Furcation Morphology Relative to Periodontal Treatment

Furcation Entrance Architecture

by
ROBERT C. BOWER*

MULTIROOTED TEETH in which chronic periodontitis has progressed to involve the furcation present special problems in treatment.[1, 2] These difficulties previously meant that a guarded to poor prognosis was ascribed to such teeth.[3, 4, 5] However, recent longitudinal studies where surgical readaptation of soft tissue has covered the defect report encouraging results.[6, 7] In situations where the furcation was deliberately exposed and no root amputation performed the prognosis after surgery remained poor over 5 years.[6]

The long term postsurgical readaptation of soft tissues to tooth surface previously exposed by chronic periodontitis is likely to depend on tooth surface preparation.[8] Plaque, calculus and contaminated cementum must be removed and curettes are the hand instruments commonly used to produce a smooth and biologically acceptable root surface.[9-14] The present study of furcation morphology in maxillary and mandibular first molars has been undertaken to investigate whether furcation morphology may influence instrumentation using curettes.

MATERIALS AND METHODS

A random sample of first permanent molar teeth comprising 114 maxillary and 103 mandibular teeth was selected from a collection of extracted teeth kept at The University of Michigan Dental School. These teeth are stored in glycerin and isopropyl alcohol (1:1). Identification was based on crown morphology. Teeth having fused roots, evidence of extraction damage near the furcation, or either caries or restorations extending apical to the cementoenamel junction were excluded from the sample.

The teeth were cleaned with soap and water using a toothbrush and any calculus or tissue tags in the furcation were removed using a narrow curette. Care was taken not to damage the root surface. The mesial and distal surfaces near the center of the area at the cementoenamel junction were similarly cleaned. Each tooth was then engraved with an identifying number.

The mesiodistal width of each tooth was measured between the buccolingual mid points of the cementoenamel junction of each surface and was recorded to the nearest tenth of a millimeter using a modified Boley gauge as described by Pagano.[15] Reproducibility was tested by seven repeated measurements of 16 teeth, with a period of at least 4 hours between measurements of the same tooth. Identical readings were obtained on the seven occasions for two (12.5%) of the teeth remeasured, a spread of 0.1 mm was obtained for four (25%) teeth and of 0.2 mm in the remaining 10 (62.5%) remeasured teeth. The maximum difference within the seven readings for any tooth was 0.2 mm.

Measurement of the furcation entrance diameter was performed using a dissecting microscope† at × 6.3 magnification. Machined metal test gauges of diameters 0.50, 0.75, 1.00, 1.25, 1.50, 1.75 and 2.00 mm (manufacturing tolerances ± 0.02 mm) were placed in the furcation entrance in ascending size until the largest gauge size was found which would fit the space between the roots and still touch the most coronal part of the furcation entrance (Fig. 1). This size was recorded for the furcation entrance under consideration. Furcation entrances which would not admit the smallest gauge were classified as having furcation entrance diameter of 0.5 mm.

Separate measurements were recorded for each furcation entrance, three for maxillary molars and two for mandibular molars.

Reproducibility of measurement was tested by six repeated measurements of 16 maxillary and 17 mandibular first molar teeth. Again at least 4 hours elapsed between measurement of the same tooth. A reproducibility of 90.6% for maxillary and 88.7% for mandibular molar teeth was achieved (Table 1). In no instance was there a difference of more than one test diameter (0.25 mm) in the measurement of a furcation. It was noted that most differences occurred in the measurement of 17 furcations where more than one of the six repeated readings was assigned a higher or lower score.

The blade face width of 12 commonly used curette types made by two different manufacturers was measured using a Vernier caliper‡ and recorded to the nearest twentieth of a millimeter (Fig. 2). All instruments were unused and had not been sharpened since leaving the manufacturer. Additional instrument manufacturers' standard widths and manufacturing tolerances were also obtained.

RESULTS

a. *Mesio-Distal Width of the Teeth*

The mean mesiodistal width between the midpoints at the cementoenamel junction of mesial and distal surfaces of the maxillary first molar teeth was 7.9 mm (SD 0.475), with a range between 7.1 and 9.3 mm, and of mandibular first molar teeth 9.2 mm (SD 0.498) with a range from 8.0 to 10.3 mm.

* Visiting Assistant Professor, Department of Periodontics, The University of Michigan, Ann Arbor, Mich 48109. Present address: 39 Colin Street, West Perth, Western Australia 6005.

† Olympus Model JM. Olympus Optical Company, Ltd. Japan.
‡ Starrett Athol, Massachusetts, U.S.A.

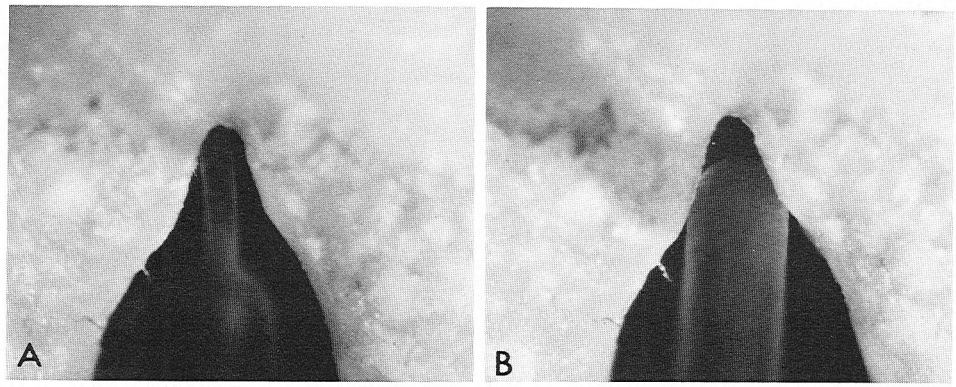

FIGURE 1. *Measurement of furcation entrance diameter using test gauges.* A. *Placement of a gauge size which allows contact with the most coronal part of the furcation entrance.* B. *Placement of a gauge size too large to allow contact with the most coronal part of the furcation entrance (original magnification × 6.5).*

TABLE 1. *Reproducibility of Furcation Entrance Diameter Measurements Using Test Gauges**

Furcation entrance studied	Number of readings	Readings different 1 test diameter
		%
Maxillary first molars		
Buccal	96	11.5
Mesio palatal	96	7.3
Disto palatal	96	9.4
Total	288	9.4
Mandibular first molars		
Buccal	102	11.7
Lingual	102	10.8
Total	204	11.3

* Results of six repeated measurements of 16 maxillary and 17 mandibular first molar teeth.

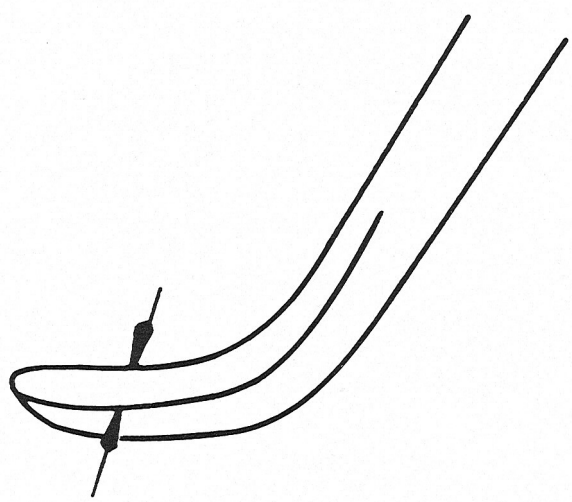

FIGURE 2. *Region of measurement of curette blade face width.*

b. *Furcation Entrance Diameter*

In 81% of the furcations (maxillary and mandibular teeth) the entrance diameter was found to be 1.0 mm or less, and in 58% the diameter was 0.75 mm or less. When results for maxillary and mandibular first molar teeth are considered separately, entrance diameters of 63% of the maxillary teeth and 50% of the mandibular teeth were 0.75 mm or less.

Further separation of maxillary first molar furcation entrance diameters into buccal, mesiopalatal and distopalatal reveals differences in distribution of furcation diameter (Fig. 3). In 85% of buccal furcations the diameter was 0.75 mm or less, whereas in 49% of mesiopalatal and 54% of distopalatal furcations the entrance diameters were 0.75 mm or less. The mandibular first molar teeth were also found to differ in furcation entrance diameter distribution, the buccal being 0.75 mm or less in 63% of the cases and the lingual in 37% of lingual furcations measured (Fig. 4).

c. *Correlation Between Mesiodistal Width and Furcation Diameter*

Correlation between mesiodistal width at the cementoenamel junction, and furcation entrance diameter for each group of teeth (maxillary and mandibular) was computer calculated and is extremely low for any of the five individual furcation entrances. (Correlation coefficients ranged between $r = 0.02$ and $r = 0.16$).

d. *Width of Curette Blade Face*

The blade face width of the types of curettes tested was found to vary with manufacturer, but in general the Gracey curettes had a narrower blade face width than the Columbia or McCall curettes. In all cases the blade face width was within the range of 0.75 mm to 1.10 mm whatever the type and manufacturer of the instrument (Table 2).

DISCUSSION

The available literature contains no report of investigations dealing with the diameter of the furcation entrance and its significance in relation to prognosis or treatment of periodontal disease.

Measurement of the mesiodistal width at the cementoenamel junction has been reported previously by Black,[16] and found to be slightly smaller than in the present study, however, the widths later mentioned by Wheeler[17] are close to those presented here. The differ-

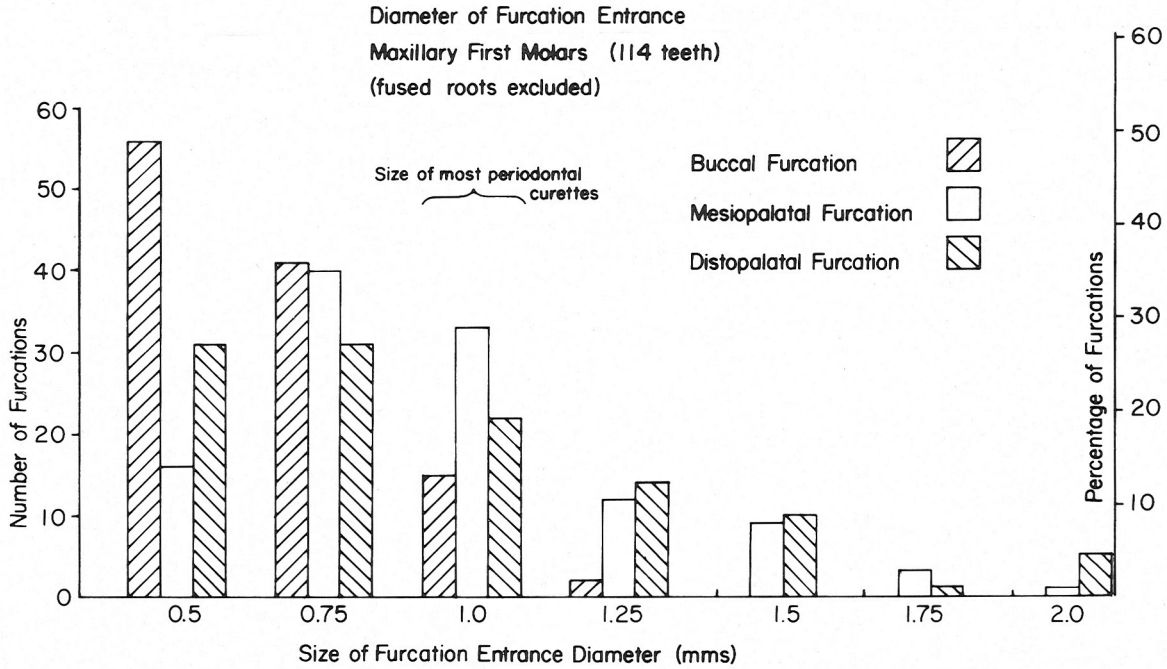

FIGURE 3. *Distribution of furcation entrance diameter size expressed in millimeters for each of the three furcation entrances of maxillary first molar teeth.*

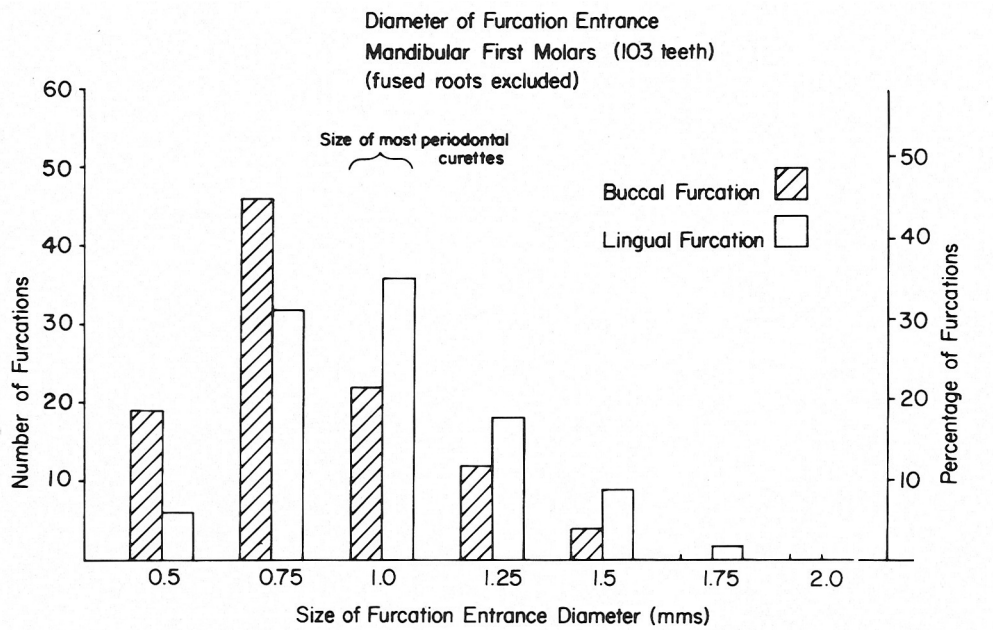

FIGURE 4. *Distribution of furcation entrance diameter size expressed in millimeters for the two furcation entrances of mandibular first molar teeth.*

ences probably reflect differences in sample selection criteria[18] and are of minimal importance to the current investigation.

Analysis of the reproducibility of performed measurements demonstrates that measurement is acceptably consistent and the method used reliable.

The importance of adequate root preparation—removal of plaque, calculus and cementum contaminated by prolonged exposure to "periodontitis" plaque in periodontal pockets—prior to the surgical readaptation of the periodontal soft tissues recently has been reemphasized.[8, 19] *In vitro* evidence also demonstrates that such contaminated root surface is irritant to both epithelial cells[20] and fibroblasts.[21] Thus, in treatment of teeth with furcation involvement it is important to prepare the furcation area prior to soft tissue adaptation.

Comparison of the furcation entrance diameters of first molar teeth and the blade face width of some of the more commonly used periodontal curettes reveals a size disparity which makes it unlikely that curettes used alone will achieve adequate preparation of this area.

Alternative regimes of instrumentation such as the use

TABLE 2. *Blade Face Widths of Commonly Used Curettes Made by Four Manufacturers*¶

Curette type	Manufacturer	Number of instruments measured	Mean width	Range	Std. manufacturing width and tolerances
			mm	*mm*	*mm*
Gracey					
Nos. 1–14 (7 curette types)	Hu-Friedy*	60	0.84	0.75–0.95	
	Star†	140	0.80	0.70–0.90	
	American Dental‡				0.813 + 0.05‖ − 0.00
	Nordent§				0.81 ± 0.08‖
Colombia					
13–14	Hu-Friedy*	20	0.88	0.75–1.00	
	Star†	20	0.84	0.80–0.90	
	American Dental‡				0.813 ± 0.05‖
	Nordent§				0.86 ± 0.08‖
2R-2L	Hu-Friedy*	20	0.99	0.95–1.05	
	Star†	20	1.01	0.95–1.05	
	American Dental‡				1.016 ± 0.05‖
	Nordent§				1.14 ± 0.08‖
4R-4L	Hu-Friedy*	20	1.01	0.95–1.05	
	Star†	20	0.99	0.95–1.05	
	American Dent.‡				0.914 ± 0.05‖
	Nordent§				1.16 ± 0.08‖
McCalls					
13–14	Hu-Friedy*	20	1.06	1.00–1.10	
	Star†	20	1.01	1.00–1.05	
	American Dental‡				1.016 ± 0.05‖
	Nordent§				1.016 ± 0.13‖
17–18	Hu-Friedy*	20	1.06	1.00–1.10	
	Star†	20	1.00	Nil	
	American Dental‡				1.016 ± 0.05‖
	Nordent§				1.016 ± 0.08‖

* Hu-Friedy manufacturing Co Inc., Chicago, Illinois, U.S.A.
† Star Dental Manufacturing Co., Conshohocken, Pennsylvania, U.S.A.
‡ American Dental Manufacturing Company, Missoula, Montana, U.S.A.
§ Nordent Manufacturing Inc., Elk Grove Village, Illinois, U.S.A.
‖ Metric conversion of data from manufacturer.
¶ Standard manufacturing widths and tolerances supplied by manufacturer.

of small burs or stones to enlarge the furcation entrance with the subsequent use of curettes for planing should be investigated.

The clinical significance of the differences in furcation entrance diameter size between the three maxillary and two mandibular molar furcations is not immediately apparent. A factor such as furcation entrance diameter cannot be considered alone in relation to the treatment and prognosis of teeth with periodontal breakdown in the furcation, and must be weighed with other factors such as access, root divergence, occluso-apical level of the furcation and remaining osseous support. It is likely however, that a smaller furcation diameter carries a poorer prognostic indication because of difficulty of instrumentation when all other factors are constant.

The lack of correlation between furcation entrance diameter and mesiodistal width at the cementoenamel junction in the first molar teeth examined indicates that large teeth do not necessarily have large furcation entrance diameters.

CONCLUSIONS

Very low correlation was found between the mesiodistal width of first molar teeth and the diameter of their furcation entrances.

In 58% of furcation entrances the diameter was less than the width of commonly used curettes, which means that such instruments are unlikely to clean the furcation entrance area in a clinical situation.

SUMMARY

The furcation entrance diameter of first permanent molar teeth has been investigated in a sample of 114 maxillary and 103 mandibular teeth, and found to be smaller than the blade face width of commonly used periodontal curettes in 58% of the furcations examined. It is suggested that because of this size disparity curettes when used alone may not be suitable for root preparation in this area as part of periodontal therapy. Alternative methods of instrumentation require clinical appraisal before recommendation.

The buccal furcation entrance diameters of the maxillary first molar teeth examined tended to be smaller than either the mesiopalatal or distopalatal. Similarly the buccal entrance diameter in the mandibular first molar

teeth examined tended to be smaller than the lingual.

The mesiodistal widths at the cementoenamel junction of both maxillary and mandibular first molar teeth were found to have very low correlation with their furcation entrance diameters. Large teeth therefore do not necessarily have large furcation entrance diameters.

REFERENCES

1. Glickman, I.: Bifurcation involvement in periodontal disease. *J Am Dent Assoc* **40:** 528, 1950.

2. Everett, F. G.: Bifurcation involvement. *Oregon Dent J* **28:** 2, 1959.

3. Schluger, S., Yuodelis, R. A., and Page, R. C.: *Periodontal Disease: Basic Phenomena, Clinical Management, and Occlusal and Restorative Interrelationships,* ed 1, pp 545–548, Philadelphia, Lea & Febiger, 1977.

4. Pritchard, J. F.: *Advanced Periodontal Disease/Surgical and Prosthetic Management,* ed 2, pp 263–273, Philadelphia, W. B. Saunders Company, 1972.

5. Saxe, S. R., and Carman, D. K.: Removal or retention of molar teeth: The problem of the furcation. *Dent Clin North Am* **13:** 783, 1969.

6. Hamp, S-E., Nyman, S., and Lindhe, J.: Periodontal treatment of multirooted teeth. Results after 5 years. *J Clin Periodont* **2:** 126, 1975.

7. Ramfjord, S. P.: Present status of the modified Widman Flap procedure. *J Periodontol* **48:** 558, 1977.

8. Waerhaug, J.: A method for evaluation of periodontal problems on extracted teeth. *J Clin Periodont* **2:** 160, 1975.

9. Barnes, J. E., and Schaffer, E. M.: Subgingival root planing: A comparison using files, hoes and curettes. *J Periodontol* **31:** 300, 1960.

10. Björn, H., and Lindhe, J.: The influence of periodontal instruments on the tooth surface. *Odontol Revy* **13:** 355, 1962.

11. Green, E., and Ramfjord, S. P.: Tooth roughness after subgingival root planing. *J Periodontol* **37:** 396, 1966.

12. Kerry, G. J.: Roughness of root surfaces after use of ultrasonic instruments and hand curettes. *J Periodontol* **38:** 340, 1967.

13. Jones, S. J., Lozdan, J., and Boyde, A.: Tooth surfaces treated "in situ" with periodontal instruments. *Br Dent J* **132:** 57, 1972.

14. Meyer, K., and Lie, T.: Root surface roughness in response to periodontal instrumentation studied by combined use of microroughness measurements and scanning electron microscopy. *J Clin Periodont* **4:** 71, 1977.

15. Pagano, J. L.: *Anatomia Dentaria,* ed 1, p 134, Buenos Aires, Editorial Mundi S. A. (1965).

16. Black, G. V.: *Descriptive Anatomy of the Human Teeth,* ed, 4, p 16–17, The S. S. White Dental Manufacturing Co., 1902.

17. Wheeler, R. C.: A *Textbook of Dental Anatomy and Physiology,* ed 4, p 229 and 259. Philadeliphia, W. B. Saunders Company, 1965.

18. Dahlberg, A. A.: Relationship of tooth size to cusp number and groove conformation of occlusal surface patterns of lower molar teeth. *J Dent Res* **40:** 34, 1961.

19. Stahl, S. S.: Repair potential of the soft tissue—root interface. *J Periodontol* **48:** 545, 1977.

20. Hatfield, C. G., and Baumhammers, A.: Cytotoxic effects of periodontally involved surfaces of human teeth. *Arch Oral Biol* **16:** 465, 1971.

21. Aleo, J. J., DeRenzis, F. A., and Farber, P. A.: *In vitro* attachment of human gingival fibroblasts to root surfaces. *J Periodontol* **46:** 639, 1975.

Announcements

POSTGRADUATE DENTAL PROGRAM, ALBERT EINSTEIN COLLEGE OF MEDICINE

The following courses are available during the academic year 1978–1979

TEMPOROMANDIBULAR JOINT DISORDERS DPD 86, John R. Varoscak, D.D.S., Friday, March 23, 1979; $70.

PERIODONTICS DPD 94, NINETEENTH ANNIVERSARY ALUMNI LECTURE, THE DR. ZACHARY DEMBO MEMORIAL LECTURE (Methods of Treatment of Periodontal Pockets) SIGURD P. RAMFJORD, D.D.S., Ph.D., Wednesday, April 25, 1979; $70.

RECONSTRUCTIVE PERIODONTAL SURGERY DPD 102, MORRIS P. RUBEN, D.D.S., Wednesday, May 16, 1979; $70.

For further information and application, write to: Dr. Irving Yudkoff, Director, Postgraduate Dental Program, Albert Einstein College of Medicine, 1165 Morris Park Avenue, Bronx, New York 10461.

TEMPLE UNIVERSITY SCHOOL OF DENTISTRY

Temple University School of Dentistry announces the following continuing education courses:

TITLE: Seminar & Review of Advanced Periodontal Surgery & Prognosis

DATE: February 7, 1979

FACULTY: IRVING ABRAMS D.D.S., Associate Professor and Chairman, Director of Surgical Clinics

The purpose of this course is to provide an advanced reprise and evaluation of periodontal surgery in depth, concentrating on comparative surgical indications and comparative techniques. Discussions of periodontal prognosis and prosthesis as it relates to advanced treatment will be included also.

We believe that attendance at a previous course in periodontal surgery is advisable as background for the advanced nature of this course.

Continental breakfast and luncheon are included.

TITLE: Clinical Periodontal Surgery

DATES: May 8, 9, 10, 11, 1979

FACULTY: D. LITWACK, I. ABRAMS AND STAFF, Department of Periodontology, Temple University

This singular course will describe the many new advances in periodontal surgery as well as study all surgical procedures now in practice. Lectures and direct rotating patient observation on a two-to-one basis will be the teaching modalities employed. Clinical surgery will be in session each morning.

Attention will also be given to instruments used and their care, a lab in sutures and suturing techniques, office emergencies and other adjunctive information necessary for successful periodontal surgery.

For further information contact: Mrs. Margaret Schmidt, Program Coordinator, Continuing Education Department, Temple University School of Dentistry, 3223 N. Broad St., Philadelphia, Pa 19140.