

## Effects Of Dentifrices On Surface Properties Of Cad - Cam Manufactured Temporary Restorative Materials

Research Article

N.E Kaviya<sup>1</sup>, Karthickraj S.M<sup>2\*</sup>

<sup>1</sup>Student, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai- 77, India.

<sup>2</sup>Senior Lecturer, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences [SIMATS], Saveetha University, Chennai- 77, India.

### Abstract

**Aim:** The aim of the study is to find the effects of dentifrices on surface properties of Computer-aided design and computer-aided manufacturing (CAD-CAM) temporary restorative materials.

**Materials and Methods:** 12 printed Poly methyl methacrylate (PMMA) blocks were collected from the CAD-CAM centre. Blocks were mounted on the die stone and 4 types of dentifrices were used for the novel technique in this study. The preparation surface roughness was taken using a stylus profilometer then the blocks were placed in the brushing stimulator (Tooth-brush stimulator ZM3.8) and readings were taken again after cycles for 1 month and 3 months.

**Results and Discussion:** Results show that there is no significant difference in the surface roughness of the PMMA blocks before and after brushing with different dentifrices for 1 month and 3 months cycles. Anova values show no significance among the Roughness average (Ra), Root mean square roughness (Rq) and arithmetic mean value of the single roughness depths of consecutive sampling length (Rz) values of preoperative, 1 month and 3 months.

**Conclusion:** The study concludes that different dentifrices have no significant changes in the surface properties of the CAD-CAM manufactured PMMA blocks.

**Keywords:** Dentifrices; Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM); Poly Methyl Methacrylate (PMMA); Surface Properties; Novel Technique.

### Introduction

A restoration that is used as a temporary or a permanent solution should have a good abrasive resistance [1]. Abrasive wear occurs mainly during the process of mastication and cleaning the tooth mechanically using toothbrushes, maintaining poor dental hygiene and decreased saliva production may lead to high plaque accumulation and cause stomatitis and oral candidiasis [2]. Tooth brushing is one of the common causes for the abrasion of the tooth surface and the restorative materials due to the mechanical process of mastication in the occlusal surface. The tooth brushing affects the roughness measurements and the gloss of the restorative material [3]. Many studies show that the stimulation of the brushing leads to the decrease in the life span of the restora-

tive materials as they produce changes in the surface properties of the restorative material [4].

A wide integration of computer aided design (CAD) and computer aided manufacturing (CAM) in dentistry, an increasingly large number of novel technical and clinical protocols have been introduced for provisional restorations manufacturing in a digital workflow [5]. The CAD-CAM aided monolithic materials are preferred as they reduce the time of manufacturing and decrease the number of appointments [6]. The need for polishing any CAD-CAM manufactured restorative materials is to eliminate the surface defects caused by the machine and to reduce the surface roughness on the external surface of the restorative material [7].

Restoration in the field of dentistry is very important and on a

#### \*Corresponding Author:

Dr Karthickraj S.M,

Senior Lecturer, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences [SIMATS], Saveetha University, Chennai 600 077, Tamil Nadu, India.

Tel: 9840094540

E-mail: karthickrajasm.sdc@saveetha.com

**Received:** September 13, 2021**Accepted:** September 22, 2021**Published:** September 23, 2021

**Citation:** N.E Kaviya, Karthickraj S.M. Effects Of Dentifrices On Surface Properties Of Cad - Cam Manufactured Temporary Restorative Materials. *Int J Dentistry Oral Sci.* 2021;8(9):4549-4552. doi: <http://dx.doi.org/10.19070/2377-8075-21000926>

**Copyright:** Dr Karthickraj S.M.©2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

base for the permanent restoration or solution there is a need for temporary restorations. Restoration materials on their chemical composition can be divided into monomethacrylate or acrylic resins, which include polymethylmethacrylate (PMMA) and poly ethyl/butyl methacrylate (PEMA) [8]. (PMMA) Polymethylmethacrylate is an amorphous thermoplastic which is derived from methylmethacrylate by the process of addition polymerization. This material has many purposes and serves good for restoration but has poor scratch resistance [9]. PMMA is preferred in the restorative field for its lightweight, transparency, low cost [10] and they even produce low oxidative stress which reduces the incidence of periodontitis. PMMA has also shown its side effects like COVID-19 on the cardiovascular system by inducing hypotension and bradycardia. A wide variety of pre-polymerised polymethyl methacrylate (PMMA) blocks have been introduced on the market based on further studies related with nanoparticles and data was produced on surface roughness [11]. Our team has extensive knowledge and research experience that has translated into high quality publications [12-24, 25-31].

The aim of this study was to find the effects of dentifrices on surface properties of CAD-CAM temporary restorative materials which are the PMMA blocks.

## Materials and Methods

12 printed PMMA blocks were collected from the CAD-CAM centre. Blocks were mounted on the die stone and 4 types of dentifrices were used for the study. The surface roughness was calculated pre and post brushing using a stylus profilometer. The

Ra, Rq and Rz values were calculated. Ra-Roughness average, Rq- Root mean square roughness, Rz- The arithmetic mean value of the single roughness depths of consecutive sampling lengths. The surface roughness readings before the stimulation was taken then the blocks were placed in the brushing stimulator -Toothbrush stimulator ZM3.8. A total of 2500 cycles were done from which for 1 month 834 cycles were done in linear motion. 1666 cycles were done from 3 months stimulation which includes 833 linear motion and 833 as clockwise 433 cycles and anti-clockwise 400 cycles. Readings of the Ra, Rq and Rz values were taken after cycles for 1 month and 3 months using a stylus profilometer and the readings were recorded accordingly for obtaining the results and graphs.

## Results and Discussion

Results show that there is no significant difference in the surface roughness of the PMMA blocks before and after brushing with different dentifrices for 1 month and 3 months cycles. At 1 month, 1 and At 3rd month, 0.441. The Ra mean p value shows preoperative, 0.16; At 1 month, 1 and At 3rd month, 0.441 shown in graph 1. The Rq mean p value shows preoperative, 0.441; At 1 month, 0.33 and At 3rd month, 0.33 shown in graph 2. The Rz mean p value shows preoperative, 2.437; At 1 month, 1.245 and At 3rd month, 2.014 shown in graph 3. that the Anova values show no significance among the Ra, Rq and Rz values of preoperative, 1 month and 3 months and the P value also no significant difference in the Ra, Rq and Rz values of the preoperative, 1 month and 3 months. These results showed that there is no significant difference on the PMMA blocks based on the type of dentifrices

Figure1. Shows the brushes and the toothpaste used for the study.



Figure 2. Shows the Stylus profilometer that was used for analysing the surface property of the restorative material.



Figure 3. Shows the Brushing stimulator-Toothbrush stimulator ZM3.8 that was used for stimulating the brushing techniques on the restorative material.



Table 1. Represents the mean values of the Ra, Rq and Rz values of the different types of dentifrices.

Dentifrices	RaPre	Ra1Mo	Ra3Mo	RqPre	Rq1Mo	Rq3Mo	RzPre	Rz1Mo	Rz3Mo
Dabur red	0.005	0.005	0.004	0.008	0.006	0.005	0.006	0.064	0.043
Meswak	0.005	0.005	0.004	0.008	0.006	0.005	0.072	0.065	0.042
Sensodyne	0.006	0.005	0.004	0.008	0.006	0.005	0.074	0.07	0.052
Colgate	0.006	0.005	0.004	0.007	0.006	0.005	0.071	0.008	0.032

Figure 4. Shows the mean Ra values preoperative in which X the axis represents the type of dentifrices and the Y axis represents the test value. At 1st month and At 3rd month. Anova values Ra Pre-2.25 and 1 month-1. P values Ra Pre-0.16 and Ra 1 month-0.441. (Ra Pre p value - 0.16;  $p > 0.05$ ) and (Ra 1 month p value - 0.441;  $p > 0.05$ ) Hence the changes in Ra value did not differ significantly as the p value was not statistically significant.

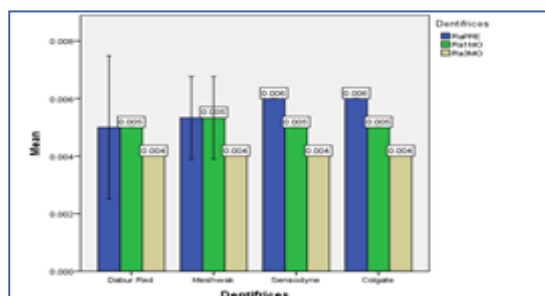


Figure 5. Shows the mean Rq values preoperative in which the X axis represents the type of dentifrices and Y the axis represents the test value. 1st month and At 3rd month. Anova values Rq Pre-1, 1 month-1.333 and 3 months-1.333. P value RqPre-0.441, 1 month-0.33 and 3 months-0.33. (Rq Pre p value - 0.441;  $p > 0.05$ ), (Rq 1 month p value - 0.33;  $p > 0.05$ ) and (Rq 3 month p value - 0.33;  $p > 0.05$ ) Hence the changes in Rq value did not differ significantly as the p value was not statistically significant.

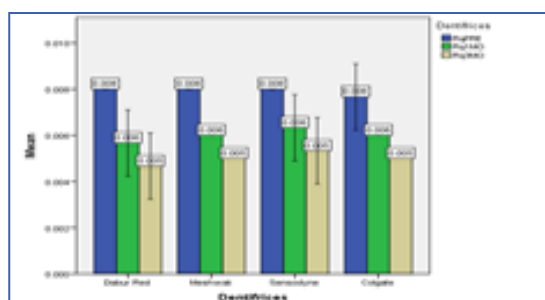
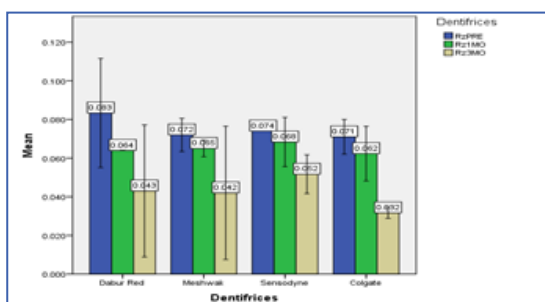


Figure 6. Shows the mean Rz values preoperative in which the X axis represents the type of dentifrices and the Y axis represents the test value. 1st month and At 3rd month. Anova values RzPre-2.437, 1 month-1.245 and 3 months-2.014. P value RzPre-0.136, 1 month-0.356 and 3 months-0.191. P(RzPre p value - 0.136;  $p > 0.05$ ), (Rz 1 month p value - 0.356;  $p > 0.05$ ) and (Rz 3 month p value - 0.191;  $p > 0.05$ ) Hence the changes in Rz value did not differ significantly as the p value was not statistically significant.



used on analysing the surface roughness for about three months before and after the mechanical process of brushing.

The PMMA blocks used in the study did not have any significance of changes in the preoperative, 1 month and 3rd month surface properties. Previous studies show that surface properties of monolithic CAD/CAM restorative materials were differently affected by the abrasive toothbrushing and storage media [32]. The surface roughness values of all tested materials were below

the plaque accumulation threshold [33]. The provisional materials prepared in the CAD/CAM have better mechanical properties for the clinical application compared to conventional materials [34].

### Conclusion

Under the limitation of the study, it can be concluded that different types of dentifrices had no significant changes in the surface properties of the CAD-CAM manufactured PMMA blocks.

There is a need for larger study sample to get a better understanding of these properties in further studies.

## Acknowledgement

I would like to thank the Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University.

## Source of Funding

The present project is funded by

- Saveetha Dental College and Hospitals,
- Saveetha Institute of Medical and Technical Sciences,
- Saveetha University
- BOSS Healthcare, Chennai

## References

- [1]. Heath JR, Wilson HJ. Abrasion of restorative materials by toothpaste. *Journal of Oral Rehabilitation*. 1976 Apr;3(2):121-38.
- [2]. Kraemer Fernandez P, Unkovskiy A, Benkendorff V, Klink A, Spintzyk S. Surface characteristics of milled and 3D printed denture base materials following polishing and coating: An in-vitro study. *Materials*. 2020 Jan;13(15):3305.
- [3]. Mörmann WH, Stawarczyk B, Ender A, Sener B, Attin T, Mehl A. Wear characteristics of current aesthetic dental restorative CAD/CAM materials: two-body wear, gloss retention, roughness and Martens hardness. *J Mech Behav Biomed Mater*. 2013 Apr;20:113-25. Pubmed PMID: 23455168.
- [4]. Heintze SD, Forjanic M, Ohmiti K, Rousson V. Surface deterioration of dental materials after simulated toothbrushing in relation to brushing time and load. *Dent Mater*. 2010 Apr;26(4):306-19. Pubmed PMID: 20036418.
- [5]. Kapos T, Ashy LM, Gallucci GO, Weber HP, Wismeijer D. Computer-aided design and computer-assisted manufacturing in prosthetic implant dentistry. *Int. J. Oral Maxillofac. Implants*. 2009 Oct 2;24: 110-7.
- [6]. Fasbinder DJ. Materials for chairside CAD/CAM restorations. *Compend Contin Educ Dent*. 2010 Nov 1;31(9):702-4.
- [7]. Teughels W, Van Assche N, Sliopen I, Quirynen M. Effect of material characteristics and/or surface topography on biofilm development. *Clin. Oral Implants Res*. 2006 Oct;17(S2):68-81.
- [8]. Astudillo-Rubio D, Delgado-Gaete A, Bellot-Arcís C, Montiel-Company JM, Pascual-Moscardó A, Almerich-Silla JM. Correction: Mechanical properties of provisional dental materials: A systematic review and meta-analysis. *PLoS One*. 2018 Apr 17;13(4):e0196264. Pubmed PMID: 29664965.
- [9]. Bodurov I, Vlaeva I, Yovcheva T, Dragostinova V, Sainov S. Surface properties of PMMA films with different molecular weights. *Bulg. Chem. Commun*. 2013 Jan 1;45:77-80.
- [10]. Padilha GD, Giacon VM, Bartoli JR. Effect of solvents on the morphology of PMMA films fabricated by spin-coating. *Polímeros*. 2017 Sep 21;27:195-200.
- [11]. Alp G, Johnston WM, Yilmaz B. Optical properties and surface roughness of prepolymerized poly (methyl methacrylate) denture base materials. *J Prosthodont*. 2019 Feb 1;121(2):347-52.
- [12]. Subramanyam D, Gurunathan D, Gaayathri R, Vishnu Priya V. Comparative evaluation of salivary malondialdehyde levels as a marker of lipid peroxidation in early childhood caries. *Eur J Dent*. 2018 Jan-Mar;12(1):67-70. Pubmed PMID: 29657527.
- [13]. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJ. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. *Clinical oral investigations*. 2019 Sep;23(9):3543-50.
- [14]. Ramakrishnan M, Dhanalakshmi R, Subramanian EMG. Survival rate of different fixed posterior space maintainers used in Paediatric Dentistry - A systematic review. *Saudi Dent J*. 2019 Apr;31(2):165-172. Pubmed PMID: 30983825.
- [15]. Jeevanandan G, Thomas E. Volumetric analysis of hand, reciprocating and rotary instrumentation techniques in primary molars using spiral computed tomography: An in vitro comparative study. *Eur J Dent*. 2018 Jan-Mar;12(1):21-26. Pubmed PMID: 29657521.
- [16]. Princeton B, Santhakumar P, Prathap L. Awareness on Preventive Measures taken by Health Care Professionals Attending COVID-19 Patients among Dental Students. *Eur J Dent*. 2020 Dec;14(S 01):S105-S109. Pubmed PMID: 33321549.
- [17]. Saravanakumar K, Park S, Mariadoss AVA, Sathiyaseelan A, Veeraraghavan VP, Kim S, et al. Chemical composition, antioxidant, and anti-diabetic activities of ethyl acetate fraction of *Stachys riederi* var. *japonica* (Miq.) in streptozotocin-induced type 2 diabetic mice. *Food Chem Toxicol*. 2021 Sep;155:112374. Pubmed PMID: 34186120.
- [18]. Wei W, Li R, Liu Q, Seshadri VD, Veeraraghavan VP, Mohan SK, et al. Amelioration of oxidative stress, inflammation and tumor promotion by Tin oxide-Sodium alginate-Polyethylene glycol-Allyl isothiocyanate nanocomposites on the 1, 2-Dimethylhydrazine induced colon carcinogenesis in rats. *Arab. J. Chem*. 2021 Jun 3;14(8):103238.
- [19]. Gothandam K, Ganesan VS, Ayyasamy T, Ramalingam S. Antioxidant potential of theaflavin ameliorates the activities of key enzymes of glucose metabolism in high fat diet and streptozotocin - induced diabetic rats. *Redox Rep*. 2019 Dec;24(1):41-50. Pubmed PMID: 31142215.
- [20]. Su P, Veeraraghavan VP, Krishna Mohan S, Lu W. A ginger derivative, zingerone-a phenolic compound-induces ROS-mediated apoptosis in colon cancer cells (HCT-116). *J Biochem Mol Toxicol*. 2019 Dec;33(12):e22403. Pubmed PMID: 31714660.
- [21]. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. *Clin Oral Investig*. 2020 Sep;24(9):3275-3280. Pubmed PMID: 31955271.
- [22]. Sekar D, Johnson J, Biruntha M, Lakhmanan G, Gurunathan D, Ross K. Biological and clinical relevance of microRNAs in mitochondrial diseases/dysfunctions. *DNA Cell Biol*. 2020 Aug 1;39(8):1379-84.
- [23]. Velusamy R, Sakthianathan G, Vignesh R, Kumarasamy A, Sathishkumar D, Priya KN, et al. Tribological and thermal characterization of electron beam physical vapor deposited single layer thin film for TBC application. *Surf Topogr: Metrol Prop*. 2021 Jun 24;9(2):025043.
- [24]. Aldhuwayhi S, Mallineni SK, Sakhamuri S, Thakare AA, Mallineni S, Sajja R, et al. Covid-19 Knowledge and Perceptions Among Dental Specialists: A Cross-Sectional Online Questionnaire Survey. *Risk Manag Healthc Policy*. 2021 Jul 7;14:2851-2861. Pubmed PMID: 34262372.
- [25]. Sekar D, Nallaswamy D, Lakshmanan G. Decoding the functional role of long noncoding RNAs (lncRNAs) in hypertension progression. *Hypertens Res*. 2020 Jul;43(7):724-725. Pubmed PMID: 32235913.
- [26]. Bai L, Li J, Panagal M, M B, Sekar D. Methylation dependent microRNA 1285-5p and sterol carrier proteins 2 in type 2 diabetes mellitus. *Artif Cells Nanomed Biotechnol*. 2019 Dec;47(1):3417-3422. Pubmed PMID: 31407919.
- [27]. Sekar D. Circular RNA: a new biomarker for different types of hypertension. *Hypertens Res*. 2019 Nov;42(11):1824-5.
- [28]. Sekar D, Mani P, Biruntha M, Sivagurunathan P, Karthigeyan M. Dissecting the functional role of microRNA 21 in osteosarcoma. *Cancer Gene Ther*. 2019 Jul;26(7-8):179-182. Pubmed PMID: 30905966.
- [29]. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Navarasampatti Sivaprakasam A. Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments. *Implant Dent*. 2019 Jun;28(3):289-295. Pubmed PMID: 31124826.
- [30]. Parimelazhagan R, Umapathy D, Sivakamasundari IR, Sethupathy S, Ali D, Kunka Mohanram R, et al. Association between Tumor Prognosis Marker Visfatin and Proinflammatory Cytokines in Hypertensive Patients. *Biomed Res Int*. 2021 Mar 16;2021:8568926. Pubmed PMID: 33816632.
- [31]. Syed MH, Gnanakkan A, Pitchiah S. Exploration of acute toxicity, analgesic, anti-inflammatory, and anti-pyretic activities of the black tunicate, *Phallusia nigra* (Savigny, 1816) using mice model. *Environ Sci Pollut Res Int*. 2021 Feb;28(5):5809-5821. Pubmed PMID: 32978735.
- [32]. Şen N, Tuncelli B, Göller G. Surface deterioration of monolithic CAD/CAM restorative materials after artificial abrasive toothbrushing. *J Adv Prosthodont*. 2018 Aug;10(4):271-278. Pubmed PMID: 30140393.
- [33]. Kamonkhantikul K, Arksornnukit M, Lauvahunon S, Takahashi H. Toothbrushing alters the surface roughness and gloss of composite resin CAD/CAM blocks. *Dent Mater J*. 2016;35(2):225-32. Pubmed PMID: 27041012.
- [34]. Jeong KW, Kim SH. Influence of surface treatments and repair materials on the shear bond strength of CAD/CAM provisional restorations. *J Adv Prosthodont*. 2019 Apr;11(2):95-104. Pubmed PMID: 31080570.