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Comparison of two orthodontic indirect bonding methods.

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COMPARISON OF TWO ORTHODONTIC INDIRECT BONDING METHODS

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A Thesis Approved on

June 8, 2011

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Sunita Chandiramani, DMD, MS

Eric Bednar, DDS, MS

DEDICATION

This thesis is dedicated to: My loving and lovely wife Claire, my sons Preston and Blake and my daughter Lauren, the faculty of The University of Louisville Graduate Orthodontics Program and the staff of the Orthodontic Graduate Clinic.

ACKNOWLEDGMENTS

I would like to say thank you to Dr. David Tasman, Dr. Sunita Chandiramani, and Dr. Eric Bednar for their input and support in this thesis.

ABSTRACT

COMPARISON OF TWO ORTHODONTIC INDIRECT BONDING METHODS

Gary D. Dixon, D.D.S.

June 8, 2011

Purpose: The initial and long term bond failure rates of two orthodontic indirect bonding methods were compared.

Materials and Methods: A review of 191 bondings provided a data base of bond failures for two indirect bonding methods. One method used a light cured adhesive system and clear vacuum formed transfer trays. A second method used a chemical cure adhesive system and putty transfer trays. The initial bond failure rates were compared using Fisher's Exact Test. The long term bond failure rates were compared using actuarial life tables and a Mantel-Haenzel comparison.

Results: In initial bond failure the light cured method had a 9% failure rate compared to the chemical cured methods 0.7% failure rate. Long term the light cured method had a 0% failure rate while the chemical cured method had a 9% failure rate.

Conclusion: The initial bond was less likely to fail with the chemically cured method but long term the light cured method was had fewer bond failures.

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CHAPTER I

INTRODUCTION

When bonding fixed orthodontic appliances to teeth orthodontists have the choice of bonding indirectly or directly. Indirect bonding involves positioning the brackets on models of the teeth and then transferring the brackets to the patient's mouth to be bonded. This allows for determining the position of the bracket in the lab away from oral sources of contamination. It also allows for the evaluation of bracket position without the use of a mirror and from view points that would be difficult or impossible if positioning brackets directly in the mouth. Once the bracket position is satisfactory a transfer tray is fabricated and the brackets can then be transferred to the patient's mouth with all of the brackets maintaining the chosen position. Conversely direct bonding involves positioning the brackets in the mouth and then bonding the bracket in place. This allows more time for the adhesive system used to bond the bracket to become contaminated. Also, due

to confined environment on the mouth often times in is difficult to fully visualize the bracket position.

A large factor in initial and long term bond failure is contamination of the bonding site by saliva, blood, and or water. This contamination can occur after etching or after the placement of the primer/bonding agent. In the light cured indirect bonding method being studied brackets are placed in the mouth in groups of 5-12 and then bonded in place individually. The light cured method recommends a total of 10 seconds of curing per tooth in two separate 5 second intervals. The chemically cured indirect bonding method being studied places the brackets in the mouth in groups of 5-12 which are bonded simultaneously to the teeth. The chemical cure requires a 4 minute set time. The difference in timing and manner of curing allow for separate paths of contamination with no clear advantage to either method.

Bond failures can represent a significant increase in treatment time. A study by Haeger et al (2007) found an average increase of 1.21 months of treatment time per bond failure. Typical treatment times range from 16-24 months with each bond failure representing a 5-8% potential increase in treatment time. Longer treatment time increases the risk of root resorption and carious white spot lesions. Root resorption decreases the amount of tooth structure supported by bone and compromises the long term health of the tooth. White spot lesions are precursors to dental cavities and also present an aesthetic blemish on the tooth that is permanent.

By determining if certain indirect bonding methods provide for decreased bond failure procedures could be selected that would reduce overall orthodontic treatment time. This would decrease the risk of root resorption and white spot lesions.

This study compared the bond failure of two indirect bonding methods to evaluate their effectiveness at creating clinically sufficient bonds. The aims of this study were to show if one bonding method had fewer initial and long term bond failures. The bonding methods evaluated were a light cured method that used a clear vacuum formed transfer tray and a chemically cured method that used putty transfer tray. The data were compiled from the patient records of The University of Louisville Graduate Orthodontic Clinic.

Literature Review

Bonding orthodontic attachments directly to teeth was first described by Newman in 1964. At that time the more common method of attaching appliances to teeth was to first fit metal bands around each tooth, then brackets were welded to the bands and the bands cemented to the teeth. According to Newman the direct placement method could "greatly simplify treatment and substantially reduce cost." These early attempts of bonding attachments directly to teeth surveyed a wide variety of adhesives and bracket base designs. Newman and others (Retief, 1970) experimented with many different adhesives including: nylon, acetal, acrylic, styrene acrylonitirle, polycarbonate and epoxy. Newman advocated the use of acrylic due to its flexibility, apparent penetration into etched enamel, and its oral tissue compatibility. With time though, the most widely used adhesives would be derived from the work of Bowmen (1962) and his development of BisGMA as an adhesive for teeth.

In 1972 Silverman introduced a method where the orthodontic attachments were first positioned on a dental cast of the patient's teeth in the lab versus placing the attachments directly to the teeth in the mouth. The brackets and there position relative to the teeth were then captured in a transfer tray. This transfer tray was then used to bond the attachments to the patient's teeth. Silverman original termed this technique a "universal direct bonding system" (Silverman, 1972). This system would later be termed the indirect method. It is interesting to note that the concept and execution of the indirect bonding method

has not changed much since it was first introduced. The main changes have dealt with bracket design and advances in adhesion but the technique remains the same.

Studies measuring the failure rate of orthodontic attachments have reported many different results. In 1974 Wisth reported on the use of ultrasonics to clean cement from banded attachments. To examine if ultrasonics disrupted the cement he tracked the number of loose bands in his study. Out of 648 bands he found 64 became loose during a period of 1 year for a 10% failure rate. Zachrisson published a report in 1977 evaluating the long term bond failure rate of attachments bonded directly to the teeth. He reported on a nonrandomized non-controlled clinical trial of 46 patients age 11-14 treated for various orthodontic malocclusions. A total of 705 brackets were bonded directly to maxillary and mandibular incisors, canines, premolars and first and second molars. The average treatment time was 17 months. Zachrisson used the percentage of failures per tooth type to describe the failure rate. The average treatment time was 17 months. The incisors, canines and first premolars had a failure rate of 4% - 10%. The second premolars and molars had a failure rate of 18%-29%. This was compared to a banded attachment failure rate of 10% (Wisth 1974).

Next Zachrisson et al published a study in 1978 that compared the failure rate of directly bonded attachments versus indirectly bonded attachments. They evaluated 243 direct bonds and 201 indirect bonds with an observation period of

6 months. It was found that the directly bonded attachments had a failure rate of 2.4% while the indirectly bonded attachments had a failure rate of 13.9%.

These studies showed failure rates across the different methods of banding, direct bonding and indirect bonding were similar. But, the comparison was incomplete because the studies varied in their observation periods. Also the bonding methods and attachment designs were rapidly changing making any comparisons less meaningful.

Recent studies have taken these flaws into account. A 2006 study by Thiyagaraiah et at reported on a two center single blind retrospective randomized controlled clinical trial that evaluated 266 direct bonds and 273 indirect bonds. Each bond was observed for 1 year. They found that the direct bond and indirect bond failure rates had no significant differences. The failure rates reported were 2.9% for direct and 2.2% for indirect. These failure rates, if clinically repeatable, represent a marked improvement over earlier materials and methods.

Other areas of comparison between direct and indirect evaluated the accuracy of bracket placement and the effect of bonding method on treatment time and number of appointments in addition to failure rate. A study by Koo et al (1999) compared the accuracy of attachment placement by having a pool of orthodontist's bond attachments to sets of dental cast directly, with the casts in mannequins, and indirectly in the lab. The study found that in the mesiodistal and angulation of the brackets there was no difference between the directly and indirectly bonded attachments. However, when they examined the height placement they found that the indirectly placed attachments were bonded .21mm

more accurately then the directly placed attachments. In a different study by Deahl et al (2007) two groups, one bonded directly and one bonded indirectly were compared to each other to see if the failure rate, treatment time and or number of appointments differed between the groups. They found a direct bond failure rate of 1.17% with a treatment time of 750 days and 22 appointments. This was not statistically different from the indirectly bonded group that had a failure rate of 1.21% with a treatment time of 745 days and 22.2 appointments. With these more recent studies it has been shown that many of the arguments for indirect bonding such as more accuracy, shorter treatment time and less bond failure have proven false. In the end it is simply the clinicians preference that dictates the use of direct or indirect.

Significance

Treatment times with fixed orthodontic appliances can vary from a few months to a few years. These treatment times depend on the severity of the case, compliance of the patient, response of the patients biologic tissue, the patients growth status, effectiveness of the treatment, and efficiency of the treatment modalities. Many of these factors are beyond the control of the Orthodontist. However, the Orthodontist does have some control in the efficiency of treatment by choosing appropriate orthodontic appliances and as much as possible ensuring their proper use. When these appliances fail it represents a potential elongation of treatment. Haeger et al (2007) reported as much as a 1.21 month elongation of treatment. As a single event or as multiple failures added together this can represent a significant increase in treatment time. This increased treatment time unnecessarily exposes the patient to a greater risk of root resorption and development of white spot lesions which ultimately lead to frank decay. This study exams two orthodontic indirect bonding methods to compare if either has fewer initial and long term bond failures.

Purpose

The purpose of this study is to retrospectively examine the initial and long term bond failure rates of two orthodontic indirect bonding methods.

Hypothesis

This study hypothesizes that the two orthodontic indirect bonding methods have different initial and long term bond failure rates.

CHAPTER II

METHODS AND MATERIALS

Sample

The institutional review board of the University of Louisville reviewed and approved the study before chart review began. The IRB tracking number is 11.0021, the approval date was 1/25/2011 and the expiration date is 1/24/2012. Any traceable patient identifiers were removed from the recorded data before data analysis.

The time period from July 20, 2009 to February 25, 2011 was selected for review because during this time the author had firsthand knowledge of the indirect bonding techniques being used. During this time period there were 592 comprehensive orthodontic cases started. Included were the following types of treatment: phase I, phase II, comprehensive adolescent and comprehensive adult. A review of each patient record revealed 16 indirect bondings.

Methods and Materials

Orthodontic brackets adhere to teeth with dental composite resins. This can be done directly in the mouth or indirectly in a lab and then transferred to the mouth. In the indirect setup brackets with composite are positioned on patient models and the composite is cured. A transfer tray is then made to transfer the brackets from the models to the patient's mouth. In the mouth the bracket and composite assembly are adhered to the teeth using either a chemically polymerized dental adhesive or a light polymerized dental adhesive. This study will review patient dental records from the past 1.5 years and identify those patients where indirect bonding was used. A study period of 1.5 years was chosen because this is the time period that the author has first hand knowledge of what indirect bonding methods were being used in the orthodontic clinic.

For this study one light cured method and one chemical cured method were evaluated. The light cured method was introduced at the University of Louisville Graduate Orthodontic program was introduced by a part time faculty member Dr. William Engilman. The chemical cured method was introduced to the residents of the University of Louisville Graduate Orthodontic program during the 2009 GORP orthodontic meeting by Dr. Brent Larsen.

The steps necessary to perform each method follow a similar pattern and vary in only three key areas. These steps can be broken down into: an initial appointment, lab preparation, and a bonding appointment. At the initial appointment accurate impressions of the teeth are made. In the dental lab the

impressions are poured in white orthodontic stone. The dental models are then dried and coated with a separating medium. Once that is dry the brackets are placed and excess resin is removed. The brackets and resin are then light cured creating a custom resin pad on the back of the bracket that precisely fits the contours of each individual tooth. At this stage the transfer trays are made and the lab portion is complete. At the bonding appointment the teeth are cleaned and etched with 37% phosphoric acid for 30 seconds. Then the bonding system is place on the teeth and the brackets and the transfer tray with the brackets is placed in the patient's mouth. After the bonding is complete any excess bonding material is removed and treatment can begin.

The first area where the two methods vary is in the type of transfer tray that is fabricated. In the light cured method two clear trays are vacuum formed over the dental models and brackets. In the chemically cured method PVS putty is used and hand formed onto the dental models and brackets. The second area of difference is the manner in which the separating medium is removed from the back of the custom resin pad. In the light cured method the separating medium is removed by micro air abrasion with 50 micron alumina. In the chemically cured method the separating medium is removed with a scaler or other sharp instrument. The third difference is the bonding system used to adhere the brackets to the teeth. In the light cured method the bonding system uses Proseal on the teeth followed by Assure with Flowtain placed on the back of the custom resin pad. These three chemicals are all polymerized through light activated free radical polymerization. In the chemically cured method the tooth and the back of

the custom resin pad is coated with Maximum Cure sealant. This is a part A and part B chemically cured sealant and bonds the bracket to the tooth. Table 1 outlines in numbered steps two methods. Where the methods vary the step number is followed by either an L for light cured method or a C for chemical cured method. Table 2 contains information on the materials used in the different methods.

Table 1. Comparison of the steps for two orthodontic indirect bonding methods

Light Cured	Chemically Cured
Initial appointment	
1. Make an accurate impression of the teeth that will be bonded using a high accuracy alginate impression material	
Lab preparation	
2. Pour impression in white orthodontic model stone	
3. Let model dry completely	
4. If desired draw bracket placement guidelines on the model	
5. Dilute separating medium 1:1 with water and paint onto dental model	
6. Let model dry completely	
7. Place brackets with resin paste in desired position and remove excess paste (this creates a custom resin pad adapted to the tooth)	
8. Light cure resin paste for 5 seconds from the occlusal aspect and 5 second from the gingival aspect	
9L1. Vacuum form 1.5mm bioplast over stone model with brackets	9C. Place putty matrix over brackets and teeth and let cure
9L2. Spray silicone separator over bioplast	
9L3. Vacuum form 1mm biocryl over bioplast	
9L4. Trim excess bioplast and biocryl from cast	
10. Soak models in warm water for 15 minutes	
11. Remove transfer tray with brackets from model	
12L. Micro air abrasion of custom	12C. Lightly scrap away separator

resin pad with 50 micron alumina	from custom resin pad
13. Cure each bracket for an additional 5 seconds from the lingual aspect	
14. With a soft brush, soap and water gently clean the surface of the custom resin pad	
Bonding appointment	
15. Polish the patient's teeth with flour pumice	
16. Acid etch entire facial surface of teeth to be bonded, rinse and dry	
17L1. Apply coat of Proseal to facial of teeth	17C1. Mix Maximum Cure sealant part A and B on mixing pad
17L2. Apply coat of assure to lingual of custom resin pad	17C2. Place sealant on teeth and lingual of custom resin pad
17L3. Apply small amount of Flowtain to lingual of custom resin pad	17C3. Seat transfer tray with brackets securely in mouth
17L4. Seat transfer tray with brackets securely in mouth	17C4. Hold tray for 2 minutes
17L5. While pushing on the bracket light cure for 10 seconds	17C5. Remove tray
17L6. Remove bioacryl tray and then bioplast tray	
17L7. Cure each bracket for an additional 5 seconds	
18. Clean up any extra bonding material with a carbide bur or scaler	

Table 2. Materials used in each bonding method

Light cured method	Chemical cured method
• Alginate (imprEssix, Raintree Essix) • Stone (Whip Mix Orthodontic Model Stone) • Separating medium (Liquid Foil, Great Lakes Orthodontics) • Adhesive (APC Transbond XT, 3M/Unitek)	• Alginate (imprEssix, Raintree Essix) • Stone (Whip Mix Orthodontic Model Stone) • Separating medium (Liquid Foil, Great Lakes Orthodontics) • Adhesive (APC Transbond XT, 3M/Unitek)

• Soft plastic tray (1.5mm Bioplast, Raintree Essix) • Hard plastic tray (1mm Biocryl, Raintree Essix) • Air abraison (50 micron silicon) • Flour Pumice • Etch (Ultra Etch, Ultra Dent) • Reliance proseal (Reliance Orthodontics) • Reliance Assure (Reliance Orthodontics) • Reliance flowtain (Reliance Orthodontics) • Curing light (OrthoLux, 3M/Unitek)	• Putty (Aquasil Easy Mix Putty, Dentsply Caulk) • Flour Pumice • Etch (Ultra Etch, Ultra Dent) • Sealant (Maximum Cure Unfilled, Reliance Orthodontics)

Inclusion/Exclusion Criteria

For inclusion into the study the patient needed to have been bonded with orthodontic brackets at the University of Louisville Graduate Orthodontic Clinic during the stated time frame. It must have been noted in the patient record that they were bonded using one of the two indirect bonding methods outlined below. Differences in brackets and bonding materials were eliminated by assuring that only cases bonded with 3M/Unitek Victory series .022 slot APC brackets, Ultra Etch, Assure and Flowtain were included. Patients were excluded if it was noted in their record that: their teeth were hypo/hypercalcified, had fluorosis, and/or were bleaching their teeth within the last 2 weeks before bonding as all of these factors affect bond strength.

Data Collection

Patient records for the time period of July 20, 2009 to February 25, 2011 from the University of Louisville Graduate Orthodontic clinic were evaluated.

Data was collected on an excel spread sheet indicating the date and type of indirect bonding method used, which teeth were bonded and if any initial bond failure occurred. Any subsequent bond failures up to 6 months were also recorded. Only the first bond failure of each tooth was recorded because subsequent rebonds were accomplished using a direct method. The spread sheet included areas for each bond failure to be recorded and then the failures were aggregated by bonding technique. Initial bond failures were any bond failure that occurred at the bonding appointment. All subsequent bond failures up to 6 months of treatment time were recorded.

Statistical Analysis

Descriptive statistics of the sample data can be found in table 3. To compare the two bonding methods Fisher's Exact Test was performed. Fisher's Exact Test is a derivation of the Chi-Square Test that is used when any expected value is less than 5. Fischer's Exact Test assumes the following: that the population from which the sample data was taken had a normal distribution of initial bond failure, that the variables used are numerical, not ratios or percentages, that the variables are independent, and that the variables are categorical. The categories that the variables fit into were the type of bonding method used and if the bond failed or did not fail. Fisher's Exact Test tests the hypothesis that the variables are independent of each other. In the case of initial bond failure the test shows weather the type of bonding system used is independent of the number of initial bond failures. To determine if there is a relationship between the type of bonding method used and the number of bond failures the contingency coefficient was examined. This statistic measures the relation between two categorical variables. It's range is from 0 to 1 with 0 meaning complete independence (StatSoft 2007).

Table 3. Descriptive statistics of the sample data

	Number	Percentage
Number of Patients	9	100%
Number of Patients per bonding method		
Light cured	3	33%
Chemically cured	6	66%
Distribution of patients by sex		
Female	3	33%
Male	6	66%
Distribution of patients by age		
13	2	22%
14	3	33%
15	3	33%
29	1	11%
Number of brackets	191	100%
Distribution of brackets by sex		
Female	54	28%
Male	137	72%
Distribution of brackets by age		
13	36	19%
14	61	32%
15	70	37%
29	24	12%
Distribution of brackets by tooth type		
Upper incisors	36	19%
Lower incisors	32	17%
Upper canines	18	9%
Lower canines	16	8%
Upper premolars	33	17%
Lower premolars	30	16%
Upper molars	14	7%
Lower molars	14	7%
Distribution of brackets by bonding method		
Putty/chemical cure	135	71%
Clear/light cure	56	29%

To examine if one of the bonding systems created a longer lasting bond, data was collected on the number and location of bond failures from the time of bonding to 6 months afterwards. Any bond failures that occurred during the initial bonding appointment were not included. A survival analysis was performed to

measure the time to bond failure. The survival analysis was done on an actuarial table bases with time interval of 180 days being the same for the entire sample. This analysis gave a 1 year projected survival rate for the two different bonding methods. Next a Mantel-Haenszel analysis was performed to compare the survival rates of the two bonding methods and determine if they were statistically different. The use of survival rate analysis was advocated by Miller (1997) as an appropriate way to analyze bracket failure because it allows for a comparison between studies even when the time interval being evaluated varies. For this analysis we must assume that the bond failure is multiplicatively related to the time and group variables. This analysis generates a Chi-Square statistic and a corresponding *p* value. The variable used was the length of the time the bracket was bonded, if the bracket bond failed during the 6 months and which group the bracket was associated with. If the bracket was still bonded at the end of 6 months then the value for the time variable was 180 days. The data was assumed to be from a normal distribution, the time variable was quantitative while the bond failure and group variables were categorical. All of the statistical analysis was performed using WINKS SDA software by TexaSoft.

CHAPTER III

RESULTS

The frequency of initial bond failure for the putty/chemical cure method was 1 failed bonding in 135 attempts and for the clear/light cure method it was 4 failed bondings in 56 attempts. Table 5 details the bond failure sites for both initial bond failure and 6 month bond survival.

Table 4. Bond failure sites

Bonding Method	Bracket	Failure timing
Putty/chemical cure	LR2	Initial bond failure
	LR5	Failed after 7 days
	UL5	Failed after 29 days
	LL2	Failed after 29 days
	LL1	Failed after 29 days
	LR5	Failed after 30 days
	LL1	Failed after 30 days
	LL2	Failed after 30 days
	LL2	Failed after 35 days
	LR2	Failed after 78 days
	UL1	Failed after 137 days
	LL3	Failed after 137 days
	LL4	Failed after 137 days
Clear/light cure	UR4	Initial bond failure
	UR5	Initial bond failure
	UR6	Initial bond failure
	UL5	Initial bond failure
	UL6	Initial bond failure

Table 5 summarizes the comparison of initial bond failures for the two methods using Fisher's Exact Test. With a *p* value of .009 we can have a high level of confidence that the results from the sample data are reflective of the sample population. To evaluat if there is a relationship between the bonding method and initial bond failure rates we find a contingency coefficient of 0.209. This can be interpreted as showing a weak or mild relationship between which bond method was used and the likelihood of a initial bond failure.

Table 5. Comparison of initial bond failure rates

	Bond Failed	Bond did not fail	Total	Percent	*p* value
Light cured	5	51	56	0.7%	0.009
Chemically cured	1	134	135	9%	0.009
Total	6	185	191		

Table 6 summarizes the results of an actuarial life table for the survival rate of a bracket bonded with one of the two bonding methods and a corresponding *p* value that indicates if the two survival rates are statistically different.

Table 6. Long term survival rate for the two bonding methods

	Bond Failed	Bond did not fail	360 day failure rate	*p* value
Light cured	0	51	0%	0.03
Chemically cured	12	122	9%	0.03
Total	12	173		

CHAPTER IV

DISCUSSION

The analysis shows that in this data set the putty/chemical cure method provided for fewer initial bond failures but the clear/light cure method provided for a longer lasting bond. Confounders to the analysis were: the type of tooth was not accounted for, the age and gender of the patient was not accounted for, three different operators were included in the data set, the exact day of bond failure was unknown and as a substitute the appointment day the failure was reported was the value used. The *p* values found in this study were statistically significant. This indicates a small likelihood committing a Type 1 statistical error where the null hypothesis of both the bonding methods being equal is actually true when the study found it to be false. However because of the low power of the study, due to small sample size, there is a risk of committing a Type 2 statistical error where the null hypothesis is rejected when in fact it is true. The risk of committing this type of error could be reduced simply by increasing the sample size.

CHATPER V

SUMMARY AND CONCLUSION

This study was designed to evaluate and compare the initial and long term bond failure rates of two orthodontic indirect bonding methods. This was accomplished by retrospective chart review of patient records at the University of Louisville Graduate Orthodontic Clinic. The conclusions of this study are two fold:

1. The putty/chemical cure method results in fewer initial bond failures. This could be attributed to higher initial bond strength, the method could be less subject to operator error or the technique could allow for lower stress to the bracket bond system when the transfer tray is removed.
2. The clear/light cure method results in a bond that initially fails more but lasts longer. This could be attributed to low initial bond strength that build over time. Difficulty of the method on bonding day. High stress delivered to the bracket bond system when the clear trays are removed.

Attributing the bond failure to lack of bond strength is difficult. The manner of each bond failure is multivariable. This study does have some implications for the overall use of the two methods studied. The light cured method performed well over time and as such could result in fewer bond failures and less treatment time than the chemically cured method that had multiple bond failures after the initial bonding.

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Education

- Current Orthodontic Resident at University of Louisville School of Dentistry
    - Graduation date June 24, 2011
- Graduated 2007 Magna Cum Laude from VCU School of Dentistry
- Graduated 2002 from Brigham Young University B.A. Economics

Awards

- May 2007, American College of Prosthodontists outstanding undergraduate achievement in the study of Prosthodontics
- May 2007, The Academy of Dental Materials award of excellence in scholarship
- May 2007, Quintessence Award in recognition of academic achievement
- May 2007, VCU Department of Prosthodontics Award for excellence as a teaching assistant
- April 2007, 3rd place Dentsply Student Clinician Research Award VCU School of Dentistry Clinic Day
- April 2005, 2nd place Dentsply Student Clinician Research Award VCU School of Dentistry Clinic Day

Leadership and Involvement

- 2009-2011 Resident Teaching Assistant for undergraduate orthodontic training at the University of Louisville
- 2006-2007 Student Teaching Assistant for Removable Prosthodontics at Virginia Commonwealth University
- 200-2007 Student Teaching Assistant for Dental Materials at Virginia Commonwealth University
- Cosmetic Dental Club at VCU school of Dentistry

    - 2005-2006 President
    - 2004-2005 Vice President
- 2005-2007 Clinical Affairs Committee student representative for the class of 2007, VCU School of Dentistry

Research

- In progress: University of Louisville Masters in Oral Biology research titled Comparison of Two Orthodontic Indirect Bonding Methods

- 2006-2007 published in International Association of Dental Research abstracts

  Viscosity of Composite Cores compared at ambient and oral temperature, G.D. Dixon, P.C. Moon, J.M. Carter, C.N. Brooks, Virginia Commonwealth University VCU/MCV, Richmond, VA, USA
- 2004-2006 published in International Association of Dental Research abstracts

  Measurement of restorative composite resin viscosity using a digital plastimeter, G.D. Dixon, C.N. Brooks, J.M. Carter, and P.C. Moon, Virginia Commonwealth University VCU/MCV, Richmond, VA, USA

Presentations

- April 2007, VCU School of Dentistry Clinic and Research Day
  Viscosity of Composite Cores compared at ambient and oral temperature
- March 2007, International and American Associations for Dental Research Annual meeting, New Orleans
  Viscosity of Composite Cores compared at ambient and oral temperatur
- March 2006, American Association for Dental Research Annual meeting, Orlando
  Measurement of restorative composite resin viscosity using a digital plastimeter
- April 2005, VCU School of Dentistry Clinic and Research Day
  Measurement of restorative composite resin viscosity using a digital plastimeter

Scholarship and Grants

- March 2006, AD Williams research fellowship, VCU School of Dentistry

- March 2004, AD Williams research fellowship, VCU School of Dentistry

Professional Associations

American Dental Association
American Association of Orthodontists

Professional Work Experience

2009-Present

- Part time General Dentist for Mortenson Family Dentistry, LaGrange, KY
- Instructor at ATA dental assisting college, Louisville, KY

2007-2009 associate at W. Baxter Perkinson and Associates

- Completion of two full mouth reconstruction cases
- Placement of 12 dental implants in 4 separate cases
- Use of rotary endodontics