"/> Other	
6. Pain:	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't know <input type="radio"/> N/A	
7. Duration of Lesion:	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ <input type="radio"/> days <input type="radio"/> weeks <input type="radio"/> months <input type="radio"/> years <input type="radio"/> Don't know <input type="radio"/> N/A	
8. Prior history?	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Don't know <input type="radio"/> N/A	
9. Referral?	<input type="radio"/> Yes <input type="radio"/> No	

Comments

DO NOT MARK IN THIS AREA

09892



NATIONAL SURVEY OF ORAL HEALTH IN SCHOOL CHILDREN

REGION ① ② ③ ④ ⑤ ⑥ ⑦

UR/RU ① ②

PSU ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

SCHOOL ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

CLASS ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

CHILD ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

AGE
Tens ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
Units ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

NAME _____ ID NUMBER _____

AGE _____ SEX _____ GRADE _____ EXAMINER _____ RECORDER _____ DATE _____

SEX M F REP

RACE AI AP BH BN WH WW

EXAMINER ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪

RECORDER ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪
⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱

DENTAL CARIES EXAMINATION

GRADE K ① ② ③ ④ ⑤ ⑥ ⑦ ⑧
⑨ ⑩ ⑪ ⑫

Soft Tissue Exam Y M F

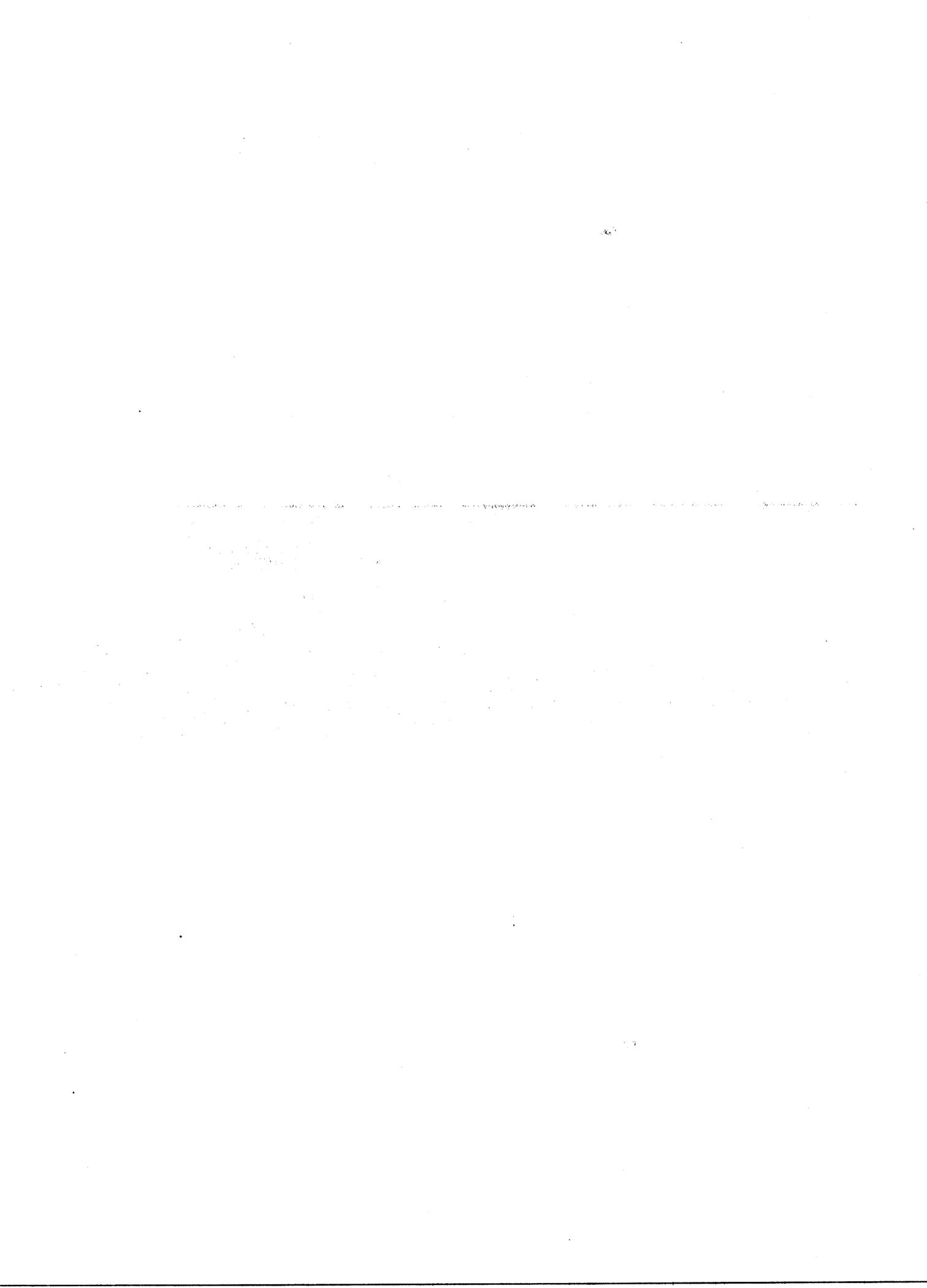
Smoking Ques. Y N

Saliva Sample Y N

Referral ① ② ③
C P L O

SUPPER PERM ENT	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯	No Exam <input type="radio"/>							
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯	No FI Exam <input type="radio"/>							
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
LOWER PERM ENT	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
	SCUEMY DLBMD ①②③ ④⑤⑥⑦⑧⑨ ⑩⑪⑫⑬⑭⑮⑯								
CENTRAL	LATERAL	CUSPID	1st Bicuspid 1st Dec Molar	2nd Bicuspid 2nd Dec Molar	1st Molar	2nd Molar			

08074





DISCRIMINATION PROHIBITED: Under provisions of applicable public laws enacted by Congress since 1964, no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity (or, on the basis of sex, with respect to any education program or activity) receiving Federal financial assistance. In addition, Executive Order 11141 prohibits discrimination on the basis of age by contractors and subcontractors in the performance of Federal contracts, and Executive Order 11246 states that no federally funded contractor may discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. Therefore, the National Institute of Dental Research must be operated in compliance with these laws and Executive Orders.

Epidemiology and Oral Disease Prevention Program
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Bethesda, Maryland 20892

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