A Comparative Analysis of the Duration and Cost of Treatment Between Glass Ionomer and Resin Based Fissure Sealants among Children in Benin City, Nigeria

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Abstract

Background: Dental service utilization in children is reduced as a result of long treatment times and prohibitive cost of treatment. This may result in an increase in early childhood caries and subsequent premature tooth loss. Fissure sealants are a preventable method in the management of dental caries but the cost may be a barrier to early treatment.

Aim: To compare the duration and cost of sealant treatment between glass ionomer and resin based fissure sealants among children in Benin City, Nigeria.

Materials and Methods: All occlusal surfaces of the lower permanent first molars (2 teeth each in a total number of 50 children) were sealed and included in the study (n=100). A split-mouth design was used in which a light cure Bis-GMA resin-based sealant was compared with a glass-ionomer sealant. They were then randomly placed in 50 matched contralateral pairs of permanent first molar teeth and a stop watch used to record the duration of placement. The cost of treatment was calculated by dividing the cost of the sealant kit with the total number of sealed occlusal surfaces. Statistical analysis was done using Statistical Package for Social Sciences version 21.0 with the chi square test for determination of variables. Probability values of $p < 0.05$ were considered statistically significant.

Results: The duration of sealant treatment using resin based sealant ranged from 235 to 446 seconds (mean time 318.86 $\pm$55.54 secs); while the duration of sealant treatment using glass ionomer based sealant ranged from 238 to 360 seconds (a mean time 292.57 $\pm$33.56 secs); and this was statistically significant ($P < 0.001$). The cost of sealing a tooth surface using resin sealant (Clinpro®) was five hundred and seventy naira only. Similarly, the cost of sealing a tooth surface using glass ionomer based sealant (GC Fuji triage®) was eight hundred and forty naira only.

Conclusion: Less chairside time is required for sealant treatment using glass ionomer than resin based sealant for fissure sealing procedures. The use of resin based fissure sealant is relatively cheaper when compared with glass ionomer based sealant

Keywords: Duration, Cost, Treatment, Sealants.

Introduction

Dental caries has historically been considered the most important global oral health burden[1]. It has a multifactorial aetiology which is related to the interactions over time between tooth substance, oral micro flora and dietary factors[1]. Consequences of untreated caries include pain, loss of function and a reduced quality of life[2]. Socio-economic status and cost of treatment have been identified as barriers to the utilization of dental services in many Nigerian studies[3-6]. Other barriers noted were the perception of dental treatment and duration of treatment[3,5]. A

previous study advocated the use of minimal intervention in managing early carious lesions or prevention with non-invasive methods on the susceptible tooth surfaces especially deep pits and fissures[7].

Recent advances in the management of carious lesions include strategies that emphasize disease prevention, other methods have advocated the use of fluorides and conservation of tooth structure with minimal intervention techniques[7,8,9]. Fluorides however, have been found to be extremely effective in preventing caries on the smooth surfaces of teeth, but are less effective on the occlusal surfaces[7,10-11]. The introduction of sealants has shown that they are the most effective clinical technique to prevent occlusal caries and accounts for a 71.0% reduction in occlusal caries after a single preparation[3,5.7,10]. Sealants achieve this by acting as a physical barrier that prevents oral bacteria and dietary carbohydrates from creating the acidic conditions that result in caries. Numerous studies have shown sealants to be efficient and cost effective in the reduction of occlusal caries even in newly erupted teeth[11-15]. Resin based materials were previously in use before the introduction of glass ionomer material as fissure sealants evolved. Glass ionomer sealant unlike resin-based sealants adheres directly to tooth surfaces, releases fluoride over time and is a less technique sensitive procedure[16].

While sealants have proven to be beneficial in the reduction of dental caries, no study has compared the cost effectiveness and treatment time conservation of sealants amongst Nigerian children. This study aimed to compare the duration and cost of sealant treatment between glass ionomer and resin based fissure sealants among children in Benin City, Nigeria.

Material and Methods

This comparative study was conducted at the Paediatric Dentistry Unit, Department of Preventive Dentistry, University of Benin Teaching Hospital, Benin City. A split-mouth design was used in which two fissure sealants; Clinpro®, a light cure Bis-GMA resin-based sealant and GC Fuji triage®, a glass-ionomer sealant were randomly placed in 50 matched contralateral pairs of permanent first molar teeth.

The approval for this study was granted by the Ethics and Research Committee of the University of Benin Teaching Hospital, Benin City, Nigeria. Assent was obtained from children and consent from parents or guardians of minors using the Nigerian National Health Research Ethics Code model.

Inclusion criteria

- Children aged 6 to 10 years,
- Those in a high caries risk group and with at least 2 sound unsealed/untreated lower first permanent molars (ICDAS II code 0, 1, 2)

Exclusion criteria:

- Children with hypoplastic or developmental anomalies on the lower first permanent molars or the presence of obvious caries on the lower first permanent molar (ICDAS II code > 2),
- Those whose medical history precludes inclusion (i.e. those with a history of hospitalization for asthma, or severe allergies).
- Children undergoing a long-term regimen of medication that could affect the salivary flow and diet modification,
- Highly uncooperative children or those with a known sensitivity to any of the product ingredients e.g. methyl acrylate in resin sealant and fluoro-aluminosilicate in glass ionomer sealant.
- Those who show obvious signs of systemic illness e.g. colds, 'flu', chicken pox or with any abnormality of the lips, face or soft tissues of the mouth that would cause discomfort in the provision of sealant.
- Those that refuse to consent to the study.

The study participants were seated on the dental chair and a simple ballot technique was used to determine the side to be first treated (left or right) and with either material. Each ballot was coded as either left or right to represent the side to receive a particular sealant. Another ballot was coded “A” (to represent the resin based sealant) and “B” the Glass ionomer sealant.

Steps in Resin sealant placement

The occlusal surface of the tooth was cleaned using a prophylaxis brush and pumice/water for gross debris removal. The tooth was isolated with cotton rolls and dried, then etched for 20 seconds, rinsed with water and dried again using oil free air. The tooth surface was checked for a white frosty appearance to confirm etching. The resin based sealant, Clinpro® was applied directly on the etched surface and light-cured for 20 seconds. Once cured, the sealant was examined with an explorer to determine that there were no voids and that all the pits and fissures were completely covered by the sealant. The cotton rolls

were removed and high spots checked with an articulating paper and adjusted where necessary with a finishing bur.

Steps in Glass Ionomer Sealant Placement

The occlusal surface of the tooth was cleaned using a prophylaxis brush and pumice/water for gross debris removal and then isolated with cotton rolls. It was then dried, and a cavity conditioner applied with a micro brush for 10 seconds, cleaned and blotted with a cotton pellet. Glass ionomer sealant (capsule type) was mixed according to the manufacturer's instruction and triturated for 10 seconds then applied to completely cover the pits and fissure. A protective coat of petroleum jelly was applied with a finger pressure immediately after setting to prevent contamination by moisture. The cotton rolls were removed and the sealed surface checked for high spots and adjusted where necessary.

Determination of duration of treatment

The timing for the placement of both resin and glass ionomer sealants was done by a trained dental surgery assistant (DSA) with the use of a stop watch. Timing started from when the selected tooth is being cleaned with pumice and a rotary brush and stopped after the high spots were checked and occlusion found to be satisfactory. Throughout the duration of the treatment, the same stop watch and personnel were utilized for standardization and reproducibility respectively

Statistical analysis

Data entry validation and analysis were done using the SPSS for Windows (version 21.0; SPSS Inc. Chicago. IL statistical software package). The statistical tool used for analysis was chi square and a P value of < 0.05 indicated statistical significance.

Results

A total of fifty (50) children with ages ranging from 6 to 10 years (mean 8.14 + 1.3 years) participated in the study. The sample comprised 28 males (56.0%) and 22 females (44.0%). All occlusal surfaces of the permanent lower first molars (2 teeth for the 50 children) were sealed and included in the study (n=100). The distribution of children in relation to their characteristics (sex and age) is represented (Table 1).

Table 1: Distribution of study participants and type of sealant used according to age and gender.

Gender	Age (years)	Type of sealant	
		Glass ionomer sealant	Resin based sealant
		No (%)	No (%)
Male	6	3(10.7)	3(10.7)
	7	3(10.7)	3(10.7)
	8	9(32.1)	9(32.1)
	9	5(17.9)	5(17.9)
	10	8(28.6)	8(28.6)
Total		**28(100.0)**	**28(100.0)**
Female	6	3(13.6)	3(13.6)
	7	8(36.4)	8(36.4)
	8	5(22.8)	5(22.8)
	9	3(13.6)	3(13.6)
	10	3(13.6)	3(13.6)
Total		**22(100.0)**	**22(100.0)**

The duration of sealant treatment using resin based sealant ranged from 235 to 446 seconds and with a mean time of 318.86 $\pm$55.54 seconds; approximately 5.19 minutes. The duration of sealant treatment using glass ionomer based sealant ranged from 238 to 360 seconds and with a mean duration of 292.57 $\pm$33.56 seconds; approximately 4.53minutes. (Fig. 1).

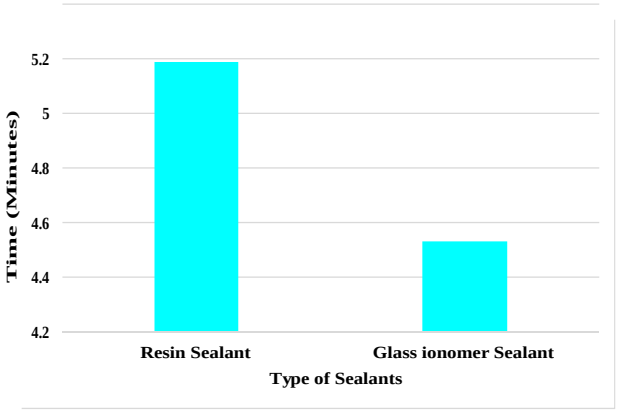

Fig. 1: Mean Duration for Sealant Placement in Minutes

The cost of treatment was the cost of material divided by the number of tooth surfaces sealed with the material. The cost of sealing a tooth surface using resin sealant (Clinpro) ® was five hundred and seventy naira only (₦570) (Table 2). Similarly, the cost of sealing a tooth surface using glass ionomer based sealant (GC Fuji triage) ® was eight hundred and forty naira only (₦840) (Table 3).

Table 2: Cost of treatment using resin sealant

Materials	Qty Used	Unit Price(₦)	Total Price(₦)
Resin Sealant	1 kit	12,240	12,240
Activating Unit	1 unit	16,560	16,560
Total Amount			28,800

Cost of treatment in focus

= Cost of material used / number of sealed surfaces

= ₦28,800/50 = ₦567 Approx. = ₦570

Resin sealant ₦570 ($1.56).

Table 3: Cost of treatment using glass ionomer sealant

Materials	Qty Used	Unit Price(₦)	Total Price(₦)
Glass ionomer Sealant	1 kit	42,000	42,000
Total Amount			42,000

Cost of treatment in focus

= Cost of material used / number of sealed surfaces

= ₦42,000/50 = ₦840

Glass ionomer sealant ₦840 ($2.30).

Discussion

Minimal intervention in paediatric dentistry is one of the current concepts in prevention of early tooth loss[2,7,8,10-11,15]. However studies have demonstrated barriers that could hinder the utilization of dental services in children in the prevention of dental caries[3-6]. These barriers included the cost of treatment and the duration of treatment[3-6]. This present study was conducted to determine the duration and cost of treatment using glass ionomer and resin based fissure sealants. The aim was to determine treatment cost which would remove this major barrier to the utilization of dental services in children.

Previous studies identified deep pits and fissures as a precursor to dental caries on the occlusal surfaces of permanent first molars[2,12-13,18-25]. Various researchers have found that the first permanent molars in children have a higher susceptibility to caries[26,27,28] due to their deep occlusal surfaces, and their posterior location which compromise access to cleaning and removal of debris. While other studies identified minimal intervention with the use of fissure sealants to reduce the incidence and prevalence of dental caries especially in children,[7,18,14-16,18,20,23], this present study aimed to demonstrate the cost of two sealants and the duration of treatment in caries susceptible children with deep pits and fissures. Other studies from various countries[13,15,19-21,22,24,25-29] identified the cost effectiveness with the use of resin sealants and glass ionomer sealants when compared with managing a grossly carious tooth. Their studies focused on government aid[19,21], dental practices[20], health centres[25], school programmes[17,24,28] and the underserved or poor children[22] with the aim of removing economic barriers in the management of dental caries in children. Such programmes do not exist in our environment. A study by Kervanto-Seppala[26] determined that sealants can be cost effective and may reduce the overall cost of treatment by direct intervention. Cost can be fixed (personnel and equipment) and variable (supplies)[15,26]. In this study, equipment and instrument purchasing cost was not considered except for the light curing unit. Clinic maintenance cost was also disregarded as this would exist even without the sealant program.

The cost of treatment included the cost of the sealant kit which was utilized during the research and divided by the total number of sealed tooth surfaces achieved with each pack of the sealant material. This study revealed that the cost of treating a single tooth surface using resin based sealant in Nigeria, is five hundred and seventy naira ₦570, while that for glass ionomer sealant is eight hundred and forty naira ₦840. The result from this study shows that it is relatively cheaper to use resin based materials for sealant treatment. This study is in agreement with that by Cao et al[27] which reported that it is more expensive to use glass ionomer sealant than to use resin based sealants.

In this study, the mean treatment time for resin sealant was 5.19 minutes while that of glass ionomer sealant was 4.53 minutes. This is in agreement with studies by Burt[29] and Chosack et al[30] which reported a mean duration of 5.3 minutes and 4.45 minutes respectively. It is also in agreement with studies by Kervanto-Seppälä et al,[26] with a similar treatment time for resin sealant of 5.44 minutes but disagrees with the duration for glass ionomer sealant where a longer chair-side time (9.59 minutes) was reported. The longer chairside time for glass ionomer sealant in their study[26] may be due to the manual dispensing and mixing of the glass ionomer material and the fact that the researcher worked alone. In this study, despite the fact that the researcher worked with an assistant; the glass ionomer sealant used was in capsule form and it was electrically triturated. The result from this study revealed that the chair-side

time for sealant placement using resin sealant is longer than glass ionomer sealant. This could be due to the fact that resin based sealant application is technique sensitive. In its application, the tooth must be properly isolated and avoidance of contamination throughout the procedure must be guaranteed[27-30]. Contamination can result in a loss of the resin sealant[19-21,30]. Saliva contamination of the etched enamel results in precipitation of salivary glycoprotein which prevents the sealant polymers from bonding to the enamel[1,7,10]. Re-drying the contaminated surface will not remove the precipitated salivary proteins even though the surface will still have an etched appearance[7,31]. Moreso, occlusal high spot when present, needs to be reduced with the use of a hand piece and bur[7, 30-31]. Another factor that could have accounted for the longer chairside time could be due to the fact that during occlusal check, most high spots that were reduced, were on the resin sealed tooth surfaces. This resin material would have hardened following light curing before the occlusion was checked and high spots removed with handpiece and bur.

Glass ionomer sealant on the other hand, is not as technique sensitive as resin sealant as it does not require micro-mechanical preparation of the pits and fissure by the use of acid etchant prior to placement because its bonding is by chemical means[30-31]; it is also not moisture sensitive and occlusal high spot when present can easily be reduced. Another possible factor for the short low chair side time in GIC sealant was that the high spot when present were easily reduced at the second stage of GIC setting phase (gelation and harding phase) by means of tooth cusps to material contact[30].

Conclusion

The use of resin based fissure sealant is relatively cheaper (average cost ₦570) when compared with glass ionomer based sealant (average cost ₦840). Less chairside time is required for sealant treatment using glass ionomer than resin based sealant for fissure sealing procedures.

Recommendation

Resin based sealant should be the first choice material for consideration for fissure sealing. Apart from the fact that resin sealant is more retentive, it is also cost effective. However, glass ionomer sealant could be a useful alternative.

Minimal intervention in children with a high risk of caries should be considered in form of Government aid, school based preventive programmes and outreaches to the undeserved should be encouraged as these materials are readily affordable and would reduce the incidence of early tooth loss in children.

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