

# Is the surface abrasiveness of the dental stain eraser on composite resin as minimal as that of the rubber-cup?

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## ABSTRACT

**Aims:** The aim of this study is to compare the abrasive effect of dental stain erasers on dental resin composites with the rubber cup and prophylaxis paste, which are routine methods used to remove stains in professional practice.

**Methods:** Composite resin blocks were prepared and initial surface roughness measurements were made. Application areas were divided into equal areas in each block and marker was used to color equal surface areas of each section (5x5 mm). The stain removal methods to be compared were applied to the divided surfaces (n=9), and roughness values were measured again.

**Results:** It was observed that the dental stain eraser (SE) group created significantly more roughness on the composite surfaces (0.312815) compared to the rubber cup (RC) group (0.213556) ( $p<0.001$ ). Additionally, the roughness values of the SE and RC groups were significantly higher than those of the control group ( $p<0.001$ ).

**Conclusion:** Compared to application with rubber cup and prophylaxis paste, dental stain eraser is more abrasive on composite resin surfaces.

**Keywords:** Polishing, dental stain, abrasion, dental stain eraser

## INTRODUCTION

Tooth color is one of the most important characteristics related to the aesthetics of the dental arch.<sup>1</sup> Extrinsic tooth discoloration occurs when chromogenic substances accumulate in the pellicle, plaque, or calcified attachments on the tooth surface.<sup>2</sup> External discoloration, which can be in various colors such as brown, yellow and black, can cause aesthetic discomfort.<sup>3</sup>

The aim of periodontal treatment is to obtain healthy periodontal tissues by eliminating local etiological factors such as bacterial deposits and tartar from the tooth surface.<sup>4</sup> Polishing can be considered the final stage of periodontal treatment.<sup>5</sup>

Although enamel and cementum may present a clinically smooth surface after debridement to the unaided eye, they present various surface irregularities that can be detected microscopically. A smooth enamel or cementum is less likely to accumulate plaque and this can only be achieved by polishing after scaling or root debridement.<sup>6</sup> Studies have shown that polishing removes microbial dental plaque, reduces bacterial accumulation, smoothes the tooth surface after scaling, and removes stains.<sup>7-9</sup> In contemporary dentistry, polishing is done with manual and motorized devices such as a porte polisher, polishing strips, a rubber/prophylaxis

cup, a bristle/prophylaxis brush, an air polisher, and a vector system with various prophylactic pastes/powders. Among the various polishing methods available, rubber cup with pumice/polishing paste is the most common.<sup>10</sup> Teeth polishing may seem easy, simple and even mundane, but it involves many interconnected and complex issues and can cause unnecessary harm if not done properly.<sup>11</sup> Dentists have made efforts to correct the tooth surface with minimal damage through many studies.<sup>12</sup>

Nowadays, products called 'dental stain eraser', which can be easily found in the markets, are offered for sale so that people can remove stains on their teeth at home without having to make a dentist appointment. With this material, people aim to provide the aesthetics of their teeth themselves. However, there are no studies investigating the effects of these commonly used products on tooth surface tissue.

Composite resin materials are designed to match the tooth structure. However, they stain more than enamel.<sup>13</sup> In our study, dental composite resin blocks were used to take advantage of their color retention properties; and the aim was to compare the abrasive effect of the rubber cup (with polishing paste), which is the most preferred in clinical applications, and the dental stain eraser after removing the stain on the dental composite surface with profilometer measurements.

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The null hypothesis of this study is that there is no difference between the dental stain eraser and the rubber cup in creating roughness on the surface structure of the stain removal process.

## METHODS

### Ethics

The present study was designed as an in vitro laboratory investigation and was conducted exclusively on restorative material specimens. The study did not involve human participants, identifiable or private human data, human biological samples, or live animals. No clinical intervention, treatment, or data collection from patients was performed. Accordingly, the study did not constitute human-subject or animal research requiring review and approval by an institutional ethics committee under the applicable institutional framework. Therefore, ethical committee approval was not obtained for this study. All procedures were carried out in accordance with the ethical rules and the principles.

### Study Design

The sample size was calculated using the software program (G\*Power version 3.0.8, Heinrich Heine University, Düsseldorf) with data from a study<sup>14</sup> evaluating the abrasiveness of various material treatments of composite surfaces. With an effect size of 3.16, 95% power, and  $\alpha=0.05$ , the minimum number of samples required for this investigation was 4 per group.

### Specimen Preparation

Dental composite material (3M Filtek Z250) was applied in block form. To ensure standardization, a Mylar matrix strip was placed on the block surface, and then the matrix was covered using a flat glass plate. A 1 kg stainless steel weight was applied to the sample for 30 seconds and the composite was allowed to flow and obtain a smoother, standard surface. The polymerization tip was applied directly to the Mylar matrix strip and the samples were light cured according to the manufacturer's instructions (Demetron Optilux 501e).

In order to create equal amounts of coloration on the application surface of the two materials compared, a single composite block was prepared with celluloid tape to form 6 equal sections and a total of 18 sections were separated for each group ( $n=9$ ). The surface of the samples was considered as two separate planes, right and left; the right side was determined as the SE surface and the left side as the RC surface. It was aimed to imitate dental stain by painting each separated section with 'permanent marker' by making use of its usage in the literature,<sup>15</sup> (ED47277, Edding®, Wunstorf, Germany) as 5x5 mm.

### Stain Removal Procedures

On the polishing areas, polishing paste (Detartine, Septodont®, Saint-Maur, France) and rubber-cup (EPY003A, Stoddard®, Letchworth, UK) were used at 2500 rpm with light pressure (to make the edges flare slightly).

On the erasing areas, dental stain eraser (Pakdent®, Bolu, Türkiye) was moved back and forth on the surface until the discoloration was observed to be removed, with the tip of the eraser applied with light pressure as recommended by the manufacturer.

All stain removal procedures were performed by a single periodontist, and then the remaining residues on the block were cleaned by rinsing with physiological saline.

### Profilometrical Analysis

Surface roughness was investigated by profilometric analysis. For this purpose, Bruker Dektak XT profilometer was used. The roughness of each sample was determined by considering the data obtained at 100  $\mu\text{m}$  intervals along 1 mm measurement profiles. The obtained profile data were corrected by polynomial curve fitting method in order to eliminate the curvilinear deviation of the sample during the process.

### Statistical Analysis

All data analyses were performed with a software program (SPSS v.20.0; IBM, Chicago, IL, USA). Parameter comparisons were made using the ANOVA test. Dunn test (with Bonferroni correction) was used for multiple comparisons of surface roughness parameters.

## RESULTS

**Table** shows the average surface roughness average (Ra) value and standard deviation of the experimental groups.

| Groups       | Ra (mean+SD)                     |
|--------------|----------------------------------|
| Control      | 0.045778+0.01294                 |
| Rubber cup   | 0.213556+0.1080661 <sup>a</sup>  |
| Stain eraser | 0.312815+0.2885772 <sup>ab</sup> |

a: significant difference compared to control group ( $p<0.005$ ). b: significant difference compared to rubber cup group ( $p<0.001$ ). Ra: Roughness average, SD: Standard deviation

As a result of the profilometric analyses, the average Ra value of the control group was recorded as 0.045778, while the RC group was 0.213556 and the SE group was 0.312815. According to the Bonferonni analysis in which we examined the difference between the groups, it was seen that the RC group showed a significant difference in surface roughness compared to the control group ( $p<0.005$ ), and the SE group showed a significant difference in surface roughness compared to the control group ( $p<0.001$ ).

When the analyses between the groups were examined, it was observed that the SE group showed significantly more roughness compared to the RC group ( $p<0.001$ ).

**Figure** shows the surface roughness values of the groups graphically.

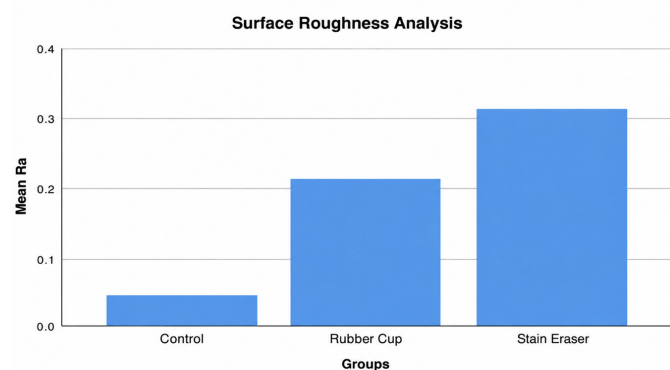


**Figure.** Surface roughness analysis according to mean roughness average values of groups

Ra: Roughness average



## DISCUSSION

Facial attractiveness and smile are closely linked. Especially in the front teeth, tooth color is an important element of smile aesthetics and therefore self-confidence.<sup>16</sup> As the severity of tooth discoloration increases, a person's sense of self-esteem decreases.<sup>17</sup>

However, since dentist appointments create stress and financial cost problems for patients,<sup>18</sup> it is understandable that they tend to turn to products that they can apply at home. No research has been observed in the literature assessing the effects of this commonly preferred product. Therefore, our study aimed to evaluate the amount of abrasion that the use of an over-the-counter product, 'dental stain eraser', will create on the tooth tissue during the stain removal process in the comfort of people's homes, by comparing it with professional application.

Manual dexterity is an important skill in mastering dentistry, and it is essential for dentistry students and clinicians to acquire the ability and skill to perform dental procedures. Practical experience of tactile knowledge is needed to gain clinical expertise.<sup>19</sup>

Tactile sensitivity allows people to extract information about objects and make decisions based on their perceived features.<sup>20-22</sup> Education level is one of the factors that increases the touch sensitivity of health sciences students.<sup>23</sup> It has been shown that professional dental stain cleaning can cause damage to the tooth enamel, depending on factors such as application time and pressure, including manual dexterity, by clinicians who will be more sensitive to dental tissues than other individuals.<sup>24</sup>

There is no professional involvement in the applications of 'over-the-counter products'.<sup>25</sup> Individuals who are not trained and have no practical experience will have insufficient touch sensitivity and will be more likely to cause harmful applications to dental tissues. However, the tooth surface should be corrected with minimum damage.<sup>12</sup> In order to ensure optimization in our study, both products compared were applied by a periodontist.

After tartar cleaning, polishing is usually applied to remove discoloration and residues on the tooth. Discolorations that can be removed by polishing are of the external tooth coloration type and occur on the outer surface.<sup>26</sup>

Different polishing techniques are preferred in dental clinics today. The most commonly used ones are polishing with a rubber cup or brush. These techniques are performed by applying an abrasive polishing paste with the help of a rotary tool.<sup>24</sup>

The reason for choosing a rubber cup in our study is that polishing with a rubber cup has been shown to be the most effective method in obtaining a smooth tooth surface and removing residues from enamel and cementum, compared to polishing with a bristle brush or air polisher.<sup>7</sup>

Generally, dental rotating systems and their associated products generate heat due to frictional forces.<sup>27,28</sup> Ertugrul and Orhan<sup>29</sup> reported that rubber cups used with prophylaxis paste resulted in relatively low intrapulpal temperature increases, whereas those used without paste frequently exceeded the critical temperature rise threshold of 5.6°C. For this reason, since the standard application would be with paste, in our study, a rubber cup application was also made together with the paste.

Commercially available prophylaxis polishing pastes usually combine abrasives with a binder, moisturizers, a coloring agent, a preservative, and a sweetener.<sup>30</sup> It creates minimum scratches and provides a highly reflective surface.<sup>31</sup> The polishing process to remove discoloration, including factors such as the abrasiveness of the paste used, the rotation speed of the rotary tool, the application pressure, and the application time, affects the increasing temperature and the roughness that occurs on the surface.<sup>24</sup> Studies have reported that the average speed that should be used is 2500 rpm.<sup>10,24</sup> In this context, we preferred to apply rubber cup and paste at 2500 rpm.

The content of the dental stain eraser product is polypropylene (PP), thermoplastic rubber (TPR), and carborundum (silicon carbide). Carborundum is used in discs and stones in dentistry practice; it functions as a grinding material in cutting and thinning the teeth.<sup>32</sup>

## Limitations

In our study, markers were used to mimic the stain to be removed. However, the fact that the homogeneity of the staining areas was visually controlled is one of the limitations of our study.

In our study, it was revealed that dental stain eraser caused more abrasion on the surface compared to the process performed with rubber-cup and paste, which is one of the professional routine applications for stain removal. It is possible that the carborundum content is a factor in this situation.

In our study, dental composite resin blocks were used to evaluate abrasiveness; however, further research on tooth surfaces is needed for a more comprehensive evaluation of the abrasive effect. Furthermore, the application pressure was not quantitatively calibrated, which may have introduced variability in the surface roughness measurements.

## CONCLUSION

Removing the discolorations with a stain eraser caused more scratches on the composite resin surface compared to professional applications. It is more reliable to prefer professional applications in stain removal for Using stain removers to remove discoloration has resulted in more scratches on the composite resin surface compared to professional applications. Professional stain removal methods are more reliable for composite surfaces.

## Clinical Relevance

- **Scientific rationale:** Although the use of over-the-counter dental products is attractive to the public, whether or not their use is safe for dental tissues is vital. Our study compared dental stain eraser abrasiveness to rubber-cup and paste, which are among the professional applications.
- **Principal findings:** Profilometric measurements showed that dental stain eraser created significantly higher roughness on the composite surface compared to rubber-cup in removing equal amounts of stain ( $p < 0.005$ ).
- **Practical implications:** Dental stain eraser showed higher abrasiveness compared to the professional application. While more research is required, steps can be taken to ensure that individuals are informed about the impacts of easily purchased dental products.



## ETHICAL DECLARATIONS

### Ethics Committee Approval

This study did not require ethical approval as it did not involve any human subjects or animal experiments.

### Informed Consent

Since the study was conducted without the participation of any living being, no written consent form was obtained.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

### Author Contributions

Design: EÖ, LS; Data Collection and/or Processing: EÖ, AE; Analysis and/or Interpretation: LS; Writing the Article: EÖ.

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