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RESEARCH ARTICLE

Shear Bond Strengths of a luting Glass Ionomer Cement and a Self-Adhesive Universal Resin Cement to a Base Metal Alloy

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Abstract

Background:The bond between the luting cement and the metal at the metal-cement interface of a fixed dental prosthesis is critical for its clinical success.
Objective: To evaluate the shear bond strengths of type 1 GIC luting cement and a self-adhesive universal resin cement to a nickel chromium based base metal alloy.
Design: Wiron alloy was taken and cast in the form of cylinders (10mm length x 8mm diameter). The base of each cylinder was joined with either a Type 1 luting glass Ionomer cement (group 1) or a self-adhesive universal resin cement (group 2) to form a bonded assembly.This bonded assembly was used for shear bond strength testing with INSTRON Universal Testing Machine.
Statistical Evaluation: The data were analyzed using Kruskal Wallistest establish whether there was a significant difference among the two groups. The significance was set at a P value <0.05.
Results:There was a significant difference in the shear bond strengths between group 1 and group 2.(p=0.0345)
Conclusion: The self-adhesive universal resin cement showed significantly higher shear bond strengths to a nickel chromium based base metal alloy compared to type 1 glass Ionomer cement.

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INTRODUCTION

Retentive characteristics of luting cements become important aspects for crown retention, when mechanical retentive aspects of the tooth preparation decrease**.(**Amara Abreu et al,2007[1]) This is especially true in case of minimally retentive preparations. The bonding of a fixed metal or metal ceramic prosthesis to a tooth has two interfaces. One is the bonding interface between the luting cement and the tooth. The second is the bonding interface between the luting cement and the crown.The problem of bonding to the tooth has largely been taken care off after the advent and advances in acid etching, dentin bonding systems and chemical bonding to teeth by materials like glass ionomer cement. But failures at the metal cement interface continue to remain a clinical problem.

Type 1 GIC is now considered a gold standard for luting metal and metal ceramic restorations. Conventional glass ionomer cements have a cariostatic potential owing to fluoride release and a coefficient of thermal expansion similar to that of tooth structure and they can chemically adhere to dentin and enamel (Andree Piwowarczyk et al,2004[2]**).** Unfortunately, this material has low tensile strength and fracture resistance and is also susceptible to moisture during the early stages of the setting process.

Traditionally resin cements, had no ability to chemically react with the restoration surface. The bond to metal was through micromechanical retention of the roughened surface**. (**Sen D et al, 2000[5]) A new classification of

resin-based cement, the so-called "universal, self-adhesives," has been developed. These products base their adhesion to tooth structure on both a glass ionomer- like chelation to di- and trivalent metal ions, as well as a simultaneous acidic demineralization of dentin and resin penetration into exposed collagen. **(**Wilson AD et al, 1983[7]**;**Yoshida Y et al,2000[8]**).**

This study evaluated the shear bond strengths of type 1 GIC luting cement and a self adhesive universal resin cement to a nickel chromium based base metal alloy.

Materials and methods:

Materials used for the study are:

TYPE	BRAND NAME	MANUFACTURER
Base metal alloy	Wiron. 99 Alloy	BEGO-WILCOS BRASIL
Glass Ionomer type I	GC Gold Label Luting & Lining Cement	GC CORPORATION
Resin cement	Rely X U 100	3M ESPE

Specimen preparation

Wiron alloy was taken and cast in the form of cylinders (10mm length x 8mm diameter). The base of each cylinder were joined with the help of a luting cement to form a bonded assembly. (FIG 1) This bonded assembly was used for shear bond strength testing with INSTRON Universal Testing Machine.

The luting cements used were:

Glass Ionomer Type I luting cement (GC Gold Label Luting & Lining Cement)

Cast metal cylinders were taken and bonded with Glass Ionomer Type I luting cement. The cement was mixed as specified by manufacturer. Mixed cement was applied over the surface of the metal pellet held in the cementing zig (Fig 2)(Manufactured at Hebich Engineering, Mangalore) and a load of 500g is applied over it to obtain uniform film thickness. Excess cement was removed from the surfaces of the joints after 10 min, and two layers of a dental varnish (GC Fuji varnish, G-C Dental Industrial Corp., Tokyo, Japan) were applied around the joints. Samples are stored in humidifier in a beaker with 100ml water at 37 ^{0}C and 50% relative humidity for 24 hours.

Self adhesive universal resin cement (Rely X U 100).

Cast metal cylinders were taken and bonded with Resin cement. RelyX U 100 contains bi-functional (meth)acrylate. The proportion of inorganic fillers is about 70% by weight; the grain size (D90%) is about 12.5µm. The cement was mixed as per manufacturer's instructions. Mixed cement was applied over the surface of the metal pellet held in the cementing zig and a load of 500g was applied over it to obtain uniform film thickness. Cement was allowed to self cure for 2-3 min. After this material becomes like a gel and excess was removed. Then the material was light cured for 20 sec from all the surfaces using a 3M LED light cure unit.Two layers of a dental varnish (GC Fuji varnish, G-C Dental Industrial Corp., Tokyo, Japan) were applied around the joints. Samples are stored in humidifier in a beaker with 100ml water at 37 ^{0}C and 50% relative humidity for 24 hours.

The Samples made with all the two luting cements were divided into two groups with twelve bonded assemblies in each group:

Group 1:Bonded assemblies were made using Glass Ionomer Type Iluting cement.

Group 2: Bonded assemblies were made usingSelf adhesive universal resincement.

Shear test:

The shear tests were conducted on an Instron Universal Testing Machine (Instron Model 4206, Germany).(FIG 3)The cross-head speed was set at 2.1 x 10^{-6} m/s. The samples were held in a shear device (Manufactured at Hebich Engineering, Mangalore) (FIG4,A,B) designed to apply a pure shear force to the joints.

Statistical Evaluation:

The data were analyzed using Kruskal Wallis test establish whether there was a significant difference among the two groups. The significance was set at a P value <0.05.

Results:

The mean and standard deviation values obtained are shown in Table 1.There was a significant difference in the shear bond strengths between group 1 and group 2.(p=0.0345)

Table 1
Mean and standard deviation values

	Mean	Standard deviation
Group 1	**4.7567**	**0.41789**
Group 2	**7.32**	**1.2929**

FIG 1: Bonded Assembly

FIG 2: Cementing Jig

FIG 3: Instron Universal Testing Machine

(A)

(B)

FIG 4 (A, B): Shear Device

Discussion:

Nickel chromium base metal alloys are commonly used in clinics for porcelain fused to metal restorations. This study evaluated the ability of a type 1 glass Ionomer cement and a Self adhesive universal resin cement to bond to a nickel chromium base metal alloy by testing the shear bond strengths.

The most common bond tests used in dental research consist of a shear stress or a tensile stress applied to a butt joint. A pure tensile stress is difficult to achieve. A very small deviation in the direction of the load can concentrate stress in a particular area of the joint and lower the resistance to fracture. Moreover, even in a perfect experimental setting, the stress may not be distributed evenly along the interface. As an alternative to tensile testing, the shear bond test is probably more representative of the stress applied on dental restorations.**(**MacKinnon MA, 1988[4];Van Noort R, 1989[6]**)**

In this study the shear bond strength of the self adhesive universal resin cement was statistically significant compared to type 1 glass Ionomer luting cement. The self adhesive universal resin cements contain phosphoric-acid methacrylates that provide a strong physical interaction, such as hydrogen bonding with the surface and thus the very high bond strengths[3]**.**

The weak shear bond strengths exhibited by Glass Ionomer cement can perhaps be explained because the samples were stored in water for only 24 hours before being fractured in shear and thus they would not have attained their full strength.

Conclusion:

Under the conditions of the study, the self adhesive universal resin cement showed significantly higher shear bond strengths to a nickel chromium based base metal alloy compared to type 1 glass Ionomer cement

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