Journal of Applied Dental and Medical Sciences
NLM ID: 101671413 ISSN:2454-2288
Volume 7 Issue 3 July--September 2021
https://www.ncbi.nlm.nih.gov/nlmcatalog/101671413
www.joadms.org

Original Research

https://doi.org/10.5281/zenodo.6307338

Effect of different finishing-polishing systems and mouthwashes on biofilm adhesion to composite surfaces: An in-vitro study

Ritu Gupta [1], Sanjeev Tyagi [2], Vartul Dwivedi[3], Sneha Dole[4], Gitali Kumawat[5], Geetika Arvind Yadav[6]

[1,6] Post Graduate Student, Department of Conservative Dentistry and Endodontics, People's Dental Academy, Bhopal ,MP
[2] Dean and Prof. & Head,Department of Conservative Dentistry and Endodontics ,People's Dental Academy, Bhopal ,MP
[3] Professor, Department of Conservative Dentistry and Endodontics, People's Dental Academy, Bhopal ,MP
[4]Senior Lecturer, Dept of Conservative dentistry and Endodontics, SMBT Institute of Dental Sciences and Research, Nashik, Maharashtra
[5] Dental Surgeon and Endodontist, District Hospital-Ujjain

ARTICLE INFO

Keywords: Composite resin, polishing systems, mouthwashes, *S. mutans*, povidone iodine, chlorhexidine.

DOI:10.5281/zenodo.6307338

ABSTRACT

Background: The occurrence of bacterial adhesion on the restored teeth with composite resin is becoming the major concern for many dentists worldwide. This study was carried out in order to compare and evaluate S. mutans biofilm adherence on surface of composite resin subjected to Sof-Lex polishing and contouring system and Shofu polishing system and mouthwashes like 0.2% CHX and 7.5% povidone iodine solution (PVI). Materials and methods: Samples (n = 30) of nanohybrid composite resin were randomly divided into three groups for polishing with aluminium oxide disks, Shofu composite polishing systems and mylar strip group followed by biofilm adhesion of S. mutans on those polished discs. These discs were then randomly treated with the mouthwashes to check for their efficacy against S. Mutans. Results: Smoother surface was generated with Sof-Lex aluminum oxide disks when compared to Shofu polishing systems. There was a statistically significant difference before and after immersion in CHX and PVI ($p<0.01$). The comparison of all the groups showed the largest decrease in PVI, followed by CHX.

Introduction

The use of composite resins and resin-based materials for anterior and posterior restorations has increased dramatically in the past decade due to the clinical demand for more esthetically acceptable and long-lasting materials.[1] Bacterial adhesion to the surface of composite resins and other dental restorative materials is an important parameter in the etiology of secondary caries formation. A polished restorative surface ensures adequate esthetics and significantly reduces the risk of initial bacterial adherence and subsequent colonization.[2] Care is required during polishing since inappropriate usage can result in greater surface roughness than that existed prior to polishing. [3,4]

Streptococcus mutans adhere to the primary colonizers by cell-to cell interactions. Further bacterial growth on tooth surface leads to the formation of biofilm on the teeth, also called dental plaque.[5,6] Among the chemotherapeutic agents used in mouthwashes, chlorhexidine (CHX) is the "gold standard" for comparison with other substances due to its proven efficiency. [7] Although effective, 0.2% CHX has certain side effects such as brown discoloration of the teeth, oral mucosal erosion, and bitter taste. Hence, there is need of an alternative mouthrinse that could negate all the side effects of CHX but yet effective equivalent to it.[8,9]

Povidone iodine (PVI), on the other hand, causes relatively low irritation to the oral mucosa and has a

Corresponding author*:* Dr. Ritu Gupta, Sanskriti girls hostel, Peoples campus, Bhanpur, Bhopal- Madhya Pradesh. Pin: 462037 . Email: rituanilgupta@gmail.com , Contact number: +91-9009188914

strong sterilizing effect.[7] It is a mixture of polyvinyl pyridine and iodine, reducing iodine-related irritation, pigmentation, and allergic reactions and exhibiting the antibacterial action of iodine simultaneously. As a topical disinfectant, it is used prophylactically in the oral mucosa and is widely used as a sterilizer and mouthwash due to its oral antibiotic effect.[10,11]

Aim

1. To compare and evaluate *S. mutans* biofilm adherence on surface of composite resin subjected to Sof-Lex polishing and contouring system and Shofu polishing system
2. To compare and evaluate *S. mutans* biofilm adherence on surface of composite resin subjected to 0.2% CHX and 7.5% povidone iodine solution

Materials and Method

Samples (n = 30) of nanohybrid composite resin (Filtek Z350 3 M ESPE, St Paul, Minnesota, USA) were prepared in a circular shaped disk –6.0 mm diameter and 2.0 mm in height.The teflon molds were filled with nanohybrid composite in a single increment and were covered with Mylar matrix strip to obtain a flat surface. Samples were cured for 20 s with a curing unit (Woodpecker LED D Curing Light Curing Unit) .Samples were retrieved from the mold using a surgical blade and immersed in dark vials containing distilled water at 37°C for 24 h.

Polishing treatment

Randomly selected samples of nanohybrid composite resin were subjected to one of three finishing and polishing techniques:

- **Group A**: Control group — use of Mylar matrix strip with no finishing or polishing procedures (n = 10).
- **Group B**: Aluminum oxide disks (Sof-Lex, 3 M ESPE, MN, USA) (n = 10).
- **Group C**: Shofu composite polishing system (Shofu Dental Corporation, Japan) (n=10)

Biofilm adhesion

S. mutans (MTCC number 890) were maintained as frozen stock cultures, and cultured anaerobically at 37°C in a CO_2 jar for 2 hours. For the adherence testing in laminar flow chamber. 1.5 ml of broth and 0.1 ml of standardized *S. mutans* suspension was added to each 24-well tissue culture plate. The plates were sealed and incubated at 37°C for 24 h in a CO_2 jar.

Samples were then removed and washed thrice with a sterile physiological solution to dislodge loosely bound material. After 24 h incubation at 37°C and mean values of colony forming units (CFU) were noted. The response variable was the mean CFU/mL present in the *S mutans* biofilms formed on the composite resin surface. Data were statistically analyzed by three-way analysis of variance (ANOVA).

Evaluating Mouthwash Effects on Resin discs

During the 7-day incubation period in heart infusion broth, composite discs were subjected to immersion cycles in the selected mouth rinses

- Group A: Control group- distilled water group(n=10)
- Group B: 0.2% CHX group(n=10)
- Group C: 7.5% Povidone iodine group(n=10)

for 60 seconds once daily. Samples were mildly agitated in the test solutions using a water bath shaker operating at 10 Hz, for 20 seconds, three times, at 1-minute intervals.The amount of S. mutans was quantified. The Colony-Forming Units (CFU) were measured and quantified.The difference was calculated to measure the change in CFU

Table 1:
Mean and SD values of the CFU/ml (log10) of *Streptococcus mutans* within the biofilms

Groups	Mean±SD values	*p*
Group A (Mylar strip)	27.2±3.6	<0.01
Group B (Sof-Lex discs)	110.6±7.2	<0.01
Group C (Shofu system)	123±9.1	<0.01

Table 2:
Mean and SD values of the CFU/ml (log10) of *Streptococcus mutans* within the biofilms

Groups	Mean±SD values	*p*
Group A (Distilled water)	26.8±5.9	<0.0 1
Group B (CHX)	25.7±8.3	<0.01
Group C(Povidone Iodine)	29.9±5.2	<0.01

Table 3:
Difference in the readings from table 1 and 2 to check the reduction in *S. mutans* count before and after immersing in the mouthrinse

Group A (Distilled water)	Less difference
Group B (CHX)	Major difference but less than group C
Group C (Povidone Iodine)	Major difference

Results

The Mylar strip group showed least bacterial adhesion than the Sof-Lex and Shofu polishing groups. This difference in the mean values between the groups was found to be statistically significant ($p < 0.01$).

Smoother surface was generated with Sof-Lex aluminum oxide disks when compared to Shofu polishing systems, which was seen as higher bacterial adhesion with Shofu polishing system and a significant mean difference was revealed statistically. Mean values of CFU/mL were converted into logarithmic (log10) values and analyzed by three-way ANOVA test for significance (Table 1)

There was a statistically significant difference before and after immersion in CHX and PVI ($p<0.01$) (Table 2). There was no great change in the CFU of *S. mutans* in the distilled water group, which was not statistically significant ($p>0.01$). The comparison of all the groups showed the largest decrease in PVI, followed by CHX (Table3)

Discussion

The composite resins are exposed to diverse conditions of the oral environment, which can result in chemical degradation and reduction in physics properties, what may affect the longevity of a restoration made with these

materials. [12,13] The sorption and solubility of composite resins may serve as precursors to a variety of chemical and physical processes that not only create biological concerns but also produce deleterious effects on the structure and function of resin matrix. [14]

Although the surface obtained by using the Mylar strip is perfectly smooth, it is rich in resin organic binder. Therefore, removal of the outermost resin by finishing and polishing procedures would tend to produce a harder, more wear resistant, and hence, a more aesthetically stable surface.[15,16]

A composite finishing system is effective if the abrading particles are relatively harder than the filler materials; otherwise, the polishing agent will only remove a soft resin matrix but leave the filler particles protruding from the surface.[17] Hardness difference between silicon carbide and the silica filler particles leads to relatively more aggressive finishing and polishing with the Shofu composite polishing system than the Sof-Lex polishing system resulting in a significantly rougher surface.[18]

The specimens with the undisturbed biofilms were inoculated for an additional 7 days to observe the ability of the two mouthwashes to inhibit the progression of carious lesions. In this study, a water bath shaker was used with a moderate stroke of 10 Hz for 20 seconds three times at 1-minute intervals to simulate the gargling condition created by an adult. One of the reasons for selecting a short exposure time (10 second vortex) of our bacterial suspensions and biofilms to the mouthwashes in this study was to provide evidence that short exposure to these antibacterial agents can be remarkably effective. Short exposure times also minimize chemical biohazard concerns associated with oral antiseptic use.[19] Chlorhexidine, though it is the most widely used and recommended mouthwash, it has it's own share of disadvantages which led to the search for more efficient and feasible replacement. [20] Povidone iodine fits the criteria perfectly providing all the benefits like reduced growth of bacteria, disinfection and no disadvantages like metallic taste with prolonged usage, burning sensation in mouth and higher prices compared to the other commercially available mouthwashes.

Conclusion

The initial adherence and subsequent colonization of bacteria on the surface of composite resins are the key of the pathogenesis of the secondary caries promoted particularly by *S. mutans*. The quality and amount of adhered biofilm are important to the success of the esthetic restorations on a long-term basis. Therefore, this study observed evaluation of S. mutans adherence on polished surface of the most commonly used restorative material as well as displayed that povidone iodine mouthrinse can prove to be a better option compared to chlorhexidine gluconate to avoid secondary caries.

References

1. Rasines Alcaraz MG, Veitz-Keenan A, Sahrmann P, Schmidlin PR, Davis D, Iheozor-Ejiofor Z. Direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth. Cochrane Database Syst Rev. 2014 Mar 31;(3):CD005620.
2. Jefferies SR, Barkmeier WW, Gwinnett AJ. Three composite finishing systems: a multisite in vitro evaluation. J Esthet Dent. 1992 Nov-Dec;4(6):181-5
3. Turssi CP, Saad JR, Duarte SL Jr, Rodrigues AL Jr. Composite surfaces after finishing and polishing techniques. Am J Dent. 2000 Jun;13(3):136-8.
4. Lepri CP, Ribeiro MV, Dibb A, Palma-Dibb RG. Influence of mounthrinse solutions on the color stability and microhardness of a composite resin. Int J Esthet Dent. 2014 Summer;9(2):238-46.
5. Evans A, Leishman SJ, Walsh LJ, Seow WK. Inhibitory effects of antiseptic mouthrinses on Streptococcus mutans, Streptococcus sanguinis and

Lactobacillus acidophilus. Aust Dent J. 2015 Jun;60(2):247-54; quiz 270.

6. Jones CG. Chlorhexidine: is it still the gold standard? Periodontol 2000. 1997 Oct;15:55-62.

7. Cazzaniga G, Ottobelli M, Ionescu AC, Paolone G, Gherlone E, Ferracane JL, Brambilla E. In vitro biofilm formation on resin-based composites after different finishing and polishing procedures. J Dent. 2017 Dec;67:43-52.

8. Adams D, Addy M. Mouthrinses. Adv Dent Res. 1994 Jul;8(2):291-301.

9. Neeraja R, Anantharaj A, Praveen P, Karthik V, Vinitha M. The effect of povidone-iodine and chlorhexidine mouth rinses on plaque Streptococcus mutans count in 6- to 12-year-old school children: an in vivo study. J Indian Soc Pedod Prev Dent. 2008 Jan;26 Suppl 1:S14-8.

10. Milgrom P, Tut O, Rothen M, Mancl L, Gallen M, Tanzer JM. Addition of Povidone-Iodine to Fluoride Varnish for Dental Caries: A Randomized Clinical Trial. JDR Clin Trans Res. 2021 Apr;6(2):195-204. doi: 10.1177/2380084420922968. Epub 2020 May 21. PMID: 32437626; PMCID: PMC7970344.

11. Miranda Dde A, Bertoldo CE, Aguiar FH, Lima DA, Lovadino JR. Effects of mouthwashes on Knoop hardness and surface roughness of dental composites after different immersion times. Braz Oral Res. 2011 Mar-Apr;25(2):168-73.

12. Bagheri R, Burrow MF, Tyas M. Influence of food-simulating solutions and surface finish on susceptibility to staining of aesthetic restorative materials. J Dent. 2005 May;33(5):389-98. doi: 10.1016/j.jdent.2004.10.018. Epub 2004 Dec 9. PMID: 15833394.

13. Yap AU, Tan SH, Wee SS, Lee CW, Lim EL, Zeng KY. Chemical degradation of composite restoratives. J Oral Rehabil. 2001 Nov;28(11):1015-21. doi: 10.1046/j.1365-2842.2001.00760.x. PMID: 11722717.

14. Sideridou ID, Karabela MM, Vouvoudi ECh. Dynamic thermomechanical properties and sorption characteristics of two commercial light cured dental resin composites. Dent Mater. 2008 Jun;24(6):737-43. doi: 10.1016/j.dental.2007.08.004. Epub 2007 Sep 21. PMID: 17889316.

15. Choi MS, Lee YK, Lim BS, Rhee SH, Yang HC. Changes in surface characteristics of dental resin composites after polishing. J Mater Sci Mater Med. 2005 Apr;16(4):347-53. doi: 10.1007/s10856-005-0634-9. PMID: 15803280.

16. Jefferies SR. Abrasive finishing and polishing in restorative dentistry: a state-of-the-art review. Dent Clin North Am. 2007 Apr;51(2):379-97.

17. Dutra D, Pereira G, Kantorski KZ, Valandro LF, Zanatta FB. Does Finishing and Polishing of Restorative Materials Affect Bacterial Adhesion and Biofilm Formation? A Systematic Review. Oper Dent. 2018 Jan/Feb;43(1):E37-E52.

18. Pereira CA, Eskelson E, Cavalli V, Liporoni PC, Jorge AO, do Rego MA. Streptococcus mutans biofilm adhesion on composite resin surfaces after different finishing and polishing techniques. Oper Dent. 2011 May-Jun;36(3):311-7.

19. Aykent F, Yondem I, Ozyesil AG, Gunal SK, Avunduk MC, Ozkan S. Effect of different finishing techniques for restorative materials on surface roughness and bacterial adhesion. J Prosthet Dent. 2010 Apr;103(4):221-7.

20. de Oliveira AL, Domingos PA, Palma-Dibb RG, Garcia PP. Chemical and morphological features of nanofilled composite resin: influence of finishing and polishing procedures and fluoride solutions. Microsc Res Tech. 2012 Feb;75(2):212-9.