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A Comperative Evaluation of 3 Different Polishing Methods on Tooth Surface Roughness

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Abstract

Objective: The objective of this study is to evaluate the effect of three different polishing procedures on surface roughness occuring after sonic scaling.

Material and Methods: Dental calculus on 60 extracted teeth stored in distilled water was removed using a sonic device. Surface roughness was measured by profilometer and then samples were divided into 3 groups. Polishing was applied to the samples in first group by rotary rubber cup and prophylaxis paste, to the samples in second group by air-flow, and to the samples in third group by stainbuster bur. The surface roughness measurements taken were recorded by profilometer at every stage.

Results: A significant reduction was determined in surface roughness in the groups used prophylaxis paste and stainbuster bur and the reduction was similar between these groups. In the group used air-flow, a significant reduction could not be detected in the surface roughness.

Conclusion: Stainbuster bur may be an alternative method for traditional polishing material, because of providing the ease of application such as air-polishing techniques and providing smooth surfaces like prophylaxis paste.

Clinical Relevance: Stainbuster bur may be an alternative method for traditional polishing material, because of providing the ease of application such as air-polishing techniques and providing smooth surfaces like prophylaxis paste.

Keywords: Air polishing; Periodontal health; Polishing materials; Stainbuster; Surface roughness; Tooth polishing

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Introduction

In develop countries, people live longer and keep their natural teeth longer compared to their ancestors. This development depends on decreased tooth decay and the incidence of periodontitis due to better motivation, improved home care habits and lifelong maintenance program [1,2].

The one of foundations in providing and maintaining the periodontal health is that the bacteria and their products remove from the dental tissue and that the surface is smoothed by giving minimal damage to the dental tissue. However, iatrogenic effects of professional instrumentation have been shown in several in vitro studies. The unwanted surface irregularities make it difficult to remove daily plaque by increasing the plaque formation and bacteria colonization [3,4]. For this reason, many authors recommend the polishing following this application [5-7]. On the other hand, repetitive polishing applications causes the loss of material on the tooth surface [3,4,8-10].

Today, the most widely used polishing material is rotary rubber cup, pumice or prophylaxis paste. This method often creates disappointment in settled colorations, it requires a long time and is tiring for the detist. In order to be able to make the process faster and more efficiently, the one of the devices developed is the air-flow polishing instrument ejecting compressed air, water and sodium bicarbonate. Both of these methods have advantages and disadvantages. In this study, stainbuster burs were evaluated as the new material for polishing. These burs were made of glass

fiber reinforced resins that were enriched by zircon. They were designed for removing the colored layers, stains and cement from enamel surface. The surface characteristics of stainbuster burs is abrasive power of fiber structure covering the entire work surfacer and divided into small fragments, when it contacts with a hard surface. While resin matrix is used, fibers occur, therefore it also has the self-sharpening feature. Stainbuster burs become sharp by itself, and the characteristics of abrasive are permanent. However, they slide over the tissues such as fibromatosis gingival membranes without cutting or trimming and they do not impact on soft tissue.

The objective of this study is to evaluate the effect of three different polishing methods in reducing the tooth surface roughness occuring after sonic scaling.

Materials and Methods

Experimental design

In the study, 60 mandibular incisors extracted for periodontal or prosthetic reasons, and had plaque and calculus on their lingual surfaces were used. After extracting, patients were informed that their teeth would be used in this study and verbal consent was obtained.

After the extracted tooth were washed under running water for 1 minute, it was maintained in distilled water. All tooth were scaled by the same researcher by using the ultrasonic device (Satelect; France) in contact with the lateral surface of teeth, in fasio-lingual direction and with light pressure.

The scaling was stopped when the test area seemed smooth and clean by visual inspection. Following the completion of scaling process, tooth were randomly divided into 3 groups so that 20 teeth are in each group.

Root surfaces of teeth were removed by cutting from cemento-enamel junction, as the measurement of roughness was only limited to the enamel surface. Groups were fixed in otopolymerizan acrylic to be 20 teeth in each table so that the measurements could be performed quickly and accurately. Teeth in this tables were evaluated in terms of surface roughness by profilometer (Perthomer M2; Mahr, Gottingen, Germany) without knowing which group there were included.

Profilometer measurements include Ra, Rq, Rz, Rmax and Rt values and surface graphics. These values are:

Ra: Arithmetic average of Ra values in roughness profile

Rq: Geometric average of the deviations occuring in roughness profile

Rz: Average height of peak-to-valley

Rmax: Maximum roughness depth

Rt: Roughness depth

In first group (G1), each tooth was polished by using prophylaxis paste (Clinpro Prophy Paste; 3M ESPE, St. Paul, MN, USA) and rotary rubber cup during 5 seconds. Clinician did not apply extra force, it was solely provided the contact with by own weight of the device. Second group (G2) was polished by using air-flow (KaVo prophyflex 3; USA and Clinpro Prophy Powder; 3M ESPE, St. Paul, MN, USA) during 5 seconds. While using, the device was held at right angles to the applied tooth surface and 1-1,5 cm away in average. In third group (G3), teeth were polished again by using stainbuster bur (Stain Buster, Carbotech, Ganges, France) during 5 seconds.

Samples were evaluated by profilometer once again in order to be able to evaluate the changes in surface roughness. Profilometer measurements were taken for 3 times in order to be able to minimize the margin of error and the average of these measurements was used in this statistical evaluation.

Results

According to the descriptive statictics, the groups showed normal distibution. For the samples in 3 groups consisting of 20 teeth in each one, Ra, Rq, Rz, Rmax and Rt values measured at the begining and after treatment were shown in **Table 1.** In Ra, Rq, Rz, Rmax and Rt values recorded in the begining measurements, there was no significant difference between groups ($p>0.05$). In the measurements following the polishing application, there was a significant difference between groups in Ra ($p<0.05$), Rq($p<0.05$), and Rz ($p=0.05$) values, whereas the difference between Rmax and Rt values were not statistically significant ($p>0.05$) (**Table 2**).

Following the polishing application, it was observed that Ra values decreased in 15 samples of G1, 11 samples of G2 and

Table 1 Surface roughness measurements at baseline and after polishing (B; baseline measurement, L; last measurement).

	GROUPS		
	G1	G2	G3
RaB	0,784 ± 0,08	0,716 ± 0,07	0,698 ± 0,08
RqB	1,164 ± 0,12	0,940 ± 0,08	1,016 ± 0,13
RzB	4,445 ± 0,50	3,292 ± 0,30	3,879 ± 0,55
RmaxB	7,910 ± 1,02	5,141 ± 0,47	6,641 ± 0,94
RtB	8,269 ± 1,02	5,519 ± 0,45	7,144 ± 0,99
RaL	0,576 ± 0,07	0,746 ± 0,07	0,526 ± 0,04
RqL	0,753 ± 0,09	1,009 ± 0,11	0,694 ± 0,05
RzL	2,671 ± 0,39	3,459 ± 0,41	2,371 ± 0,21
RmaxL	3,736 ± 0,51	5,943 ± 0,98	3,745 ± 0,38
RtL	4,312 ± 0,62	6,375 ± 0,98	4,186 ± 0,37

Table 2 Comparision of the data obtained at the beginning and at the end of the research.

	Ki-square	df	Asymp. Sig
RaB	0,592	2	0,774
RqB	1,223	2	0,543
RzB	2,117	2	0,347
RmaxB	3,663	2	0,16
RtB	3,369	2	0,186
RaL	6,731	2	0,035
RqL	6,695	2	0,035
RzL	5,777	2	0,056
RmaxL	4,287	2	0,117
RtL	4,404	2	0,111

16 samples of G3 compared to the values before the polishing application. In the last measurement of Rq values, it was observed that Ra values decreased in 14 samples of G1, in 10 samples of G2 and 15 samples of G3, compared to the values before the polishing application. In the last measurement of Rz values, it was observed that Ra values decreased in 16 samples of G1, 10 samples of G2 and 16 samples of G3 compared to the values before the polishing application. It was observed that the decrease was not statictically significant in 16 samples of G1, in 10 samples of G2 and in 16 samples of G3 for Rmax values; and respectively in 14, 15 and 10 samples for Rt values compared to the values before polishing application (**Tables 3a-3c**).

Discussion

The objective of this study is to compare the amounts of roughness reduction in different materials used in polishing process that was performed for reducing the roughness resulting during the scaling and root planning process; hence it can be compared to the efficacy of their clinical use.

The first study showing that there was no difference between manual applications and ultrasonic devices in terms of the activity was done by Badersten et al. [11] and then it was supported by so many studies [11-18]. It was agreed that sonic and ultrasonic devices provided similar clinical results with the scaling and root planning process in the American Academy of Periodontology 1996 world workshop' [14].

Although similar results were obtained between hand devices and sonic/ultrasonic devices in terms of the effectiveness and clinical results, hand tools have been known to leave partially smoother surfaces, when surface roughness, adverse effects and contraindications were evaluated. In our study, we chose to scale

Table 3a Alteration of surface roughness values before and after polishing in group 1.

GROUP			N
G1	RaL-RaB	Negative Ranks	15[a]
		Positive Ranks	5[b]
		Ties	0[c]
		Total	20
	RqL-RqB	Negative Ranks	14[d]
		Positive Ranks	6[e]
		Ties	0[f]
		Total	20
	RzL-RzB	Negative Ranks	16[g]
		Positive Ranks	4[h]
		Ties	0[i]
		Total	20
	RmaxL-RmaxB	Negative Ranks	16[j]
		Positive Ranks	4[k]
		Ties	0[l]
		Total	20
	RtL-RtB	Negative Ranks	14[m]
		Positive Ranks	6[n]
		Ties	0[o]
		Total	20

a: RaL<RaB, b: RaL>RaB, c: RaL=RaB, d: RqL<RqB, e: RqL>RqB, f: RqL=RqB, g: RzL<RzB, h: RzL>RzB, i: RzL=RzB, j: RmaxL<RmaxB, k: RmaxL>RmaxB, l:RmaxL=RmaxB, m:RtL<RtB, n:RtL>RtB, o:RtL=RtB.

Table 3b Alteration of surface roughness values before and after polishing in group 2.

GROUP			N
G2	RaL-RaB	Negative Ranks	11[a]
		Positive Ranks	9[b]
		Ties	0[c]
		Total	20
	RqL-RqB	Negative Ranks	10[d]
		Positive Ranks	10[e]
		Ties	0[f]
		Total	20
	RzL-RzB	Negative Ranks	10[g]
		Positive Ranks	10[h]
		Ties	0[i]
		Total	20
	RmaxL-RmaxB	Negative Ranks	10[j]
		Positive Ranks	10[k]
		Ties	0[l]
		Total	20
	RtL-RtB	Negative Ranks	10[m]
		Positive Ranks	10[n]
		Ties	0[o]
		Total	20

A: RaL<RaB, b: RaL>RaB, c: RaL=RaB, d: RqL<RqB, e: RqL>RqB, f: RqL=RqB, g: RzL<RzB, h: RzL>RzB, i:RzL=RzB, j: RmaxL<RmaxB, k: RmaxL>RmaxB, l:RmaxL=RmaxB, m:RtL<RtB, n:RtL>RtB, o:RtL=RtB

Table 3c Alteration of surface roughness values before and after polishing in group 3.

GROUP			N
G3	RaL-RaB	Negative Ranks	16[a]
		Positive Ranks	4[b]
		Ties	0[c]
		Total	20
	RqL-RqB	Negative Ranks	15[d]
		Positive Ranks	5[e]
		Ties	0[f]
		Total	20
	RzL-RzB	Negative Ranks	16[g]
		Positive Ranks	4[h]
		Ties	0[i]
		Total	20
	RmaxL-RmaxB	Negative Ranks	16[j]
		Positive Ranks	4[k]
		Ties	0[l]
		Total	20
	RtL-RtB	Negative Ranks	15[m]
		Positive Ranks	5[n]
		Ties	0[o]
		Total	20

a: RaL<RaB, b: RaL>RaB, c: RaL=RaB, d: RqL<RqB, e: RqL>RqB, f: RqL=RqB, g: RzL<RzB, h: RzL>RzB, i:RzL=RzB, j: RmaxL<RmaxB, k: RmaxL>RmaxB, l:RmaxL=RmaxB, m:RtL<RtB, n:RtL>RtB, o:RtL=RtB

by ultrasonic devices, because we would evaluate the reduction of roughness by using different materials after scaling process. Although hand devices were not preferred and ultrasonic devices, which smear layer formation were known to be less frequently, were used, teeth were washed under running water for 3 min in order to be able to be obtained the accurate measurements after scaling process.

In order to reduce the surface roughness after scaling process, various techniques and materials are used. For these materials, removal times of colorations vary by grain size of the used material and/or the applied force. In our study, periodontal prophylaxis paste and air-flow applications routinely used in clinical practice for polishing was compared to stainbuster suggested as a new polishing material.

In many study, it was shown that air-polishing devices became time-saving and effective in the application on normal enamel surface [19-23]. However, it does not generally lead to surface modification and loss of materials to be able to be detected clinically [23,24]. In contrast, spray may occur a significant amount of loss of material, if applied directly on root surface or dentin. As a rule, it is known that it should be certainly avoided to use these devices on dentin and cement [25]. Tissue loss caused by the technique is depends on application time, powder and water application as much as the probe distance and the application surface [25,26]. While we used air powder instrument in our study, the application was done by the same researcher from 1-1,5 cm by approaching at a right angle to the tooth surface. Likewise, the polishing application that was done by using rotary rubber cup was performed by the same researcher only by the weight of rotary instrument without extra pressure.

The one of the most commonly used polishing method is prophylaxis paste used with rotary rubber cup/brush. The abrasive properties of paste vary by content and size of paste. However, fine-grained paste can be more abrasive than a thick-grained paste, because there is no standard in abrasiveness of paste among manufacturers.

In our study, it was studied that prophylaxis paste and air-flow powder were provided to be completely the same properties in order to be able to eliminate the effects of abrasive powder used in air-polishing techniques on the amount of abrasion. Therefore, the same paste and powder products having the same contents and produced by the same manufacturer were used for testing. In this way, it was evaluated if the application of the products having the same abrasive properties with the rotary instruments and aerator devices affected on surface roughness. According to the statistical analysis of data, it was determined that reduction observed in roughness values of prophylaxis paste group has been significant.

Another material tested in our study is stainbuster burs. Studies on the effect of burs on hard tooth tissues and especially surface roughness are not sufficient on the literature. For comparing the effects of bur on surface roughness, it was preferred air-polishing method that was known to leave rough surfaces and the prophylaxis paste that was the most commonly used in clinics.

While comparing the materials, polishing application was made only in the enamel surface in each group, thus it was provided that different degrees of abrasion observed on cement and dentin did not affect the result of the study, and the roughness was evaluated only on the enamel surface.

Although some loss of tooth structure was observed in the reports on air-powder instruments, there were also studies showing that the surface became surprisingly smooth [20,27]. In our study, while it was observed a smooth appearance on half of the tooth in group applied air-flow and polishing in average, the surface roughness increased in the other half, in line with the other studies showing the harmful effects of air-polishing systems [21,23,27-29]. Although polishing applications were only limited to the enamel surface in our study, this result emerged showed that air-polishing could lead to the opposite results with the philosophy of polishing application, even though it was applied on the enamel surface.

In our study, it was discovered statistically significant decrease in the group which we applied prophylaxis paste. This result is in line with the studies recommending the polishing application following scaling and root planning processes. However, our study supports the argument that application by the rotary rubber is more effective option in reducing the surface roughness independently of the grain size, because prophylaxis paste that was used in paste application done by rotary rubber cup and the powder that was used in air-flow instrument were manufactured by the same manufacturer and they had the same grain size [5,6,30-32].

In our study, stainbuster, the new material intended to be evaluated by comparing the efficacy was also reduced the surface roughness in a statistically significant way. There was no sufficient study related to this material. Studies on roughness have been designed with regard to restorative materials.

Conclusion

As a result, repeated polishing processes have iatrogenic effects occurring depending on increasing the life time of the teeth. Careful selection of patients who polishing will be applied will reduce the complications and adverse effects.

Our study tries to be a scientific guide for the clinical application of polishing processes. According to the results of our study,

stainbuster burs are seen as an alternative to traditional polishing materials, because it provides smooth surfaces like prophylaxis paste and ease of application like air-polishing technique.

Compliance with Ethical Standards

Conflict of interest

Author Neyran TUZCEL declares that she has no conflict of interest. Author Murat AKKAYA declares that he has no conflict of interest. Author Fatma KARACAOGLU declares that she has no conflict of interest.

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Ethical approval

All procedures performed in study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Verbal informed consent was obtained from all individual participants included in the study.

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