ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 3, Issue – 4, August - 2020, Page No. : 355 - 360

Comparative evaluation of change in microhardness of demineralized enamel underneath bio-smart pit and fissure sealants.

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Citation of this Article: Dhanshri S Khade, Swapnil Taur, Shashikiran N.D, Savita Hadakar, Sachin Gugawad, Namrata Gaonkar, Pooja N Mapara, "Comparative evaluation of change in microhardness of demineralized enamel underneath bio-smart pit and fissure sealants", IJDSIR- August - 2020, Vol. – 3, Issue -4, P. No. 355 – 360.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Pit and fissures are difficult to clean because of plaque retentive nature. The use of pit and fissure sealants is necessary to protect the pit and fissures from caries. Sealant application is a minimal invasive approach involving the introduction of sealants into the pits and fissures of caries prone teeth.

Aim: To evaluate the change in microhardness of demineralized enamel underneath bio-smart pit and fissure sealants.

Method: Forty five freshly extracted non-carious posterior teeth were collected from the dental clinics and roots of the teeth were resected perpendicular to the long axis of the tooth with diamond disk. With the help of

tapered fissure bur (1 mm) fissurectomy were done. Samples were stored in demineralizing solution for 5 days. Samples were randomly divided into 3 Different groups , Group 1 was Clinpro 3M , Group 2 was Ultradent ultraseal XT plus, Group 3 was Embrace ™ wetbond.™ After demineralization pit and fissure sealants were applied into prepared fissures. Samples were subjected to pH cycling. Teeth were sectioned bucco-lingualy on 3rd, 7th, 15th, 30th, 45th, 60th day. Samples were mounted in acrylic and polished as per recommendation for microhardness test. Surface microhardness was measured at three different points around the applied pit and fissure sealants on enamel surface by Vickers microhardness tester for each specimen. Data were statistically analyzed using one- way analysis of variance (ANOVA) test. **Result:** The values were recorded as Vickers hardness number (VHN).The values obtained were statistically analyzed. One way ANOVA was done to compare between the three groups. For all days, there was significant difference between three groups ($p<0.05$). **Conclusion:** Ultradent ultraseal XT plus hydrophilic sealant and Embrace ™ wetbond ™ with remineralizing ability may provide additional protection against pit and fissure caries formation.

Keywords: Pit and fissure sealant, Ultradent Ultraseal XT plus, Clinpro 3M, Vickers hardness number, Analysis of variance.

Introduction

Dental caries is a multifactorial disease caused by alteration in the composition of the bacterial biofilm, leading to an imbalance between the demineralization and remineralization processes and manifested by the formation of caries lesions in primary and permanent dentition. Incidence of caries decreases with the use of The community water fluoridation, topical fluoride therapy, plaque control and dietary sugar control which act as preventive approaches, which in turn had a greater effect on smooth surface carious lesion reduction[1]. Smooth surface caries are less susceptible to caries than pits and fissures. Pit and fissures are difficult to clean because of plaque retentive nature. The use of pit and fissure sealants is necessary to protect the pit and fissures from caries[2]. Sealant application is a minimal invasive approach involving the introduction of sealants into the pits and fissures of caries prone teeth; this sealant then bonds to the tooth, act as a physical barrier that keeps bacteria away from their source of nutrients. Emerging bio smart pit and fissure sealants like Clinpro 3M, Ultraseal XT plus hydrophilic sealant and Embrace ™ wetbond ™ with remineralizing ability may provide additional protection against caries formation. Clinpro 3M contains BIS-GMA, TEGDMA, colorants, initiators and this sealant has ability to release fluoride, Filled 6% by weight with amorphous silica. Clinpro sealant is Pink in colour but changes to opaque light yellow when cured and this will helped to ensure all pits and fissures were sealed. Ultraseal Xt plus releases fluoride and it is radiopaque. Flows well into pits and fissures. However, due to application with the Inspiral tips, it doesn't seem runny intraorally, since you can control the amount dispensed very precisely. Embrace ™ wetbond contains di-, tri- and multi-functional acrylate monomers in what is being called Resin Acid-Integrating Network (R.A.I.N.), which is presumably very hydrophilic. The material is supposed to be activated in the presence of moisture and is recommended for use on surfaces that are slightly moist. Hence it's a need to evaluate and compare these bio smart pit and fissure sealants to emphasize the modern approach of dental decay in line with principles of preventive strategies in the form of remineralization by using microhardness test.

Materials and Methods

Forty five freshly extracted non-carious posterior teeth were collected from the dental clinics and stored in 0.1% thymol, to inhibit bacterial growth. Teeth with caries, cracks on buccal and lingual surfaces and hypo-mineralized surface were excluded from the study.

Specimen preparation and microhardness test

The roots of the teeth were resected perpendicular to the long axis of the tooth with diamond disk. Varnish was applied on all the crown structure except 2 mm around the pit and fissure areas of the teeth. With the help of tapered fissure bur (1 mm) fissurectomy were done. Samples were stored in demineralizing solution for 5 days. Samples were randomly divided into 3 Different groups , Group 1 was Clinpro 3M , Group 2 was Ultradent ultraseal XT plus, Group 3 was Embrace ™ wetbond.™ After demineralization pit and fissure sealants were applied into prepared fissures. Samples were subjected to pH cycling. Teeth were sectioned bucco-lingualy on 3rd, 7th, 15th, 30th, 45th, 60th day. Samples were mounted in acrylic and polished as per recommendation for microhardness test (Fig-1). Surface microhardness were measured at three different points around the applied pit and fissure sealants by Vickers microhardness tester in Vickers' units by applying 300 gm of force for 15 seconds. The hardness were measured at 100 µm away from pit and fissure sealant and then the average of the three readings was calculated for the surface microhardness value (Fig-2).

Statistical analysis

Data entry was done in Microsoft Excel. The values were recorded as Vickers hardness number (VHN).The values obtained were statistically analyzed using computer software Instat demo version software. The data were expressed with the mean and standard deviation. One-way analysis of variance (ANOVA) was applied for statistical analysis. P value less than 0.05 ($P < 0.05$) was considered to be statistically significant at 95% confidence interval.

Results

One way ANOVA was done to compare between the three groups. For all days, there was significant difference between three groups ($p<0.05$). Post hoc test was done to find out in which pair of groups there was difference. It was found that there was difference in Group 1 with Group 2 and Group 1 with Group 3. Group 2 shows higher surface microhardness value even after 60 days as compared to Group 1 and Group 3. Repeated measures ANOVA was done to check whether there was difference in days for particular group. It revealed no significant difference.

Discussion

Caries occurrence in the pits and fissures of the occlusal surface of molars is responsible for about 67–90% of caries in children from 5 to 17 years of age. Caries frequently occurs on these surfaces, and progression of the lesion can occur quite rapidly because the pits and fissures predispose occlusal surfaces to decay. Fissure enlargement using a bur enhances retention by allowing deeper penetration of the sealant and increasing the surface available for bonding. Moreover, it removes the outermost prismless layer of enamel described as 'coral-like' by Garcia godoy and gwinett. In this study, the Fissurotomy Micro STF bur was used, which are designed for recontouring fissures and accessing decay with minimal enamel removal. These are fast cutting, yet conservative during preparation. These are specifically indicated for enameloplasty, as its head length is 1.5 mm. The tapered shape of the bur allows the cutting tip to encounter very few dentinal tubules at any given time. It also minimizes heat build-up and vibration[3].

3M™ ESPE™ Clinpro™ Sealant is a light-cure, low viscosity, fluoride releasing pit and fissure sealant with a

unique patented colour change feature. Clinpro™ sealant is pink when applied to the tooth surface, and changes to an opaque off white colour when exposed to light. The pink color helps the dental professional with the accuracy and amount of material placed during the sealant procedure and and gives Long-lasting protection against caries. UltraSeal XT plus hydrophobic pit and fissure sealant is a light-cured, radiopaque, fluoride-releasing composite sealant. It is strong and wear resistant because it is a 58%-filled resin and has low polymerization shrinkage. The spiral in the Inspiral™ Brush tip causes shear thinning of the filled, thixotropic resin, reducing its viscosity as it is placed. The resin firms when shear thinning ceases and placement is complete, preventing the resin from running before it can be light cured. Using PrimaDry™ drying agent with UltraSeal XT plus sealant enhances penetration into pits and fissures by eliminating moisture that can cause failure in hydrophobic sealants[4]. Pulpdent embrace wetbond sealant contains di-, tri- and multi-functional acrylate monomers in what is being called Resin Acid-Integrating Network (R.A.I.N.), which is presumably very hydrophilic. The material is supposed to be activated in the presence of moisture and is recommended for use on surfaces that are slightly moist. Does not contain Bisphenol A.

It is for the first time that the three sealants , Clinpro 3M , Ultradent ultraseal XT plus, Embrace ™ wetbond™ have been tested for microhardness test . All the three sealants are resin based, fluoride releasing and light curable sealants.

The results of this study, as expected, confirmed that microhardness value for different pit and fissure sealants decreased over the time and higher microhardness values showed with Ultradent ultraseal XT plus pit and fissure sealant. Prabhakar J et.al , Explanation for this is that hydrophilic sealant (Ultraseal XT plus) exhibited lower viscosity and formed resin tag of sufficient length than that of conventional sealants. Therefore, hydrophilic sealant showed better results as compared to a conventional sealant[5]. Nalcaci et al. 2006, the microhardness reduction was observed over time might be explained with the water sorption in the sealant; this may lead to a softening of the organic matrix and the release of unreacted monomers, which reduces the mechanical properties of the material[6].

The mechanical properties of the dental materials are often influenced by the adverse environment of the oral cavity that can invalidate the aims for which these materials are used. Choosing a high flow dental sealant with an optimal adhesion to the enamel and with good mechanical properties means reducing the onset of decay in occlusal pits and fissures.

Conclusion

The results of this study are encouraging and it has been proved Ultradent ultraseal XT plus hydrophilic sealant and Embrace ™ wetbond ™ with remineralizing ability may provide additional protection against pit and fissure caries formation with added advantages of ease of availability, cost effectiveness. The patients will be benefitted with sealant application is a preventive conservative approach involving the introduction of sealants into the pits and fissures of caries prone teeth; this sealant then bonds to the tooth micromechanically, providing a physical barrier that keeps bacteria away from their source of nutrients.

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Legend Table and Figure

Table1: Descriptive statistics for mean microhardness number

Days	Descriptive Statistics	Clinpro 3M	Ultraseal XT Plus	Pulpdent Embrace Wetbond	One Way ANOVA	
					F statistic	p value
3rd day	Mean	126.27	344.27	327.67	66.82	0.001
	SD	10.73	24.95	35.30		
7th day	Mean	120.33	301.07	311.00	25.61	0.001
	SD	8.96	44.43	44.64		
15th day	Mean	120.10	308.00	299.43	11.96	0.008
	SD	17.09	72.00	54.74		
30th day	Mean	83.07	299.00	301.87	9.21	0.014
	SD	63.91	72.39	75.20		
45th day	Mean	108.67	280.33	291.67	14.29	0.005
	SD	3.51	44.64	67.93		
60th day	Mean	105.67	274.67	285.00	12.09	0.007
	SD	4.04	56.08	66.19		
Repeated Measures ANOVA	p value	0.09	0.13	0.17		
	F statistic	5.45	17.16	1.95		

Fig.1: Sample embedded in acrylic resin

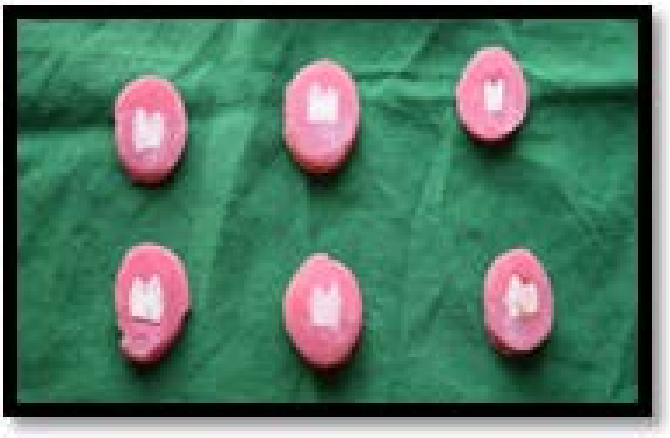

Fig.2: Indentation of Vickers tester