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Retention of Glass Ionomer Cement and Resin-Based Fissure Sealant and Their Effect on Caries Outcome During Chemotherapy: A Pilot Study

SUMMARY

The retention and caries preventive efficacy of light-cured resin-based fluoride fissure sealant (RBS) in comparison with glass ionomer cement (GIC) were studied during chemotherapy. The survival rates of GIC and RBS were: 44.8% and 51.7% at 3 months, 26.2% and 43.9% at 12 months, respectively. The percentage of fully retained sealants at month 3 was 25.9% in GIC group and 12% in RBS group. At 12 months, the difference between the percentages was insignificant in both groups. The percentage of carious lesions seen in GIC sealant and RBS group was 6.9% at month 3. At month 12, 7.3% carious molar was found in RBS group, whereas the same estimation was 19% in GIC group. Regarding caries development on molars at 12 months, in which sealants were fully disappeared at month 3, the percentage was 29.3% for RBS and 33.3% for GIC groups. Caries preventive efficacy and survival rate of GIC were not found superior compared to RBS at the end of 12 months.

Keywords: Chemotherapy; Pit-Fissure Sealant; Caries Prevention; Children

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Introduction

Various reports have indicated the relationship between dental caries and chemotherapy[1-4]. These studies suggested that children with malignant diseases had more carious teeth compared to healthy subjects. Depending on the reduced buffer and antibacterial action of saliva encountered during chemotherapy, cariogenic flora increases, and this results in an increased susceptibility to dental caries. This fact indicates the need for preventive strategies to promote dental health and to avoid the development of caries prior to chemotherapy.

A number of caries preventive measures have been developed for children with malignant diseases, as well as the healthy ones[2,3,5]. These include cleaning tooth surfaces with a toothbrush and a fluoridated toothpaste[6,7], application of a fluoride varnish[8], application of a chlorhexidine varnish, sealing pits and fissures with a composite resin and/or a glass ionomer[9,10], and different combinations of these preventive measures. Only effective clinical regimen available for preventing occlusal caries is the use of pit-and-fissure sealants[11,12].

Pit-and-fissure sealing has been described as a procedure of introducing a material into the occlusal pits and fissures of caries-susceptible teeth, therefore forming a micro-mechanically bonded protective layer that blocks nutrients of caries-producing bacteria[13]. To the best of our knowledge, neither retention nor caries preventive efficacy of sealing materials has been investigated in children who were on chemotherapy. In the present study, the retention and caries preventive efficacy of glass ionomer cement (GIC) in comparison with light-cured fluoride resin-based sealant (RBS) were studied intra-individually in a period of 1 year in children who were on chemotherapy for solid tumours.

Materials and Methods

Sample Selection

Eligible subjects among the children diagnosed with solid tumours between 2002 and 2005 in the Department of Pediatric Oncology, Faculty of Medicine of Uludağ University were included in this prospective clinical study. Criteria for eligibility were as follows: The patient should suffer from solid tumour, be hospitalized for chemotherapy, and had no carious teeth; patients should have no stain and/or soft debris, and supragingival calculus covering not more than one third of their exposed tooth surface[14], and should follow the same oral care guideline during the therapy. In order to follow oral care guideline, teeth and tongue were cleaned 4 times a day (after meals and before bed time) with a soft-bristled brush to remove plaque and debris. Once brushing was completed, 10 ml of 8.4% sterile sodium bicarbonate (Drogsan®, Turkey) was administered as a rinse to remove loose debris and to irrigate healthy tissue.

All the first permanent molars should fully be erupted and sound, with absence of mobility due to periodontal disease, and with no evidence of hypoplasia or history of previous sealant application.

Pre-Operative Assessment

The study was approved by the Ethics Review Committee of the faculty. Informed written consents were obtained from each family using separate forms written in simple clear native language. A systematic and precise dental examination was performed and the teeth were examined for caries with a No.4 plain mirror and a No.6 right-angle probe.

Assignment of the Teeth to the Study Groups

The material was randomized with respect to teeth, mandibular and maxillary, and left and right side. The study consisted of 33 children with a total of 132 molars. 66 maxillary and mandibular first permanent molars were sealed with a RBS (Alpha-Seal®, Dental Technologies, Inc.) and a GIC (Fuji IX®, GC Europe).

Sealant Procedure

The sealant procedure was performed on every child by a resident dentist in Pediatric Dental Care Unit. Following the initial dental examination, the sealant materials were applied on molars of each child in 1 session before chemotherapy has been initiated. The occlusal surfaces of the teeth where RBS material was applied were cleaned with a brush mounted on a low speed engine, washed and dried, and isolated with cotton wool rolls and high volume suction. The teeth were etched for 30 seconds using 37% orthophosphoric acid, washed for 10 seconds, and dried for a further 10 seconds. The occlusal surface was checked for the characteristic chalky white matt appearance, indicative of appropriate etching. The RBS material was applied by using the tip of a small excavator and cured by applying visible light for 30 seconds using a dental-curing unit (LA 500, Model Blue-light, Apoza Enterprise Co, Taiwan).

The occlusal surfaces of molars where GIC material was applied, was cleaned with a brush mounted on a low speed engine, washed and dried, and isolated with cotton wool rolls and high volume suction. The occlusal surfaces of each tooth were conditioned with polyacrylic acid for 10-15 seconds, and dried for a further 10 seconds. The GIC was applied according to the ART manual[15]. Subjects were instructed not to eat for at least 1 hour.

Post-Operative Assessment

After completion of treatment, 2 calibrated dentists, who were not operators, carried out the evaluation at 3 months, during intensive chemotherapy, and at 12 months when the therapy was completed using the criteria described by Frencken et al (Table 1)[15]. The follow-up examination was performed using a No.4 plain mirror and a No.6 right-angle probe. It was decided that if caries was detected clinically in any of the teeth included in the study, the patient would be appointed for restorative care and the specific tooth/teeth would be excluded from the study. The inter-examiner reliability was assessed by examination of an independent sample of sealants of children who attended for reviews (5 molars during each of the 3 and 12 month follow-up periods), by the 2 examiners. Each examiner was unaware of the other examiner's findings. This ensured a constant check on the reliability of the examiners.

Table 1. Evaluation criteria of the GIC and RBS

Scores	Evaluation criteria
0	Present, good seal
1	Partly present, visible pits and/or fissures are free of active caries; no sealant needed
2	Partly present, visible pits and/or fissures show signs of active caries; treatment needed
3	Not present, pits and/or fissures show no signs of active caries; no treatment needed
4	Not present, pits and/or fissures show signs of active caries; treatment needed
5	Unable to diagnose

Survival: Scores 0 and 1
Failure: Scores 3 and 4
Retention: Scores 0, 1, and 2
No retention: Scores 3 and 4

Statistical Analysis

The data were entered into a database, checked for errors and analyzed using SPSS software (Release 11.0 version). All the data in this study were categorical and

therefore non-parametric statistics was used. Analysis of the data was carried out using Chi-square test, which is used to assess quantitatively whether or not the observed frequencies differ significantly from those expected on the basis of the null hypothesis. For purposes of analysis of sealant procedure, we considered the tooth and not the patient to be the unit sample. Retention was considered present for the combined scores 0, 1, and 2. Scores 3 and 4 represented no retention. Survival of the sealants placed was identified with the combined scores of 0 and 1. Caries scores 0, 1, and 3 were combined in the analyses as sound. Caries was considered present for the combined scores 2 and 4. A probability value less than 0.05 were considered significant[16].

Results

In this study, 33 children who were on chemotherapy for solid tumours (mean age 9.2±1.8 years - 7-14 yr; male/female ratio: 18/15) were included (Tab. 2).

Table 2. Description of the sample

Patient characteristics	n
Males	18
Females	15
Age (years)	
Mean	9.2 yr
Range	7-14 yr
Type of cancer	
Medulloblastoma	15
Osteosarcoma	4
Lymphoma	14

The Number of Molars Evaluated at 3 and 12 Months Follow-Ups

At the beginning of the study, a total of 132 sealants were placed on occlusal surfaces of molar teeth. After 3 months, 116 molars were available in 29 children. 4 children did not attend their follow-up. At evaluation on month 12, there were 21 children available, with a total of 83 molars. Table 3 presents the number and percentage of teeth lost at follow-ups at 3 and 12 months.

Table 3. The number and percentage of sealed teeth lost to follow-up after 3 and 12 month

Sealant material	No. placed	No. evaluated		% lost to follow-up	
		At 3-months	At 12-months	At 3-months	At 12-months
GIC (Fuji IX®)	66	58	42	12%	36.3%
RBS (Alpha-Seal®)	66	58	41	12%	37.9%

Table 4. The cumulative survival percentage of sealants according to the evaluation periods

Time span (months)	No. failures	No. survival	No. transfers (teeth without caries)	Survival rate (%/SD)
GIC (Fuji IX®)				
0-3	32	26	54	44.8/1.2
3-12	31	11	34	26.2/3.3
RBS (Alpha-Seal®)				
0-3	28	30	54	51.7/1.3
3-12	23	18	38	43.9/1.6

SD: standard deviation
Survival: Scores 0 and 1
Failure: Scores 3 and 4

Retention Rates at 3 and 12 Months Follow-Ups

Almost 1 out of the 2 RBSs (51.7%) and GIC sealants (44.8%) had found disappeared at evaluation on month 3 ($p>0.05$). However, the evaluation made at month 12 indicated a survival rate of 43.9% for RBS material, whereas the same estimation was determined to be 26.2 in GIC group, and the difference was significant (Tab. 4). The number of fully retained (score 0) GIC sealants at month 3 was 15 (25.9%), whereas 7 RBS (12%) were fully retained ($p<0.05$). At evaluation on month 12, fully retention was detected on 3 RBSs out of 41 (7.3%). However, the result was found significantly different ($p<0.05$) in the 7 GIC sealants out of 42 teeth (16.6%).

Caries Rates at 3 and 12 Months Follow-Ups

The percentages of caries development in GIC sealant and RBS groups were: 6.9% (n=4 for each group)

at 3 months and 19% (n=8) and 7.3% (n=3) at 12 months, respectively. The results obtained on month 12 in GIC group were significantly different ($p<0.01$) from those obtained on month 3. Additionally, the results obtained on month 12 in GIC and RBS groups were also significantly different ($p<0.01$) from each other. The percentages of children with carious molars in GIC sealant and RBS groups were: 13.8% (n=4) at 3 months and 28.6% (n=6) at 12 months, respectively. Out of 4 subjects, 1 patient was excluded from the study at month 3 since the patient had developed caries on 4 molar teeth.

Evaluation for Caries Development on Molars on Month 12, in which Sealants were Fully Disappeared (Score 3) at Month 3

The percentages of carious molars in GIC sealant and RBS groups were 7% (n=3) and 2.4% (n=1), respectively. In the RBS group, no caries development was detected in 29.3% of molars (n=12), whereas in the GIC sealant group, it was as high as 33.3%. The difference between the percentages was insignificant ($p>0.05$).

Discussion

The results of this study provided data on retention and caries preventive efficacy of GIC and RBS applied to children with solid tumours during chemotherapy. In the literature, other investigations on this subject were held only in healthy children from different socioeconomic status[17].

The present investigation has preliminary results. Therefore, the power calculation was not performed. However, it was still possible to randomize the sealants over the first molars by the jaw of the mouth. Another important aspect that needs discussion is that the cumulated lost to follow-up observed in the present study was high (37.1%). This can be explained by the fact that children and their parents became too debilitated to stick to regular dental follow-ups during intensive chemotherapy.

Fissure sealant application is one of the preventive measures recommended before the onset of chemotherapy to ameliorate its impact on dental tissues. 2 materials are commonly used as a sealant material: composite resin and glass ionomer. It is generally accepted that composite resin as a sealant retains longer than glass ionomer[18-20].

Many researchers demonstrated low retention rates for glass ionomer when it is used as a fissure sealant in periods of 6 months and 7 years[20,21]. A total retention rate of polyacid-modified resin composite was found 20% after 1-year follow-up[18]. In our study, RBS indicated a lower complete retention rate (7.3%) from those obtained in the trial conducted by Aranda et al[18]. Some authors[19,21] observed a 10% total retention rate after 3- and 7-year follow-ups of a conventional glass ionomer used as fissure sealant, thus demonstrated worse results than in this study after 1 years of clinical evaluation (16.6%). The difference between survival rates of these 2 materials was statistically insignificant at the month 3. However, our findings obtained at month 12 clearly indicated that the survival rate of the resin based sealant was significantly higher than that of the glass ionomer material.

To the best of our knowledge, clinical trials related to effectiveness of glass ionomer materials have usually discouraged their use as fissure sealants[22,23]. But, all of them were held on healthy subjects[17]. However, the present study investigated the efficacy of this material on patients receiving chemotherapy.

Although, recently published clinical trials have consistently found poorer retention of glass-ionomers than resin-based materials[18-21,24,25], there appears no difference in their caries preventive effect over a long period[19-21,25,26]. Williams et al[26] found no difference in the effect on caries 2 or 4 years after the sealant application. However, Forss and Halme[21] found an increased risk of caries in glass-ionomer-sealed teeth compared with resin-sealed-teeth after a 7-year follow-up. This later finding is consistent with clinical results of GIC we have reported previously. However, evaluation of caries development on molars where sealants fully disappeared (Score 3) at month 3 were in accordance with the results conducted by Williams et al[26].

Chemotherapy regimen of the subjects varied according to the diagnosis, which comprised BFM-95 (Berlin-Frankfurt-Munsten-95), ABVD (Adriamycine-Bleomycine-Vinblastine-DTIC), carboplastine, vincristine, CCNU and/or VP-16 agents. However, the subjects with medulloblastoma (n=15) were provided post radiotherapy chemotherapy. Before chemotherapy was initiated, the children had cranial radiotherapy 180 cGy per day within 5 days (total 5400 cGy irradiation). Then these subjects with this disease (45% of the study population) had carboblastine, vincristine, CCNU and/or VP-16 agents.

Intensive chemotherapy combined with and without therapeutic radiation to the head can result in both short- and long-term debilitating oral side-effects, such as mucositis, loss of salivary function, and taste loss. These side-effects, particularly oral mucositis and loss of salivary function, may cause lowered pH in oral environment and resultant demineralization of enamel, dentinal hypersensitivity, and dental caries[27]. Therefore, it is logic to assume that the complete retention rates of sealants in children undergoing cancer therapy would be lower compared to healthy children, even they are in high-risk group for dental caries.

All subjects had the same oral care regimen during this highly oral-toxic therapy. It is known that the intensive oral care may not completely eliminate the deteriorative effect of chemotherapy on dental tissues[28]. Additionally, the subjects and parents may not stick to regular dental care during the therapy. This could be the possible reason of the low survival rates of these 2 materials during chemotherapy (at 3 months).

Despite the higher rate of complete retention of GIC sealants at the end of 3 months; their caries preventive effect and survival rate was found unsatisfactory compared to RBS at the end of 12 months. Therefore, application of RBS was recommended as a caries preventive measure in children with malignancy before chemotherapy was initiated. It is obvious that further long-term comparative clinical studies, in which additional measures are established to maintain oral health, such as regular applications of fluoride and artificial saliva, are needed to discuss the longevity of GIC sealant and RBS in the presence of chemotherapy.

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