



EFFECT OF NUTRIENTS AND MEDICINES ON SURFACE OF COMPOMER

ABSTRACT

Objectives: The objective of this study is to examine the effect of nutrients and medicines frequently consumed by children on the surface roughness of the Polyacid-Modified Composite Resin (compomer), a restorative material typically used in pediatric dentistry.

Materials and Methods: VOCO Glasiosite® Caps compomer was used as the restoration material. Seven control groups consisting of nutrients and medicines frequently consumed by children from 0-6 years (Group 1: Ferro Sanol® B (150 ml) syrup, Group 2: Augmentin®-BID (400 mg/57 mg) suspension, Group 3: Calpol® (120 mg/150 ml), Group 4: Bebelac® Gold 5 follow-on milk, Group 5: Danino® strawberry yogurt, Group 6: Nesquik® chocolate milk, Group 7: Cappy® orange juice) were formed and their pH values were measured. Compomer discs were created and their initial surface roughness was measured by Bruker® Stylus Profilometer. Taking into consideration its annual usage period, compomer material was brought in contact with solutions. Then the roughness test was repeated. SEM images of each compomer material were taken and compared with the control group.

Results: The evaluation of the medicine group revealed that Ferro Sanol® B displays the highest level of surface roughness difference (23.3 nm). As to the nutrients group, Cappy® orange juice showed the highest surface roughness difference (21.4 nm). SEM images support these findings.

Conclusions: The effect of the solutions on the surface roughness of filling surfaces increases depending on their acidity. However, it is believed that pH solely does not have any impact. These studies should be supported by corrosion experiments.

Keywords: Surface properties, compomers, foods, drug utilization.

*Tamara Pelin Gündoğdu Özdal¹
Gülşüm Duruk¹

ORCID IDs of the authors:
T.P.G.Ö. 0000-0002-3154-5180
G.D. 0000-0002-6756-6637

¹ Department of Pediatric Dentistry, Faculty of Dentistry, Inonu University, Malatya, Turkey

Received : 27.12.2018
Accepted : 02.04.2019

INTRODUCTION

Surface properties of restorative materials used in dentistry that are in contact with the oral environment affect the endurance of restoration. Dental materials are used not only for treatment but also to provide long-term aesthetics. Thus, the materials are desired to be as durable and smooth as the tooth surface.¹⁻³ Not only the corrosion and roughness on the teeth but also surface irregularities of the restoration materials cause plaque retention and therefore secondary caries, damage to the opposing teeth, and periodontal diseases due to restorations incompatible with the gingiva.⁴⁻⁶ Long-term success of the restoration depends on a variety of factors such as foreign materials on the surface, micro-mechanical properties of the material, way of implementation, duration of the polymerization, and porosity.⁷ In addition, acidic foods and beverages cause porosities on the surface of the material in the long term.⁸ Different types of fruit juice, yogurt, and formula in particular that are frequently used in childhood and medicines that are high in acidity were shown to be capable of affecting the restorative materials as well as causing corrosion on the tooth surface.⁹⁻¹¹ Surface hardness of the restorative materials used in pediatric dentistry were shown to decrease in case of contact with food having low pH values.^{12,13} Since the nutrition of children differs from that of

adults, the number of studies on the impact of food and medicines on the compomer material used in pediatric dentistry is not sufficient.¹⁴

Today, compomer material is widely used in pediatric dentistry. This material is capable of releasing fluoride, highly resistant to abrasion, fracture and bending, easily shaped, can be polished, and meets aesthetic expectations. The objective of this study is to examine the impact of food and medicines frequently consumed by children on the surface roughness of the compomer material.

MATERIALS AND METHODS

Medical suspensions and liquid nutrients that are frequently consumed by children between 0-6 years were selected. Seven groups consisting of 3 medicine groups and 4 nutrient groups were formed. Group 1: Ferro Sanol® B (150 ml) syrup, Group 2: Augmentin®-BID (400 mg/57 mg) suspension, Group 3: Calpol® (120 mg 150 ml), Group 4: Bebelac® Gold 5 follow-on milk, Group 5: Danino® strawberry yogurt, Group 6: Nesquik® chocolate milk, and Group 7: Cappy® orange juice. Ingredients of the nutrients and medicines are shown in Tables 1 and 2. pH values and annual usage periods (consultated with pediatricians) of the samples from nutrient and medicine groups are shown in Table 3.

Table 1. Nutrients used and their ingredients

Nutrients	Manufacturer	Ingredients
Bebelac® Gold 5 follow-on milk	Nutricia®	Skim milk, lactose, whey components, maltodextrin, prebiotic fibers, vegetable oils, tricalcium phosphate, calcium carbonate, tripotassium citrate, trisodium citrate, L-ascorbic acid, magnesium chloride, emulgator, taurine, choline chloride, sodium L-ascorbate, potassium chloride, iron sulfate, zinc sulfate, DL- α -tocopheryl acetate, nicotinamide calcium D-pantothenate, pteroylmonoglutamic acid, copper sulfate, DL- α -tocopherol, retinyl palmitate, D-Biotin, cholecalciferol, thiamine hydrochloride, pyridoxine hydrochloride, riboflavin, cyanocobalamin, potassium iodide, manganese sulphate, phytomenadione, sodium selenite.
Strawberry yogurt	Danino®	Pasteurized and homogenized cow's milk, strawberry prepartate (10%) [strawberry, sugar, modified starch, black carrot juice concentrate, strawberry flavorant, stabilizer (carrageenan), acidity regulator (sodium citrates), sugar, strawberry puree (0.01%), yogurt culture.
Nesquik® chocolate milk	Nestle®	Pasteurized drinking milk, sugar, cocoa powder (1.1%), salt, stabilizer (carrageenan), minerals (iron phosphate, zinc sulfate), flavorant (vanillin), cinnamon
Cappy® orange juice	Coca-Cola®	At least 50% mixed fruit juice from concentrate (orange), water, sugar or fructose-glucose syrup, flavorants, acidity regulator (citric acid), vitamin A.

Table 2. Medicines and ingredients

Medicines	Manufacturer	Ingredients
Ferro Sanol® B (150ml) syrup	Adeka İlaç ve Kimyasal Ürünler San. ve Tic. A.Ş.	Ferrous(II)-glycine-sulphate complex, 43 mg riboflavin-sodium phosphate, 0.32 mg of Vitamin B1, 0.63 mg of Vitamin B6 (pyridoxine hydrochloride), Ascorbic acid, single refined sugar, glucose monohydrate, sorbitol, 95-98% sulphuric acid, orange oil, pear oil, deionized water.
Augmentin®-BID (400 mg/57 mg) suspension	GlaxoSmithKline	Amoxicilline 400mg/5ml , Clavulanic Acid 57 mg/5 ml
Calpol® (120 mg/150ml) suspension	Abdi İbrahim İlaç Sanayi ve Ticaret A.Ş.	Paracetamol, sorbitol solution, strawberry flavor, sucrose, Nipagin M (methyl parahydroxybenzoate), glycerol, Avicel rc 591, Carmoisine E 122, xanthan gum, purified water.

Table 3. Annual usage periods of the samples

Samples	pH	Usage time in a year	In-mouth duration time
Ferro Sanol® B (150ml) syrup	2	2×1 2.5 months Once a year	2 min
Augmentin®-BID (400 mg/57 mg) suspension	6.3	2×1 10 days 4 times in a year	2 min
Calpol® (120 mg/150ml) suspension	6	3×1 5days 6 times in a year	2min
Bebelac® Gold 5 follow-on milk	7	5×1 365 days	5 min
Danino® strawberry yogurt	5.5	1×1 365 days	5 min
Nesquik® chocolate milk	6.5	1×1 365 days	5 min
Cappy® orange juice	3.5	1×1 365 days	5 min

Distilled water was used as the control group. Glasiosite® Caps compomer (VOCO, Cuxhaven, Germany) was used as the restoration material. The composition for the compomer material determined by the manufacturer is as follows: BIS-GMA, diurethane-dimethacrylate, TEGDMA, BHT, 77.5% 2.6-bis (1.1-dimethylethly)-4-methylphenol filler. Acidity of all nutrients and medicines was measured by pH paper strip. Metal plates of 5 mm width and 2±0.1 mm thickness were produced to place the compomer material in. To ensure standardization, A3 was chosen as the color of the compomer material placed in the metal plates. The material was placed in the discs in a way to overflow a bit. Cellulose acetate matrix tape was used for insulation and pressure was applied on the glass plate. As recommended by the manufacturer, the material was polymerized from a single direction for 40 seconds through Monitex® Blue LEX LD-105 Led-C curing light (wavelength 450-470). Each compomer disc was polished for 10 seconds by the same person using 600, 800, and 100 grits silicon carbide discs, respectively. The procedure was repeated by preparing 80 compomer discs, 10 for each group. Each sample was kept at 37°C for 24 hours for rehydration. Roughness on the samples was measured over 100 lines with intervals of 10 micrometer through Stylus Profilometer (Dektak 150, Bruker, Santa Barbara, CA) with 2 micrometer probe tip and the values were recorded in nanometer (nm). The solutions

were prepared as recommended by the manufacturers. Distilled water was used for solutions to which water should be added. Afterwards, an approximate annual usage period for the solutions was calculated (Table 3). Samples were kept in the solutions whereas the control group in distilled water at 37°C in closed containers. Once the soaking was completed, each sample was rinsed with distilled water for 10 seconds and left to dry.

Roughness measurements were repeated. The difference between the two roughness values was calculated and the statistical measurements were performed based on this value. The samples were examined in two separate groups, namely medicines and nutrients. Scanning Electron Microscope (SEM) images of the samples tested for roughness were examined in Inonu University Scientific And Technological Research Center (IBTAM). In SEM imaging, the entire compomer surface was scanned and samples magnified by 2.50 X and 10.00 X which show the best image were collected with 20.00 kV from the area providing the best image.

Statistical Analysis

Data concerning surface roughness were uploaded to SPSS (version 21.0) software. Shapiro-Wilk test and Paired Sample t-Test was used in the assessment of data. The data were recorded as arithmetic mean±standard deviation and level of error was taken as 0.05.

RESULTS

Despite being taken once a year on average, Ferro Sanol®-B, the most frequently used medicine in the medicine group, was found to have the longest in-mouth duration since it is used for 2.5 months. It is followed by Calpol® and Augmentin®, respectively. Considering its pH value, Ferro Sanol® B was found to be the most acidic (pH=2) medicine.

The evaluation of surface roughness revealed that Ferro Sanol® B displays the highest level of surface roughness difference (23.3 nm) (p<0.01), followed by Calpol® (5.3 nm) (p>0.05). Augmentin® displayed values close to the distilled water group (as 1.0 nm (p>0.05) (Figure 1).

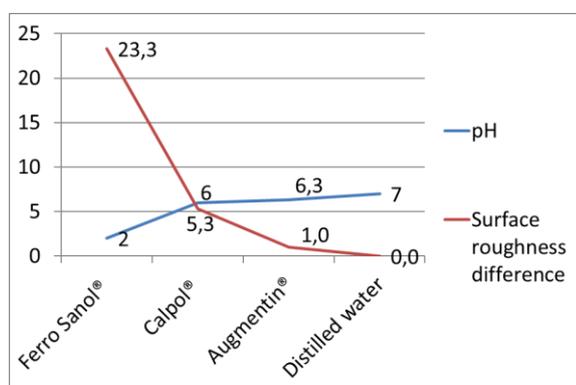


Figure 1. Surface roughness difference and acidity of medicine group

The in-mouth duration of the foods in the nutrient group was taken as 5 minutes when consumed at

once. As to the nutrient group, Cappy® orange juice was found to have the highest level of acidity (pH=3.5) and followed by Danino® strawberry yogurt (pH=5.5), Nesquik® chocolate milk (pH=6) and Bebelac® 5 follow-on milk (pH=7) respectively. The evaluation of surface roughness revealed that Cappy® orange juice displays the highest level of surface roughness difference (21.4 nm) (p<0.01). Surface roughness and acidity of Danino® strawberry yogurt (13.4 nm) (p>0.05), Nesquik® chocolate milk (2.2 nm) (p>0.05), Bebelac® 5 follow-on milk (1.8 nm) (p>0.05) are directly proportional (Figure 2). The surface roughness difference caused by all of the solutions on the compomer material are shown in Table 4.

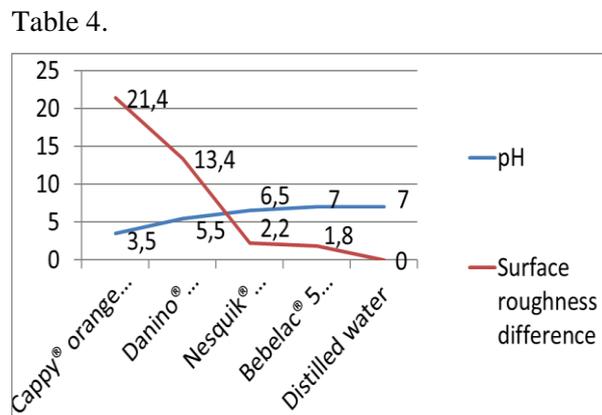


Figure 2. Surface roughness difference and acidity of nutrient group

Table 4. Surface roughness difference caused by all of the solutions

Samples	Before (average nm)	After (average nm)	95% Confidence Interval of the Difference		Difference mean	p value
			Lower	Upper		
Ferro Sanol® B (150ml) syrup	323.0±33.5	346.4±22.8	-33.5	-13.1	23.3	0.001
Augmentin®-BID (400mg/57mg) suspension	304.2±22.4	305.1±33.7	-10.5	8.50	1.0	0.817
Calpol® (120 mg/150ml) suspension	289.3±27.2	294.6±35.3	-16.7	6.1	5.3	0.320
Bebelac® Gold 5 follow-on milk	312.9±31.8	314.8±43.8	-14.9	11.3	1.8	0.764
Danino® strawberry yogurt	294.3±31.5	307.6±23.3	-27.3	0.5	13.4	0.057
Nesquik® chocolate milk	222.5±25.0	224.6±36.2	-13.1	8.7	2.2	0.658
Cappy® orange juice	213.0±33.6	234.6±43.1	-30.8	-11.9	21.4	0.001
Distilled water	302.1±22.2	302.1±22.2	-	-	0.0	-

SEM images of the samples kept in solutions were taken. SEM images support that acidity and surface roughness are in direct proportion. SEM images of the material on which Ferro Sanol® B was applied revealed a considerable degree of roughness compared to the ones on which Calpol® and Augmentin®-BID were applied. Ferro Sanol® B applied sample was observed to have pits on the surface and distortions in the flat surface form. The roughness ratio was observed to

decrease with a significant difference in the Calpol®-applied sample. Surface properties of Augmentin®-BID-applied sample was similar to that of the control group. When SEM images of nutrients were examined, samples on which foods with low pH values were applied showed higher surface roughness. Cappy® orange juice-applied sample showed the highest surface roughness which is supported by SEM images. Acidity of Danino® strawberry yogurt (pH=5.5) destroyed

the integrity of the compomer material. SEM image of the Nesquik® chocolate milk-applied compomer material did not reveal an intense roughness. Surface roughness difference of 2.2 nm between samples and acidity (pH=6.5) close to that of the distilled water group was observed supported by SEM images. Having a neutral pH, Bebelac® 5 follow-on milk did not cause a significant roughness on the compomer material and showed values close to that of the distilled water group (Figure 1).

DISCUSSION

Compomer is undoubtedly the most frequently used material in restoration of the deciduous teeth.¹⁵ Endurance and preventiveness of this material will both increase the patient's comfort and effect the dentist's long-term success. Acidic foods, which are mostly consumed by children, may harm not only the teeth and the surrounding tissues but also the filling material.¹⁶ As to the medicines frequently used by children, Ferro Sanol® B, used in iron deficiency treatment, is prescribed for the children from 6 months- 15 years of age.¹⁷ Correr *et al.*¹⁸ showed that acidic foods effect the surface roughness of resin composites, compomer and resin-modified glass ionomer materials. In this study, highly acidic Ferro Sanol® B (pH=2) caused nanocracks on the surface of the compomer material. Ferro Sanol® B, which has the highest difference (23.3 nm) between initial and post-application surface roughness, can also affect the endurance of the compomer material. Therefore, patient's parents should be warned to take several measures as follows: the medicine should be swallowed without keeping in the mouth, nutrients to neutralize the acidity of the oral environment should be consumed afterwards, and the patient should rinse his/her mouth with water. On the other hand, Calpol®, frequently used by children as analgesic, caused roughness on the compomer material compared to the distilled water group (5.3 nm). Being acidic, Calpol® did not cause surface roughness as much as Ferro Sanol® B. However, SEM images reveal that due to its sucrose content, Calpol® leaves residuals on the compomer material. When consuming foods and medicines with sugar content, oral and dental

health should be considered. Augmentin® is the most frequently used broad spectrum antibiotic. Santos *et al.*¹⁹ also showed that pediatric syrup containing amoxicillin increased the surface roughness of compomer material. Performing oral cleaning after using this medicine, showing values close to the distilled water group when the surface roughness is taken into consideration (1.0 nm), will be appropriate.

The compomer samples showing the maximum surface roughness difference in the nutrient group were the Cappy® orange juice-applied samples. In the SEM images of the samples with high surface roughness difference (21.4 nm), fragmentations were observed in the attachment points. Cappy® orange juice, containing citric acid, caused damages on the compomer material due to high acidity (pH=3.5). Such food should be consumed less, and awareness should be raised among parents. It is believed that the connection between the treated teeth and the compomer material may be destroyed in case nutrients causing surface defects on the compomer material are consumed very often.

Defects were detected on the surface of the compomer material in contact with Danino® strawberry yogurt. Surface roughness difference was found to be high in the measurements performed using profilometer (13.4 nm). Due to its sugar content and thickness, this food left non-isolated and invisible residuals on the compomer material. When consumed frequently, such food may cause propagation of oral bacteria and both tooth tissue and compomer material be damaged.

Nesquik® chocolate milk, having an acidity close to distilled water group (pH = 6.5) showed a surface roughness difference of 2.2 nm, which was supported by SEM images. Bebelac® 5 follow-on milk with the same pH value as the distilled water group (pH=7) hardly damaged the compomer material (1.8 nm) but caused residuals due to its thickness and additives in its content. Residuals were observed in some samples although each of them was washed with distilled water for 10 seconds after nutrients and medicines were applied. Although it is recommended to consume water after feeding or taking medication,

a good oral cleansing thereafter will protect the oral and dental health and prolong the life of the restorative material.

CONCLUSIONS

Highly acidic medicines and nutrients cause corruptions in compomer restoration. Ferro Sanol B® and Cappy® orange juice effected the surface of compomer material most, compared in their group samples. However, more detailed studies should be conducted on this topic.

ACKNOWLEDGEMENTS

Part of this study was presented in a poster presentation at 23rd Congress of the Turkish Pedodontics Association - TPD. OP40.0153 Sept 24-28, 2016. Kusadasi, IZMIR.

CONFLICTS OF INTEREST

None

Besin ve İlaçların Kompomer Yüzeyine Etkisi ÖZ

Amaç: Bu çalışmanın amacı çocukların sıklıkla tükettiği gıda ve ilaçların çocuk diş hekimliğinde sıklıkla kullanılan bir restoratif materyal olan Poliasit Modifiye Kompozit Rezin (kompomer)'in yüzey pürüzlülüğü üzerine etkisini araştırmaktır. **Gereç ve Yöntemler:** Çalışmada kullanılan solusyonlar tablo 1'de verilmiştir. Restorasyon materyali olarak VOCO Glasiosite® Caps kompomerden diskler oluşturuldu Tüm besin ve ilaçların asiditesi ölçüldü. Materyal, üreticinin önerdiği doğrultuda Led-C ışık cihazı ile 40 sn süresince tek yönden polimerize edildi. Kompomer plaktan kontrol grubuyla birlikte 8 grup olacak şekilde, 10'ar örnek elde edildi. Örnekler üzerindeki pürüzlülük Bruker® stylus profilometre ile ölçüldü ve değerler nanometre (nm) cinsinden kaydedildi. Sonrasında solüsyonların 1 yıllık yaklaşık kullanım süreleri hesaplanarak örnekler hazırlanan solüsyonlarda, kontrol grubu ise distile suda ağzı kapalı şekilde bekletildi. Pürüzlülük ölçümleri tekrarlandı. Her iki pürüzlülük değerleri arasındaki fark hesaplanarak istatistiksel ölçümler buna göre yapıldı. Gruplar arası fark hesaplanırken Shapiro-Wilk test and Paired Sample t-Test testi kullanıldı. **Bulgular:** Ferro Sanol® B ilaç grubunun en yüksek yüzey pürüzlülüğüne neden olan ilaç olarak bulundu (23,3 nm). Cappy® portakal suyu ise besin grubunun en yüksek yüzey pürüzlülüğü gösteren besini oldu (21,4 nm). SEM görüntüleri de bu

sonuçları desteklemektedir. **Sonuçlar:** Solüsyonların kompomer dolgu yüzeylerinde yüzey pürüzlülüğüne etkisi çeşitlilik sergilemekte olup, yüzey pürüzlülüğünün yanında aşınma miktarının da araştırıldığı ilave çalışmalara ihtiyaç vardır. Yüzey pürüzlülüğünü artıran solüsyonların tüketiminde daha dikkatli davranılmalıdır.

Anahtar kelimeler: Yüzey özellikleri, kompomerler, besinler, ilaç kullanma.

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