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***IN THE NAME OF ALLAH,
THE MOST GRACIOUS,
THE MOST MERCIFUL.***

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**Shiraz University Of Medical Sciences,
School Of Dentistry.**

Thesis

**For Receiving The
Doctor Of Dental Medicine
Degree.**

Title,

**A Comparative Analysis Of The Marginal
Microleakages Of Two Pit And Fissure Sealants,
Conseal-F And Conseal Clear.**

Guiding Professor And Advisor

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EVALUATION OF THESIS

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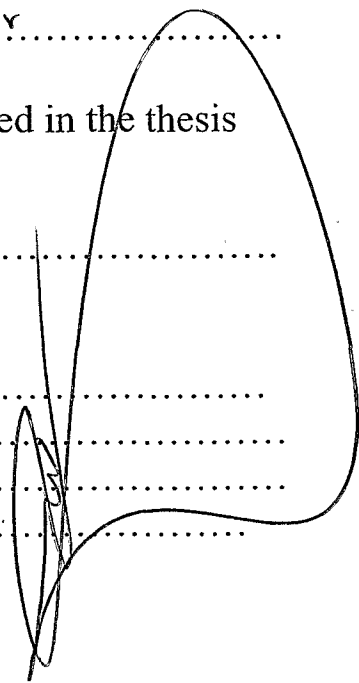
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And We have enjoined on man to be dutiful and kind to his parents. His mother bears him with hardship. And she brings him forth with hardship, and the bearing of him, and the weaning of him is thirty months, till when he attains full strength and reaches forty years, he says: " My Lord! Grant me the power and ability that I may be grateful for Your Favour which You have bestowed upon me and upon my parents, and that I may do righteous deeds, such as please You, and make my offspring good. Truly, I have turned upon You in repentance, and truly, I am one of the Muslims (submitting to your Will). "

V.26:30

To my mum,

For bearing all the hardships, for her indispensable care, support, prayers, love and kindness, words cannot simply say thank you, but thanks for the long and tireless efforts to see me reach the peak of success.

And your Lord has decreed that you worship none but Him. And that you be dutiful to your parents. If one of them or both of them attain old age in your life, say not to them a word of disrespect nor shout at them but address them in terms of honour.

And lower unto them the wing of submission and humility through mercy, and say: "My Lord! Bestow on them your Mercy as they did bring me up when I was young."

V.15:23-24

To my dad,

Who could not live long enough to see the rewards of his support, patience, commanding nature, tough and enforcing pieces of advice. He straightened and made me understand the importance of knowledge, meaning and priorities of life. May the Almighty have Mercy on you.

To all my brothers and sisters, close friends and colleagues who not only showed me love, gave me respect and support but also shared my joys and sorrows in this long period of time.

To My Guiding Professor and Advisor,

Dr Mehran Mortazavi,

Your kindness was Great, thanks a lot for accepting to undertake the duty of guiding me through this thesis and for making my work easier. Wishing you all the best in all your present and future endeavours.

*He grants wisdom to whom He pleases, and he to
Whom wisdom is granted is indeed granted abundant
Good. But none remember (will receive admonition)
Except men of understanding.*

V.2.269.

*With special dedications and gratitudes to Dr Seyyid Ali
Asghar Alawi and all my professors and lectures at the
Shiraz Dental School and all my former teachers for their
services and honors.*

ABSTRACT

Purpose : *An in vitro study was conducted to evaluate the Enamel marginal microleakage of two pits and fissure sealant conseal –f and conseal clear following acid etching.*

Methods: *30 human premolars without caries removed for orthodontics reasons were collected from different dental clinics and stored in distilled water. The teeth were randomly distributed into two groups of 15 according to the sealants to be used. The materials were manipulated according to the manufacturers instructions, and no invasive enamel technique was used in preparing the teeth. Staining was done with 2% fuchsin. The results were evaluated using the chi-square test.*

Results: *no significant difference was seen between the marginal microleakage of the two sealants ($p=0.7$).*

Conclusion: *even though the manipulation and application of this sealants were easy the individual sealants showed relatively high degree of microleakages . Suggesting that this materials like many other materials presently in use are still not able to secure total sealing of the space between the material used and the dental tissue.*

KEY WORDS: *FISSURE SEALANT, MICROLEAKAGE.*

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INTRODUCTION

The introduction of sealants in the 1960's, marked a revolution in the preventive dentistry and a significant decrease in the incidence of caries in children and adolescents. Pits and fissures in the occlusal surfaces of permanent teeth are particularly susceptible to decay, and fluoride treatments have been least effective in preventing caries in this areas. The susceptibility of occlusal pits and fissures to caries is related to their physical size and morphology, which can provide shelter for organisms and obstruct oral hygiene procedures.

Pits and fissure sealants are currently the most effective means of reducing the risk of caries that arises from these sites. However, this materials should have some ideal properties which are necessary for their successful clinical use which includes biocompatibility, retention capacity, resistance to wear and abrasion, and adequate adhesion to the surface. On the other hand, their marginal integrity and microleakage are very important factors in evaluating their clinical success. Microleakage is used as a measure by which clinicians and researchers can predict the performance of restorative and preventive materials in the oral environment. The importance placed on this measure is based on the premise that no restorative material is perfectly adaptive or adhesive to the tooth.

The purpose of this thesis is to compare and evaluate the enamel marginal microleakage of two pits and fissure sealants i.e conseal-f and conseal clear which are currently in use in the dental profession. These products from Southern Dental Industries, Australia, were selected for the study because no previous reported study on their microleakages and use were found in previous dental papers and journals, especially in Iran where they are new and seem to be getting more popularity in the dental profession.

CHAPTER ONE

REVIEW OF ARTICLES

Microleakage of sealants has been investigated by numerous in vitro studies where different procedures materials and preparation techniques have been used in order to study their clinical efficiency and improve their physical chemical and mechanical properties. One of the first studies on microleakage of resin sealants was conducted by Silverstone LM in 1976 where he found that microleakage occurs at the margins of restorations as demonstrated by the use of an artificial caries technique in which "outer" and "cavity lesion" are produced. He stated that the incidence of cavity lesions is less if a composite material is used rather than amalgam, and microleakage can be decreased further by the use of resins to the composite /enamel margins. ⁴

In 1979 Powel KR studied the microleakage retention, durability and cariostatic efficacy of Bis-GMA resin fissure and sealants, but his studies were based on the response of teeth to these qualities and found that newly-erupted permanent molars benefited least but the benefit of premolars was consistently high. ⁵

In 1990 Ovebro RC and Raadal M (Norway) investigated if microleakage occurred in the fissures after being sealed with a glass ionomer cement (Fuji III). They sealed in vivo, ten pairs of contralateral maxillary premolars to be extracted for orthodontic reasons. Glass ionomer cement was randomly used on one tooth and diluted composite on the contralateral. An air polishing instrument was used for cleaning the fissures before sealing them. After 14 days the teeth were extracted, placed in 0.5% solution of methylene blue, subjected to thermocycling procedure and finally sectioned. The sections were then photographed in a stereomicroscope, and then recorded according to a scoring system. Extensive leakage was

seen in all glass ionomer specimen with dye penetration. No leakage was seen in composite specimen. The study indicated that Fuji III was poorly retained in the fissures and that it permits leakage even when fully retained.⁶

In 1991 Reid JS, Saunders WP, and Chen YY (Glasgow, Scotland) conducted a study to assess, *in vitro*, the microleakage of class V composite resin restoration following sealing of the margins with a fissure sealant or the resin component of a dental bonding agent and to compare it to unsealed control group. They found no significant difference between the two groups.

In 1996 Theodoridou-Pahini and Tolidis (Greece) conducted a study to evaluate and compare the degree of microleakage exhibited by 5 resin sealants (concise, helioseal, durafil, fissurit, sci-pharm) and a glass ionomer sealant (Fuji Glass ionomer Type III). In this study the fissure systems of the occlusal surfaces of the freshly extracted teeth were opened using a pear shaped bur, and limited to the enamel. 14 teeth were prepared for each group, and for each group seven teeth were thermocycled (5-37°C, 37°C and 60°C) for 2000 cycles, and the other seven were not thermocycled. All the teeth were immersed in 0.5 % fuchsin solution for 48 hours before being sectioned longitudinally in the buccolingual direction and 3mm thick sections (distal, central, proximal) were obtained, each section was photographed and examined under stereomicroscope. In this study all materials presented microleakages both thermocycled and non thermocycled specimen, microleakage being more in the former specimens. Their results supported the idea of opening unquestionable carious fissures and removing caries (if present) before sealing.⁹

In 1998 Hatibovic-Kofman S, Wright and Braverman (Canada) conducted a study to compare the microleakage of unfilled sealants after a conventional bur and air abrasion tooth preparation. In this study 72 extracted molars were divided into 3 groups. Group 1 - the teeth were prepared by pumice and etching with 37 %

phosphoric acid. Group 2- the teeth were prepared with a round bur in a low - speed hand piece and then acid etched. Group 3- were prepared by high speed (160 psi) microabrasion using 50 mu alumina particles in a kcp 2000 machine. In each group 12 teeth were sealed with filled sealant and 12 with unfilled sealant. In this study 216 sections were obtained of which 66% showed no leakage. They concluded that

- i) superior results were obtained when the teeth were prepared by a bur.
- ii) conventionally and kcp 2000- prepared tooth surfaces yielded the similar results.
- iii) the unfilled sealant was superior to the filled sealant.^{10.}

In 1998 Grande RH ,Ballester R and others (Brazil) evaluated the microleakage of a universal hydrophilic adhesive (optibond and dual-curve) by itself as a pit and fissure sealant compared to that of ionomeric product (variglass) and two hydrophobic sealant (delton and fluroshield).They found that under no humidity condition, the average score for variglass was significantly higher than that corresponding to the three remaining materials which were considered equivalent. Under humid conditions (plasma contaminated), there was complete loss of Delton and Flouroshield in all cases whereas the score for variglass was slightly higher than that for optibond. Their results suggested that optibond can be used by itself as a pit and fissure sealant instead of the combination of adhesive plus sealant.^{12.}

In 1999 do Rego and de Araujo MA (Brazil) evaluated the microleakage of pit and fissure sealant after different surface preparation (invasive technique and laser irradiation) and the use of different materials (fluoride resin –filled sealant, resin – modified glass ionomer cement adhesive system). After the accomplishment of the different treatments, the sample were thermocycled and the micoleakage was assessed under scanning electron microscope(SEM). The results show that laser irradiation did not lessen microleakage in pit and fissures when using a filled sealant

with fluoride or resin-modified glass ionomer cement. The use of adhesive system and laser irradiation, followed by the resin-filled sealant with fluoride, showed the lowest microleakage scores in pits and fissures. They concluded that the use of an adhesive system decreased microleakage with or without previous laser irradiation.^{13.}

In 2000 Zervou C, Doherty Eh, Zavras A, and others (Boston, USA) evaluated the effects of load on microleakage of pit and fissure sealants. In phase one of the study a load of maximum force ($F=880N$) was applied on the central and peripheral enamel. Group A- no force, Group B-application of force on the central pit of the tooth, Group C-application of force on the peripheral enamel 2.5 mm away from the margin of the tooth at the level of the dentoenamel junction. The study results showed that significant increase of microleakage on the peripheral sealed enamel as well as enamel microcracks. So, in the phase II 60 wisdom teeth were sealed with ultra seal XT plus and load of different magnitudes was applied on the peripheral enamel. The specimen were then thermo cycled for 500 cycles at 5 degrees. Six groups of ten specimens were tested for microleakage under load. The force was applied at the level of the DEJ in a cross-section view. (Groups A B C D E F) were obtained with - Group A with force =0 and the rest with forces ranging from 300N to 700N. Their results showed that, the magnitude of force and tooth morphology may influence the degree of microleakage observed after the placement of sealants.^{14.}

In 2000 the same authors evaluated the effects of enameloplasty technique on microleakage of sealants when occlusal force was applied on the teeth. Their study also allowed for a direct comparison of the effectiveness of enameloplasty when two different burs were used. Their findings indicated that enameloplasty reduced the microleakage of pits and fissure sealants, especially when load was applied to the teeth irrespective of what bur was used to enlarge the fissure as there was no statistical difference between the round and fissure diamond burs. The

application of occlusal force to the tooth produces significantly more leakage, unless enameloplasty was performed.^{15.}

In 2001 Borsatto MC, Corona SA, Dibb RA and others (Brazil) conducted an in vitro study to assess microleakage underneath pit and fissure sealant bonded to occlusal surfaces treated by four enamel treating techniques. Before this there had been no report of a study assessing microleakage of a pit and fissure sealant, comparing etching Er;YAG laser and air abrasion for treating enamel surfaces. They sealed 40 extracted human third molars and randomly assigned them into four groups of ten. Group 1 the occlusal surfaces were acid etched; Group 2 a very short pulsed Er;YAG laser was used to treat the surfaces; Group 3 aluminum oxide, air abrasion was associated with acid-etching conditioning. The specimen, were sealed and stored in distilled water for 7 days, then thermocycled and immersed in 0.2% rhodamine solution, sectioned and finally analyzed for leakage using optical microscope connected to a video camera. The images were digitalized and analyzed by software that allowed microleakages assessment in mm. Their results showed that occlusal surfaces treated exclusively by Er;YAG laser (Group 2) provided the poorest marginal sealing and that acid etching (Group 1) was statistically similar to aluminium oxide abrasion + acid etching (Group 3) and Er;YAG + acid etching (Group 4). Therefore they concluded that the complementary either air abrasion or Er;YAG laser irradiation with subsequent acid etching did not lessen microleakage at the enamel- sealant interface compared with a acid etch group.^{16.}

In 2002 Gillet D, Nanay J, Dupuis V, Dorigna G (France) performed two in vitro experimental study to evaluate the microleakage and penetration study of three types of materials in fissure sealants : self-etching and prima + etching. In their first in vitro experimental study they evaluated the microleakage and penetration of three types of materials by vivadent : helioseal F, tetric, tetric flow. The teeth were etched with phosphoric acid and

bonded using a one bottle bonding in order to determine the best material for sealing the fissure. The depth of penetration of fuchsin as well as that of the tested material was measured with a grid, and then compared and expressed in percentage. The penetration was as follows ; 96.90% for helioseal F , 90.82% for tetric and 86.10 % for tetric flow. In this first study tetric flow showed no microleakage and was more efficient compared to helioseal F and tetric in obturating deep fissures of non carious bicuspid. ¹⁷.

Their second experimental study evaluated the microleakage and the penetration of tetric flow when bonded by two different methods: Group 1; total etch (phosphoric acid) and scotch bond (3M) and Group 2: self etching primer with prompt (Espe). There was no significant difference between classical bonding against self etching primer . They suggested that the self etching primer was efficient against phosphoric acid in obturating the fissures on the non carious bicuspid with tetric flow. They concluded that for prevention by sealing, using a ceromer (tetric flow) with the self-etching (prompt), was a really good technique . ¹⁷.

In 2002 Blackwood JA, Dilley DC, Roberts MW ,and Swift EJ , (Chapehill , USA) conducted a study with the aim of evaluating microleakage techniques : 1) traditional pumice prophylaxis and acid etching 2) fissure enameloplasty and acid etching 3) air abrasion and etching . In this study Delton opaque light cured sealant was used after preparation with one of the three techniques. Their findings showed no significant difference in microleakage between the 3 fissure preparation methods prior to sealant placement that is, neither air abrasion nor enameloplasty followed by acid etching produced significantly less microleakage than the traditional pumice prophylaxis with acid etching. ¹⁸.

In 2003 Perez-Lajarin L ,Cortes Lillo D, Garcia Ballester C, Cozar Hidalgo A (Spain) conducted a study to evaluate the enamel marginal microleakage following acid -etching of two fissure sealant of established clinical efficacy .The purpose of their study was to assess sealant leakage following etching in

combination with the use of latest generation adhesives. They collected 22 human premolar teeth extracted for orthodontic reasons, and stored them in distilled water and then sealed the occlusal surface. They used concise (3M) and Dyract seal (Dentsply de Trey) sealants. The teeth samples were randomly distributed into two groups of 11 according to sealant used. The materials were manipulated according to the instructions of the manufactures, and no invasive preparing technique was used. Staining was done in 2% fuchsin. They found out that concise sealant produced significantly greater marginal leakage than Dyract seal. They concluded that the application of an adhesive layer beneath the sealant afforded less microleakage than when no adhesive layer was used. Nevertheless, despite the possibility of combining adhesive and sealant resins, with good bonding between both components over the entire fissure interface, microleakage was still observed, regardless of the material used, suggesting that presently there is no material that can secure sealing of the interfacial space and prevent microleakage.^{22.}

In 2003 Eronat N, Bardaka Y, Sipahi M (Izmir Turkey) conducted a study to compare the microleakage of a compomer and resin in vitro using different surface preparation techniques. Microleakage of a compomer (Dyract seal, De Trey) and a resin sealant (Helioseal F, vivadent) was investigated on 125 intact third molars, materials and surface preparation techniques were: Group 1 -37% phosphoric acid + helioseal F. Group 2 -Aluminium oxide, air abrasion +Helioseal F. Group 3 - non rinse conditioner (NRC) +Prime &Bond + Dyract seal; Group 4- phosphoric acid +Dyract seal, Group 5 -Aluminium oxide, air abrasion +Dyract seal. Their results showed that pretreatment with phosphoric acid produced the lowest scores when applied with compomer and resin fissure sealant and there was no statistical difference. They concluded that compomer sealant used with non-rinse conditioner (NRC) was not a successful pretreatment with phosphoric acid etching where Aluminium oxide, air abrasion treatment was effective in preventing microleakage in both sealants.^{27.}

In Spring of 2004 Lupi Perrier L, Muller- Bolla, Betrand M, Fradet T (Nice, France) conducted one of the latest study to assess the microleakage of pit and fissure sealants after classical enamel preparations (prophylaxis followed by acid etching alone and mechanical widening with bur) and after air abrasion. Their results showed that the microleakage of sealants prepared with abrasion alone displayed significantly greater microleakage than the one placed after prophylaxis and etching, bur and etching or abrasion and etching. They also found that samples prepared with air abrasion alone showed the highest mean microleakage than the other samples. They concluded that air abrasion treatment does not eliminate the need for etching the surface before applying the sealant.^{29.}