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EVAUATION OF FLOURIDE RELEASE FROM CONVENTIONAL CHEMICAL CURE GLASS IONOMER AND RESIN MODIFIED GLASS IONOMER AS PIT AND FISSURE SEALANTS IN PERMANAT MOLARS: AN IN VITRO STUDY

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ABSTRACT

Purpose: To evaluate the fluoride release from conventional chemical cure glass ionomer and the resin modified glass ionomer as pits and fissure sealants.

Methodology: Thirty extracted human caries-free permanent molars were used in the study and divided into two groups. Group I for resin modified glass ionomer FujiTRIAGE and group II for conventional chemical cure glass ionomer VOCO as 15 teeth in each group, Each tooth was cleaned with water and soft-bristle brush before the fissure sealant was applied according to manufacturer instruction. Then kept in artificial saliva to be examined after 48 hours,7,15,28 days subsequently.

Results: This study showed that the resin-modified glass ionomer group FujiTRIAGE exhibit more fluoride release than the conventional glass ionomer VOCO group.

Conclusions: Both materials used in this study release fluoride, but there was a difference in each material's fluoride release rate. The initial release of fluoride was higher from resin-modified glass ionomer than from conventional glass ionomer. Both materials exhibited the highest fluoride release in the first 48 hours.

KEYWORDS: glass ionomer, pits and fissures, fluoride, sealants, dental sealant

INTRODUCTION

Dental caries is considered one of the most widespread diseases of humankind. Caries in children begin shortly after the deciduous teeth' eruption and continue to increase in an obvious way in their school age. Deep pits and fissures favor food retention sites and are difficult to clean by routine hygiene ways provide a favorable environment for the oral microorganisms to survive, converting carbohydrates substances into acids, leading to demineralization of the enamel. The most efficient way to prevent pit and fissure caries is by sealing the

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fissures using resins called pit and fissure sealants **Alesia and Khalil (2013).** Pit caries incidence is about 90% of the total incidence of caries in children and adolescents. There are signs that the severity of caries in the first molar increases in young children, especially in those at high risk of caries; therefore, the use of pit and fissure sealants plays an important role in preventing the development of occlusal caries by isolating the covered tooth surfaces from microorganisms and food stagnation **Ahovuo et al., (2013).** Posterior teeth are considered as one of the most vulnerable teeth to caries attack. The high susceptibility is directly related to the morphology of their occlusal surface. More effective measures are essential to protect pits and fissures; these include pit and fissure sealants. Sealant application is a conservative preventive approach involving using sealants into the pits and fissures of caries susceptible teeth. This sealant bonds to the tooth micro-mechanically, which provides a physical barrier keeping bacteria away from their source of nutrients **Alhareky et al., (2014).** One of the widely used dental restorations is the glass-ionomer, one of the advantages of glass ionomer over conventional sealants is their ability to release fluoride, which may result in increased resistance of fissures to demineralization; they are also able to form strong adhesive bonds to both enamel and dentine **Frencken (2010).**

MATERIALS AND METHODS

This study was In-Vitro study approved by by the Institutional Ethics Committee of Faculty of Dentistry Cairo University The sample size was calculated according to evidence-based committee at the faculty of dentistry, Cairo University Based on the previous paper by **Arbabzadeh et al., (2012).**

Thirty extracted human first permanent molars were collected from surgery clinic of National diabetes and endocrinology institute in Cairo and surgery Clinic of Dar Alsalam general hospital in Cairo. Teeth were extracted due to progressive periodontal problems and severe mobility

Criteria for teeth selection were depending on including all sound caries free molar teeth ,excluding all decayed, voids containing, cracked, stained molars. The artificial saliva used in this present study was prepared according to **Mcknight -Hane and Whitford (1992)** formula for artificial saliva preparation, The pH of artificial saliva was adjusted to 6.75 with KOH

Fluoride release measurement was done by fluoride electrode coupled with standard PH meter (Orion 901 microprocessor ion analyzer & Orion 407).

Randomization is done by using block randomization to ensure balance and equal sample size across groups overtime, to avoid selection bias assistant doctor will give each molar tooth a number by writing the number on each molar from one to thirty randomly **Krithikadatta et al., (2014)** Assistant doctor then distribute teeth randomly and equally into two jars that representing two testing materials without knowing which jar is assigned to which material to avoid selection bias Phone call to dental assistant before applying fissure material to the tooth to choose any number randomly representing tooth from any of two jars to avoid performance bias Each tooth.

Fissures were etched for ten seconds by using 37% phosphoric acid gel etchant, Using air water tip for removing etchant and dry tooth, Mixing each glass ionomer capsule in the amalgamator for 7 seconds according to manufacture instructions Sealants were applied according to manufacturer`s instructions for each group, group I for Fuji(TRIAGE) and group II for VOCO All of the teeth surfaces were polished by (SofLex disc, 3M ESPE) to remove the resin rich surface layer which may increase the fluoride release rate All of the materials were kept in moist environment at 95% relative humidity and 37°C for 24 hours to allow them to set completely

then transferred to the department of biochemistry faculty of medicine at Cairo University.

RESULTS

For all studied groups, Fluoride release in 2,7,15 and 28 days was estimated.

Statistical significant decrease in fluoride release in 7days, 15 days durations compared to the first two days duration (p value<0.001) while a significant increase in the fluoride release showed again at 28 days (p-value < 0.001).

No significant difference between 7 days, 15 days durations (p-value =0.99) while a significant increase in fluoride release in 28 days compared to 7 days duration (p-value<0.001), and a significant increase in fluoride release in 8 days compared to15 days duration (p-value<0.001).

Regarding the VOCO group, repeated measure ANOVA test revealed a statistically significant difference in fluoride release all through the experiment (P-value =0.001), that's why post hoc Bonferroni test was done and revealed; a statistically significant decrease in fluoride release at the end of the study compared to starting two days period (p value<0.001), While there was a significant increase in fluoride release in 7days, 15 days durations compared to the first 2 days (p-value = 0.9).

TABLE (1): Fluoride release in two days duration

	Group (I) Fuji triage n= 15	**Group (II) VOCO n=15**	**P value**
Fluoride (Mean ±SD)	78.7 ±21.1	36.5 ±10.9	<0.001

TABLE (2): Fluoride release in 7 days duration

	Group (I) Fuji triage n= 15	**Group (II) VOCO n=15**	**P value**
Fluoride (Mean ± SD)	68.95 ±18.99	37.16 ±12.17	<0.001

TABLE (3): Fluoride release in 15 days

	Group (I) Fuji triage n= 15	**Group (II) VOCO n=15**	**P value**
Fluoride (Mean ±SD)	67.95±18.18	37.87 ±12.01	<0.001

TABLE (4): Fluoride release in 28 days duration

	Group (I) Fuji triage n= 15	**Group (II) VOCO n=15**	**P value**
Fluoride (Mean ±SD)	74.98 ±20.35	30.22 ± 9.57	<0.001

TABLE (5): Fluoride release in each group all through the experiment

	2 Days	**7 Days**	**15 Days**	**28 Days**	**P value**
Fuji triag	78.7±21.1	68.95±18.99	67.95±18.18	74.98±20.35	< 0.001
VOCO	36.5 ±10.9	37.16 ±12.17	37.87 ±12.01	30.22 ± 9.57	< 0.001

DISCUSSION

Pits and fissures have been recognized as one of the susceptible areas for the stagnation of dental caries. Fluoride helps in increasing resistance of teeth to caries progression as its incorporation into the dental plaque, saliva, and tooth enamel, increases tooth resistance to acid attack, also acting as a reservoir for remineralization of carious lesions, and inhibits cariogenic bacteria **Al Agili et al., (2012).** Application of fissure sealants is one of the most effective ways for preventing caries on occlusal surfaces **Chestnutt et al., (2017).** Dental sealants containing fluoride act as fluoride reservoirs, which increase fluoride levels in saliva, plaque, and hard dental tissues, helping prevent or reduce secondary caries **Eggertsson et al., (2013).** The present study aimed to evaluate fluoride release from conventional chemical cure glass ionomer (VOCO) and resin modified glass ionomer Fuji(TRIAGE). the teeth surfaces were polished by (Sof-Lex, 3M ESPE) to remove the resin rich surface layer (which may increase the fluoride release rate) **Lobo et al., (2005)** All teeth will be stored in saline solution according to **Serra et al., (1992)** Artificial saliva is used as a medium for fluoride leaching to simulate to an extent the natural oral environmental conditions. However duplicating precisely the properties of human saliva is impossible due to the inconsistent and unstable natural saliva nature. So the development of artificial saliva is essential for well justified and controlled experiments **Ulusu et al., (2012).**

The result of the study showed that the greatest fluoride release was detected in the Fuji TRIAGE groups (78.7 ±21.1), while it was (36.5 ±10.9) in the VOCO group in the day 2 of the study, This finding gains support from the earlier reports **of Bahsi et al., (2019), Bao et al., (2014) and Sakkas et al., (2013)** which proved that the initial fluoride release from glass ionomer was due to an acid-base reaction and rapid elution of fluoride liberated, which takes place on the surface of the glass particles ,the amount of fluoride released proportional to the concentration of fluoride in the material, this is responsible for the phenomenon of "burst effect" where in high amounts of fluoride are released during the first two days This difference in fluoride release levels may be due to the difference in chemical and physical properties of Fuji (Triage) and VOCO GI as the glass filler content in the last one with fewer monovalent ions cross linking the polymer chains holding them close together, leading to less water transport and subsequently less fluoride release **Paschoal et al., (2011).**

Asmussenand (2002) explained the difference in fluoride release between glass ionomer material and resin modified one was due to the difference in the composition between ionomeric and resinous materials, resulting in subsequent differences in fluoride-releasing profiles, diffusion of water into the material is necessary for the formation of hydrogen ions, which attack the fluoride-containing glass particles, releasing fluoride. Ionomeric materials are more permeable to water, which enhances fluoride diffusion and release. The results of the study showed a decrease in fluoride release levels in Fuji triage groups in the second and third week (68.95±18.99),(67.95 ±18.18) respectively compared to the first two days, while the fluoride level increase again in the fourth week (74.98±20.35), this result is agreed with **Rao and Sudha (2011)** that used Fuji Triage as RMGI and Fuji II LC as non-resin one, the fluoride release of Fuji triage in the first day was (7.9±0.8) while in the second and third week the mean fluoride release was (7.8±0.6),(6.8±0.4) respectively re-increase in fluoride level at the end of the fourth week (7.1±0.8) was shown. **Neelakantan (2011)** proved that conventional GI, resin modified GI, and nano-ionomers show an initial burst effect for fluoride release, which then declines through the 1st week and stabilizes within 3–4 weeks. This can be explained by the rapid elution of fluoride liberated as a result of the acid-base reaction, which takes place on the glass particles' surface. According to **Bell et al., (1999), Shen et al., (2007), Upadhyay et al.,**

(2013), the difference in fluoride release between different groups of glass ionomer may be influenced by other factors Such as external variables as the pH and the type of storage media used.

From the limitation of the current study is measuring fluoride release in artificial saliva environment. Fluoride release increases in an acidic medium which could be the case in the oral cavity. The oral cavity is a challenging environment that cannot be precisely replicated in experimental conditions. However, simulating these conditions could give valuable information **Harhash (2017).**

CONCLUSIONS

All materials used in this study show fluoride release, but there is a different in fluoride release rate for each material, The initial Fluoride release was highest from Resin Modified GI followed by conventional GI 2-Resin modified glass ionomer Fuji (TRIAGE) has the ability to sustain more intrinsic fluoride release and maintain fluoride recharge capability despite long-term compared to conventional chemically cure glass ionomer (VOCO)

RECOMMENDATIONS

1. Recording date of application, this schedule of application would permit sealants to be checked annually to ensure retention
2. Further In vivo clinical trials with long term follow-up should be conducted to compare fluoride release of these materials in relation with oral flora

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