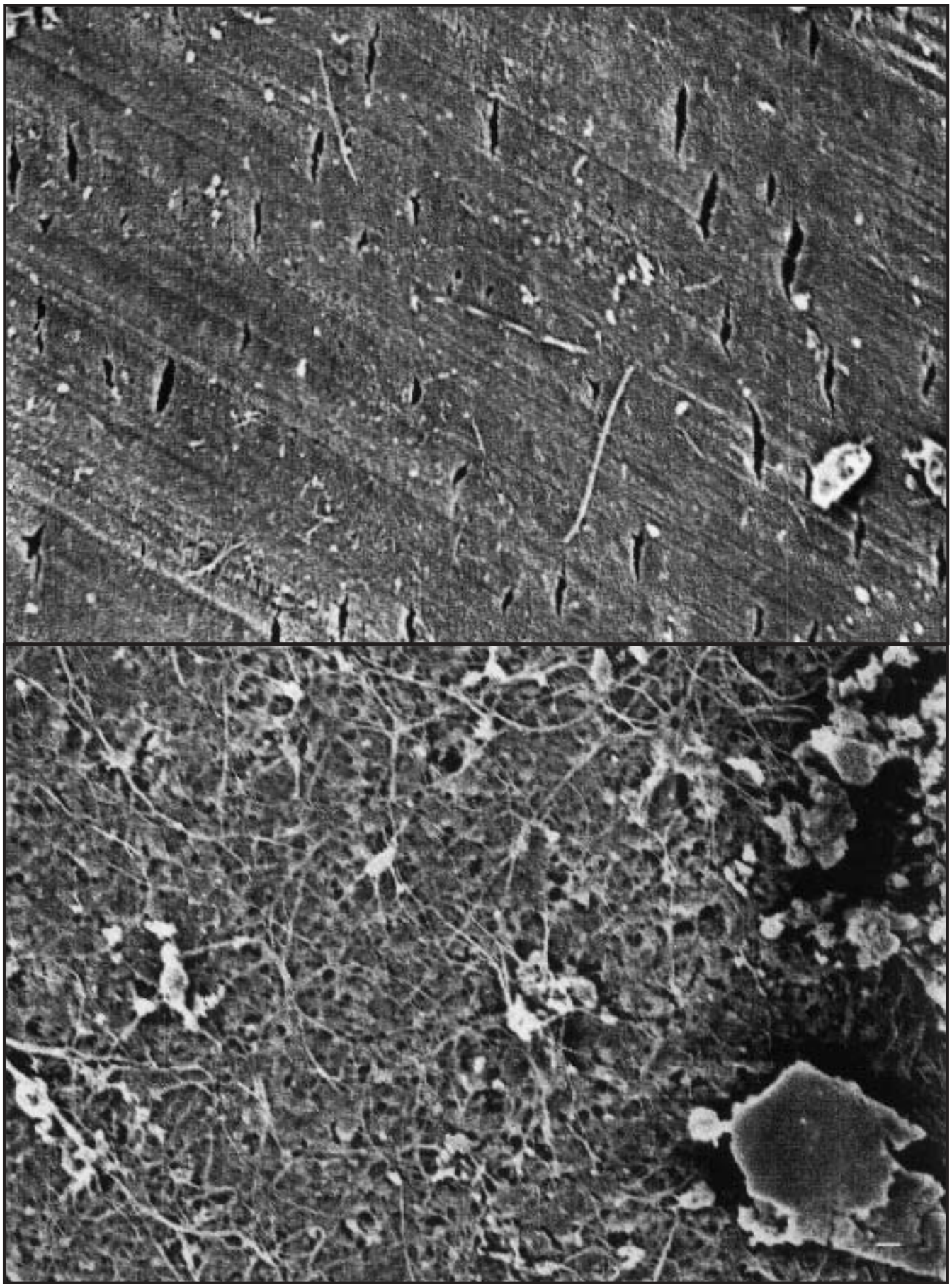

Comparison of the Effectiveness of Scaling and Root Planing In Vivo Using Hand vs Rotary Instruments

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The purpose of the present investigation was to compare the effectiveness of a scaling bur and conventional Gracey curettes in vivo. Ten teeth scheduled for extraction were scaled and root planed thoroughly before extraction. The instrumented areas were observed using SEM. Scaling with a No. 12 fluted carbide bur was more effective in removing debris and plaque than were conventional Gracey curettes. Because of the aggressive nature of the process, a certain learning curve is necessary to get accustomed to bur scaling; otherwise, dentinal hypersensitivity and patient discomfort may be increased. (Int J Periodontics Restorative Dent 2004;24:370–377.)

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Periodontal therapy can be broadly classified as surgical and nonsurgical. Nonsurgical therapy has aimed at the removal of dental plaque mechanically and/or chemically. The effective mechanical removal of plaque and calculus from diseased root surfaces using various types of instruments has been tested.[1–4] Several authors have examined multiple parameters, both in vitro and in vivo, in an attempt to identify the best instrument to treat diseased root surfaces.

An in vivo study on 20 patients evaluated the residual bacteria after instrumentation with hand instruments versus rotary diamond burs and found no significant differences; both methods were judged equally effective.[5] In the 1990s, the effectiveness of Gracey curettes was compared with that of several rotary instruments, including carbide finishing burs.[6] That scanning electron microscopic (SEM) analysis of the resulting root surfaces stated the superiority of Gracey curettes over rotary instruments. Other authors have advocated the use of rotary instruments in otherwise inaccessible

Fig 1 *No. 12 fluted carbide bur.*

root areas.[7,8] Investigators have also tested carbide burs versus diamond burs. Carbide burs appear superior to diamond burs in terms of their planing abilities and close to results obtained with hand instrumentation.[7,8]

Uncertainty still prevails as to the ideal amount of root substance to be removed to ensure a "biologically acceptable" root surface. Classic publications on the necessity of complete removal of endotoxins and "contaminated" cementum[9,10] have been challenged by the observation of weak lipopolysaccharide adherence to cementum.[11–13] Studies have shown no difference in results using a more conservative approach to root instrumentation.[12–14] Other authors[15,16] have documented the presence of bacteria deep in the dentinal tubules, hence the term bacterial "reservoirs" and the hypothesis for recurrence of disease.

The influence of surface roughness after instrumentation on postoperative healing has been extensively studied. Surface roughness by itself seems not to be of any biologic significance.[17,18] Ruben et al[19] state that a "roughened, yet debrided, surface is needed for new attachment." The same authors, following Stahl,[20] highlight how the presence of a mineralized, microirregular cementum layer is a primary factor for cementogenesis in the healing process. A rough residual surface could obviously constitute a potential danger if colonized by periodontal pathogens.[21]

A series of studies evaluated the influence of the presence/absence of a smear layer on treated root surfaces during wound healing.[22–25] According to them, this amorphous irregular surface layer should be removed to set the stage for new connective tissue attachment. Rotary instruments have the potential to increase the residual amount of smear layer after instrumentation compared to hand instruments. Potential iatrogenic damage after root instrumentation has been discussed.[26,27]

The aim of the present investigation was to compare the aspect of the root surface left after scaling and root planing with a No. 12 fluted carbide bur versus conventional Gracey curettes. The root surfaces were examined using SEM.

Method and materials

Five patients (three men and two women; mean age 49.2 ± 8.5 years) with severe chronic periodontitis were selected from a private practice setting. Selection criteria included pocket depth greater than 7 mm and mobility greater than or equal to 3 (Miller classification); patients were free of systemic diseases and had been referred to the practice for periodontal treatment.

Ten hopeless teeth were selected for extraction. Each tooth was divided into two working sides (mesial and distal); one side was scaled with a Gracey curette (Nos. 11 and 12 for mesial sides, Nos. 13 and 14 for distal sides), and the other side was instrumented using a carbide finishing bur (Brasseler 7104014) (Fig 1). Scaling was completed when the operator achieved a smooth, glass-like surface.

The teeth were then extracted and fixed in a buffered formaldehyde/glutaraldehyde solution for 24 hours to preserve the biofilm coating. After dehydration in a graded series of ethanol, the samples were air dried, mounted, sputter coated with gold, and examined in a Jeol 6400 SEM operating at 15 Kv. The two halves of each tooth were examined under SEM observation at low (200×) and high magnifications (1,700×). The two most representative views of each half were taken (total of four areas per tooth). A magnification of 200× was selected for statistical comparison. A scale ranging from 1 to 3 was used to evaluate the degree of cleanliness:

- Grade 1: absence of visible debris and plaque, with good exposure of the dentinal tubules and no evidence of remaining smear layer (Fig 2)

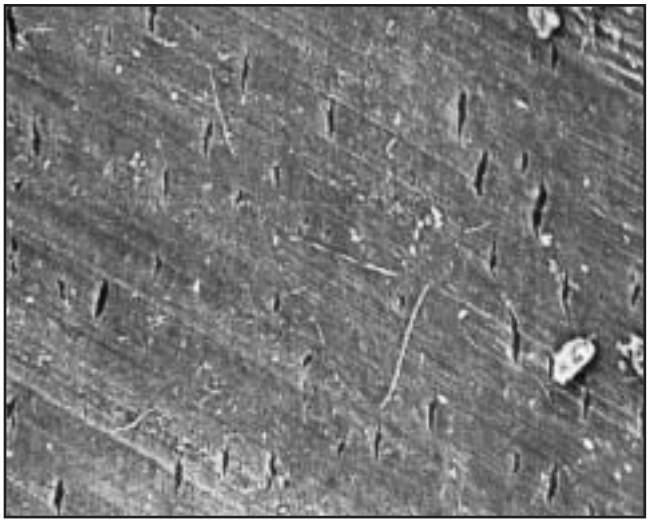

Fig 2 *Clean radicular surface and absence of visible debris and plaque, with good exposure of dentinal tubules and no evidence of remaining smear layer.*

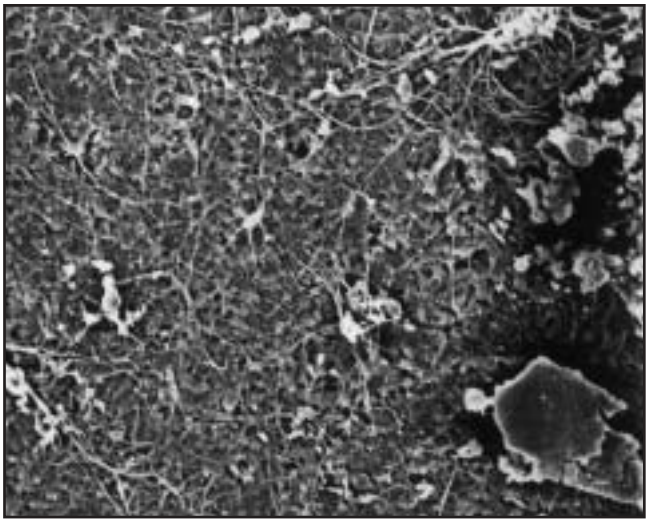

Fig 3 *Contaminated radicular surface, presence of visible debris, and plaque all over the scanned area; tubuli are not visible, and smear layer is present on entire surface.*

- Grade 2: no visible debris, no exposure of the dentinal tubules, and presence of a smear layer
- Grade 3: presence of visible debris and plaque all over the scanned area, no visible tubuli, and smear layer present on the entire surface (Fig 3)

Three examiners evaluated the scanned areas independently, and the results were subjected to statistical analysis.

Results

One of the 10 samples was discarded because of an inaccuracy in the processing. A total of 36 surfaces were examined and rated by the examiners.

Intra- and interrater reliability

Two areas on the surface of each tooth were chosen to be evaluated by each rater. To evaluate the consistency of these paired observations, intrarater reliability for each rater was determined by the kappa statistic. For rater 1, kappa for his double set of evaluations was .531 ($P = .002$). Rater 1 was perfectly consistent in 13 of the 18 pairs of observations. For rater 2, kappa for his double set of evaluations was .326 ($P = .053$). Rater 2 was perfectly consistent in 11 of the 18 pairs of observations. Rater 3 was the most consistent, with $\kappa = .723$ ($P < .001$). Of 18 observations, rater 3 was perfectly consistent in 15 pairs.

To assess interrater reliability, pairwise evaluation was undertaken for each pair of raters. For the first scoring, the consistency between raters 1 and 2 was the lowest, with $\kappa = .443$; $\kappa = .720$ for raters 1 and 3, and $\kappa = .708$ for raters 2 and 3. For the second rating, the consistency between raters 1 and 2 was again the lowest, with $\kappa = .312$; $\kappa = .455$ for raters 1 and 3, and $\kappa = .373$ for raters 2 and 3.

To obtain an overall measure of agreement, Cronbach's alpha was found for each set of observations. For the first rating, Cronbach's overall alpha for agreement was .91; for the second scoring, it was .84. In all cases, there was statistically significant agreement among the raters.

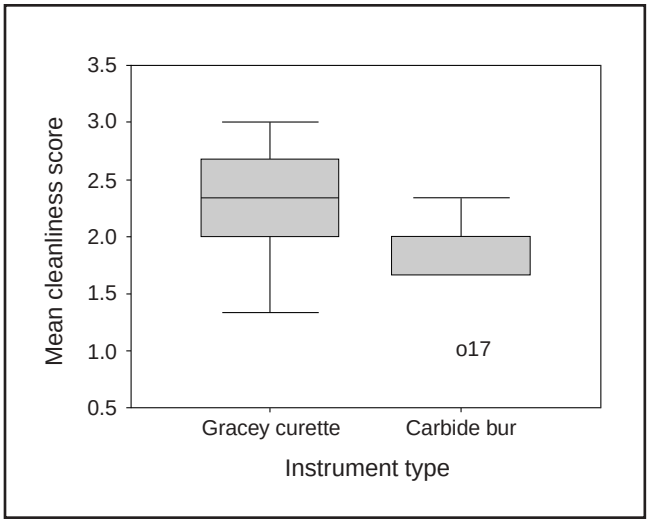

Fig 4 *Mean surface cleanliness scores for Gracey curettes and carbide bur (n = 9 per group); o = outlier.*

Comparison of Gracey curette and carbide bur

It was decided that the best measure of the cleanliness produced on each surface would be a mean of the ratings recorded for each surface. Hence, the mean of all six ratings for each observation was calculated, and these means were used to compare the surface cleanliness produced by the Gracey curette and carbide bur, respectively. The mean surface cleanliness produced by the Gracey curette was 2.28 (standard deviation 0.50, median 2.33, range 1.33 to 3.00), whereas the mean surface cleanliness produced by the carbide bur was 1.72 (standard deviation 0.49, median 1.67, range 1.00 to 2.33) (Fig 4). The two groups were compared using the Mann-Whitney test; the Gracey curette produced a mean surface cleanliness rating higher than that of the carbide bur ($P = .026$). Similar results were also obtained from an independent sample *t* test ($P = .029$). Considering that a grade of 3 is the worst and a grade of 1 is the best, the No. 12 fluted carbide bur was superior to the Gracey curette.

Discussion

At first sight, there appeared to be no significant differences in the level of cleanliness achieved by hand versus rotary instrumentation. No major bacterial deposits were noted in either treated surface, in agreement with other authors.[5] In the analysis of the available literature, the curette seems to be the best instrument for root planing.[5–8]

In our study, some residual bacterial deposits could be identified in small lesions (10 μm) on the roots, more often with surfaces instrumented by the Gracey curettes. The presence of small, bacteria-contaminated resorption lacunae in root-planed areas has been documented,[5] and their existence, confirmed by the present study, may prevent complete elimination of periodontal pathogens from treated surfaces. Based on our observations, more "aggressive" root instrumentation by means of rotary instruments seemed to be more effective in eliminating these lesions.

There seems to be agreement on the need for adding ultrasonic and rotary instruments to the more conventional forms of therapy in accessing difficult areas such as root concavities, deep narrow infraosseous defects, and furcations.[8,9,28] The use of a bur combined with hand instruments to grant thorough cleaning of contaminated areas has been studied; an improved level of root cleanliness was reported after

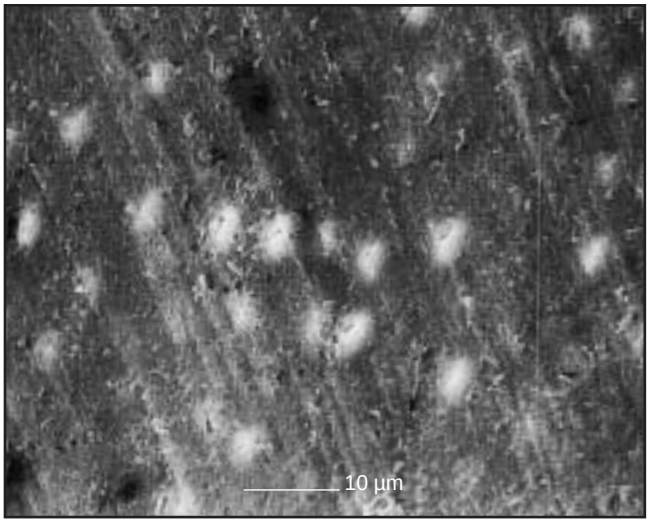

Fig 5 *Radicular surface scaled with No. 12 fluted carbide finishing bur.*

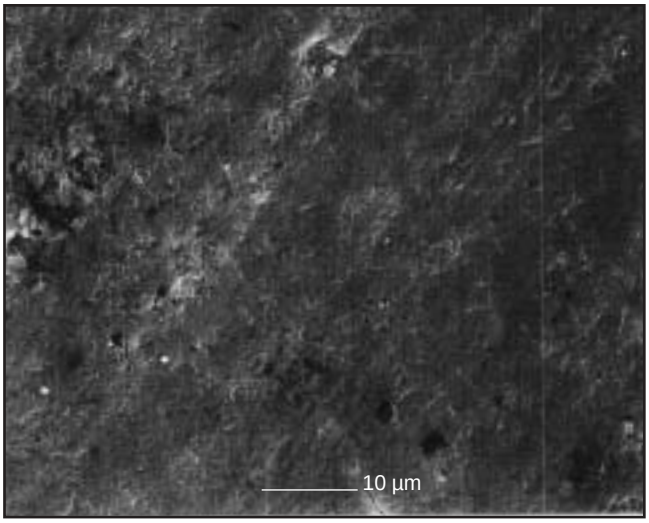

Fig 6 *Radicular surface scaled with conventional Gracey curette.*

combining hand instruments, used for 3 minutes, with 1 minute of instrumentation with a 15-µm diamond bur and an additional minute using an air-abrasive system.[29]

Other authors[26,27,30] have issued warnings on the potential damage caused by excessively aggressive root debridement. An in vitro investigation found much greater root substance losses after instrumentation with diamond burs (15 µm). Those findings are in accordance with the conclusions of others.[30] Zappa et al[27] measured a wide range of variability in root substance removal, such as number of stokes with a Gracey curette (up to 40) and amount of force applied. The values they report are even superior to those measured after instrumentation with a 15-µm diamond bur (343.3 µm for Gracey curette vs a maximum of 185.7 µm for diamond bur).[26] They observed a variation of up to 15 times between operators in the amount of force used during hand instrumentation. This could lead to pulp approximation during root planing.

Based on the previous reports and our SEM analysis, the time allowed for instrumentation and the force applied represent determinant factors in the final results. Time and force of instrumentation seemed to be more important than the instrument used in creating root damage. Because of the aggressive nature of the process, a certain learning curve is necessary to get accustomed to bur scaling; otherwise, a considerable increase in dentinal hypersensitivity and patient discomfort may occur. The higher cutting ability of the No. 12 fluted carbide finishing bur requires a reduced time of instrumentation with a light touch to achieve the best results.

The mechanical instrumentation resulted in a more aggressive removal of tooth substance, with a slightly irregular surface. The roughness of the surface after instrumentation does not seem to impair postoperative healing,[31] and, according to Stahl,[20] a microirregular surface is conducive to the formation of new cementum. Roughness of the surface might constitute a serious problem in the presence of bacterial plaque contaminants deriving from inadequate plaque control or inefficient debridement of the root surfaces during the active phase of treatment.[21,31]

The choice of a carbide finishing bur for scaling and root planing originated with several previous works. Meyer and Lie[32] describe the surface obtained by the use of a low-speed carbide scaling bur (Roto-Pro, Ellman) as slightly rougher than that obtained with hand instruments but

less "smeared." They report that "a smeared surface structure was more frequently seen following the use of hand curette than following Roto-Pro instrumentation." The same type of instrument was reported[33] to be equal to hand scaling in a clinical longitudinal study on 50 periodontal patients. More recently, an SEM comparison of the Gracey curette to several rotary instruments found a low-speed carbide instrument (Desmoclean, Hager & Werken) to achieve results closest to those achieved by hand scaling.[6]

The tested hypothesis was that a high-speed No. 12 fluted carbide finishing bur used with a light touch for a short period could grant equal or better results than the more commonly used Gracey curettes. In the design to assess the cleanliness of the treated root surfaces, we evaluated three main features of the microscopically observed areas: *(1)* presence/absence of debris, *(2)* presence/absence of plaque, and *(3)* presence/absence of smear layer. The elimination of bacterial contaminants from the diseased root surfaces is the main goal of periodontal therapy. Polson et al,[23] and more recently Blomlof et al,[34] define the smear layer as an amorphous, irregular layer (2 to 15 μm) of organic/inorganic nonbiocompatible material.

The present study supported the initial hypothesis, showing statistically significantly superior results for the high-speed No. 12 fluted carbide finishing bur (Fig 5) over the Gracey curettes (Fig 6). Presumably, the difference in our results compared to other studies may be due to the use of vigorous irrigation on a high-speed carbide finishing bur with highly effective cutting action. Further in vivo and histologic investigations are needed to fully evaluate the real value of this new approach to everyday scaling and root planing.

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