



DEPARTMENT OF THE AIR FORCE
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18 MAY 2016

MEMORANDUM FOR SGDTG

ATTN: MAJ HELENA SWANK

FROM: 59 MDW/SGVU

SUBJECT: Professional Presentation Approval

1. Your paper, entitled **Bond Strength of Resin Cement to Ceramic with New Simplified Primers and Pre-Treatment Solutions** presented at/published to the **Journal of General Dentistry** with MDWI 41-108, and has been assigned local file #**16210**.
2. Pertinent biographic information (name of author(s), title, etc.) has been entered into our computer file. Please advise us (by phone or mail) that your presentation was given. At that time, we will need the date (month, day and year) along with the location of your presentation. It is important to update this information so that we can provide quality support for you, your department, and the Medical Center commander. This information is used to document the scholarly activities of our professional staff and students, which is an essential component of Wilford Hall Ambulatory Surgical Center (WHASC) internship and residency programs.
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Linda Steel-Goodwin

LINDA STEEL-GOODWIN, Col, USAF, BSC
Director, Clinical Investigations & Research Support

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b. Bailey, Clifton	Lt Col	59 DTS/59 DG/SGDTG	
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Bond Strength of Resin Cement to Ceramic with New Simplified Primers and Pre-Treatment Solutions

Abstract

Manufacturers have introduced new surface primers and pre-treatment solutions that reportedly allow bonding of resin cements to glass-based ceramics with various combinations of etchant and/or coupling agents to simplify the application process. The purpose of this study was to compare the shear bond strength of resin cement to a lithium-disilicate glass-ceramic material using new surface primers and pre-treatment solutions. Ceramic blocks were sectioned with a diamond saw into wafers and mounted in PVC pipe. The wafers were steam cleaned, dried, and the surfaces were treated with various primers and pre-treatment solutions per manufacturer's instructions. Five groups were created with 16 specimens each. Group 1: Air abrasion with aluminum oxide and Interface (Apex Dental); Group 2: Hydrofluoric (HF) acid (Ceramic Gel, Ivoclar Vivadent) and Monobond Plus (Ivoclar Vivadent); Group 3: Monobond Etch & Prime (Ivoclar Vivadent); Group 4: Air abrasion, HF acid, and Optibond XTR (Kerr); and Group 5 (control): HF acid and silane (Bis-Silane, Bisco). Resin cement (NX3, Kerr) was placed onto the surface of the specimen using a mold and light cured. The specimens were stored in water for 24 hours at 37°C and tested in shear. Data were analyzed with Kruskal-Wallis and Mann Whitney U tests with Bonferroni correction to evaluate the effect surface primers and pre-treatment solutions on the shear bond strength of resin cement to lithium disilicate ($\alpha=0.005$). A significant difference was found based on type of surface treatment ($p<0.001$). The control group (HF acid /silane) was significantly greater than the other groups which were not significantly different from each other. Surface treatment of lithium-disilicate glass-ceramic with HF acid and silane (control) resulted in significantly higher shear bond strength of the resin cement than the other pretreatment solutions.

Introduction

All-ceramic restorations have become a favorable alternative to metal-ceramic and all-metal restorations as more and more patients seek esthetic restoration of their teeth (Denry and Holloway, 2010). Ceramics can be divided into different categories based upon the specific materials used in fabrication. McLaren divides dental ceramics into 4 composition categories. Category 1 materials are glass-based systems that contain mainly silica dioxide (silica or quartz) and varying amounts of alumina. These systems are typically powder-liquid versions which can

be used to create porcelain veneers and fine-grained machinable blocks for use in CAD/CAM systems. Category 2 materials are also glass-based systems, usually with silica and added crystalline fillers. Fillers can be fluoroapatite, leucite, or lithium disilicate. Adding or growing different fillers and amounts of those fillers changes the properties of the ceramic. Leucite-reinforced materials may be milled or pressed or used as powder/liquid system, and are often termed a "glass ceramic" because the crystals are grown within the glass phase. Lithium-disilicate materials contain a similar glass base but with the addition of lithium-oxide crystals. Because of the unique shape of the crystals, flexural strength and fracture toughness are significantly increased, although it still retains a high level of translucency, making it suitable for both anterior and posterior applications. These materials come in both a pressable or millable form. In Category 3, the ceramic materials are crystalline-based systems with glass fillers. The crystalline structure (i.e., alumina, alumina/zirconia, alumina/magnesium) is infiltrated with a lanthanum glass and can be fabricated by a process called slip casting, or it can be milled. These infiltrated ceramics have a high degree of flexural strength attributed to the high amount of crystals in the structure. And finally, Category 4 consists of polycrystalline solids of alumina or zirconia oxides with no glass matrix. These oxide ceramics have high strength and toughness but less translucency (McLaren and Cao, 2014; McLaren and Whiteman, 2010; Denry and Holloway, 2010, Lawson and Burgess 2014).

In both Categories 1 and 2, the glass-ceramic materials may be chemically-etched, silanated, and bonded with resin-based cements to maximize adhesion and strength. Etching with HF acid provides an irregular, retentive surface while silane provides the chemical bond to the matrix of the resin composite and to the silica in the glass. However, HF is considered a hazardous substance and a safer, simplified etching or conditioning process would be clinically advantageous (Özkan et al., 2012). The oxide-ceramic materials in Categories 3 and 4 do not require adhesive cementation because of their intrinsic strength (Suh, 2013). However, due to compromised retention such as with short clinical crowns, a durable bond to oxide ceramic may be desired. These densely sintered oxide ceramics have surface structures with little to no glass phase and require alternative techniques for bonding (Papia et al., 2014). Several methods of surface treatment and modification have been described in the literature to increase the retention of oxide ceramics. Roughening the intaglio surface with air abrasion can increase surface roughness, but may introduce micro-cracks and cause phase transformation, with subsequent reduction in the strength of the ceramic (Zhang et al., 2006). However, there are no controlled clinical studies evaluating the effect of airborne particle abrasion (Papia et al., 2014)

on the success of oxide ceramics. Different cement systems and primers have been marketed that contain functional monomers, such as MDP (10-methacryloyloxy-decyl dihydrogenphosphate), that provide a chemical adhesion to alumina and zirconia. Several other techniques have been utilized such as tribochemical coating, plasma spraying, and selective infiltration etching (Wegner et al., 2000; Derand et al., 2005; Aboushelib et al., 2007). However, the literature suggests that establishing a strong and reliable bond to oxide ceramics, especially zirconia oxide, is difficult and unpredictable (Kern, 2014). New surface treatment products have been introduced to the marketplace to make the process faster and easier with greater safety. The manufacturers attempt to either combine separate steps such as etchant and silane or combine primers specific to the different types of ceramics such as 10-MDP combined with silane. Laboratory studies suggest that the mix of acidic primers such as 10-MDP with basic primers such as silane may render the silane less effective (Yi et al., 2015; Griffin et al., 2010).

Interface by Apex Dental Materials, Inc (Lake Zurich, IL) is "a revolutionary ceramic primer which allows the clinician to bond any type of ceramic to tooth including the new higher strength materials." According to the Material Safety Data Sheet, Interface is a proprietary blend of organic/inorganic acids and silane. The manufacturer claims that this one product can replace HF-acid etchant and silane with glass-based ceramics or the primer with oxide-based ceramics (apexdentalmaterials.com). Monobond Plus (Ivoclar Vivadent, Amherst, NY) is a simplified system which is marketed as a universal restorative primer which combines three different functional groups of silane, 10-MDP and a disulfide acrylate. The universal primer reportedly aids in the adhesive bond between the luting cement and all indirect restorative materials, including glass or oxide ceramics and metals. The manufacturer instructs the user to etch with HF acid prior to application of the Monobond Plus (ivoclarvivadent.com). Ivoclar Vivadent recently released Monobond Etch and Prime for use with glass ceramics. It reportedly "etches and silanizes silicate surfaces in one easy working step" without the toxic potential of HF acid. The manufacturer suggests that this product creates a durable bond with glass ceramics comparable to HF-acid etch and silane treatment (ivoclarvivadent.com). Optibond XTR (Kerr, Orange, CA) is a universal self-etching adhesive for use with direct and indirect restorations. The manufacturer reports that when bonding to glass ceramics using NX3 resin cement (Kerr), the use of silane is optional. Instructions include air abrasion with aluminum oxide and etching with HF acid (kerrdental.com). Very little research has been published evaluating these new simplified combination surface primers and solutions.

The purpose of this study was to compare the shear bond strength of resin cement to a lithium-disilicate glass-ceramic material using new surface primers and pre-treatment solutions. The null hypothesis tested was that there would be no difference in the shear bond strength of resin cement to lithium disilicate based on type of surface pre-treatment solution or primer.

Materials and Methods

Lithium-disilicate blocks (e.max CAD, Ivoclar Vivadent) were sectioned using a precision saw (Isomet 5000, Buehler, Lake Bluff, IL) into 3-mm thick block specimens and then crystallized in a ceramic oven (Programat P500, Ivoclar Vivadent) according to manufacturer's specific instructions. Next, the ceramic specimens were mounted in PVC pipe using dental stone. The surfaces of the specimens were steam cleaned and air dried. Eighty specimens were divided into five groups of 16 specimens each based on type of ceramic surface preparation. The following primers or surface pre-treatment solutions were evaluated in this study. Interface (Apex Dental), Monobond Plus (Ivoclar Vivadent), Monobond Etch and Prime (Ivoclar Vivadent), Optibond XTR (Kerr) and Bis-Silane (Bisco). See Table 1 for a list of components and application techniques.

In group 1, the lithium-disilicate specimens were air abraded with 50- μ m aluminum oxide (Quattro IS, Renfert) according to the manufacturers' recommendations for Interface. The distance of the air-abrasion tip from the ceramic surface was kept at 10 mm, using a simple positioning support jig. Interface was then mixed and applied. For group 2, HF acid was applied, rinsed, then air dried. Monobond Plus was then applied per manufacturer's instructions. With group 3, Monobond Etch and Prime was applied per manufacturer's instructions. For group 4, the lithium-disilicate specimens were air abraded with 50- μ m aluminum oxide. Then HF acid was applied, rinsed and air dried. Optibond XTR was applied according to manufacturer's instructions. With group 5 (control), HF acid was applied, then rinsed and air dried. Bis-Silane was applied per manufacturer's instructions.

The specimens were mounted into a jig (Ultradent Products, South Jordan, UT). Auto-mixed dual-cure resin cement (NX3, Shade A2, Kerr) was injected into the white non-stick Delrin mold to height of 4 mm and cured for 20 seconds using the Bluephase G2 (Ivoclar Vivadent) light curing unit. Irradiance of the curing light was determined with a radiometer (LED Radiometer, Kerr) to verify levels above 1000 mW/cm².

The specimens were stored in 37°C distilled water in a lab oven (Model 20GC, Quincy Lab, Chicago, IL) for 24 hours, then were loaded perpendicularly with a knife-edge blade in a

universal testing machine (Model 5943, Instron, Norwood, MA) using a crosshead speed of 1 mm per minute until failure. Shear bond strength values were calculated in megapascals from the peak load of failure (newtons) divided by the specimen surface area. A mean and standard deviation was determined per group. Due to the non-normal distribution of some of the groups and unequal variances, the data were analyzed with non-parametric tests. A Kruskal-Wallis and Mann Whitney U with a Bonferroni correction was used to evaluate the effect of surface pre-treatment on the shear bond strength of resin cement to ceramic ($\alpha=0.005$). Following testing, each specimen was examined using a 10X stereomicroscope to determine failure mode as either: 1) adhesive fracture at the resin cement/ceramic interface, 2) cohesive fracture in resin cement, 3) mixed (combined adhesive and cohesive) in resin cement or ceramic, or 4) cohesive fracture in ceramic.

Table 1: Surface treatment of lithium disilicate

Product	Components	Instructions	Manufacturer
Interface	Proprietary blend of organic and inorganic acids, trimethoxysilyl propyl methacrylate (silane)	The lithium-disilicate specimens were air abraded with 50- μ m aluminum oxide at 30 psi for 10 seconds and then steam cleaned and air dried. Interface was prepared by mixing one drop from bottle A and B. The two liquids formed a bubble which collapsed after 20-30 secs. Then the mixture was stirred 5 secs with a microbrush applicator and an even coat was applied. It was allowed to dwell for 10s then was air dried for 5 secs.	Apex Dental Materials
Monobond Plus	Ethanol, trimethylpropyl methacrylate (silane), methacrylated phosphoric acid ester (10-MDP), disulfide acrylate	HF acid (Ceramic Etching Gel) was applied for 20 secs then rinsed and air dried for 30 secs. One coat of Monobond Plus was applied, left for 60 secs, then air thinned for 5 secs.	Ivoclar Vivadent
Monobond Etch and Prime	Trimethylpropyl methacrylate (silane), ammonium polyfluoride (etchant), alcohol and water	Monobond Etch and Prime was applied with microbrush and agitated for 20 secs, allowed to sit for another 40 secs, then rinsed with water and air dried for 10 secs.	Ivoclar Vivadent
Optibond XTR	Primer: glycerophosphate dimethacrylate, hydrophilic co-monomers, water, ethanol, acetone Bond: resin monomers, hydroxyethyl methacrylate, inorganic fillers, ethanol, photoinitiators	The lithium-disilicate specimens were air abraded with 50- μ m aluminum oxide at 30 psi for 10 seconds and then steam cleaned and air dried. HF acid (Ceramic Primer) was applied for 20 secs then rinsed and air dried for 30 secs. One coat of Optibond XTR was applied and air thinned gently and then more strongly for avoidance of pooling. Then surface was light cured for 10 secs.	Kerr
Bis-Silane	Ethanol, silane	1 drop each from A and B were mixed with a microbrush. Two coats were brushed on the HF-acid etched lithium	Bisco

		disilicate surface. After 30 seconds the surface was dried with an air syringe.	
Ceramic Etching Gel	4.8% hydrofluoric acid	Applied for 20 secs, then rinsed with water and air dried	Ivoclar Vivadent

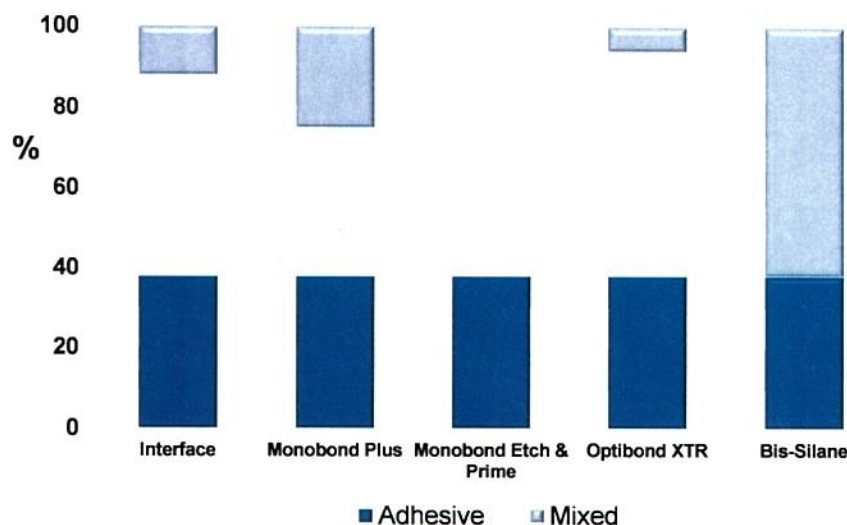
Results

A significant difference in shear bond strength of resin cement to lithium disilicate was found based on type of surface treatment ($p < 0.001$). The control group using HF acid and silane had the highest bond strength (23.2 ± 7.2 MPa) and was significantly greater than all of the other groups. Monobond Etch and Prime had the lowest bond strength (8.0 ± 7.4 MPa), but it was not significantly different from the other simplified primer solutions. See Table 2 below. Less adhesive failures were observed with the control group. See Figure 1 below.

Table 2: Shear bond strength of resin cement to lithium disilicate

Group	Surface Pre-treatment	Shear Bond Strength MPa (st dev)
1	Interface (Apex Dental Materials)	8.4 (3.9) b
2	Monobond Plus (Ivoclar Vivadent)	11.7 (6.0) b
3	Monobond Etch and Prime (Ivoclar Vivadent)	8.0 (7.4) b
4	Optibond XTR (Kerr)	10.6 (4.4) b
5	Bis-Silane (control) (Bisco)	23.2 (7.2) a
Groups with the same letter are not significantly different ($p > 0.07$)		

Figure 1: Failure mode of resin cement to lithium disilicate



Discussion

The null hypothesis was rejected, a difference in shear bond strength of the resin cement to lithium disilicate was found based on type of surface pre-treatment primer or solution. In this study, all novel surface pretreatments performed similarly to one another with no statistically significant difference in shear bond strength. However, these combined or simplified solutions resulted in significantly lower bond strength of the resin cement to lithium disilicate compared to the control group of HF acid and silane. When evaluating the mode of failure, the use of HF acid and silane resulted in more mixed adhesive/cohesive failures. However, all of the novel surface pretreatments resulted in predominantly adhesive failures to the lithium disilicate, suggesting a weaker interface (Al-Salehi et al., 1997).

Interface is a two-bottle primer system marketed for the preparation of any type of ceramic (including newer high-strength materials) as well as enamel and dentin. The composition of Interface is largely proprietary; however, bottle A contains a blend of organic and inorganic acids while bottle B contains trimethoxysilyl propyl methacrylate (silane). The two solutions remain separate until use and then are mixed per specific manufacturer instructions (apexdentalmaterials.com). Interface contains novel acids with silane primers for preparing glass ceramic surfaces without the use of a separate hazardous HF-acid etchant. However, the shear bond strength was less than that of the control group in this study. Perhaps the organic and inorganic acids may not have sufficiently roughened the glass-ceramic surface.

Monobond Plus is considered a universal primer system containing three different functional methacrylates including silane methacrylate (glass ceramics), phosphoric methacrylate (oxide ceramics), and sulfide methacrylate (metal) for bonding to all indirect restorations (ivoclarvivadent.com). The goal of the manufacturer was to create a surface treatment solution that allows its use with various types of substrates without requiring multiple bottles and different protocols for the primer. The use of HF acid is recommended when bonding to glass ceramics. In this study, the shear bond strength of Monobond Plus was less than the control group of HF-acid etch and silane. The acidic nature of phosphate monomers, such as 10-MDP used in Monobond Plus, may have reduced the function of the silane (Griffin et al., 2010). The silane may have been hydrolyzed and its priming ability may have been retarded by a subsequent condensation reaction that formed a polysiloxane oligomer (Hooshmand et al., 2004). In a recent study by Lise et al., (2015) Monobond Plus produced higher shear bond strength to lithium disilicate when compared to no treatment or treatment with only HF acid. However, Monobond Plus was not compared to the use of HF acid and silane-only solutions.

Another study evaluated the bond strengths of Monobond Plus when bonding to zirconia. The study concluded that use of the primer Z-Prime Plus (Bisco) and air abrasion or air abrasion alone resulted in higher bond strengths than did the Monobond Plus with air abrasion (Yi et al., 2015). Similarly, a study by Kobes et al., (2013) found that bond strengths of resin cement to zirconia were significantly higher using Z-Prime Plus compared with Monobond Plus, Clearfil Ceramic Primer (Kuraray, Houston, TX) and AZ Primer (Shofu Dental Corporation, San Marcos, TX) when using MultiLink Automix (Ivoclar Vivadent) resin cement. Z-Prime Plus contains only 10-MDP and carboxylate monomers while Monobond Plus and Clearfil Ceramic Primer contain both 10-MDP and silane (Griffin et al., 2010). By not including silane into Z-Prime Plus, the greater concentration of 10-MDP may have facilitated a higher bond strength of the resin cement to zirconia.

Monobond Etch and Prime has most recently been marketed as a one-step, self-etching surface pretreatment for glass ceramics that contains a new polyfluoride conditioner and silane in one bottle. The manufacturer seeks to eliminate the use of hazardous HF-acid etchant and simplify the process to a one step procedure (ivoclarvivadent.com) similar to Interface. According to the manufacturer, the polyfluoride reportedly creates a roughness pattern on the ceramic which is less pronounced than HF acid, but just as efficient for bonding. In this study, the shear bond strength of resin cement to lithium disilicate was significantly less using Monobond Etch and Prime compared to the control group of HF acid and silane. Perhaps the polyfluoride conditioner may not have sufficiently roughened the glass-ceramic surface or it reduced the efficacy of the silane in Monobond Etch and Prime.

Optibond XTR is a two-step, self-etch light-cure universal dental adhesive. The self-etching primer contains an acidic phosphate monomer, glycerophosphate-dimethacrylate (GPDM), which reportedly provides chemical and mechanical adhesion with any ceramic material and any resin composite or core material (kerrdental.com). After air abrasion with aluminium oxide and etching with HF acid, the manufacturer states that when bonding to glass ceramics, the use of silane is optional with Optibond XTR if using NX3 resin cement. This study used NX3, a dual-cure esthetic resin cement that does not contain additional functional monomers. The shear bond strength of the resin cement to lithium disilicate was significantly less with Optibond XTR compared to the control group of HF acid and silane. A recent study evaluated the bond strength of resin cement to lithium disilicate using Scotchbond Universal (3M ESPE, St. Paul, MN) with or without the use of silane. Scotchbond Universal contains silane and therefore the manufacturer suggests that additional silane is not required when bonding to glass ceramics.

Lower bond strengths were found with the universal adhesive without the additional use of silane. According to the authors, the constituent silane in the universal adhesive was not effective in optimizing the ceramic-resin bond (Kalavacharla et al., 2015). A recent study by Passia et al., (2015) determined that universal bonding agents that do not contain silane, such as Optibond XTR, had significantly reduced bond strength of resin cement to lithium disilicate compared to groups that were treated with silane-containing primer solution such as Monobond Plus.

A large base of published evidence supports the use of traditional surface treatment with HF acid and silane when bonding to glass ceramics. Tian et al., (2014) completed a literature review elucidating the role of HF acid and silane in the bonding procedure to glass ceramics which includes lithium disilicate. The bifunctional monomer creates a durable bond to both silica in the ceramic and the resin cement (McLaren and Cao, 2009; Papia et al., 2014; Panah et al., 2008). The silane coupling agent used in this study, Bis-Silane, does not contain any additional functional monomers or acidic agents. Bis-Silane is a two-part silane coupling agent that reportedly offers additional shelf-life stability (bisco.com). Laboratory studies demonstrate that the bond strength of resin cement to lithium disilicate significant increases with the use of a HF-acid etchant and silane. New surface treatment products have been introduced to the marketplace which attempt to either combine separate steps, such as etch and silane, or combine primers specific to the different types of ceramics, such as 10-MDP combined with silane. Very little research has been published evaluating these new products. And studies that do evaluate these combination products rarely compare them to HF-acid etchant and silane alone (Passia et al., 2015, Lise et al., 2015). Given the results of this laboratory study, clinical research is indicated to analyze whether these simplified or combination type primers and pretreatments should be routinely used by practitioners.

Conclusion

The new surface primers and pre-treatment solutions resulted in significantly lower shear bond of the resin cement to lithium-disilicate glass-ceramic compared to the use of hydrofluoric acid and silane alone.

Disclaimer

The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the view of the DoD or the USUHS. The authors do not have any financial interest in the companies whose materials are discussed in this article.

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18 MAY 2016

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1. Your paper, entitled **The Spiritual Needs of the Religiously Unaffiliated Airmen and Trainees in Basic Military Training** presented at/published to the **Division 19 Section, APA Conference 2016, Denver, CO 5 Aug 2016** with MDWI 41-108, and has been assigned local file #**16199**.
2. Pertinent biographic information (name of author(s), title, etc.) has been entered into our computer file. Please advise us (by phone or mail) that your presentation was given. At that time, we will need the date (month, day and year) along with the location of your presentation. It is important to update this information so that we can provide quality support for you, your department, and the Medical Center commander. This information is used to document the scholarly activities of our professional staff and students, which is an essential component of Wilford Hall Ambulatory Surgical Center (WHASC) internship and residency programs.
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Title: The Spiritual Needs of the Religiously Unaffiliated Airmen and Trainees in Basic Military Training

Abstract

Statement of Problem:

In the United States the “religiously unaffiliated” are growing (Pew Research Center, 2015). This group includes atheists, agnostics, and “nothing in particular,” and now accounts for 22.8% of the U.S. population. These figures are not unique to civilians and are replicated across our joint branches of the U.S. Military (Military Leadership Diversity Commission, 2010); 25.50% of Service Members (SMs) identify as religiously unaffiliated and 3.61% as Humanist. Evidence points to a clear, and growing, cultural presence of the religiously unaffiliated in our U.S. Military (Hunter & Smith, 2009). There are significant differences in religious attitudes between enlisted members and their officer leadership, with only 15.65% of officers holding religiously unaffiliated beliefs compared to 27.63% of enlisted members (Hunter & Smith, 2009). In this atmosphere, without systemic support for their beliefs, many young service members may feel adrift and alienated as they attempt to assimilate into their new military culture.

In August 2014, a programmatic innovation supported by the U.S. Air Force emerged to serve this group. The Humanist Group developed after one atheist trainee requested to meet with a non-theistic chaplain. His request sparked a program that now serves Basic Trainees and Airmen every week during the 8.5 weeks they are in Basic Military Training (BMT). The Humanist Group is currently the only a-theistic programming in the Department of Defense that functions exclusively to serve the non-religious spiritual needs of this population. The program includes an 8-week sequential format through the following topics: (1) Humanism, Communication, and Military Life, (2) Morals, (3) Fallacies, (4) Coming out, (5) Separation of church and state, (6) “Nones”, (7) Grief and stress, and (8) Death.

Participants:

The participants include BMT trainees and graduates, who may or may not identify as religiously unaffiliated, as well as the Retired, Active Duty, and civilian volunteer facilitators, who identify as Atheist, Humanist, or Agnostic. Roughly 400 Basic Trainees and Airmen attend the group every week. This translates to approximately 900 individuals served annually out of a total of 35,000 recruits at JBSA-Lackland (2.57%; 737th Training Group).

Procedure and results:

The present study uses a descriptive, qualitative method to present the structure and development of this group, along with the needs it fills. Factors to be addressed in these results include: procedural description of meetings and session topics, attendance outcomes, and the systemic barriers faced by facilitators.

Conclusion:

The results of this study offer clear evidence that all branches of the military need to consider offering spiritual options for the unaffiliated. In addition, findings in this study offer guidance for the Air Force to consider broadening the chaplaincy to support the growing number of unaffiliated. Expanding the chaplaincy to incorporate Humanist chaplains would serve to address the spiritual needs of all their Airmen. Finally, implications are drawn on the impact of discrimination and systemic barriers that interfere with the development of programming for the religiously unaffiliated.

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