Tooth Roughness After Subgingival Root Planing

BY E. GREEN* AND S. P. RAMFJORD,* ANN ARBOR, MICHIGAN

ROUGH SURFACES of the teeth facilitate the accumulation and retention of dental plaque and calculus.[1-7] Consequently one reason for subgingival root planing is to reduce the roughness of surfaces of the teeth and thereby alter a condition which favors the accumulation of irritant deposits. Until recently investigations of the effectiveness of various hand instruments used to plane the surfaces of the teeth have had to rely on qualitative visual impressions to evaluate the roughness of instrumented areas.[8-12] However, industrial devices now have become available for quantitative measurement of surface roughness. These devices have been utilized for dental research,[13-17] and one of them** was used in the present study. The purpose of this study was to compare the roughness of root surfaces following subgingival root planing with various hand instruments.

MATERIALS

Samples. The material for this study consisted of 75 selected anterior and/or bicuspid teeth, which were scheduled to be extracted in preparation for prosthetic service at the United States Veterans Administration Hospital, Ann Arbor, Michigan. The patients (fourteen males ranging in age from 31-67 years) had exposed cementum and moderate to gross subgingival deposits of calculus.

Instruments. The following hand instruments were used for subgingival root planing: Curettes (Bunting #5 or #6),† Sickles (#3-s or #4-s),† Hoes (University of Michigan, #9-H or #10-H),† Files (Bunting #15 or #16).† All of the instruments, with the exception of the files, were sharpened on a flat Arkansas stone‡ lubricated with oil, and sterilized in an autoclave prior to each appointment. The corners of the cutting edges of the hoes were rounded.

The equipment used for measurement of root surface roughness consisted of the following profilometer components: a type AE automatic pilotor with a GP adaptor beam on a type GH tracer, and a type QB amplimeter. The piloting device moves a diamond tracing stylus (radius = .0005″) over the surface being investigated. As the stylus follows the various surface deviations electrical impulses are relayed to the amplimeter which indicates surface roughness on a numbered gauge.

METHOD

Clinical Procedure. Five anterior or bicuspid teeth from a patient were selected on the basis of availability and the subgingival root planing for these teeth was accomplished during the same appointment. This series of five teeth (A, B, C, D, E) were instrumented as follows:

Tooth A: use of curettes only
Tooth B: use of sickles only
Tooth C: use of hoes only
Tooth D: use of files only
Tooth E: use of files and curettes (files followed by curettes)

Clinical work sheets were used to record the following information (1) code letter identifying sample tooth; (2) tooth number; (3) calculus score;[18] (4) instrumentation used; (5) depth of gingival crevice in

*The University of Michigan, School of Dentistry, Ann Arbor, Michigan.
**Profilometer, Micrometrical Manufacturing Co., Ann Arbor, Michigan.
†Manufactured by S. S. White Dental Mfg. Co.
This paper was taken from a thesis submitted to the faculty of the Graduate School of the University of Michigan in partial fulfillment of the requirements for the degree Master of Science (Periodontics).

†Manufactured by S. S. White Dental Mfg. Co.
‡B. D. Needle Sharpening Stone.

TABLE 1

Mean Roughness Values of Experimental Tooth Surface Areas

Experimental Instrumentation	*Sickles*	*Curettes*	*Files + Curettes*	*Hoes*	*Files*
$\bar{X}$ Roughness value	9.12	10.05	10.54	12.89	13.95
s (standard deviation)	2.67	2.29	2.45	2.16	3.69
S.E. (Standard error)	.69	.59	.63	.56	.95

mm.; (6) distance from the free gingival margin to the cementum enamel junction in mm.; (7) sequential order of instrumentation; (8) date of last previous scaling; (9) presence or absence of tooth approximal to the experimental surface.

After obtaining local anesthesia, the location of the free gingival margin was scratched into the surface of the tooth with a sharp instrument. The mesial surfaces of the selected teeth were then root planed beneath the gingival margin to the base of the gingival crevice. The sequence of instrumentation was rotated for each of the different series of five teeth in order to equalize the fatigue factor. All root planing was done from the facial (labial or buccal) approach. One investigator carried out all clinical procedures.

Root planing on each tooth was continued until the subgingival root surfaces were considered to be as smooth as could be obtained. A sharp #17 explorer was used to determine subgingival smoothness. When a series of five teeth had been instrumented, the subgingival surfaces were again tested clinically with the sharp explorer. If any roughness or inequity was noted, additional instrumentation was performed as previously specified until it was felt that all five teeth were equally smooth. Immediately after root planing was completed, the teeth were extracted, using special care to avoid contacting the experimental area with the extraction instruments. The extracted teeth were rinsed under running tap water. Each tooth was stored in a separate bottle containing physiologic saline solution.

Laboratory Procedures. The Profilometer measurements of surface roughness were performed on each series of experimental teeth within six hours following their extraction. A dissection microscope was used to select a flat portion of the experimental area (approximately four square mm.) which was outlined with a sharp pencil. The Profilometer equipment was adjusted for high speed tracing with a stroke length of .010″. The amplimeter was set to measure roughness in terms of the arithmetic average of the height in microinches (1 microinch = .000001 inch) of vertical deviations of the surface. The tooth was stabilized with modeling clay, and eight Profilometer readings were taken at different points within the outlined area. Four readings were obtained with the stylus moving parallel to the long axis of the tooth, and four readings were obtained with the stylus moving perpendicular to the long axis.

A mean roughness score was determined for each planed root area by calculating the average of the eight Profilometer readings. The mean roughness score for each of the experimental areas planed by the same type of instruments (curettes only, sickles only, etc.) were averaged to provide a mean of the means of roughness scores. Thus a mean of the means, or mean roughness value, was determined for each of the five instrumentations.

Upon completion of the Profilometer measurements, the experimental teeth were placed in a 10% buffered formalin solution. After decalcification, vertical and horizontal histologic sections of the experimental areas were prepared for microscopic examination.

Statistical Analysis. The standard deviation of each mean roughness value and the standard error were determined. The statistical significance of the differences between the mean roughness values were determined using the student's "t" test.

RESULTS

Profilometer Measurements. The mean surface roughness values following the experimental root planing are indicated in Table 1. The roughest tooth surfaces are indicated by the highest mean roughness values.

The difference between the mean roughness values of the five experimental instrumentations and the significance of these differences (t) are indicated in Table 2.

TABLE 2

Differences Between the Mean Surface Roughness Values and "t" Values

Instruments Being Compared	*Difference Between the Means*	*"t" Values*
Sickles, and curettes	.93	1.024
Sickles, and hoes	3.77	4.255**
Sickles, and files	4.83	4.107**
Sickles, and files + curettes	1.42	1.517
Curettes, and hoes	2.84	3.498*
Curettes, and files	3.90	3.479*
Curettes, and files + curettes	.49	.566
Hoes, and files	1.06	.960
Hoes, and files + curettes	2.35	2.788*
Files, and files + curettes	3.41	2.981*

*Statistically significant difference beyond the 1 per cent level of confidence.

**Statistically significant difference beyond the .1 per cent level of confidence.

Root planing using sickles, curettes, or files + curettes resulted in significantly smoother (less rough) tooth surfaces than root planing using hoes, or files. Root planing using files followed by curettes (files + curettes) resulted in significantly smoother (less rough) root surfaces than root planing using files.

No significant difference was found between the mean surface roughness values following the use of either sickles, curettes, or files + curettes. No significant difference was found between the mean surface roughness values following the use of hoes or files.

DISCUSSION

The method used in this study to measure and compare the roughness of root planed tooth surfaces was derived after consideration of previous investigations[9, 13, 15] and preliminary testing. The stroke length of .010″ was found to yield the least variable measurements and therefore was selected. The high rather than the low tracing speed was used because at this speed a wider range of irregularities were measured as surface roughness. By measuring only instrumented tooth surfaces that were similar in flatness and area, variation due to tooth contour was minimized.

The areas chosen for experimental instrumentation were equally favorable to the use of all the instruments. The data indicated that use of sickles or curettes resulted in significantly smoother subgingival root surfaces than use of hoes or files ($P > .01$). It cannot be assumed that instrumentation of a similar nature by all clinicians would result in identical findings; however, with different methods of evaluation, similar results have been reported by other investigators.[8, 9, 12]

"Burnish" marks following use of the Profilometer were evident on the tooth surfaces which had been measured with the diamond tracing stylus (vertical force = 2 grams). To standardize any effect on the roughness measurements as a result of this burnishing, the measurements used were those indicated on the amplimeter dial during the fifth to the eighth traverse of the diamond stylus. The degree of tooth surface roughness registered on the dial was reduced when the tracing stylus was permitted to operate continuously. Previous investigations have considered the machining effects produced on dentin surfaces by single edge cutting tools,[14, 19] but a burnishing effect as suggested by Thebaud[12] may also reduce tooth surface roughness.

The method used in this study to compare the roughness of similar tooth surfaces is applicable to future investigations of the effects on tooth surfaces of various clinical instruments, mechanical devices or polishing agents. At present it is not possible to attribute a definite biological significance to measured differences in surface roughness, even though such differences may appear to be significant on the basis of statistical methods of analysis.

In 22 of the 25 teeth examined histologically, the cementum was completely removed in the experimental area. This finding was in agreement with other studies.[11, 12, 20, 21]

SUMMARY

A profilometer was used to measure and compare the roughness of similar tooth surfaces after subgingival root planing with various hand instruments. The measurement method used provided a direct index of the roughness of the experimental areas in objective numerical terms. On the basis of statistical analysis of the results, subgingival root planing with sickles or curettes resulted in significantly smoother tooth surfaces than subgingival root planing with hoes or files. When compared to the use of files alone, the use of curettes after files significantly reduced surface roughness.

CONCLUSION

Subgingival root planing with sickles or curettes resulted in root surfaces which were smoother (less rough) than subgingival root planing accomplished with hoes or files. The difference in roughness was statistically significant.

REFERENCES

1. Bodecker, C. F.: The difficulty of completely removing subgingival calculus. J.A.D.A., 30:703-708, May, 1943.

2. Frumker, S. C. and Gardner, W. M.: The relation of the topography of the root surface to the removal of calculus. J. Periodont., 27:292-295, Oct., 1956.

3. Swartz, M. L. and Phillips, R. W.: Comparison of bacterial accumulations on rough and smooth enamel surfaces. J. Periodont., 28:304-307, Oct., 1957.

4. Turesky, S., Renstrup G. and Glickman, I.: Histologic and histochemical observations regarding early calculus formation in children and adults. J. Periodont., 32:7-14, Jan., 1961.

5. Waerhaug, J.: Effect of rough surfaces upon gingival tissue. J. Dent. Res., 35:323-325, April, 1956.

6. Waerhaug, J.: Effect of zinc phosphate cement fillings on gingival tissues. J. Periodont., 27:284-290, Oct., 1956.

7. Zander, H. A.: The attachment of calculus to root surfaces. J. Periodont., 24:16-19, Jan., 1953.

8. Barnes, J. W. and Schaffer, E. M.: Subgingival root planing: a comparison using files, hoes, and curettes. J. Periodont., 31:300-303, Sept., 1960.

9. Braum, S. T.: The radicular surfaces of teeth following the use of curettes, hoes and files. Thesis. University of Michigan, School of Dentistry, 1961, 41 pp.

10. Orban, B. and Manella, V. B.: A macroscopic and microscopic study of instruments designed for root planing. J. Periodont., 27:120-135, April, 1956.

11. Schaffer, E. M.: Histological results of root curettage of human teeth. J. Periodont., 27:296-300, Oct., 1956.

12. Thebaud, J.: Some microscopic aspects of the curetted surface of the cementum after the subgingival curettage. J. Canad. D.A., 17:127-130, March, 1951.

13. Charbeneau, G. T., Peyton, F. and Anthony, D. H.: Profile characteristics of cut tooth surfaces developed by rotating instruments. J. Dent. Res., 36:957-966, Dec., 1957.

14. Lindhe, J.: Orthogonal cutting of dentine. Odont. Revy., Vol. 15, supplement 8, 1964.

15. Nissle, R. R.: Ultrasonic scaling: Effects on gingiva and root surface. Thesis. University of Michigan, School of Dentistry, 1962, 54 pp.

16. Stoller, S. M.: The microtopography of teeth. J. Periodont., 36:485-493, Nov.-Dec., 1965.

17. Technical Bulletin on surface texture, surface measurement, and the American Standard ASA B46. 1-1962. Micrometrical Manufacturing Co., Ann Arbor, Mich.

18. Ramfjord, S. P.: Indices for prevalence and incidence of periodontal disease. J. Periodont., 30:51-59, Jan., 1959.

19. Björn, H. and Lindhe, J.: The influence of periodontal instruments on the tooth surface. A methodological study. Odont. Revy., 13:335-369, 4-1962.

20. Box, H. K.: Treatment of the periodontal pocket. Toronto, University of Toronto Press, 1928, 123 pp.

21. Riffle, A. B.: The dentine, its physical characteristics during curettage. J. Periodont., 24:232-241, Oct., 1953.