Submitted by Catherine Dahl in partial fulfillment of the requirements for the degree of Master of Science in Oral Biology.

Accepted on behalf of the Faculty of the Graduate School by the thesis committee:

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Marginal Adaptation of Bulk-Fill Resin Based Composites

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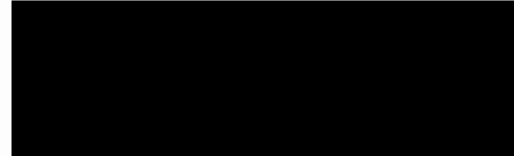

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MARGINAL ADAPTATION OF BULK-FILL RESIN BASED COMPOSITES

BY
Catherine M. Dahl

Submitted in partial fulfillment of the requirements
for the degree of Master of Science in the
Department of Oral Biology
In the Graduate School of
The Uniformed Services University of the Health Sciences

FORT BRAGG, NC
2016

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List of Abbreviations

RMGI……………….Resin Modified Glass Ionomer

Bis-GMA…………..Bisphenol-A-glycidyl dimethacrylate

C-factor……………Cavity Configuration factor

SDR………………..Smart Dentin Replacement

NaOCl……………..Sodium Hypochlorite

LED………………...Light Emitting Diode

OEM………………..Original Equipment Manufacturer

mW………………....Milliwatt

cm…………………..centimeter

BIS-EMA…………..Bis-A-dimethacrylate

UDMA……………...Urethane dimethacrylate

TEGDMA…………Triethylene glycol dimethacrylate

FL…………………..Filled

HEMA………………Hydroxyethyl methacrylate

PAMM………………Phthalic acid monoethyl methacrylate

SP………………..…Stephanie Price

AC…………………..Andrew Callahan

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ABSTRACT

Objective:

Evaluate the marginal seal of bulk fill resin composites compared to conventional composites.

Materials and Methods:

Class II preparations were prepared on non-carious third molar teeth; the interproximal portion extended at least 1mm onto the root surface.

Teeth were restored with Filtek Supreme Ultra and X-tra fil bulk composite.

After 24 hours samples were immersed in methylene blue dye for 30 minutes, rinsed and sectioned.

Sectioned teeth were evaluated visually for marginal leakage at the enamel and dentinal margins.

Results:

Statistically significant differences were seen in the marginal leakage at the dentinal margin. Conventional composites had a median microleakage score of 1, bulk fill composites median score was 0.

No leakage was detected for either group at the enamel margin.

Conclusion and Significance:

The bulk fill composite demonstrated better marginal adaptation at the dentinal margin at 24 hours.

Additional research is needed to evaluate marginal seal at longer time frames

INTRODUCTION

STATEMENT OF THE PROBLEM

The development of new materials designed to increase the efficiency of dental treatment for today's patients is constantly evolving. Recent developments in dentistry include the release of new bulk fill resin composites which are reported to have reduced polymerization shrinkage when compared to conventional packable composites. (VOCO GmbH) This reduction of polymerization shrinkage is advantageous since the stress that develops in response to polymerization shrinkage causes cuspal deflection resulting in sensitivity or micro cracks in resin and or tooth structure. The stress related to polymerization shrinkage can also lead to adhesive failure at the interface between the tooth and resin which can cause marginal gaps, microleakage and recurrent caries. (O'Brien, 2008) (S. El-Safty, 2012)

Microleakage is described as the chemically undetectable passage of bacteria, fluids, molecules or ions between the cavity wall (tooth structure) and the restorative material. (Nicola Scotti, 2014) Studies evaluating microleakage of class II restorations, restored with bulk fill composites, have demonstrated promising results in terms of sealing ability both at enamel and at the dentinal

margin. (Jelena Juloske, 2013) A class II restoration extends from the chewing surface to the interproximal surface of a posterior tooth.

SIGNIFICANCE

The US Army currently spends a great deal of money on the oral health of soldiers. (Chisick M, 2000) Reported cost of a single resin bonded composite range from $158 to $297 depending on location and the number of surfaces involved. The demand for composite restorations has increased dramatically since their introduction in the late 1960s. (Lindberg A, 2004) Placement of predictable and successful resin composites in a reasonable time is essential in minimizing practice overhead and maintaining the health and wellness of Soldiers.

A fundamental goal of clinicians when restoring teeth is to obtain a tight marginal seal. The strength of the marginal seal is critical to the long term success of the restoration. A successful restoration should be expected to preserve and protect the remaining tooth structure. All restorations have a limited life span and will eventually need to be replaced. As restorations require replacement, additional tooth structure is often removed leaving the tooth further compromised. The patient may also experience pain and anxiety related to the need for dental treatment, in addition to the decreased productivity from time lost from work.

Reliable adhesion of resin composites may be compromised by polymerization contraction which adversely affects the stability of the adhesive interface. (Braga, 2005) Contraction stresses create strain on the bonded tooth surface leading to microleakage and increasing the chances of postoperative pain and secondary caries. The effects of contraction stress are considered one of the main reasons for negative clinical outcomes of resin composites. (Ferracane JL, 2003) To minimize the effects of contraction stress, incremental filling technique has been recommended which has been shown to reduce cuspal deflection and increase microtensile bond strength of resin restorations. (Park J, 2008) Disadvantages to the incremental filling of composite restorative material include an increase in time and complexity of the restoration. As each additional increment is added to the cavity preparation, moisture control must be maintained during which time the patient may be fidgeting or salivating increasing the difficulty of the procedure. It should also be taken into consideration that placing a larger number of layers means more treatment time.

The continual development of dental materials and demand for time saving procedures have led to the development of resin composites with low stress behavior that allow for bulk-filling of cavity preparations. The new bulk-fill resin based composites have been reported to provide increased marginal adaptation to enamel and dentin.

Failure of composite restorations is seen more frequently when the restoration extends below the cemento-enamel junction. The higher organic component, tubular structure, fluid pressure, and permeability along with lower surface energy of dentin make bonding of the composite to dentin more difficult than to enamel. (Narayana V, 2014) A possible solution to the less than ideal seal on dentinal margins is the use of resins with reduced polymerization shrinkage such as the new bulk fill resin composites.

If a bulk fill composite can provide a superior marginal seal compared to conventional composite, its use in clinical practice could extend the service life of a restoration saving both time and money for the patient.

History of Restorative Materials

In the 1950's, general dentistry was primarily focused on dental amalgams, direct and cast gold restorations. Direct esthetic restorations were silicates and polymethyl methacrylate, and indirect esthetic restorations used dental porcelains. (Bayne, 2013) The search for an ideal esthetic material for restoring teeth has resulted in significant improvements in esthetic materials. (Roberson T, 2006) Most patients prefer their teeth to appear natural. In 1959 Skinner wrote "The esthetic quality of a restoration may be as important to the mental health of the patient as the biological and technical qualities of the restoration are to his physical or dental health". (Skinner E W, 1960)

Amalgam

Dental amalgam has served as a dental restoration for more than 165 years. (Ramesh Bharti, 2010) Dental amalgams provide long term reliable performance in load bearing areas. Dental amalgams gained universal acceptance largely due to the work of G V Black. Older, low copper amalgams had a limited life span due to the presence the gamma-2 phase that leads to corrosion. (Guthrom CE, 1983) Several studies of high copper amalgams have shown satisfactory performance for more than 12 years. (Osbourne JW, 1991) Despite the successful long-term record of amalgam, when esthetics is important such as in anterior restorations, amalgam is, in my opinion, not a suitable dental restoration.

First Translucent Restorative Material

Silicate cement was the first translucent filling material introduced in 1878 by Fletcher. (GT, 1975) Silicate cement is composed of acid-soluble glasses in powder and phosphoric acid, water and buffering agents in liquid. Silicate cements were used extensively for the restoration of anterior carious lesions for approximately 60 years. Due to the high fluoride content of the silicate cements they were recommended for use in high caries risk patients. Silicate cements possessed tooth-matching ability, ease of manipulation, provided good pulpal insulation and its coefficient of thermal expansion approached that of enamel. The brittleness and poor edge strength of the silicate cements require box-like preparations for mechanical retention with a butt joint margin-conventional type similar to those for amalgams. The initial low pH of the silicate materials required

the use of a liner or base for pulpal protection. (Roberson T, 2006) The silicates discolored easily and the average longevity was reported to be approximately 4 years. (Albers, 2002)

Chemically Activated Restorative Material

Self-curing acrylic resin became available in the late 1940's for restoration of anterior carious lesions. Initially the acrylic resins were disappointing due to poor activator systems, high polymerization shrinkage, high coefficient of thermal expansion and lack of abrasion resistance. Improvements in these materials reduced the severity and frequency of these problems. Preparations for acrylic resin restorations were conventional or beveled conventional. The acrylic resins demonstrated better color stability but significant shrinkage, limited stiffness and poor adhesion. (Albers, 2002) Today acrylic resins are primarily used for provisional restorations when two or more appointments are required to complete treatment. (Roberson T, 2006)

Glass Ionomer

Conventional glass ionomer (GI) cements were first introduced in 1972 by Wilson and Kent. Glass Ionomers are similar to their predecessors-the silicate cements in their ability to release fluoride but glass ionomers also possess the ability to bond to tooth structure. (Albers, 2002) Glass ionomer cements contain polyacrylic acid and aluminum fluorosilicate glass. (J O. W., 2008) When the powder and liquid components are mixed together, an acid-base reaction occurs;

fluoride is released from the glass powder at the time of mixing and lies free within the matrix. The fluoride can therefore be released without affecting the physical properties of the cement. Since fluoride can also be taken up into the cement during topical fluoride treatment and released again, the cement may act as a fluoride reservoir over a relatively long period. (GJ, 1994) The anti-cariogenic properties of glass ionomer make it an ideal choice for the restoration of high caries risk patients. (Roberson T, 2006) (Fernanda Tavares Borges1, 2010 sept-oct) However, low strength and wear resistance of GI limits these restorations to low stress areas. (Roberson T, 2006)

Resin Modified Glass Ionomer

In 1992, resin-modified glass ionomer (RMGI) cements were developed that could be light cured. In these materials, the fundamental acid-base reaction is supplemented by a second resin polymerization usually initiated by a light-curing process. (Sidhu SK, 1995) RMGIs have improved physical and esthetic properties when compared to GIs and they are less susceptible to dehydration and cracking than conventional self-cured versions. (Roberson T, 2006) The coefficient of thermal expansion is similar to dental hard tissue and therefore provides good marginal adaptation. (McLean J. W., 1988) (Burgess J., 1994) While the shear bond strength is not as strong as the latest dental bonding agents, glass ionomers placed at the cervical margin are very durable. (Burgess J., 1994) Although the addition of resin in the modified materials has further

improved their translucency, they are still rather opaque and not as esthetic as composite-resins. In addition, surface finish is usually not as good. The color of resin-modified materials has been reported to vary with the finishing and polishing techniques used.

Filled Resin Material

In 1962 Bowen and others introduced a large hydrophobic dimethacrylate (Bis-GMA) - a key advance in resin chemistry. Bis-GMA forms the basis of present day composite resins due to its limited shrinkage and fracture resistance. (Albers, 2002) Dr. Bowen effectively coated silica, bonded it into bisphenol A-glycidyl methacrylate (bis-GMA) and produced a material with very encouraging early properties. (Bayne, 2013) Composites are currently the most popular tooth colored materials, having completely replaced silicate cement and acrylic resin. (Roberson T, 2006)

Volumetric shrinkage

One of the major concerns regarding resin based composites is the volumetric shrinkage that occurs during polymerization. Reliable adhesion may be compromised by the polymerization contraction stress that occurs when composite shrinkage is restricted by adhesion to cavity walls. A potential complication associated with polymerization shrinkage is an increased gap formation at the cavo-surface margin. The increased gap formation leads to contamination by bacteria resulting in postoperative sensitivity, increased risk of

recurrent caries, pulpitis and marginal staining. (Ferracane JL, 2003) Clinically the main cause of failure of composite restoration is related to the occurrence of an increased gap formation more commonly referred to as marginal leakage.

The factors affecting polymerization shrinkage are the cavity configuration factor (C-factor), properties of the restorative material, filler volume and polymerization kinetics. C-factor refers to the ratio of bonded to unbounded tooth surface and as the C-factor of a bonded restoration increases, the contraction stress of the bonded restoration increases as well. (Feilzer AJ1, 1987) To counteract the effect of contraction stress incremental filling techniques have been used. The conventional composite material is inserted in 1-2mm thicknesses to allow the curing light to properly polymerize the material and reduce the effect of polymerization shrinkage. Several studies have shown the use of this method reduces the amount of cuspal deflection, increases microtensile bond strengths and reduces leakage. While the placement of composites in increments reduces the effect of polymerization shrinkage on the tooth, it is very time consuming and increases the complexity of restoration. The added time and complexity are disadvantages to the clinician and may not be practical for clinicians in today's Army. (Park J, 2008) The time-consuming layering process used with traditional resin bonded composites can be skipped by using Bulk fill resin composites. (Ilie N, 2014) As Ronald D. Jackson, DDS, recently wrote, "Given today's overhead per hour, dentists need material and technology advancements so that posterior

composites can be placed faster, easier, and profitably without taking compromising shortcuts." (RD, 2011)

Bulk Fill Composites

Dental material science has focused on developing resin composites with a low stress behavior that would allow for simpler bulk filling without compromising quality and clinical success. The bulk placement of the resin composite saves the dentist chair time while making the restoration less time consuming and more predictable. The first bulk fill composites on the market, SureFil SDR flow, Venus Bulk Fill, X-tra base and Filtek Bulk Fill required an additional capping layer of a traditional resin bonded composite. (Czasch, 2013) The additional capping layer of conventional resin composite was necessary due to the products lower filler content (44-45%). (J G. , 2013) Recently developed bulk fill composites such as SonicFill (83.5% by weight), Tetric EvoCeram Bulk Fill (61% by volume) and X-tra Fil (86% by weight) can be placed without the traditional composite cap. The different application of materials belonging to the same class of materials can be confusing for many clinicians as many would assume the behavior of the material would be similar. (Czasch, 2013)

The manufacturer, VOCO, reports X-tra Fil can be light cured in 4mm thickness with an exposure time of only 10 seconds (800mW/cm^2). They also claim that X-tra Fil has excellent physical properties that result in reduced shrinkage stress for a restoration with tight marginal seals. Scotti et, al reported bulk fill flowable

resins provided significantly better marginal seal in dentin both before and after artificial ageing. (Nicola Scotti, 2014)

PURPOSE

The purpose of the present study is to evaluate the microleakage of X-tra fill and Filtek Supreme Ultra at the enamel and dentin margins.

HYPOTHESIS

X-tra Fil Bulk fill resin composites have a superior marginal seal on enamel and root surfaces as compared to traditional resin bonded composites.

MATERIALS AND METHODS

Detailed Methodology

20 extracted intact non-carious teeth were selected. The teeth were stored in 2.5% NaOCL and used within 6 months of extraction. Teeth were mounted on acrylic jigs. Class II preparations were created under abundant water cooling using a cylindrical diamond bur. (FG245 Henry Schein) mounted on a high-speed hand piece (Midwest). A new bur was used after five preparations. Preparations had an interproximal box around 7 mm in occluso-gingival depth with the margin approximately 1mm below the cement-enamel junction and 2 mm in a mesio-distal direction at the base of the gingival box. The width of the preparations was

4 mm bucco-lingually and the pulpal floor was approximately 4mm in depth (Figure 1). Teeth were randomly divided into two equal groups (n=10).

Group 1: Filtek Supreme

Group 2: X-tra Fil

Materials were used according to manufacturer's instructions. A three step etch and rinse (Optibond FL by Kerr) was used in this study to emphasize the influence of restorative composites. Chemical composition of materials used in the study and their application mode is reported in Table 1. Preparations in both groups were restored using a metal Tofflemire matrix band by Superdent. Restoration was performed by filling the proximal box as a first step and subsequently the occlusal part of the cavity. Portions were separately light cured for 30 seconds each using a Mini LED OEM (1,250 mW/cm^2) that was in contact with the coronal edge of the matrix band.

After storage in distilled water at 37°C for 24 hours restored teeth were covered with two layer of fast-setting nail varnish (Maybelline) applied up to within 1 mm of the restoration margin. Before their dehydration teeth were immersed into 1:10 solution of 1% methylene blue tracer dye (Benz Optics) for 30 minutes at 25°C. (Ernst CP, 2008) The teeth were removed from the dye, brushed under tap water for 1 minute and embedded in transparent acrylic resin.

Teeth were then cut in a mesio-distal direction into two halves using an Isomet Diamond Wafering Blade (Figure 2). A digital image of each section was obtained using a Canon T3 digital camera equipped with a 100mm macro lens. In

order to qualify the microleakage on the digital image of each tooth half a score analysis, as described in Table 2, was performed separately by two evaluators (SP, AC). In case of disagreement, differences in scoring were discussed until a final value was assigned on consensus. Microleakage was separately assessed at the enamel (occlusal) margin and at the dentin (interproximal) margin on a digital image of each section. The microleakage evaluation was carried out on both halves but only the side exhibiting the highest leakage was considered in the statistical analysis.

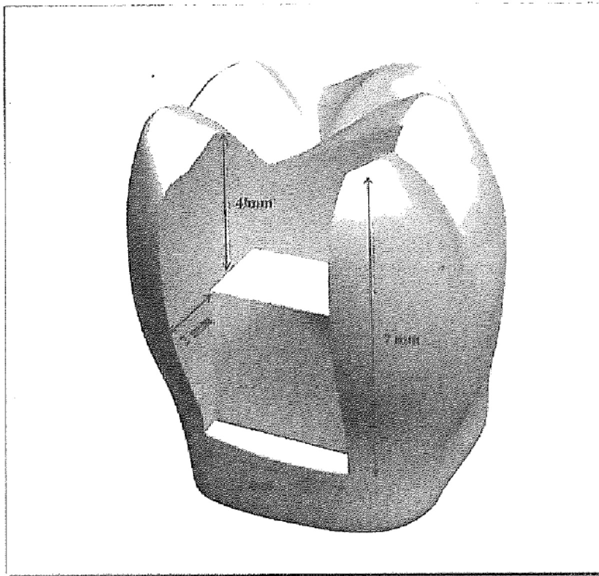


Figure 1. Drawing of class II preparation

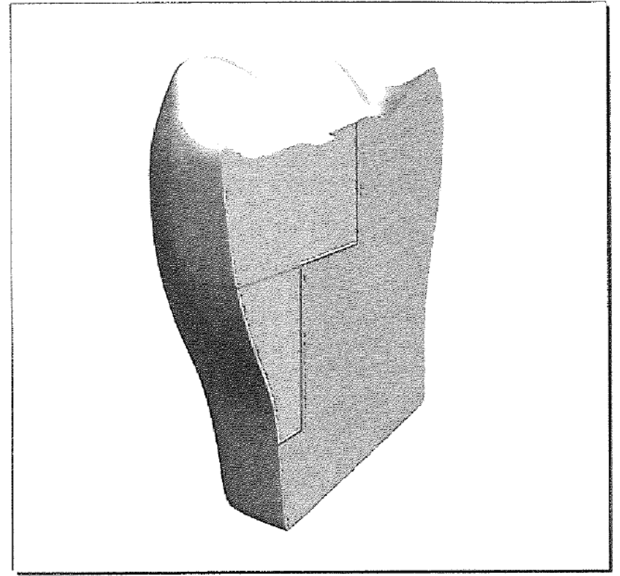


Figure 2 Preparation to assess microleakage

Table 1. Composition and Mode of application of the materials used in the study.

Material	Type	Composition	Application
Filtek Supreme Universal	Light cure restorative composite	BIS-GMA, BIS-EMA, UDMA with small amounts of TEGDMA. 20 nm nanosilica filler, and loosely bound zirconia/silica nanocluster, consisting of agglomerates of primary zirconia/silica particles with size of 5-20 nm fillers. The cluster particle size range is 0.6 to 1.4 microns. The filler loading is 78.5% by weight.	Apply in 2mm increments and cure for 20 seconds
X-tra-fill bulk fill composite	Light cure restorative composite	Unknown-Proprietary composition	Apply in 4mm increments and cure for 10 s when using lamps rated at 800 mW/cm2 or higher. 20 s when using lamps rated at 500 to 800 mW/cm2.
Optibond FL	Light cure total etch dental adhesive	**FL Prime (1)** HEMA, GPDM, mono (2-methacryloxy ethyl) phthalate (PAMM), ethyl alcohol, camphorquinone, and water. **FL Adhesive (2)** BIS-GMA, HEMA, barium aluminum borosilicate glass (0.6µ particle size), fumed silica, disodium hexafl uorosilicate, glycerol dimethacrylate, and camphorquinone.	Etch for 15s, Rinse and leave preparation moist, Apply primer for 15s**,** apply gentle air to evaporate the solvent, apply adhesive using brush-on/brush/off, light-cure adhesive for 20s.

Table 2. Scoring system used to quantify interfacial leakage

Score	Enamel interface (occlusal)	Dentin interface (interproximal)
0	No leakage	No leakage
1	Leakage not deeper than enamel dentin junction	Leakage not deeper than half length of cervical wall
2	Leakage deeper than enamel dentin junction	Leakage along entire length of cervical wall
3	Leakage along occlusal floor	Leakage along axial wall
4	Leakage into dentin tubules	Leakage into dentin tubules

Figure 3 Mounted on acrylic jig

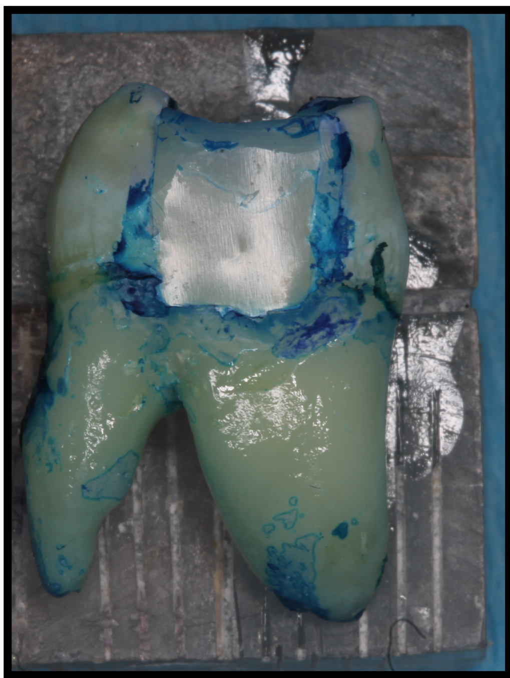
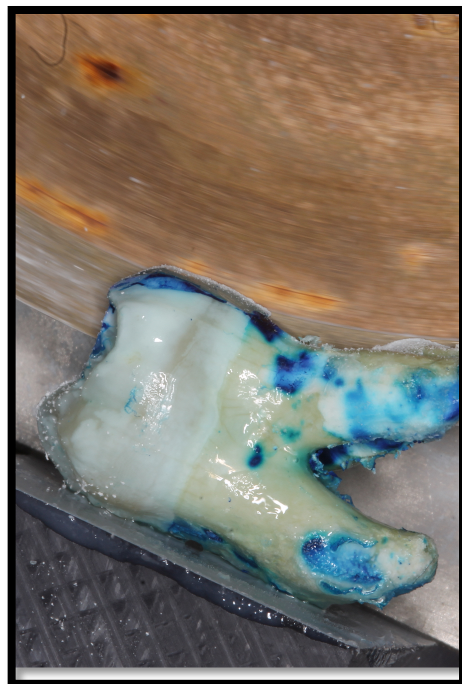


Figure 4 Sectioning



Results

Statistical analysis revealed no significant differences among the groups at the enamel margin (occlusal); the most frequent score was "0" for both groups (refer to table 2). At the dentin margin (gingival) the X-tra fil groups had a "0" score in all groups. The Filtek Supreme Ultra group had microleakage scores of "1" in 60% of the cases. The microleakage scores at the dentinal margin were statistically significant (table3).

Table 3 X-tra fill

Sample #	Enamel		Dentin	
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0

Table 4 Filtek Supreme Ultra

Sample #	Enamel		Dentin	
1	0	0	2	2
2	0	0	0	1
3	0	0	0	0
4	0	0	1	1
5	0	0	0	1
6	1	1	0	0
7	0	0	0	0
8	0	0	0	1
9	0	0	0	1
10	0	0	0	1

Graphical Depiction of Results

Table 5

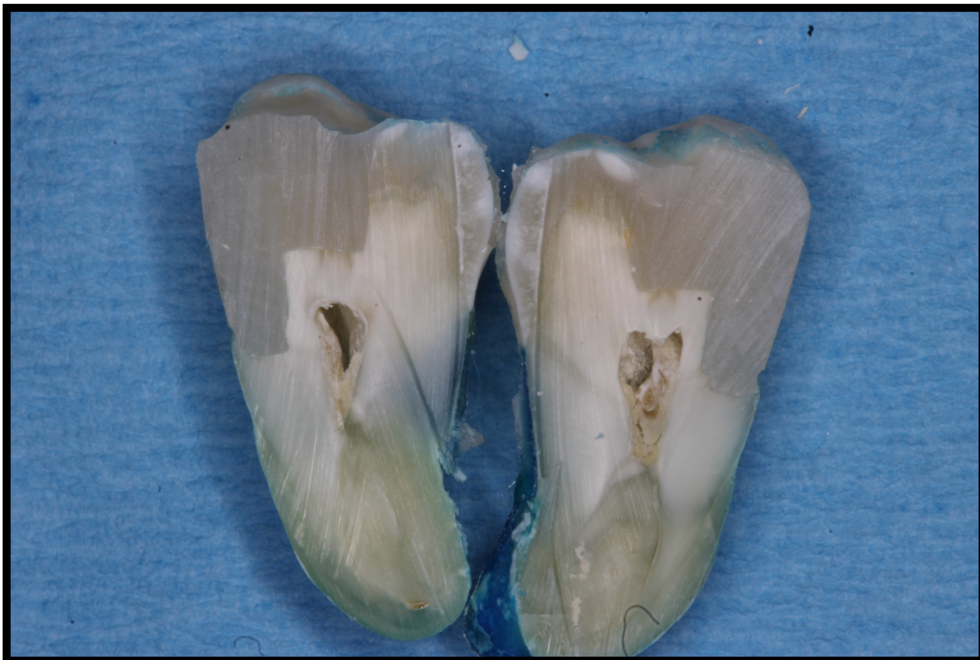
Material	**Enamel**	**Dentin**
	Median (Mdn)	Median (Mdn)
Filtek Supreme Ultra	0	1
X-tra fil	0	0

Data Analysis

A Mann-Whitney test was performed to evaluate the median enamel marginal leakage scores in the X-tra Fil Bulk Composite (Median = 0) and Filtek Supreme Ultra (Median = 0); the distributions in the two groups did not significantly differ (Mann–Whitney $U = 45.00$, $P = 0.32$). In contrast, a Mann-Whitney test indicated that the dentinal marginal leakage score in the X-tra Fil Bulk Composite group (Mdn = 0) differed from the Filtek Supreme Ultra group (Mdn = 1), $U = 15.00$, $P < 0.01$.

Figure 5-Traditional Composite, enamel and dentin margin

Figure 6 Bulk fill-enamel and dentin margins



Discussion

Shrinkage of composite resins occurs as monomers cross link during polymerization, the more shrinkage that occurs during polymerization the greater the stress placed on the wall of the restoration. These stresses strain the bond between the composite and the tooth leading to microleakage, causing post-operative sensitivity and an increased risk of recurrent caries. Factors that contribute to polymerization shrinkage include the amount of inorganic filler, the type of monomer and method of placement of the composite in the tooth. Recommended clinical techniques to avoid polymerization shrinkage include placement of composite in 2-mm increments and polymerizing each increment independently. Despite preventive clinical measures, all composites undergo volumetric shrinkage upon setting.

Placement of resin composites is a tedious and exacting procedure. Due to concerns such as managing overhead costs and reimbursement, dentists must work efficiently. Dentists need material and technology advancements so that posterior composites can be placed faster, easier, and profitably without compromising quality. New bulk-fill resin composites promote the effective use of 4-mm increments while decreasing shrinkage stresses generated during polymerization. The obvious benefits of bulk fill composites include a reduction in the presence of voids, reduction in treatment time and ease of placement. According to the manufacturer, X-tra fil is a hybrid composite with high radiopacity that was developed especially for quick use in the posterior area. The manufacturer also claims a curing depth of 4-mm and low shrinkage. Research

has demonstrated an acceptable hardness (cure) at 4-mm when cured for 10 seconds. (Fleming GJ, 2008)

Success of resin based composites is related to the adhesion between the restorative material and the dental tissues. (Jelena Juloske, 2013) The highly mineralized tissue of enamel, 90% hydroxyapatite, makes bonding enamel straight forward and highly predictable. Dentin contains a higher concentration of water and organic material reducing the percentage of mineralized tissue to 50%. The ability of the adhesive resin to penetrate the dental tissue is directly related to the free surface energy. Hydrophobic resin monomers form a strong bond with dry etched enamel however etched dentin is wet and resin monomers must be able to adequately penetrate the network of collagen fibers. The increased organic tissue of dentin reduces the surface energy thereby reducing the predictability of adhesion. (Nicola Scotti, 2014) (Roberson T, 2006) Studies of bonded composites have shown that 95% of all secondary caries associated with the composite restoration is in the interproximal area. The interproximal margin is typically bonded to dentin rather than enamel. (Sakaguchi, 2011)

Fourth generation dentin bonding agents were introduced in the early 1990’s introducing the idea of “wet bonding”. The fourth generation, or 3 step etch and rinse dentin bonding agents, are considered to be the gold standard among bonding systems. (Krithikadatta, 2010) The 3 step etch and rinse adhesive first removes the smear layer with phosphoric acid (30-40%), before applying a primer containing hydrophilic and hydrophobic components. The hydrophilic end binds collagen and the hydrophobic end binds the adhesive. The adhesive is

then applied which penetrates the interfibrillar spaces of the collagen network and the dentine tubules. (MV Cardoso, 2011) Three step etch and rinse adhesives such as Optibond FL have demonstrated retention rates of 94% at 13 years of clinical follow up. (MV Cardoso, 2011) In order to evaluate the microleakage of the restorative materials the gold standard fourth generation dentin bonding agent was used to reduce its influence on microleakage.

For this study, comparisons between the marginal adaptation of Filtek supreme ultra and X-tra fil composites were observed. Filtek supreme ultra is a nanocomposite which demonstrates good modelling properties, easy adaptation, low stickiness and high polishability. The nanocomposite has the desirable mechanical properties of a hybrid and is very esthetic. X-tra fil is a recently introduced bulk fill composite that can be placed in 4 mm increments. (Fleming GJ, 2008) Fleming et al found that in terms of flexural strength, water uptake, and biocompatibility, X-tra fil performed similarly to conventional resin-based composites. X-tra fil has one universal shade that has a chameleon effect for good esthetics. (Small, 2009)

Based on the results of the study the null hypothesis was partially rejected. There were no significant differences in microleakage at the enamel margin; however the dentinal margin demonstrated differences in microleakage scores. The bulk fill composite demonstrated a superior marginal adaptation than the conventional composite resin at 24 hours. Both types of resin composites maintained an adequate enamel seal (occlusal) after storage in distilled water for 24 hours. The marginal seal at the cervical margin differed significantly between the two groups

with the conventional composite demonstrating more microleakage. The differences in microleakage at the cervical margin led to the partial rejection of the null hypothesis.

The bond between resin and dentin has proved to be a challenge and to combat new generations of dentin bonding agents have been introduced to improve bonding to dentin. Each new generation has been characterized by new problems not previously exhibited by their predecessors. Currently available dentin bonding agents can maintain the peripheral seal that is integral to all adhesive procedures only if the seal is bounded by enamel. A solution to the difficulty of maintaining the integrity of the dentin bond is the use of the sandwich technique. Glass ionomer or resin modified glass ionomer are placed in the gingival portion of the restoration allowed to cure or light polymerized and the restoration is then completed with resin composite. (Liebenberg, 2005) As with placement of traditional resin composites the sandwich technique requires additional time for placement complicating the management of overhead cost. Current study demonstrates new bulk fill composites may be an alternative to sandwich technique when esthetic concerns are present.

Conclusion

1. No leakage was noted in the traditional or bulk fill composite groups at the enamel margin.
2. The traditional composite demonstrated a higher percentage of leakage than the bulk fill composite at the dentinal margin at 24 hours.
3. Additional study of the marginal leakage of bulk fill composites is recommended at longer time periods.

Future plans: Comparison of bulk fill composites and glass ionomers. If bulk fill resin composites have superior marginal adaptation how does this marginal adaptation compare to that of GI on dentinal surfaces?

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