



Comparative Evaluation of Surface Roughness of Centon N after Brushing Simulation with Herbal and Fluoridated Toothpaste - An *In-vitro* Study

N. Mohamed Arsath ^a, S. Balaji Ganesh ^{b*} and S. Jayalakshmi ^b

^a Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600077, India.

^b White Lab-Material Research Centre, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600077, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Centon N, a new alternative tooth coloured resin based filling material. Toothbrushing abrasion is a key issue in restorative dentistry. A smooth surface is a crucial factor to be considered for establishing a successful restoration because the surface roughness of a restorative material results in plaque deposition, discoloration of the restoration, microleakage and secondary caries. The present study aims in evaluating the surface roughness of Centon N before and after brushing with herbal toothpaste and fluoridated toothpaste.

Materials and Methods: A total of 8 Centon N samples were prepared and randomly divided into two groups into 2 groups as Group A- herbal toothpaste(n=4), Group B- fluoridated toothpaste(n=4). The samples were placed in a brushing simulator for 30000 cycles and their surface roughness was evaluated by using stylus profilometer-Mitutoyo SJ 310 and with the results collected a statistical analysis was performed using the statistical software "SPSS VERSION 23" and its results are demonstrated in the form of bar graph.

Results: The Ra values of both the samples before and after brushing simulation was constant and only the Rq and Rz values showed difference between the groups. There was no notable changes in surface roughness parameters between the groups. The statistical "paired t test" analysis depicts that the p value for Rz parameter was 0.359 which is ($p < 0.05$), hence statistically insignificant.

*Corresponding author: E-mail: balajiganeshs.sdc@saveetha.com;

Conclusion: Brushing simulation did not influence the surface roughness of Cention N restorative material. There was no significant increase or decrease in surface roughness values after brushing simulation which indicates cention N material can withstand abrasive forces, but the results can vary in oral cavity environment.

Keywords: Brushing simulator; Cention N; innovative measurement; surface roughness; toothpaste.

1. INTRODUCTION

Cention N, an alternative tooth coloured restorative material developed by “ivoclar vivadent” [1]. Cention N is a filler technology based material belonging to the “Alkaside” family, the patented filler used increases the release hydroxide ions and regulates the PH value during acid attacks. Cention N possesses benefits such as high flexural strength compared to other restorative materials and it is also an economical material [2,3]. Cention N high flexural strength is derived from a highly cross-linked polymer structure. Cention N consists of a separately packed powder and liquid. The powder contains various glass fillers, initiators, pigments and the liquid part consists of dimethacrylates and initiators [3,4].

The resin/monomer technology of Cention N consist of four different dimethacrylates such as UDMA (urethane dimethacrylate), DCP (Tricyclodecane-dimethanol dimethacrylate), Aromatic aliphatic-UDMA and polyethylene glycol 400 dimethacrylate(PEG-400 DMA) [5,6]. The main component of the monomer matrix UDMA exhibits viscosity and imparts strong mechanical properties to the material, DCP enables the hand mixing of Cention N, the hydrophilic character also promotes Cention N ability to wet tooth substrate and adapt to the smear layer [7]. The filler technology of Cention N imparts adequate strength to withstand the stresses and strains of the oral cavity. The filler system consists of Barium aluminium silicate glass, Ytterbium trifluoride, isofiller, calcium barium aluminium fluorosilicate glass and calcium fluoride silicate glass [8].

Brushing simulator, a mechanical device which can simulate various brushing movements. A maximum of 8 samples made of different materials in different forms with different load and different contact angle is simultaneously exposed to abrasion. The simulator device uses a central drive system to control all the brushes placed and to perform a high grade motion with speed from 1 mm/s to 60mm/s [9].

Toothbrushing abrasion is a key issue in restorative dentistry. Brushing can expose the filler particles and cause them to loosen due to continuous wearing leading to abrasion of the surface of restorative materials. A smooth surface is a crucial factor to be considered for establishing a successful restoration because the surface roughness of a restorative material results in plaque deposition, discoloration of the restoration, microleakage and secondary caries [10,11].The current study aims at analysing the surface roughness of Cention N before and after brushing simulation with herbal and fluoridated toothpaste.

2. MATERIALS AND METHODS

2.1 Sample Preparation

Cention N restorative material is available in a pack of powder and liquid component. Powder contains Calcium-barium-aluminium fluoro-silicate glass, iso fillers and initiators. Liquid contains dimethacrylate. Eight disc shaped samples of alkaside restorative material Cention N brand with 2 mm of thickness were prepared using a customised mould (Fig. 1). The samples were subdivided into two groups with 4 samples in each group. Group A was tested for the surface roughness with herbal toothpaste (Dabur red) and group B was tested for the surface roughness with fluoridated toothpaste (Colgate).

2.2 Brushing Simulator

Eight disc shaped samples were placed in a brushing simulator (ZM3.8 SD Mechatronik). The samples are subjected to 9 hours of brushing which is equal to around three years of brushing and to around 30000 cycles in total among which 10000 cycles were performed in the linear X axis, 10000 cycles in the linear Y axis and the last 10000 were further subdivided and 5000 cycles were performed in the clockwise direction and the remaining 5000 cycles in the anti-clockwise direction. For long term evaluation of variations in surface roughness and abrasion property of the cention N restorative material, the brushing simulation was done for 30000 cycles (Fig. 2)

2.3 Surface Roughness Assessment

The surface roughness assessment of the prepared Cention N circular discs samples were done prior to brushing simulation and post brushing simulation using a Stylus profilometer - Mitutoyo SJ 310. It has 2µm tip/60°angle, the device was moved physically on the surface of the cention N sample material to obtain the surface roughness values prior to brushing. After obtaining the surface roughness value, the Cention N circular disc samples were placed in the brushing simulator. The surface roughness

value after brushing simulation was again determined using the stylus profilometer. (Fig. 3)

2.4 Statistical Analysis

The surface roughness value prior and after performing brushing simulation were obtained and the values were tabulated, with the tabulated values descriptive analysis "Paired t test" was performed using the statistical software "SPSS version 23" and the result of the analysis carried out was depicted in the form of bar graphs.



Fig. 1. The image shows the 8 samples prepared using Cention N restorative material



Fig. 2. The image shows the samples placed in the brushing simulator



Fig. 3. Represents the stylus profilometer used to obtain the values of surface roughness

3. RESULTS AND DISCUSSION

The current study focused on analysing the surface roughness of an alcasite restorative material before and after brushing simulation for around 30000 cycles which is almost equal to a mean brushing of around 3 years of period. Table 1 shows the tabulated values of pre and post Ra,Rq,Rz recorded using the stylus profilometer. The Ra values of both the samples before and after brushing simulation was

constant and only the Rq and Rz values showed difference between the groups. There was no notable changes in surface roughness parameters between the groups. The statistical “paired t test” analysis depicts that the p value for Rz parameter was 0.359 which is ($p < 0.05$), hence statistically insignificant. (Table 2, Fig. 4) The results of the statistical analysis depicts clearly that there is no significant difference between both the groups.

Table 1. It depicts the values of surface roughness of the Cention N material before and after brushing simulation

Sample	Surface roughness value before brushing simulation			Surface roughness value after brushing simulation		
	R _a	R _q	R _z	R _a	R _q	R _z
sample 1	0.005	0.007	0.071	0.003	0.004	0.029
sample 2	0.005	0.006	0.057	0.003	0.004	0.028
sample 3	0.005	0.006	0.053	0.003	0.004	0.027
sample 4	0.006	0.008	0.072	0.003	0.004	0.029
sample 5	0.006	0.007	0.074	0.003	0.004	0.028
sample 6	0.005	0.006	0.063	0.003	0.004	0.027
sample 7	0.005	0.006	0.056	0.003	0.004	0.028
sample 8	0.005	0.007	0.067	0.003	0.004	0.028

Table 2. Significance testing among the groups

		Mean	std deviation	significance
Ra parameter	Herbal toothpaste group samples	0.00225	0.000500	1.000
	Fluoridated toothpaste samples	0.00225	0.000500	
Rq parameter	Herbal Toothpaste Samples	0.00275	0.000957	0.267
	Fluoridated Toothpaste samples	0.00250	0.000577	
Rz parameter	Herbal Toothpaste Samples	0.03500	0.008756	0.359
	Fluoridated Toothpaste Samples	0.03725	0.007455	

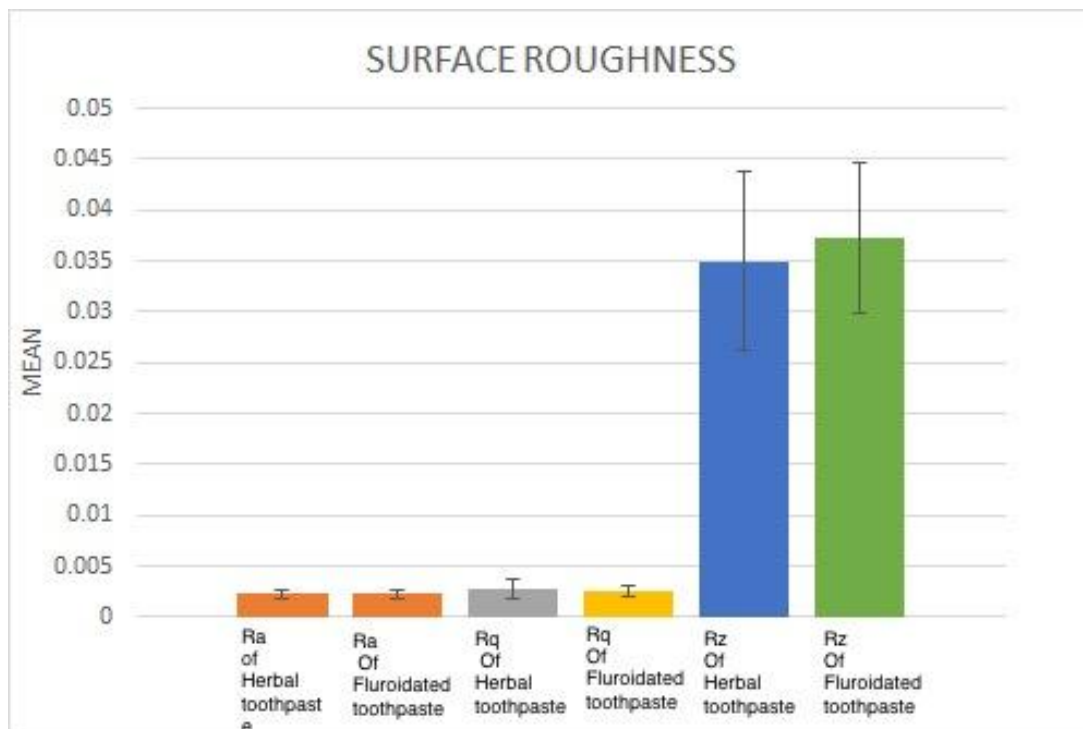


Fig. 4. The bar graph above shows the surface roughness values of cention N material before and after brushing simulation. The x axis represents the Cention N samples and Y axis represents the mean of Ra, Rq and Rz values. Rz values alone slightly increased in the fluoridated toothpaste group. P value is 0.359<0.05, hence statistically insignificant

Cention N, an esthetic alternative tooth coloured resin based filling material with a highly cross-linked polymer structure which imparts high flexural strength to the material. Cention N is claimed to be less time consuming material since it can be used without the application of any primer or varnish. Previous in-vitro study conducted by Nagesh J et.al to compare and analyse the surface roughness of Cention N material with Filtek z350XT concluded that there was a significant difference in the mean surface

roughness between the groups in their study and the study finding finally concluded that the novel material. Cention N possesses a higher value of surface roughness compared to the other materials [12].

Similarly a previous study conducted by Park C et.al to compare and analyse the surface roughness and microbial adhesion of Cention N found that the finishing of Cention N specimens caused a significant decrease in the surface

roughness and it also concluded that Cention N showed lower microbial adhesion [13]. Still more studies are needed to possibly give a proper conclusion on the properties claimed by the manufacturer. A study conducted by Chowdhury et.al analysed the surface roughness of composite and Cention N by using a dentifrice and automated tooth brushing stimulation. They discovered that the surface roughness possessed by the Cention N material was less compared to other groups tested in the study. The current study findings depict that the surface roughness of Cention N decreases after brushing stimulation [14]

Our team has extensive knowledge and research experience that has translated into high quality publications [15-34]. The current study within the limitations demonstrated the surface roughness of cention N before and after brushing stimulation but still the study analysed the surface roughness of only one product by simulating brushing between herbal and fluoridated toothpaste and sample size was less. Future studies which compare and analyse the surface roughness, studies which deal with multiple parameters in different types of restorative materials are also required to prove the clinical efficacy of the material. Future in-vitro,in- vivo,ex- vivo studies should be performed to use Cention N as an alternative restorative material instead of amalgam or composite resin.

4. CONCLUSION

It can be concluded that no significant changes were observed in surface roughness of Cention N samples before and after brushing simulation with herbal toothpaste and fluoridated toothpaste. Brushing simulation did not influence the surface roughness of Cention N restorative material. There was no significant increase or decrease in surface roughness values after brushing simulation which indicates cention N material can withstand abrasive forces, but the results can vary in oral cavity environment.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by

the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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