EVALUATION OF SHEAR BOND STRENGTH OF DIFFERENT TYPE OF PIT AND FISSURE SEALANTS- IN VITRO STUDY

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Abstract

Introduction: Selection of the type of pit and fissure sealants for a specific clinical case becomes a priority task against preventive dentistry because it may effect on the long-term treatment resultand the patient satisfaction with the result of the work

Material and methods: The three types of sealant used are, Ultraseal XT hydro, pinky flow (compomer), and Ionoseal, where all the three types of sealants are light cured. The pellets were prepared by a 3 x 5mm mold and light cured by the 570 nm light curing unit by the investigator himself. Total of 15 samples were divided into 3 groups. The universal testing machine (INSTRON E3000) for the evaluation of shear bond strength

Results: The results showed Ionoseal mean rank (12.80) has the maximum shear bond strength compared to other materials and is statistically significant ($p<0.05$). The least is the compomer with the mean rank of 4.

Conclusion: The Shear Bond strength of the Ionoseal sealant was found to be superior to that of the Ultra seal XT and compomer.

Keywords: pit and fissure sealants, shear bond strength, light cure sealants

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1. Introduction

Occlusal surfaces' complex architecture makes them potentially cariogenic [1]. The 1960s saw the introduction of the practice of sealing pits and fissures, which isolates the fissure from the oral cavity and subtly makes cleaning the masticatory surfaces easier[2]. In order to reduce occlusal caries initiation and/or progression, treating caries-susceptible pits and fissures with sealants has been regarded as an excellent complementary resource to oral health care measures[3,4]. The potential of the sealant to completely fill pits, fissures, and/or anatomical defects, as well as to remain intact and adhere to enamel surfaces without minor microleakage at the resin-tooth interface, is directly related to the preventive benefits of such therapy[4,5]. Pit and fissure sealants are materials that are placed inside the occlusal pits and fissures of teeth that are prone to dental caries[2,6]. This creates a micro mechanically bonded, protective coating that prevents caries-causing bacteria from accessing their source of nutrients[78]. Numerous clinical studies have demonstrated the remarkable effectiveness of this technique in reducing dental caries[9]. Currently, dental sealants could be classified into four categories: resin-based sealants, glass ionomer cements, polyacid-modified composite resins, and resin-modified glass ionomer cements[10].

Fissure sealants should ideally have the following qualities: greater sealing ability, biocompatibility, and resistance to wear and abrasion[11–13]. Varied fissure sealants are employed, each with a different sealing capacity and shear bond strength. Better sealing performance will result from less microleakage. Longevity of sealant is increased by improved shear strength[11].Our team has extensive knowledge and research experience that has translate into high quality publications [14–23].

Accordingly, the present study aimed to evaluate and compare the shear bond strength of three different types of the PFS (Ultraseal XT hydro, pinky flow (compomer), and Ionoseal after 24 hours of storage in distilled water at 37 degrees C then performed the stress loading it in a statically axially loading test and analysis done by Universal testing machine (INSTRON E3000), so as to find the material of choice.

2. Methodology

Study design: In vitro study

Study setting: The study was done in WHITE LAB (Dental material lab), Saveetha institute of medical and technical science (SIMATS), Chennai.

Ethical approval: Ethical approval was obtained from institutional review board, Saveetha University (SIMATS).

Materials used: The three types of sealant used are, Ultraseal XT hydro, pinky flow (compomer), and Ionoseal, where all the three types of sealants are light cured and have fluoride releasing properties.

Preparation: The pellets were prepared in 3 x 5mm size using a mold in cylindrical shape and light cured by the 570 nm light curing unit by the investigator himself. Total of 15 samples were divided into 3 groups, 5 in each group. The pellets were then bonded on a previously extracted premolar. The premolars selected were orthodontically extracted permanent upper first premolar. They were cleaned with saline and air dried. The buccal surface of the premolar was etched with 37% phosphoric acid for 15 sec, after air drying the pellets were bonded to the tooth surface and light cured. The prepared specimens were then submerged in saline for 24 hours and then it was mounted on pre fabricated acrylic blocks to test it in the universal testing machine (INSTRON E3000) for the evaluation of shear bond strength (figure.1,2).

Figure.1 Specimens mounted on the premolar in the acrylic blocks

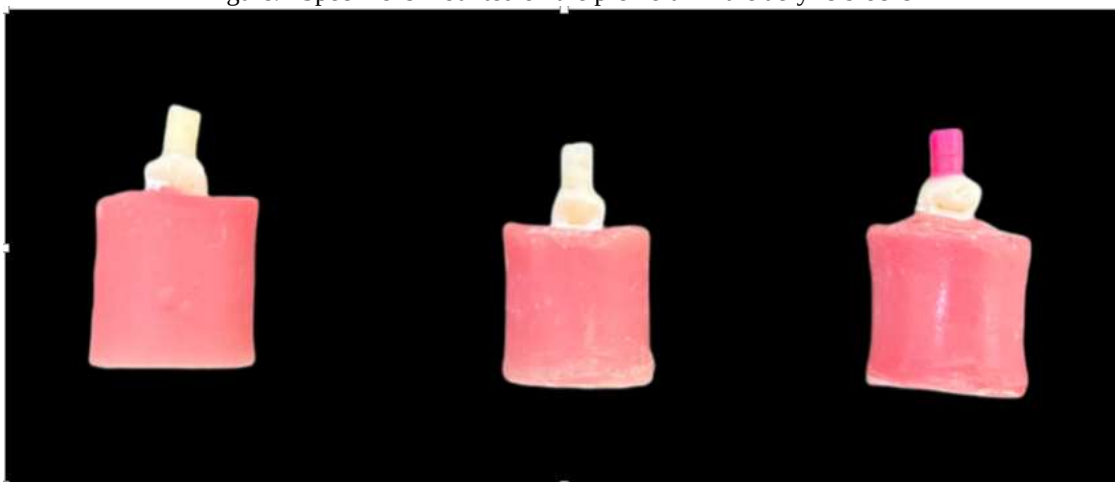
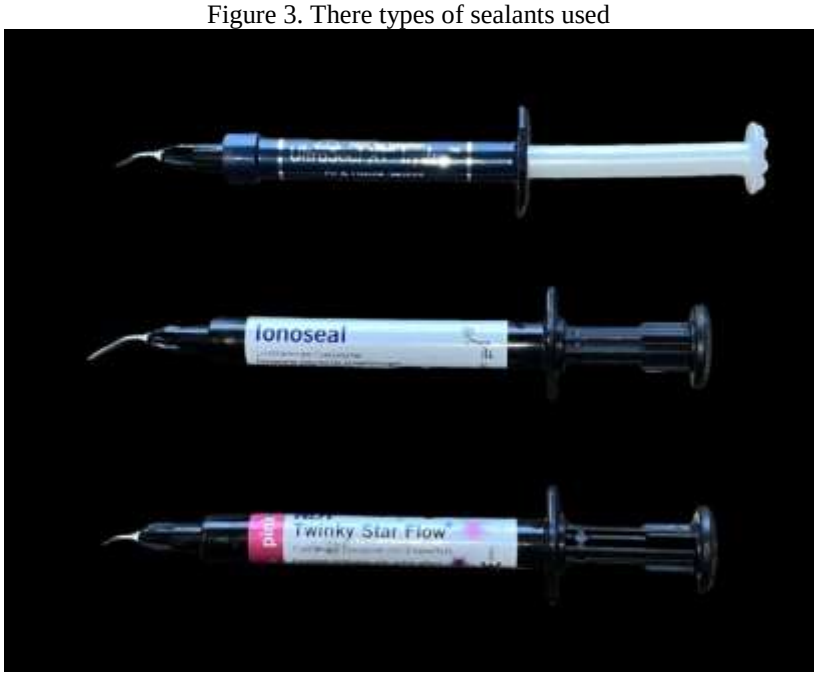


Figure 2. Universal testing machine-INSTRON E3000

Figure 3. There types of sealants used



Statistical Analysis

For statistical analysis SPSS software used was IBM SPSS software 23. To know the statistical significance between and within 3 groups, a non parametric Kruskal Wallis test was used, where p value <0.05.

3. Results

The results showed the mean MPa of Ionoseal is 14.12±1.58 and the mean maximum force (N) with-standard was 202.5±12.9 and has the maximum shear bond strength compared to other materials and is statistically significant ($p<0.05$). The lowest is the compomer with the mean MPa of 9.69±1.61 and mean maximum force (N) withstanded was 131±4.5 with the mean rank of 4.00 (refer table 1 and 2).

Table 1. Comparison of Mean MPa between the groups

Materials	Mean±SD (MPa)	Kruskal Wallis test	P Value
Ultra-seal XT hydro	10.55±2.51	8.420	0.015
Twinky star flow	9.69±1.61		
Ionoseal	14.12±1.8		

P value, p<0.05*, MPa- Megapascal

Table 2 Comparison of Mean Max force between the group

Materials	Mean±SD (MPa)	Kruskal Wallis test	P Value
Ultra-seal XT hydro	152.7±30.9	9.920	0.007
Twinky star flow	131±4.5		
Ionoseal	202.5±12.9		

P value, p<0.05*, N-Newton

4. Discussion

The current study is an in-vitro evaluation of the shear bond strength of 3 types of pit and fissure sealants, featuring fluoride-releasing and light-cured sealants. The penetration and subsequent polymerization of the resin sealant into the microporosity network produced by the acid etchant on the enamel surface creates a micromechanical mechanism that ensures the retention of resin sealants[24,25]. Due to the high degree of enamel reactivity brought on by acid etching, it has been reported that even quick salivary exposures of just one second are sufficient to form pellicules that partially occlude the micropores, altering the ultrastructure of the etched enamel and preventing the formation of the resin tags necessary for mechanical adhesion[26,27].

The mean shear bond strength of group I (ultraseal XT hydro) is 10.55±2.51 MPa, group II (compomer, twinky star flow) is 14.12±1.58 MPa and compomer with 9.69±1.61 MPa. Because all of the fissure sealants used in this experiment had shear bond strengths that were higher than the Reynolds-recommended minimum shear bond strength (5.9-7.8 MPa), they were all deemed to be acceptable and capable of withstanding masticatory pressures[28].

Since 2002, coloured composites have been implemented in the restoration of primary teeth, and Twinky Star composite is one of them. Due to its appealing colors, this material is especially popular with pediatric patients[29]. According to an in vitro study done by Özge-Erken Güngör et al, [29] the mean shear bond strength of compomer, twinky star flow is 6.78±0.45 which in contrast, our results showed higher mean shear bond strength

According to the theory of salivary contamination, newer resin-based hydrophilic sealants, like Ultraseal XT hydro, chase moisture deep into pit and fissures on a microscopic level and their advanced adhesive technology allows them to flow into pit and fissures and bond effectively to the tooth without the use of a drying agent [30]. In an in vitro study by jayashri et al., [31] the mean shear bond strength of Ultraseal XT hydro was found to be 20.39 ± 0.98 MPa but the mean shear bond strength observed in our study showed less mean shear bond strength and similar to a study done by Irina Mézquita-Rodrigowhere et al., [32] the mean shear bond strength was 11.23± 0.11 MPa. Nadia malek taher et al., [3334] concluded that resin modified glass ionomer cement has the mean MPa of 14.46 ± 0.31 similar to our study where the bond strength is MPa of 14.12 ± 1.58

In any case, the improvement in bond strength will result in better retention for sealants used in clinical settings[35]. Successful fissure sealing in the oral environment depends on the sealant's optimal

physical qualities. By supporting occlusal loads created by chewing while safeguarding the adhesive interface and enhancing long-term retention, a material with increased mechanical strength can be used to cover pits and fissures. It has been demonstrated that maintaining the sealant throughout time is essential for successful caries prevention and for halting the progression of caries[364]. Our team has extensive knowledge and research experience that has translated into high quality publications [37–46].

5. Conclusion

Within the limits of this in vitro study and according to the methodology and the results drawn, the following statements were concluded that Shear Bond strength of the Ionoseal sealant was found to be superior to that of the Ultra seal XT and compomer. Since this is an in-vitro study, the clinical significance of these findings can only be determined with further studies assessing the clinical retention.

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