Fuji III vs. Fuji VII Glass Ionomer Sealants – A Clinical Study

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Glass ionomer cements possess several properties that support their consideration in a wide variety of clinical applications including Pit and fissure sealants. The aim of this study was to compare and evaluate Fuji III and Fuji VII glass ionomer sealants in terms of retention, caries incidence and salivary fluoride release between two groups of children aged 6 and-8 years respectively. One hundred and ten first permanent molars were sealed and the clinical evaluation showed no incidence of caries. There was partial or complete retention of the sealant in 80% of the treated teeth in both groups at the one-year evaluation. Irrespective of the sealant used, the pattern of fluoride release remained consistent, with an initial high fluoride release followed by low prolonged leakage before returning to baseline value at the end of one year.

Keywords: *pit and fissure, sealants, glass ionomer, children*
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INTRODUCTION

The caries experience of children and adolescents who receive regular dental care is predominantly composed of pit and fissure caries[1] as observed over the past three decades. To prevent fissure caries the concept of altering the pit and fissure morphology as a mean of reducing the susceptibility of occlusal surfaces to dental caries has been in vogue for over 100 years.[2]

The American Dental Association (ADA) accepted pit and fissure sealants in 1971.[3] Since then, pit and fissure sealants have experienced a series of modifications in the materials used[4-7] and application techniques involved.[8] A more recent innovation has been the introduction of fluoride-releasing sealants. When glass ionomers are used as sealants, they exhibit low technique sensitivity and good adherence in addition to the fluoride-releasing property. The glass ionomer acts as a reservoir from which the added fluoride is gradually released into the oral cavity to inhibit enamel demineralization and enhance remineralization.[9]

With the advent of the Fuji VII glass ionomer sealant claiming to possess better properties, it becomes necessary to evaluate the clinical efficacy of this sealant when compared with the Fuji III glass ionomer sealant. There have been recent reports comparing micro leakage between Fuji VII and light cured- unfilled resins, marginal integrity of Concise, a resin based sealant with Fuji VII, and the different adaptation techniques (Invasive and Non-Invasive techniques).[10-12] However, little has been reported on the clinical efficacy comparison between the Fuji VII and Fuji III glass ionomer sealants. The aim of the present study was to evaluate retention, caries incidence and salivary fluoride release of Fuji III and Fuji VII glass ionomer sealants at 24 hours, 7 days, 1 month, 3 months, 6 months and 12 months of placement.

MATERIALS AND METHODS

The study sample consisted of 110 children [6 to 8 years old] with unsealed, caries free first permanent molars. The children were selected from those seeking care at the A.B. Shetty Memorial Institute of Dental Sciences, Department of Pedodontics and Preventive Children Dentistry in Deralakatte, Mangalore.

Inclusion criteria:

- Children belonging to the Caries Risk Assessment Tool (CAT)[13] low to moderate risk category.
  The AAPD (pediatric reference manual 2002) introduced the caries – risk assessment tool (CAT), where the caries assessment can be graded as low, moderate and high risk. This tool was formulated using the clinical, environmental and general health conditions as caries-risk indicators. The low risk category includes no carious teeth in the past 24 months, no enamel demineralization (enamel caries "white-spot lesions"), and no visible plaque or gingivitis. The moderate risk category includes carious teeth in the past 24 months, 1 area of enamel demineralization (enamel caries "white-spot lesions"), and gingivitis. The high risk category

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includes carious teeth in the past 12 months, more than 1 area of enamel demineralization (enamel caries "white-spot lesions"), visible plaque on anterior teeth, radiographic enamel caries, high titers of mutans streptococci, wearing dental or orthodontic appliances and enamel hypoplasia.]

- The teeth selected should be free of dental caries.
- The teeth selected should be non-hypoplastic, healthy with complete and intact tooth structure.
- The teeth selected should be free of any developmental defect.

Exclusion criteria:

- Children belonging to the "High risk" category.[13]
- Children exposed to fluoride release either by preventive (children brushing with a fluoridated tooth paste) or restorative measures.

The selection of teeth was performed by visual inspection and probing. The selected children were grouped into Groups A and B of 55 children each by a simple randomization process. Groups A and B had Fuji VII and Fuji III glass ionomer sealants applied respectively to the selected 110 first permanent molars of the right or left quadrant of each arch. The contra lateral molars were left unsealed as control. The fluoride released from the glass ionomer sealants provides anticariogenic effect both at the site of placement and the entire oral cavity.[14] Hence, the contra lateral unsealed molars are not being completely deprived from the sealant benefits.

The sealants were applied according to recommended techniques (Taifour D, Frencken JE et.al).[15] All the children received instructions on good oral health behavior and were shown how to clean teeth on an individual basis before starting treatment.

The clinical evaluation performed at 24 hours, 7 days, 1 month, 3 months, 6 months and 12 months for retention, caries incidence, and estimation of fluoride release. The authors were both, the operators and evaluators in this study.

A. Retention

Retention was clinically evaluated using a mouth mirror and an explorer. The evaluation criteria adopted is shown in Table l. (Pereira AC, Pardi V *et al* 2001).[16]

Table 1.

Total Retention (TR)	Total retention of the sealant on the occlusal surface.
Partial Retention Type 1 (PRI)	Presence of the sealant in two third of the fissure extension, observing small fractures and losses of the material.
Partial Retention Type 2 (PR2)	Presence of the sealant in one third of the fissure extension. Larger fractures and losses of the material were observed.
Total Loss (TL)	Absence of the sealant on the occlusal surface of the teeth.

(Reference: Pereira AC, Pardi V et.al 2001)[15]

B. Caries Incidence:

A visual inspection[17] was performed to evaluate the presence of any incipient carious lesion on the occlusal surfaces at all recall intervals on both sealed and unsealed molars.

C. Estimation Of Fluoride Release:

Stimulated whole saliva samples were collected from seven children on each group at random, before placing the sealant and at all recall intervals. Seven children were selected by simple randomization process due to cost considerations. Three sample replicates per child were analyzed in each period. The amount of fluoride released from the sealant materials was assessed using an Orion microprocessor ion analyzer with a fluoride specific ion electrode.[18]

Statistical Analysis:

The Chi-square test was used to compare the retention rates between the Fuji VII and Fuji III sealants. The Friedman test was used to compare the retention rates among the different evaluation times. The Mann-Whitney U test was used to compare and evaluate the fluoride release from the sealant materials. The Wilcoxon-signed rank sum test was used to compare the mean salivary fluoride concentration values with the baseline values.

RESULTS

Retention was evaluated using a mouth mirror and an explorer. On clinical visual inspection, total or partial retention of Fuji VII and Fuji III sealants were found to be 100% until the 1-month recall visit (Table 2). Total loss of 16.4% was observed with the Fuji VII sealant and 20% with the Fuji III sealant at the 12-month recall visit (Table 3).

Table 2. Retention of the Glass Ionomer Sealants at 24 Hours, 7 Days & 1 Month Time Intervals

		24 HRS		7 DAYS		1 MONTH	
		Fuji VII	Fuji III	Fuji VII	Fuji III	Fuji VII	Fuji III
Total Retention	Count	100	96	94	990	8.6	78
	%	90.9%	87.3%	85.5%	81.8%	78.2%	70.9%
Partial Retention[1]	Count	6	10	12	16	14	20
	%	5.5%	9.1%	10.9%	14.5%	12.7%	18.2%
Partial Retention[2]	Count	4	4	4	41	0	12
	%	3.6%	3.6%	3.6%	3.6%	9.1%	10.9%

Table 3. Retention of the Glass Ionomer Sealants at 3, 6 & 12 Month Time Intervals

		3 months		6 months		12 months	
		Fuji VII	Fuji III	Fuji VII	Fuji III	Fuji VII	Fuji III
Total Retention	Count	6.8	62	44	42	32	26
	%	61.8%	56.4%	40.0%	38.2%	29.1%	23.6%
Partial Retention[1]	Count	24	24	38	40	38	42
	%	21.8%	21.8%	34.5%	36.4%	34.5%	38.2%
Partial Retention[2]	Count	14	16	18	16	22	20
	%	12.7%	14.5%	16.4%	14.5%	20.00%	18.2%
Total loss		4	8	10	12	18	22
Count		3.6%	7.3%	9.1%	10.9%	16.4%	20.0%
%							

Table 4. Salivary Fluoride Levels – Before and After the Application of Glass Ionomer Sealants

GROUP		N	MEAN	Std. Deviation	Z
0 hrs	Baseline		0.078ppm		
24 hrs	Fuji VII	7	.092	.001	3.19800
	Fuji III	7	.104	.001	p=.001 ***
7 days	Fuji VII	7	.058	.001	1.39500
	Fuji III	7	.059	.001	p=.163 *
1month	Fuji VII	7	.087	.002	3.14100
	Fuji III	7	.094	.002	p=.002 ***
3 months	Fuji VII	7	.082	.001	.207400
	Fuji III	7	.085	.003	p=.038 **
6 months	Fuji VII	7	.075	.002	.3.15100
	Fuji III	7	.082	.001	p=.001 ***
12 months	Fuji VII	7	.074	.001	3.14400
	Fuji III	7	.083	.002	p=.002 ***

* not significant
** significant
*** highly significant

Table 5. Comparison of the Mean Salivary Fluoride Concentration Values at Different Time Intervals with the Base Line Value

GROUP		Paired		Z	P
		Mean	Std. Deviation		
Fuji VII	Base – 24 hrs	.0176	.0013	2.379	.017**
	Base – 7 days	.0157	.0015	2.375	.018 **
	Base – 1 month	.0129	.0027	2.375	.018 **
	Base – 3 months	.0080	.0014	2.375	.018 **
	Base – 6 months	.0004	.0017	.680	0.497 *
	Base – 12 months	-.0006	.0014	.755	0.45 *
Fuji III	Base – 24 hrs	.0221	.0012	2.410	.016 **
	Base – 7 days	-.0228	.0016	2.375	.018 **
	Base – 1 month	.0121	.0029	2.371	.018 **
	Base – 3 months	.0025	.0034	1.524	.128 *
	Base – 6 months	.0001	.0020	.341	.733 *
	Base – 12 months	.0007	.0033	.405	.686 *

* not significant
** significant

Incidence of caries was not found on any sealed or unsealed contra lateral teeth at the end of the clinical evaluation period of 12 months.

The salivary fluoride concentration reached a peak within 24 hrs of sealant application with mean values of 0.092ppm and 0.104ppm for the Fuji VII and Fuji III sealants respectively. This rise in the value was found to be statistically significant. After the first sudden rise in salivary fluoride levels, there was a rapid and significant decline in the salivary fluoride levels after 7 days with mean values of 0.058ppm and 0.059ppm for the Fuji VII and Fuji III sealants respectively (Table 4).

A significant statistical correlation was found between the two groups at the 1 month and 12 month evaluation. The comparison of mean salivary fluoride levels at various recall intervals with the baseline value showed a significant statistical correlation for the Fuji VII sealant at 24 hours, 7 days, 1 month and 3 months whereas the Fuji III sealant showed a significant statistical correlation at 24 hours, 7 days and 1 month (Table 5). No statistically significant correlation was observed on comparison of salivary fluoride release at different time intervals between the Fuji VII and Fuji III sealant.

Table 6. Comparison of the Retention Between the Two Groups

Fuji VII	N	110
	Ch-Square	316.305
	df	5
	Asymp. Sig	.000
Fuji III	N	110
	Ch-Square	328.230
	df	5
	Asymp. Sig	.000

DISCUSSION

Caries occurrence in the pits and fissures of the occlusal surface of molars is responsible for 67-90% of caries in children from 5 to 17 years of age. Sealants have been developed to protect the pits and fissures from caries by preventing the impaction of food and bacteria, which produce acidic conditions that result in caries initiation.[19] Mclean and Wilson[20] reported the first application of glass ionomer cement for fissure sealing. Since then, several investigators[10-12] have reported on the efficacy of glass ionomers as sealants.

In the present study Fuji VII and Fuji III glass ionomer sealants were the materials used for determining clinical efficacy. The Fuji III sealant showed total retention in 23.6% of the cases whereas the Fuji VII sealant showed total retention in 29.1% of the cases after twelve months. These findings are in accordance with the observations reported by Komatsu *et al*.[21] There was no statistically significant difference between the retention rates of Fuji VII and Fuji III glass ionomer sealants (Table 6). This is in contrast with the observations reported by Ganesh M, Shobha T (2007) where the concise resin based sealant performed better in terms of sealing ability than the Fuji VII sealant.[11]

In this study, more than one-half of the sealants in both groups showed partial retention after one year. There has been an opinion that if some part of the sealant is missing in the fissures there is still enough material in the deeper part to prevent caries (Wendt-LK and Koch G, 1988).[22] Due to the inherent properties of the glass ionomer sealant like fluoride release and adherence to dental structures,[1, 11, 12] possible total or partial loss is not considered to be a problem, since the small amounts of the material remaining in the fissures apparently result in a cariostatic effect.[1] In the present study, no incidence of caries was found on the occlusal surfaces of the sealed and unsealed contra lateral teeth.

In clinical practice, an operator faces problems in keeping the ideal conditions for sealant placement in the oral cavity of a 6-8 year old child. A distinct advantage of using Fuji VII and Fuji III sealants over others is the ease of application. The Fuji VII sealant has an additional advantage of being colored (pink). Visibility is better and thereby any loss of the sealant in subsequent follow up visits can be easily detected.

The present study showed no caries incidence on occlusal surfaces of the sealed and the contra lateral unsealed teeth in all evaluations with respect to both Fuji VII and Fuji III glass ionomer sealants. This may be the result of the combined effect of an increased fluoride level in the enamel or plaque and residual material in the fissures. The release of fluoride from glass ionomer restorations may demonstrate an anti-cariogenic effect at the site of placement and throughout the entire oral cavity.[14]

The fluoride release can be affected by several intrinsic and experimental variables, including the composition of the material,[23] solubility,[23, 24] porosity,[25] the powder- liquid ratio used in preparing the material,[23] the method of mixing[26, 27] (for example, hand mixing v/s mechanical mixing), the amount of exposed area[28] the media into which the fluoride is released and other unknown factors.[29]

In the present study the pattern of fluoride release remained consistent, with an initial high burst of fluoride release, followed by low prolonged leakage[23] similar to the findings reported by Morphis TL and Toumba K.J *et al*.[30] Glass ionomer is moderately soluble, providing release of fluoride ion as a positive offshoot of this negative characteristic.[1] This explains the early rise in the salivary fluoride levels. Except on the first week evaluation, all other comparisons presented a highly significant statistical correlation between the two groups. However, on the seven-day evaluation, mean salivary fluoride concentration values for both sealants were below the baseline values. This could be due to the released fluoride that is incorporated into the enamel exerting the expected effect on the demineralization and remineralization processes.[31]

During a cariogenic challenge, increased fluoride levels within the tooth structure and dental plaque resist mineral dissolution and promote reposition of mobilized mineral phases (remineralization).[32-34] The results of the present study show that both Fuji VII and Fuji III sealants release fluoride in low to moderate proportions over a period of time thus providing a caries preventive effect to both the sealed and the unsealed teeth.

The limitations of the present study were: 1) the inability to detect the presence of caries below the sealant because of Fuji VII being a colored (pink) sealant. 2) Tooth selection was performed through visual inspection and probing and not through a radiographic examination.

A long-term follow-up study is necessary to arrive at a definitive conclusion. Future research must also consider the unanswered questions of what level of fluoride is necessary and for how long must exposure to that level of fluoride last for caries inhibition.

CONCLUSIONS

- Partial or total retention of sealants was observed in more than 3/4th of the treated cases at 12 months recall.
- No statistically significant difference was observed when comparing the retention rates of Fuji VII and Fuji III sealants.
- No incidence of caries was observed on the occlusal surfaces of the sealed and the contra lateral unsealed teeth in both groups.
- The pattern of fluoride release remained consistent, with an initial high burst of fluoride, followed by a decrease below the baseline, and slow prolonged leakage before returning to the baseline values at one year following sealant application.

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