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Evaluation of pit & fissure sealants following disinfection with and without chlorhexidine solution

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Abstract

Aim: To evaluate the effect of chlorhexidine on the outcome of Pit and fissure sealant (PFS) sealant in permanent molars.

Methods: Double-blind randomized control trial was conducted for a period of 6 month. Maxillary or mandibular permanent molar which satisfies the criteria for application of PFS were included in the trial. Simple randomization of treatment allocation was carried out using computer generated random number for treatment assignment of the right molar tooth. The left molar received the alternate treatment. The outcomes of PFS were evaluated by a lone proficient assessor by means of the mouth mirrors and probes following the US public health service criteria.

Results: 6-month evaluation for the PFS with and without chlorhexidine showed 77.27% and 89.39% retention respectively. PFS without chlorhexidine suffered a greater loss of surface texture and marginal discoloration in comparison to PFS with chlorhexidine at 3- and 6-months intervals but it was statistically insignificant.

Conclusion: The present study showed improvement in outcome of PFS when an additional step of chlorhexidine is added although the results were statistically nonsignificant.

Keywords: pit and fissure sealant, chlorhexidine

Introduction

It has been an accepted fact that deep Pits and fissures (PF) lead to nearly 90% of cavities in permanent posterior teeth [1]. Pit and fissure sealant (PFS) is widely regarded as a cavity inhibitory prophylaxis of choice in recent times.

PFS outcome depends on their retention rate and their ability to prevent micro-leakage around the sealant and teeth [2, 3]. The accepted cause for micro-leakage is bacterial contamination. Though acid etching does remove microorganisms from the enamel surface, in deep pits and fissures – particularly with early carious lesions [4]– the tooth may still show various amounts of bacteria remaining even after acid etching [5] during fissure sealant therapy. So, to make sure that residual bacteria have been removed, a separate antibacterial agent chlorhexidine digluconate (CHX) can be very handy [6] as it is acknowledged as an agent with bactericidal effect. Still, there is hullabaloo regarding the outcome of CHX on the bonding capability of diverse adhesive systems, and its influence has not been assessed in fissure sealant therapy till date. Hence there is a felt need to conduct an in vivo study to assess the consequence of chlorhexidine on the outcome of PFS sealant in permanent molars.

Materials and Methods

The present research was a double-blind randomized control trial using split-mouth design conducted for a period of 6 month. 66 children having age in the range of 7-14 years, had participated in the study. The study was conducted at private clinic. Study participants were arbitrarily allocated to two groups i.e. sealant with chlorhexidine in one molar (intervention arm) and sealant without chlorhexidine (control arm) in the contralateral molar. In the present study, experimental groups and investigator were blinded to treatment allocation. A split-mouth design was applied for the present trail, in which the PFS with and without chlorhexidine solution were arbitrarily placed in matched contralateral pairs of permanent molar teeth. Participants with previously untreated fully erupted first or second molar having intact contralateral molar (molar pair) which satisfies the criteria for application of PFS, the presence of at least two deep occlusal fissures (prone for food entrapment), no prior preventive treatment were included in the trial. Patients with parafunctional habits, systemic disease, current participation in other studies, allergy to restorative materials, uncooperative and differently abled kids were not considered for the present trail.

Simple randomization of teeth undergoing PFS application with and without chlorhexidine was carried out by a statistician using computer generated random number for treatment assignment of the right molar tooth. The left molar received the alternate treatment.

In the present trial both intervention (PFS with chlorhexidine) and control group (PFS without chlorhexidine) has undergone a similar procedure for PFS application. The procedural steps followed are: a) the chosen tooth received

oral prophylaxis i.e. scaling and polishing of the chosen tooth, b) after scaling and polishing the tooth was isolated with cotton rolls. Etching was done of the occlusal fissures with 37% phosphoric acid (Total Etch Ivoclar Vivadent, Switzerland) for 15 seconds followed by rinsing for 30 seconds and then drying with air syringe, c) Adper Single Bond 2 was applied to occlusal fissure using microbrushes followed by light curing for 10 seconds, d) After curing of the adhesive, opaque fissure sealant material was applied and light cured for 20 seconds. The only difference between intervention and control group was that there was an additional step of application of chlorhexidine solution to occlusal fissures with microbrushes which was followed by natural drying for 1 minute after scaling, isolation and acid etching in the intervention group. After application of chlorhexidine solution, the rest of procedure was same in the intervention arm i.e. application of bonding agent and fissure sealant material.

Participants received a call for the follow-up visit on completion of 3 and 6 months respectively after PFS application. The participant was considered a drop out if he/she did not return for follow-up. Based on the US public health service criteria [7], PFS were rated by already trained and calibrated two examiner using the mouth mirrors and probes. This criterion was opted because of its: a) simplicity, b) information can be recorded easily in a presentable form, c) easy communication, d) insure coverage of all the factors that justifies clinical accomplishment for the restorations. PFS assessment factors included retention, anatomical form, surface texture and marginal discoloration. The recording was done either by designating letters (like A, B, C… etc.) or algebraic numbers (0, 1, 2…etc.). Because the algebraic number was easier for statistical analysis, we have implemented the same in the current trial. For criteria like anatomical form and marginal discoloration, we have given a score of 0 to indicate acceptability and scores of 1 and 2 to indicate progressively lessening degrees of clinical acceptance. For criteria like surface texture, we have given a score of 0 to indicate acceptability and scores of 1 to indicate progressively lessening degrees of clinical acceptance. The retention was evaluated by visual inspection with the help of a probe and mouth mirror as advocated by Horowtiz, Heifetz and Poulsen [8]. A score of 0 was given for complete retention, 1 was given for partial retention and 2 was given for no retention.

The collected data was tabulated in an excel sheet. Data was analyzed using IBM SPSS. Statistics Windows, Version 20.0. (Armonk, NY: IBM Corp) for the generation of descriptive and inferential statistics. Chi-square test was used to determine the statistically significant difference among intervention and control groups.

Results

The data was collected at three different intervals i.e. at 3 and 6 months. In the current trial, the 3 and 6-month assessment for the PFS without chlorhexidine revealed 86.36% & 77.27% retention respectively and 92.42% & 89.39% retention respectively for PFS with chlorhexidine as shown in table 1.

It can be well appreciated from the table 2 that PFS without chlorhexidine suffered a greater loss of surface texture in comparison to PFS with chlorhexidine at 3- and 6-months intervals but it was statistically insignificant. Similar sort of result was observed when PFS without and with chlorhexidine was compared for marginal discoloration and anatomical form (table 3 and 4).

Table 1: Comparison of retention between PFS with and without chlorhexidine

Period	PFS without chlorhexidine			PFS with chlorhexidine			Chi-square value	p value
	0 N (%)	1 N (%)	2 N (%)	0 N (%)	1 N (%)	2 N (%)		
3 months	57 (86.36)	4 (6.06)	5 (7.58)	61 (92.42)	4 (6.06)	2 (3.03)	1.41	0.49
6 months	51 (77.27)	7 (10.61)	8 (12.12)	59 (89.39)	4 (6.06)	3 (4.55)	3.67	0.16

Statistically significant if, $p<0.05$, 0 – Complete retention; all the pits and fissures were covered by the sealant. 1 – Partial retention part, but not all of a pit and fissure were uncovered. 2 – No retention; no sealant was seen at the pits and fissure.

Table 2: Assessment of marginal discoloration between PFS with and without chlorhexidine

Period	PFS without chlorhexidine			PFS with chlorhexidine			Chi-square value	p value
	0 N (%)	1 N (%)	2 N (%)	0 N (%)	1 N (%)	2 N (%)		
3 months	63 (95.45)	1 (1.52)	2 (3.03)	64 (96.97)	1 (1.52)	1 (1.52)	0.34	0.84
6 months	55 (83.33)	6 (9.09)	5 (7.58)	62 (93.94)	2 (3.03)	2 (3.03)	3.70	0.16

Statistically significant if, $p<0.05$, 0- No discoloration anywhere along the restoration margin and adjacent tooth surface. 1- Slight discoloration along the margin between the restoration and the adjacent tooth surface. 2- Discoloration penetrated along the margin of the restorative material in a dentinal direction.

Table 3: Assessment of anatomical form between PFS with and without chlorhexidine

Period	PFS without chlorhexidine			PFS with chlorhexidine			Chi-square value	p value
	0 N (%)	1 N (%)	2 N (%)	0 N (%)	1 N (%)	2 N (%)		
3 months	60 (90.91)	4 (6.06)	2 (3.03)	63 (95.45)	3 (4.55)	0	2.22	0.33
6 months	55 (83.33)	8 (12.12)	3 (4.55)	59 (89.39)	6 (9.09)	1 (1.52)	1.43	0.49

Sig = Significant ($P < 0.05$); NS = Non-significant ($P > 0.05$), 0- Restoration is continuous with existing anatomical form. 1- Restoration is discontinuous with existing anatomical form. 2- Sufficient material with complete loss of anatomical form

Table 4: Assessment of surface texture between Pit and fissure with and without chlorhexidine

Period	PFs without chlorhexidine			PFs with chlorhexidine			Chi-square value	p value
	0 N (%)	1 N (%)	2 N (%)	0 N (%)	1 N (%)	2 N (%)		
3 months	59 (89.39)	5 (7.58)	2 (3.03)	63 (95.45)	3 (4.55)	0	2.63	0.27
6 months	54 (81.82)	9 (13.64)	3 (4.55)	61 (92.42)	4 (6.06)	1 (1.52)	3.35	0.19

Statistically significant if, $p<0.05$, 0- Restoration surface is as smooth as the surrounding enamel, 1- Restoration surface is rougher than the surrounding enamel, 2- There is a crevice and fracture on the surface of the restoration

Discussion

In a developing country like India, the focus is rarely on preventive treatment. There is no doubt that fee of cavity inhibitory agents like PFS may cost more when compared to the cost of restorative materials, but PFS are far better when compared with restorative materials in term of cost effectiveness as the tooth would be maintained in a state of health. The maximum benefit of PFS can be only achieved when PFS should bond properly to the enamel surface, because only then there should be an establishment of acceptable retention and prevention of microleakage along the interface between the tooth and the sealant.

At the end of 6-month evaluation, marginal discoloration was low among PFS with chlorhexidine as compared to PFS without chlorhexidine but statistically nonsignificant. This difference may be due to the fact that in the cases where PFS without chlorhexidine was done, they may still show various amounts of bacteria remaining even after acid etching during fissure sealant therapy whereas PFS cases with a separate antibacterial agent (chlorhexidine), it ensures almost complete removal of bacteria. This has been well documented by Eminkahyagil [9] *et al*. in 2005 and Türkün [10] *et al*. in 2006, that a separate antibacterial agent like chlorhexidine digluconate (CHX) can be useful to prevent caries. Chlorhexidine is known to reduce caries with immediate bactericidal effect in the cavity (Türkün [6] *et al*.).

Assessment of the surface texture of PFS is scarce in the literature. The surface texture is another important factor to assess the outcome of PFS, because if there is an increase in surface texture then it acts as a niche for the accumulation of plaque and food debris, which encourage the penetration of oral fluids and cause microleakage. This microleakage may result in the formation of secondary caries. In the present study, PFS without chlorhexidine suffered a greater loss of surface texture than the PFS with chlorhexidine. This will result in rapid surface disintegration, thinning of the sealant and, ultimately, fracturing it off from the enamel surface.

Success of PFS as a caries inhibitory agent depends upon its complete retention. Numerous researchers [10, 11] reported that the caries increment is low when there is complete retention of the PFS. In the current trial, the 3-month valuation revealed 86.36% retention for PFS without chlorhexidine and 92.42% retention for PFS with chlorhexidine.

Obviously, the question rose after this study: Is it essential to add an antimicrobial step to kill bacteria before PFS application? Settembrini [12] states that "the issue of bacterial entry or residual bacteria within a cavity preparation may diminish in importance, especially if the restoration is able to maintain its seal. Here is the restorative crux of the challenge. As PFS do shrink during their polymerization process which mostly leads to microleakage and because of this there are chances of secondary caries due to residual bacteria. Similarly, since microleakage can occur around PFS, we have to find the ways to minimize the effects of this microleakage and possible ingress of bacteria at the junction between the cavity preparation and PFS.

Conclusion

The present trail was an attempt to see whether the application of antibacterial agent after acid etching will improve the result of pit and fissure sealant or not? The present study showed improvement in outcome of pit and fissure sealants when an additional step of chlorhexidine is added although the results were statistically nonsignificant. The author recommends further such type of studies in future so that a clear hypothesis can be generated.

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