Calculus removal from multirooted teeth with and without surgical access

(I). Efficacy on external and furcation surfaces in relation to probing depth


Abstract. The purpose of this study was to evaluate the efficacy of the calculus removal from multirooted teeth after closed root planing, open root planing and use of a rotary diamond for the furcation area. The effect of pocket depth on the effectiveness of calculus removal was also examined. 30 first and second lower molars scheduled for extraction, with a calculus index >2 and a degree II or III furcation involvement, were divided into 3 groups: 10 molars were scaled and root planed using a closed approach; 10 molars were scaled and root planed using an open approach; 10 molars were scaled and root planed with an open approach and rotary diamond was used for removal of deposits in the furcation area. After extraction, the teeth were assessed in a stereomicroscope and the % of residual calculus was calculated on external and furcation surfaces. The % of residual calculus on the external surfaces was significantly higher after closed than open root planing (p = 0.002). Pocket depth affected the effectiveness of scaling and root planing, with more residual calculus observed for depths ≥7 mm for both groups. Differences between the 3 groups in the % of residual calculus on furcation surfaces were statistically significant (p < 0.0001 and p < 0.0005). The most effective method was the combination of open root planing and rotary diamond. More calculus was observed in all groups for pocket depths ≥7 mm but the difference was significant only in the closed group (p = 0.006). Closed root planing left more surfaces with residual calculus in the flute (70%) and the roof (60%) of the furcation than open root planing (35% and 50%). However, the most effective method was the use of rotary diamond, particularly for the flute area where residual calculus was detected on only 5% of the surfaces.

Key words: calculus removal; multirooted teeth; surgery versus non-surgery.

Accepted for publication 21 December 1991

It is generally accepted that scaling and root planing is an important and effective part of periodontal treatment (Hughes & Caffesse 1978, Badersten et al. 1984). The therapeutic benefit of these procedures results from removal of subgingival plaque and calculus and the mechanical disturbance of subgingival plaque (Rosenberg et al. 1981, Cerkek et al. 1983): Furthermore, there are indications that the removal of calculus and superficial layer of cementum minimizes the effect of bacterial endotoxins that have penetrated the root surface (Jones & O'Leary 1978).

Removal of subgingival calculus is considered essential for a successful periodontal treatment, maintenance of periodontal health and regeneration of periodontal tissues. Although apical migration of plaque is the primary reason for periodontal destruction, calculus, which retains plaque and its products, creates the conditions for further destruction and adds to the chronicity of the lesion (Mandel & Gafar 1986).

Numerous studies, however, have shown that even with the best efforts of clinicians, considerable amounts of subgingival calculus still remain on external root surfaces with moderate or advanced pockets and that more residual calculus is found with increasing pocket depths (Waerhaug 1978, Stambaugh et al. 1981, Rabbani et al. 1981). Although direct access to root surfaces significantly increases the ability to remove calculus, total removal is not always accomplished (Caffesse et al. 1986, Buchanan & Robertson 1987).

Multirooted teeth present special anatomical characteristics that make access for adequate instrumentation in the furcation area difficult, if not impossible (Bower 1979a, Bower 1979b). It has been proposed that the reason for the more frequent loss of multirooted teeth is the inability of the clinician to adequately instrument the furcation (Goldman et al. 1986). Reports indicate that total calculus removal in furcations...
is limited (Matia et al. 1986, Wyllam et al. 1986, Fleischer et al. 1989). Furthermore, it is suggested that surgical access to the furcation does not improve significantly the effectiveness of scaling and root planing (Wyllam et al. 1986). For these reasons, alternative methods such as the use of diamond and stones for instrumentation of the furcation have been proposed (Bower 1979a, Fleischer et al. 1989).

The purpose of this study was to evaluate the efficacy of calculus removal on molar teeth using a closed approach, an open approach and rotary diamond instrumentation for the furcation areas. The effect of pocket depth on the efficiency of scaling and root planing was also evaluated.

Material and Methods

30, first and second lower molars scheduled for extraction, were selected for this study from 23 patients, 38 to 67 years old, with moderate to advanced adult periodontitis. The criteria for selection of these molars were (1) a degree II or III furcation involvement (Lindhe & Nyman 1975), (2) horizontal and vertical probing depth ≥ 5 mm in the furcation area, (3) calculus index ≥ 2 according to the criteria of the PDI (Ramfjord 1967), (4) no previous periodontal treatment, (5) absence of extensive restorations extending beyond the CEJ. Inclusion of teeth in the study continued until 15 with narrow furcations (< 2.4 mm) and 15 with wide furcations (≥ 2.4 mm) had been obtained. Each of these groups was divided equally and randomly between the three treatment conditions described below. All patients were given detailed explanations about the nature of the procedure and were asked to sign an informed consent form.

Pocket depths were measured using a periodontal probe (Goldman-Fox, Hu-Friedy). Measurements were recorded on 6 locations on the tooth (buccal, lingual, and mesial and distal proximal contact points) and were rounded to the nearest millimeter. The calculus index and furcation grade were also recorded.

Following local anesthesia, an inverted cone bur on a high speed handpiece was used to mark the level of the free gingival margin buccally and lingually to allow differentiation between supra- and subgingival calculus. These marks were extended as much as possible on the mesial and distal root surfaces and connected after tooth extraction.

In the 1st treatment group (closed), 10 molars were scaled and root planed using a closed approach. The external and furcation surfaces, including the roots, were scaled without time constraints until a smooth, hard surface was achieved. A No 17/23 explorer (Hu-Friedy) was used to check the smoothness of each surface. All root surfaces were treated using four rotational packs of instruments that consisted of Gracey 11/12 and 13/14, Columbia 4R/4L and McCall 17/18 curettes (Hu-Friedy).

In the 2nd group (open), 10 molars were scaled and root planed using an open approach. Full-thickness flaps were elevated extending at least to the two adjacent teeth and granulation tissue was removed with Kirkland 13K/13KL surgical curettes. All external and furcation surfaces were instrumented using the same packs of instruments as in the closed group.

In the 3rd group (diamond), 10 molars were scaled and root planed using an open approach as in the open group. In addition, a rotary diamond was used for removal of deposits in the furcation area. The diamond (W2 Viking Hallward Foss and Co) was used on a low speed handpiece under constant saline irrigation.

Scaling and root planing was judged to be complete when the no. 17/23 explorer indicated a smooth, hard surface. The teeth were then extracted and flaps were sutured. The teeth were immediately rinsed with running water and brushed lightly with a soft toothbrush to remove blood and loosely adhering debris. The width of the furcation entrance was then measured both buccally and linguually 2 mm apical from the bifurcation. The teeth were then placed in 10% buffered formalin solution. Before scoring they were stained for 2 min in 1% solution of methylene blue to disclose the connective tissue attachment.

The teeth were viewed under a stereomicroscope and evaluated for residual calculus using a method similar to that described by Rabbani et al. (1981). The extent of external tooth surfaces (buccal, lingual, mesial and distal) was defined apico-coronally by the stained connective tissue and the gingival notch and axially by fine pencil lines placed on the line angles. The furcal line angles of the roots were also marked to demarcate the external surfaces from the furcation aspects of the roots. This prevented a root surface from being scored more than once. The calculus present was assessed using a 10 x 10 ocular grid subdivided into 100 squares. The magnification of the stereomicroscope was adjusted so that the grid covered as much as possible of the examined surface. The area of root surface exposed to the pocket was measured by counting the number of squares from the gingival notch to the stained connective tissue. Only surface areas covering more than one-half of a square were counted as a square unit. The number of squares with calculus was counted, including squares occupied only by a very small piece or fragment, and the percentage of the pocket surface occupied by calculus was then calculated. Measurements were repeated three times on different days and the average was taken. Next, the roof and the area of the flute coronally to the root separation were recorded as positive or negative for the presence of calculus. The furcation areas were then evaluated after sectioning of the teeth with the vertical cut method suggested by Weine (1982). A tapered fissure carbide bur in an ultraspeed handpiece was used for this procedure. As the bur approached the furcation surface, care was exercised not to penetrate the root surface. When the bur cut had sufficiently weakened the tooth, the roots were separated by gentle finger pressure. The furcation aspect of the roots was then assessed for the percentage of residual calculus with the grid as described for the external surfaces.

The % of residual calculus was compared between groups and in relation to pocket depth for external and furcation surfaces utilizing the Kruskal-Wallis and Mann-Whitney tests. The % of surfaces with any residual calculus was compared between groups by the chi-squared test. In order to relate pocket depth to the amount of calculus remaining on surfaces, the average of mesiobuccal and distobuccal and the average of distolingual and distolingual pocket depths were calculated and used for the comparison. The average between the buc-

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
<th>4-6 mm</th>
<th>≥ 7 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>closed</td>
<td>39*</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>open</td>
<td>80</td>
<td>39</td>
<td>41</td>
</tr>
</tbody>
</table>

* In the closed group, one surface had a probing depth of 3 mm.
cal and lingual depths was used for the comparison of the furcation surfaces. In most analyses, the statistical testing requires the assumption of independence between surfaces on the same tooth. This was justified by calculating the interclass correlation coefficient (Kish 1965). This took the values 0.22 for residual calculus on external surfaces and 0.36 for furcation surfaces, which seem sufficiently low to make it unnecessary to attempt any more complicated analysis.

A total of 120 external and 60 furcation surfaces were evaluated.

Initial mean values of the calculus index were 2.5 in the closed group, 2.7 in the open group and 2.6 in the diamond group, with standard deviation 0.5 with each group. Tables 1, 2 show the frequency distribution of the external and furcation surfaces grouped by probing depth as well as degree of involvement for the furcation area.

### Results

Table 3, presents the frequency distribution of the percentage of residual calculus on external surfaces. There were statistically significant differences between the closed and open groups, with direct visualization of root surfaces significantly increasing the ability to remove calculus ($p = 0.002$, Mann-Whitney test).

Table 4 shows the distribution of the % of residual calculus on external surfaces in relation to probing depth within groups. The statistical analysis showed significant differences in each group in relation to pocket depth. The Mann Whitney test comparing open and closed surfaces showed a highly significant difference for probing depths 4-6 mm ($p = 0.0005$) and $\geq 7$ mm ($p = 0.008$). These results indicate that the ability to remove calculus decreases with increasing probing depths but the result is significantly better with surgical access.

Fig. 1 shows the frequency distribution of furcation surfaces according to degree of involvement for the 3 groups analyzed. The median percentage of residual calculus was significantly higher in the closed group (17.5%) than the open group (7.5%). However, the smallest value (2%) was obtained in the group treated with the rotary diamond. The Kruskal-Wallis test revealed highly significant differences between the three groups ($p < 0.0001$). Additionally, in the diamond group 45% of surfaces were calculus free while the rest had low percentages of residual calculus (1-10%). In the open group, low percentages of residual calculus (1-10%) were observed in most of the surfaces (60%). However, only 15% of surfaces were calculus free. In the closed group, high percentages of residual calculus (10-20% and >20%) were detected on the most surfaces, 10-20% residual calculus on 45% of surfaces and >20% residual calculus on 35% of surfaces.

Table 5 relates the frequency distribution of percentage of residual calculus on furcation surfaces to pocket depth. The median percentage of residual calculus for the closed and open group is higher for furcation surfaces with pocket depths $\geq 7$ mm (21% and 8%, respectively) than for surfaces with pocket depths 4-6 mm (10% and 7% respectively). Complete removal of calculus for pocket depths $\geq 7$ mm was not possible with closed and open root planing but was feasible with the use of rotary diamond in 50% of the surfaces. Although surfaces with deeper pockets had more residual calculus in both the closed and open root planing groups, this difference was statistically significant only for the closed group ($p = 0.006$).
Fig. 1. Frequency distribution of furcation surfaces according to percent of residual calculus (0%, 1–10%, 11–20%, >20%) for the three experimental groups.

Fig. 2 shows the % of roofs and flutes of root separation with residual calculus in the 3 experimental groups. The most effective method, especially in the area of the flute, was the combination of open root planing and rotary diamond instrumentation. Closed scaling and root planing was the least effective in the roof and flute area with 60% and 70% of surfaces exhibiting residual calculus. Differences between groups in the flute area were highly significant (χ²=18.2, p<0.0001).

Discussion

Previous clinical studies evaluating the effectiveness of calculus removal from external surfaces have demonstrated an increased ability after flap reflection, particularly for areas with moderate or deep probing depths (Caffesse et al. 1986, Buchanan & Robertson 1987, Fleischer et al. 1989). The results of the present study support these findings. In both the open and closed groups the % of residual calculus in deep pockets was significantly higher than in shallow ones. This is in accordance with previous reports indicating that the percentage of residual calculus on external surfaces increases as deeper probing depths are encountered (Caffesse et al. 1986, Fleischer et al. 1989, Brayer et al. 1989). Open debridement was particularly effective for pockets up to 6 mm. However, even for external surfaces total removal of calculus was rarely accomplished, particularly when a closed approach was used. Reports of recent studies support these results. Kepic et al. (1990) showed that instrumentation of root surfaces, either using a closed approach and a second in combination with a flap, is not effective in removing all calculus from teeth with severe periodontitis. 12 of 14 teeth treated by ultrasonic, and 12 of 17 teeth treated by hand instruments, retained calculus. Sherman et al. (1990) also found that 57% of all surfaces had residual microscopic calculus after scaling and root planing.

It seems clear from these results that the methods for detection of residual calculus are inadequate. Currently, clinicians use a sharp explorer guided by the sense of touch to detect calculus. However, the majority of retained calculus after planing of the roots represents thin veneers (Kepic et al. 1990, Sherman et al. 1990). In addition, calculus is also located in cemental crevices and resorption lacunae. The tactile sensitivity of the operator is inadequate to detect such small differences particularly on surfaces with irregularities and difficult access. More sophisticated methods of detection need to be developed in order to overcome this problem.

The findings for furcation surfaces in this study indicate that open debridement is more effective than closed scaling and root planing. The most effective method, however, was the combination of open root planing and rotary diamond. Only 5% of surfaces from the closed and 15% from the open group were rendered calculus free. The inadequacy of calculus removal from furcation areas is supported by other studies. Matia et al. (1986) found that, although surgical access significantly decreases the mean percentage of residual calculus, only 7 surfaces out of a possible total of 60 were rendered completely calculus free in the open group. Wylam et al. (1986) found 5% of nonsurgically treated furcations and 11% of those surgically treated calculus-free. They suggested that surgical access provides limited advantage in furcations with class II or III involvement. Fleischer et al. (1989) also observed no statistically
cally significant differences between open and closed groups when experienced operators instrumented the furcation. However, calculus removal was better when surgery was used. They concluded that both surgical access and a more experienced operator significantly enhance calculus removal in molars with furcation invasion, but total calculus removal using conventional instrumentation is limited. Furthermore, they proposed alternative methods to gain access such as stones or burs.

The results of this study suggest that the rotary diamond is advantageous in removing calculus from furcation surfaces. Total reduction of calculus as well as the number of surfaces free of calculus was significantly better after use of the diamond. Reduction was also significant for the root and the flute of the furcation. This is in accordance with the findings of Duff et al. (1988).

Regarding the effect of probing depth of the furcation area in calculus removal, significant differences between moderate (5–6 mm) and deep pockets (≥7) were observed only in the closed group. It seems that, unlike the external surfaces after flap reflection, the depth of the furcation lesion does not influence the effectiveness of root planing.

In conclusion, within the limits of this study, total calculus removal from furcation surfaces using closed scaling and root planing was rare. Surgical access increased significantly the effectiveness of calculus removal but total removal was limited. The use of rotary diamond was the most effective method for calculus removal from the furcation area. However, a significant number of surfaces still exhibited small amounts of residual calculus.

Zusammenfassung

Zahnsteinentfernung an mehrwurzeligen Zähnen, mit oder ohne chirurgischem Zugang (1). Effektivität auf äußeren und Furkationsflächen in Relation zur Sonderungstiefe

Der Zweck dieser Studie war die Bewertung der Effektivität der Zahnsteinentfernung an mehrwurzeligen Zähnen nach geschlossener Wurzelglättung, offener Wurzelglättung und nach dem Gebrauch von rotierenden Diamanten im Furkationsbereich. Die Auswirkung der Taschentiefe auf die Effektivität der Zahnsteinentfernung wurde ebenso untersucht. 30 erste und zweite Unterkiefermolaren, die zur Extraktion vorgesehen waren, und einem Zahnsteinwert ≥2 sowie Furkationsbefall Grad II oder III hatten, wurden in 3 Gruppen eingeteilt: bei 10 Molaren wurde mittels geschlossenem Vorgehen eine Zahnsteinentfernung und Wurzelglättung durchgeführt. Bei 10 weiteren Molaren wurde mittels offenen Vorgehen eine Zahnsteinentfernung und Wurzelglättung durchgeführt, und bei 10 Molaren wurden mittels offenen Vorgehen sowie Anwendung von rotierenden Diamanten zur Belangentfernung im Furkationsbereich eine Zahnsteinentfernung und Wurzelglättung durchgeführt. Nach der Extraktion wurden die Zähne in einem Stereomikroskop beurteilt und der Prozentsatz an zurückgelassenem Zahnstein auf äußeren und Furkationsflächen wurde berechnet. Der Prozentsatz an zurückgelassenem Zahnstein auf äußeren Flächen war signifikant höher nach geschlossenem als nach offener Wurzelglättung (p=0,002). In beiden Gruppen beeinflusste die Taschentiefe die Effektivität der Zahnsteinentfernung und Wurzelglättung, mit dem Vorhandensein von mehr zurückgebliebenem Zahnstein in Tiefen ≥7 mm. Die Unterschiede zwischen den drei Gruppen bezüglich des Prozentsatzes an zurückgebliebenem Zahnstein im Furkationsbereich waren statistisch signifikant (p=0,0001 und p<0,0005). Die effektivste Methode war die Kombination von offener Wurzelglättung und rotierenden Diamanten. In allen Gruppen wurde bei Taschentiefen ≥7 mm mehr Zahnstein beobachtet, aber die Unterschiede waren nur in der “geschlossenen” Gruppe signifikant (p=0,006). Geschlossene Wurzelglättung hinterließ mehr Zahnstein im Bogen (70%) und im Dach (60%) der Furkation als offene Wurzelglättung (35% und 50%). Die effektivste Methode war jedoch der Gebrauch von rotierenden Diamanten, besonders im Bogenbereich, wo zurückgebliebener Zahnstein nur auf 5% der Flächen nachgewiesen wurde.

Résumé

Elémination du tarte sur les multiradiculées, avec et sans accès chirurgical (1). Efficacité sur les surfaces externes et sur celles de la furcation suivant la profondeur des poches au sondage

La présente étude se proposait d’évaluer l’efficacité de l’élimination du tarte sur les dents multiradiculées après surfaçage radiculaire fermé, surfaçage radiculaire à ciel ouvert et utilisation d’une pointe diamante dans la région de la furcation. L’influence de la profondeur des poches sur l’efficacité de l’élimination du tarte a aussi été examinée. L’étude portait sur 30 premières et 2ème molaires inférieures qui devaient être extraites; elles avaient un indice de tarte ≥2 et une attente de la furcation de degré II ou III. Elles ont été réparties en 3 groupes: 10 molaires ont subi un détartrage et un surfaçage radiculaire sans accès chirurgical (fermé = closed), 10 molaires ont subi détartrage et surfaçage radiculaire avec accès chirurgical (ouvert = open) et 10 molaires ont subi détartrage et surfaçage avec accès chirurgical et en utilisant une pointe diamante rotative pour l’élimination des dépots dans la région de la furcation (diamant = diamond). Après extraction, les dentons ont été examinés au stéréomicroscope et la proportion de tarte résiduel a été calculée sur les surfaces externes et sur celles de la furcation. La proportion de tarte résiduel sur les surfaces externes après surfaçage fermé était significativement plus élevée qu’après surfaçage ouvert (p<0,002). Le fournisseur des poches avaient une influence sur l’efficacité du détartrage-surface: on observait dans les 2 groupes plus de tarte résiduel pour les profondeurs ≥7 mm. Les différences entre les proportions de tarte résiduel au niveau des surfaces de la furcation dans les 3 groupes étaient statistiquement significatives (p<0,0001 et p<0,0005). La méthode la plus efficace était la combinaison du surfaçage ouvert avec l’emploi des pointes diamantées. Dans tous les groupes, on observait plus de tarte pour les profondeurs de poche de ≥7 mm, mais la différence n’était significative que dans le groupe fermé (p=0,006). Le nombre de surfaces où il restait du tarte après surfaçage radiculaire fermé dans le sillon de la furcation (70%) et sur la voûte de la furcation (60%) était plus élevé que l’après surfaçage ouvert (35% et 50%). Cependant, la méthode la plus efficace était l’emploi de pointes diamantées rotatives, particulièrement dans la zone du sillon de la furcation, où on n’observait de tarte résiduel que sur 5% des surfaces.

References


Address: Andreas Parashis
33 Sp. Merkouri Str.
Athens 116 34
Greece
This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.