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In Vivo Calculus Assessment: Part I A Method and Its Examiner Reproducibility

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CLINICAL evaluations of calculus have been made in both epidemiological surveys and in studies to determine the effect of potential calculus inhibiting formulations. The methods of evaluation have been varied. Disclosing solutions of various colors and chemical composition, subjective classification by the examiner, and intraoral photographs all have been employed with various degrees of success.¹⁻¹⁹ In 1957²⁰ cellulose acetate strips were contoured and fastened to the lingual surface of lower anterior teeth providing for the collection and histologic study of plaque and calculus. This method was modified a year later²¹ to utilize roughened polyester strips and has since been used extensively²²⁻²⁹ to study calculus formation. In 1961³⁰ a method of calculus assessment was presented which also depends upon the attachment of polyester foils to tooth surfaces and is reported to have the additional advantage of allowing chemical analysis of the accumulations.³¹⁻³⁴ Additionally, in 1961, the Calculus Surface Index method³⁵⁻³⁷ was introduced. In this technique all surfaces of the lower four anterior incisors are air-dried and the examiner determines the presence or absence of subgingival or supragingival calculus on the total 16 surfaces by tactile examination with the tine of a dental explorer. The C.S.I. method is reported to have excellent reproducibility among examiners and is purported to be especially efficacious in detecting subgingival calculus.

In 1962³⁸ a method of calculus assess-

ment was set forth which utilizes a periodontal probe, graduated in millimeters, and tape colored at one end to facilitate accurate readings. This system measures calculus formation on the lingual surface of the lower incisors by bisecting the surfaces with the periodontal probe and recording the calculus heights in millimeters.

This report will present additional data concerning this periodontal probe (V-M) method of calculus assessment and will include:

- (1) Data from a 3 month calculus clinical study demonstrating examiner reproducibility, and
- (2) A modification of the originally presented technique which is believed will result in increased sensitivity and consequently greater reproducibility of calculus assessment.

METHOD AND PROCEDURE

A. Technique. Calculus is a solid mass having height, width, depth and weight or volume. Height and width measurements were selected as the most logical, simplest and probably most easily reproducible measurements for in vivo studies. The lingual surfaces of the lower anterior teeth were selected as those to be measured because of their predisposition toward calculus formation. The periodontal probe, previously described, was inserted to the most inferior border of visible calculus formation in such a manner as to bisect the lingual surface of the lower incisors (Figure I), or to reach diagonally through the point of greatest height of calculus formation (Figure II).

Prior to calculus evaluation, the subjects were instructed to brush their teeth to remove as much non-calcified material as

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Figure I. This photo shows the tape-colored periodontal probe as it is inserted to the most inferior border of calculus formation and bisects the lingual surface of the lower anterior teeth.

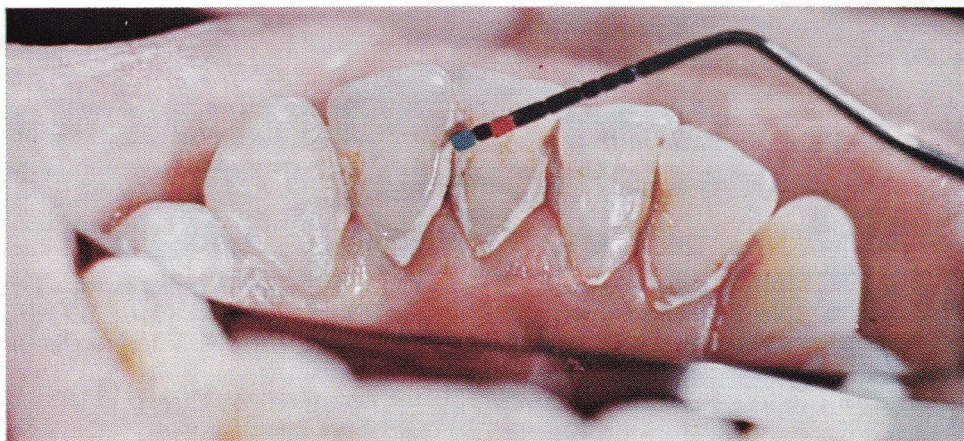


Figure IV. This photo illustrates the second plane of measurement. The probe is positioned diagonally through the mesio-incisal angle of the tooth through the area of greatest calculus height.

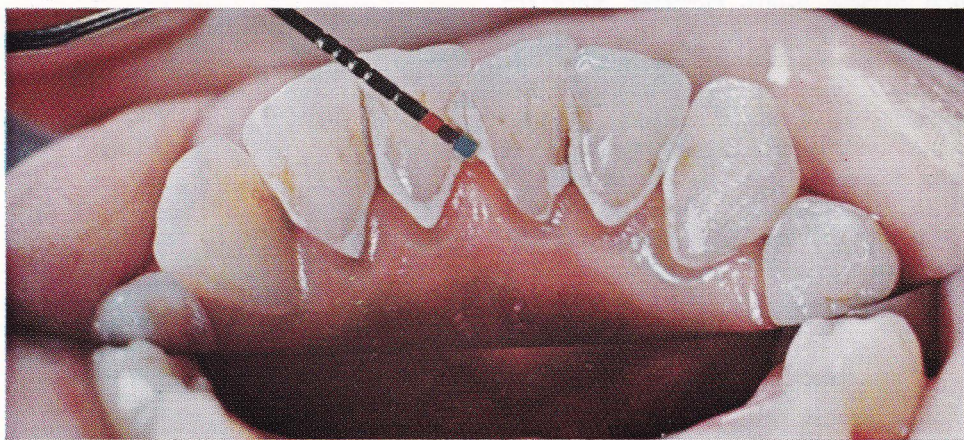


Figure V. The third measurement plane is shown in this view. The probe is positioned diagonally through the disto-incisal angle of the tooth through the area of greatest calculus height.

possible because in the evaluation of anti-calculus agents only the material which remains after routine toothbrushing procedures is considered to be of importance. The teeth were dried by a stream of air and the height of the calculus was measured by the periodontal probe. The outline, location, and height of the calculus then were recorded on score sheets. A sample sheet is shown in Figure III.

It is essential to note at this time that this procedure must be followed accurately to obtain reliable, reproducible results. Any material remaining on the teeth, other than actual calculus, may confuse the measurements. Also, teeth which are not thoroughly dried may give the impression of an absence of calculus. It is suggested that the stream of air from a dental unit or small portable compressor be allowed to dry the teeth for at least 30 seconds before any measurements are attempted.

B. *Clinical Study.* In the clinical study employed to test the V-M method for reproducibility, 66 subjects with a history of calculus formation were divided into two balanced groups with one receiving an experimental dentifrice and the other a control. Such balancing of the groups usually is attempted on a statistical basis with a value being assigned to each patient at the preliminary screening with regard to amount of calculus present, age, sex, and oral hygiene habits. However, since the length of time it takes for deposits to accumulate is seldom accurately known, it is believed that use of such a value in attempting to divide the populations into subgroups is incorrect. Instead, all subjects who presented large amounts of calculus at the initial screening procedure received a thorough oral prophylaxis and were placed on a uniform oral hygiene program for 3 months to determine their actual rate of calculus formation. The 3 month period was selected because it was the authors' experience that this amount of time provided sufficient calculus to be accurately measured and could serve as a basis for determining differences between test and

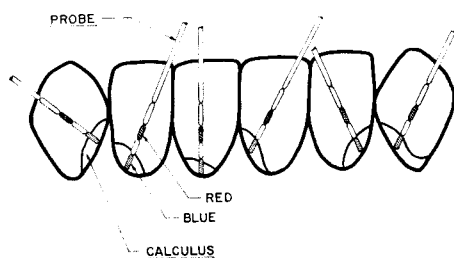


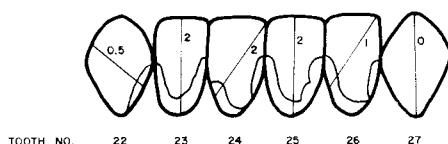
Fig. II. This diagram indicates the diagonal movement of the probe as it measures the amount of calculus at its point of greatest height. (Lingual surfaces of lower anterior teeth.)

control groups. Additionally, this period of time generally corresponds to the frequency at which heavy calculus forming patients should present themselves for prophylaxis in the dental office.

The prophylaxis consisted of a subgingival as well as supragingival scaling and use of a disclosing solution to check the thoroughness of the procedure. The tooth surfaces then were planed and polished because it is possible that the rate of calculus formation may vary with surface smoothness. Additionally, this prophylaxis was performed by the same hygienist with the same equipment so as to eliminate this particular variable. Unpublished data of the

CALCULUS SCORING FORM

NAME _____
DATE _____
GROUP _____
LOCATION _____



TOTAL SCORE 7.5

EXAMINER _____

COMMENTS _____

Fig. III. This diagram shows a typical calculus clinical study score sheet, indicating both calculus locations and height.

authors' indicates that there is no difference in amount of calculus formed when either hand instruments or mechanical or ultrasonic procedures are utilized, as long as the teeth are properly planed after the scaling.

During this initial control period, all subjects received the same dentifrice, toothbrushes, oral hygiene instruction, and diet. When possible, toothbrushing was supervised. Upon completion of this initial 3 month control period, the subjects were scored for calculus formation. This value, along with the other factors previously mentioned (age, sex, oral hygiene habits) enabled the total population to be subdivided into 2 statistically balanced test groups.

The actual clinical study began now. Each subject received another complete prophylaxis and the control and experimental dentifrices were distributed. After 3 months of the test procedure subjects were recalled and examined for calculus formation according to the method previ-

ously described. The examinations were conducted by three dentists who were instructed minimally in the scoring technique. They scored the calculus formed by the subjects independently of one another and both the dentists and subjects were unaware of the distribution of the experimental products. A strong source of overhead light was used, together with an individual examiner head lamp. The dental unit provided the source of air.

RESULTS

The results of the examination are shown in the accompanying tables.

Table 1 indicates that when the three examiners were compared according to the mean calculus score per subject in the control group there was good agreement between examiners A and B and between A and C. However, a significant difference existed between examiners B and C. When compared according to the mean calculus score per subject in the experimental group there were no significant differences among any of the examiners.

TABLE I
Examiner Replication Using V-M Technique
of Assessing Calculus Formation

1. Control Group				
	N	Mean Calculus Score*	C.R.	Significance
Examiner A	32	3.28 \pm 3.28	0.183	Non-sig.
Examiner B	34	3.41 \pm 2.40		
Examiner C	33	3.22 \pm 2.50	0.317	Sig. .01 level
Examiner A	32	3.28 \pm 3.28	0.082	Non-sig.
2. Experimental Group				
Examiner A	34	3.59 \pm 3.13	0.114	Non-sig.
Examiner B	34	3.50 \pm 3.36		
Examiner C	35	3.59 \pm 2.97	0.117	Non-sig.
Examiner A	34	3.59 \pm 3.13	Non-sig.

*This value refers to the mean calculus score *per subject* in that particular group. It was obtained by dividing the total amount of calculus formed on all 6 lingual surfaces of *all* of the subjects in a particular group by the number of subjects in that particular group.

Table 2 compares control group mean per subject versus experimental groups mean per subject scores. The data indicates that all three examiners showed no statistically significant difference between the two groups, either when evaluated according to individual examiner values or combined examiner values.

Table 3 indicates the percentage agreement among examiners when compared on a particular calculus score range. Since examiners, when using the V-M method, rarely encountered a calculus score of greater than 3 units for any particular lingual surface, it was decided to consider 3 units as the maximum per tooth calculus score. This then allowed for a maximum value of 18 units for the six lower an-

teriors. The calculus score range for examiners in this study was between 0-15 points. This refers to the fact that the lowest calculus score per subject as recorded by any of the three examiners was 0 units and the highest score per subject was 15 units.

The results of Table 3 indicate that in 49% of the subjects, there was agreement among the three examiners within 1 unit; in 70% of the subjects, all examiners agreed within 2 units, and in 84% of the subjects, there was a 3 unit difference among the three examiners.

As a result of the 3 month clinical calculus study the following information was obtained:

- (1) Three examiners, when using the

TABLE 2
Control Group vs. Experimental Group

Examiner	N	Control Score*	N	Exper. Score*	C.R.	Significance
A	32	3.28 ± 3.28	34	3.59 ± 3.13	0.39	Non-sig.
B	34	3.41 ± 2.40	34	3.50 ± 3.36	0.13	Non-sig.
C	33	3.22 ± 2.50	35	3.59 ± 2.97	0.55	Non-sig.
Combination of three Examiners	99	3.30 ± 2.76	103	3.56 ± 3.14	0.42	Non-sig.

*These values refer to the mean calculus score *per subject* in that particular group. They were obtained as described in Table 1.

TABLE 3
Examiner Agreement Within Specific Calculus Score Ranges

Calculus Score Range per Subject	Number of Subjects* All 3 examiners have Scored within Point Range	Percentage of subjects all examiners have scored within Point Range
No difference in scores	11	17%
1 Point Difference in scores	21	32%
2 Point Difference in scores	14	21%
3 Point Difference in scores	9	14%
4 Point Difference in scores	11	17%

*The total number of subjects that all three examiners evaluated for calculus formation was 66.

CALCULUS SCORING FORM

NAME _____

DATE _____

GROUP _____

LOCATION _____

TOOTH NO.	22	23	24	25	26	27
TOTAL SCORE PER TOOTH	0.5	4	3	5	3.5	0

TOTAL SCORE _____ **16** _____

EXAMINER _____

COMMENTS _____

Fig. VI. This diagram depicts a sample score sheet used for recording calculus measurements and location in the three previously described planes.

basic V-M method of calculus assessment, agree well in their ability to score calculus clinically.

(2) The technique of measuring calculus in only one plane was too subjective and needed modification because of the uneven pattern in which calculus forms on teeth and because no fixed reference point is provided for subsequent examinations.

MODIFICATION OF TECHNIQUE

The basic technique was modified so as to allow for measurement of calculus in three constant planes, rather than the one formerly employed. It was believed that these three readings for each lingual surface would more fully incorporate the concept of calculus height and width, more accurately assess the amount of calculus present and provide a fixed reference point for subsequent examinations. It was suggested, therefore, that readings be taken in the following three planes:

- (1) Bisecting the lingual surface (Figure I)
- (2) Diagonally through the mesio-incisal angle of the tooth through the area of greatest calculus height (Figure IV)

- (3) Diagonally through the disto-incisal angle of the tooth through the area of greatest calculus height (Figure V)

Since it was arbitrarily decided to use a value of 3 units as the maximum calculus score in any one plane, this modification now provides for a maximum score of 9 units per tooth or a total of 54 units per subject. The calculus height values and outline are recorded on a form such as that shown in Figure VI.

SUMMARY

- 1. A simple method of clinically scoring calculus has been presented.
- 2. A 3-month clinical calculus study involving 66 subjects and three examiners has demonstrated the reliability of the method.
- 3. A modification of the technique is described which should result in increased sensitivity and accuracy. It is believed that additional clinical studies, now in progress, will confirm this assertion.

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