

The effect of indirect veneering materials as light interpose on microhardness of dual cured resin cements

Maha A AL-Murad
BDS, MSc. (Lec.)

Department of Conservative Dentistry
College of Dentistry, University of Mosul

Ma'an M Nayif
BDS, PhD (Lec.)

Department of Conservative Dentistry
College of Dentistry, University of Mosul

الخلاصة

الأهداف: التحقق من تأثير أنواع مختلفة من القشرة الزينية على صلادة السمنت من نوع ثنائي المعالجة. **المواد وطرائق العمل:** عمل ثلاثة اقراص ب(ارتفاع ٢ ملم و قطر ٥ ملم) والتي حظرت من مواد القشرة الزينية وهي Indirect composite resin, Feldspathic porcelain, and Zirconia veneer. استخدم نوعين من السمنت هما Variolink and Bis-Cem. ولقد حظرت ٢٠ عينة من كل نوع من السمنت ولقد جرت الى اربعة مجاميع. المجموعة الاولى وهي المجموعة القياسية اما بقية المجاميع فهي المواد المجردة الغير مباشرة. ولقد حظرت السمنت بوضعه داخل قالب بلاستيكي (بارتفاع ١ ملم وقطر ٥ ملم) ولقد تمت عملية خلال اقراص القشرة الزينية لمدة ٣٠ ثانية باستخدام جهاز Light curing curing ذو ٥٠٠ مايكرو واط/ستمت مريع ولقد عرضت العينات لتقل ٥٠ غرام لمدة ١٥ ثانية باستخدام Vicker Hardness machine. ولقد اجريت ثلاثة قراءات لكل عينة واخذ المعدل لها حللت البيانات احصائيا باستخدام Anova and T-test. **النتائج:** لكلا النوعين من السمنت. المجموعة الاولى وهي المجموعة القياسية, اظهرت اعلى قيمة مقارنة بالمجاميع الاخرى. المجاميع التي تم معالجتها خلال Indirect composite resin اظهرت اعلى قيمة للصلادة. المجاميع التي تم معالجتها خلال (Ceramic, Zirconia) اظهرت قيم اقل. السمنت الذي من نوع Variolink اظهر اعلى قيمة من السمنت الذي من نوع Bis-Cem. **الاستنتاجات:** انواع القشرة الزينية او التجميلية لها تأثير على صلادة السمنت من نوع ثنائي المعالجة.

ABSTRACT

Aims: The aim of this study was to investigate the influence of different indirect veneering materials on the microhardness of dual-cured resin cements. **Materials and Methods:** Three disc specimens (2.0 mm height and 5mm diameter) were prepared from the following indirect restorative materials (Indirect composite resin, Gardia-GC, JAPAN, Feldspathic porcelain VITA VIMK 95-Germany and Zirconia veneer, VITA-Zahnfabrik, Germany). Two dual cure resin cements were used (Variolink II, Ivoclar Vivadent AG, Liechtenstein and Bis-Cem, Bisco-Schaumburg, USA). Twenty specimens were prepared from each type of cement and divided into 4 groups, one as control and others as indirect restorative materials. After mixing cements were placed in a plastic mold (5mm diameter and 1mm height) and light activated directly or through veneering discs for 30s using LED light at 500mW/cm². Specimen subjected to three indentation using Vicker hardness tester with load of 50gm for 15 second. Data were statistically analyzed using ANOVA and independent t-test at ($\alpha=0.05$). **Results:** For both cements the control groups showed higher hardness value than other groups. Specimens cured through indirect resin composite shows the highest microhardness while those cured through Zirconia shows the lowest value. Variolink II resin cement demonstrated higher microhardness than Bis-Cem cement regardless of the curing condition. **Conclusions:** Type of indirect restorative veneering materials influence microhardness of resin cement luting agent.

Key words: Microhardness, Resin cement, Indirect composite resin, Ceramic, Zirconia.

AL-Morad MA, Nayif MM. The effect of indirect veneering materials as light interpose on microhardness of dual cured resin cements. *Al-Rafidain Dent J.* 2013; 13(2): 290-295.

Received: 8/2/2012

Sent to Referees: 13/2/2012

Accepted for Publication: 22/4/2012

INTRODUCTION

Different indirect restorative materials were used for correction of discoloration, malformation or alignment of teeth. Ceramic was the most common veneering material used in dentistry. Recently, materials like indirect composite resin and zirconia have been introduced and applied as indirect veneering materials.^(1,2)

Previously, these materials might be

cemented with conventional cements like zinc phosphate and glass ionomer cements. The procedure might be associated with many drawbacks like weak retention, and improper color match.⁽³⁾ With the introduction of resin cement as luting agent it become possible to minimize drawbacks resulting in considerable increase in their uses. Resin cements offer advantages such as adhesion

to dental structure as well as low solubility, easy handling, and favorable esthetic.⁽⁴⁾ Longevity and survival of the restorations depend partially on the degree of conversion of these agents. This is because the degree of cure may influence cement properties such as hardness, retention, water absorption, residual monomer, and biocompatibility^(5,6) Dual cure resin cement (DCRC) is modified cement from the light and chemical cure cement. DCRC have been introduced in an attempt to combine the desirable properties of chemical and the light polymerization thus can be used in situation where the cement light curing is not granted. To maximize the clinical performance of indirect restorative material its crucial to maintain the optimum polymerization of luting cement. According to MCcomb (1996) complete polymerization of resin cements is essential for strength, retention and longevity of restorations⁽⁷⁾ When visible light applied through the veneering material, part of the light is transmitted to reach cement, part is absorbed, and part is reflected on the surface. Therefore, the type of veneering material is expected to influence the amount of light transmitted for activation of cement.⁽⁸⁻¹⁰⁾ Thus different mechanical properties of resin cement might be expected under different types of veneering material due to variation in degree of cement polymerization influenced by different level of light intensity. The degree of conversion can be assessed by direct and indirect methods. Direct methods such as FT-IR⁽¹¹⁾ and laser Raman spectroscopy⁽¹²⁾

These methods are very time consuming and expensive. Alternatively, an indirect method such as microhardness test can be applied which was shown to be reliable and easy to perform.⁽¹³⁻¹⁵⁾ The hardness of the material represents a relative measure of its resistance to indentation when a specific, constant load is applied. The purpose of this in vitro study was to evaluate the microhardness of two dual cure resin cements polymerized through different types of the veneering materials (indirect resin composite, ceramic, zirconia). The null hypothesis tested were: (1) there is no difference in the hardness of DCRC between direct and indirect activation through veneering materials.⁽²⁾ cement activation through different types of veneering materials yielding different hardness values.

MATERIALS AND METHODS

Three disc shaped specimens (2.0mm height and 5mm diameter) of single shade A2 were prepared from the following veneering materials according to the manufacturer's instruction (Indirect composite resin, Gardia-GC, Japan; Feldspathic porcelain, VITA VMK 95 – Germany; and Zirconia, VITA-Zahnfabrik, Germany).

Specimen preparation for microhardness:

Two DCRCs were selected for evaluation the influence of veneering materials on microhadness (Variolink II, Ivoclar Vivadent, Germany and Bis-Cem, Bisco-Schaumburg-USA). The compositions of the resin cement are shown in Table (1).

Table (1): Dual cured resin cements used in the study.

Materials	Composition	Manufacturer
Variolink II	Base: monomer 26.3% , filler 73.4% Catalyst: monomer 22%, filler 77.2% Bis-GMA, Urethan dimethacrylate, Inorganic fillers (Barium, ytterbium trifluoride, Ba Al fluorosilicate)	Ivovlar Vivadent AG, Liechtenstein
BisCem	Base : Bis-GMA > 10 Dimethacrylate monomer > 20 Glass filler > 50 Catalyst: Phosphate acidic monomer > 10 Glass filler > 50	BISCO, Inc., USA

A plastic mold (5mm diameter and 2.0 mm height) was fabricated and placed on glass slide covered by a Mylar strip. Resin cement was mixed according to manufacture instruction and injected into the mold. A second Mylar strip was placed over the mold and squeezed to remove excess material. A specified veneer material was placed over the resin cement and light activated with LED light at 500mW/cm² for 30 second (LEDition, Ivoclar Vivadent, Liechtenstien). Twenty specimens were prepared from each type of cement and divided into four groups one as control and others as experimental (n=5). G1: Specimens were cured directly without interpose through glass slide. G2: Specimens were cured through indirect composite resin disc. G3: Specimens were cured through a ceramic disc. G4: Specimens were cured through Zirconia disc. All specimens were removed from the plastic mold and stored at 37°C for 24 hours.

Microhardness Test: Specimens were embedded in self cured acrylic resin. After

set the specimens were subjected to wet polishing up to (# 1000 SIC).

Microhardness measurement were preformed with VHN testing machine (Wolpert, Germany) at load of 50g for 15 seconds. The indentation was performed three times for each specimen with mean (VHN) value was obtained. Data were submitted to one way ANOVA followed by Dunnett test at 5% level of significance. Independent student T-test was used to compare between cements at each condition.

RESULTS

Means and standard deviation of microhardness values for both resin cements were shown in table (2). Analysis of variance of each cement groups revealed a statistically significant difference in microhardness values among the groups ($p < 0.05$). ANOVA result for Variolink II and BisCem cements were shown in tables (3, 4) respectively.

Table (2): Mean and SD for Variolink II and BisCem dual cure resin cements

Materials	Control	Indirect composite	Ceramic	Zircon
Variolink	70.78(0.7)	54.30(.2)	50.34(1.3)	47.20(1.3)
BisCem	64.20(2.5)	45.28(1.3)	43.70(2.2)	40.60(0.7)

Table (3) : ANOVA for Variolink II cement.

	Sum of Sequares	df	Mean square	F	Sig.
Between Groups	1651.690	3	550.563	503.372	.000
Within groups	17.500	16	1.094		
Total	1669.190	19			

Table (4): ANOVA for BisCem cement

	Sum of Sequares	df	Mean square	F	Sig.
Between Groups	1711.482	3	570.494	169.575	.000
Within groups	53.828	16	3.364		
Total	1765.10	19			

Dennett's test indicate that the microhardness values of Variolink II cement groups were significantly different with the following order starting from the highest to the lowest value (control, indirect composite, ceramic, and zirconia). Comparison of the means for BisCem

cement shows similar result to Variolink II but the difference between indirect composite and ceramic; and between ceramic and zirconia was not significant ($p > 0.05$). Comparison of the hardness values between the two cements demonstrated that Variolink II was

significantly higher than BisCem irrespective of veneering materials ($p < 0.05$). Figure (1) demonstrates the

comparison among the means of hardness values among all groups.

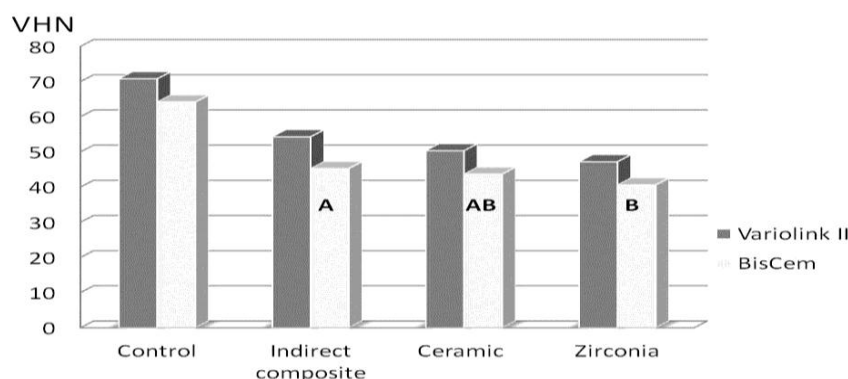


Figure (1): Microhardness values of the dual cure resin cements (Similar letters are not statistically different)

DISCUSSION

This study was designed to assess the hardness of dual cured luting materials after activation with light irradiance penetrating through indirect restorative materials as light interpose structure. Hardness is one of the mechanical properties that greatly affected by light intensity.⁽¹⁶⁾ The first hypothesis tested in this study was rejected; as indirect activation through the prepared discs was significantly reduce the hardness of dual cured luting materials in comparison to control group where specimens activated directly without light interpose. The finding suggests that all indirect restorative materials evaluated in this study considerably decreases light irradiance reaching the cements and none of the materials allows complete transmittance of the light.

As a result to light reduction the development of resin polymer net work will be reduced interfering with degree of cross linking. This indicate that even the chemical curing of the dual resin cement materials 24 hours post light activation was insufficient to ensure the adequate polymerization in comparison to control group.⁽⁸⁾ Further study may be necessary to evaluate the effect of storage time on the degree of dual cure cements polymerization.

Analysis of the hardness values among the different experimental groups revealed that generally the Variolink II and BisCem shows almost similar behavior following irradiation through the three indirect materials. Higher hardness value was observed when resin cured under indirect resin composite compared to other groups (ceramic and zircon). Meanwhile lowest hardness was observed in case of zirconia group. According to these data it can be suggested that type of indirect restorative materials is important factor in the development of hardness property of the resin cement. Thus type of veneering materials influenced the results and the second hypothesis was accepted. Light attenuation within restorative materials was dependent on the characteristics of the material, composition, color and thickness.⁽¹⁷⁻¹⁹⁾ The combination of scattering, reflecting and absorbing properties at the surface and within intervening material will determine the amount of light transmission and as a result with the polymerization process of the cement.⁽²⁰⁾

The light intensity of LED unit used in this experiment was approximately 500 mW/cm² as determined by radiometer. During the pilot study we measured light intensity through veneering materials and recorded a makeable decrease in the light

intensity with the following reading values and their percentages (indirect composite resin 250 (50%), ceramic 150(30%), zircon 120 (24%) mw/cm²). Similar findings were reported in a previous studies.⁽¹⁷⁾ Porcelain being partially amorphous in structure as a result, various kinds of light are reflected and absorbed in different manners. The more reduction in light transmittance is expected in case of zirconia which is composed of dense non porous polycrystalline structure.⁽²¹⁾

Comparison of the microhardness between the two dual cure resin cements (Variolink II and BisCem) demonstrated a significant difference. Variolink II resin cement had higher (VHN) in comparison to BisCem irrespective of the curing mode or type of veneering materials Figure (1). Such difference might be related to the inherent variation in composition and formula of the two cements because luting agent formulation is a factor controlling the material properties (20)Variolink II has a higher filler load percentage that affect the development of material resistance. Clinically to improve restoration longevity the reduction in light during the cementation of indirect restoration indirect restorative materials should be taken into account. Also selecting a cement provide high mechanical properties should be considered.

CONCLUSIONS

In conclusion the indirect restorative materials negatively affect the microhardness of dual cure resin cement. Microhardness of dual cure resin cement was dependent on type of indirect restorative materials.

REFERENCES

1. Dérand P, Dérand T. Bond strength of luting cements to zirconium oxide ceramics. *Int J Prosthodont.* 2000; 13(2): 131-135.
2. Jack D, Griffin Jr, DMD. Bonding of zirconia veneers. *Inside Dentistry.* 2011; 7:1-8.
3. Alopaz AR, Ertugrul F, Cogulu D, AK AT, Tanoglu M, Kaya E. Effect of light curing and exposure time on mechanical properties of resin based dental materials. *EurJDent.* 2008; 2: 37-42.
4. Tango RN, Mario , Sinhoreti MAC, Correr- Sobrinho L, Ferreira GDS, Saavedra A. Effect of light-curing method and indirect veneering materials on the knoop hardness of a resin cement. *Braz Oral res.* 2009; 23: 108-112.
5. Rasetto FH, Driscoll CF, VON Fraunhofer JA. Effect of light source and time on the polymerization of resin cement through ceramic veneers. *J Prosthodont.* 2001; 10: 133-139
6. Sinhoreti MAC, Menetta IP, Tango RN, Iregoma NT, Consani RLX, Correr sobrinho L. The effect of light curing methods on resin cement knoop hardness of different depths. *Braz Dent J.* 2007; 18: 305-308
7. McComb D. Adhesive luting cements-classes, criteria and usage. *Compend Contin Educ Dent.* 1996; 17:759-773.
8. El-Mowafy OM, Rubo MH. Influence of composite inlay/onlay thickness on Harding of dual-cured resin cements. *J Can Dent Asso.* 2000; 66:147.
9. Tango RN, Sinhoreti MAC, Correr AB, Correr-Sobrinho L, Consanti RLX. Effect of veneering materials and curing methods on resin cement knoop hardness. *Braz Dent J.* 2007; 18:235-239.
10. Koch A, kroeger M, Hartung M, Manetsberger I, Hiller KA, Schmalz G. Influence of ceramic translucency on curing efficacy of different light-curing units. *J Adhes Dent.* 2007; 9: 449-462.
11. Peutzfeldt A, Asmussen E. The effect of postcuring on quantite of remaining double bonds, mechanical properties, and in vitro wear of two resin composites. *J Adhes Dent.* 2000; 28: 447-52.
12. Pianelli C, Devaux J, Bebelman S, Leloup G. The micro- Raman spectroscopy, a useful tool to determine the degree of conversion of light-activated composite resins. *J Biomed Mater Res.* 1999; 48: 675-81
13. Hooshmand T, Mahmoodi N, Keshvad A. Microhardness of a resin cement polymerized by light-emitting diode

- and halogen lights through ceramic. *J Prosthodont*. 2009; 18: 411-6.
14. Rueggeberg FA, Craig RG. Correlation of parameters used to estimate monomer conversion in a light-cured composite. *J Dent Res*. 1988; 67:932-7.
15. Rueggeberg FA, Ergle JW, Mettenburg DJ. Polymerization depths of contemporary light-curing units using microhardness. *J Esthet Dent*. 2000; 12: 340-9.
16. Valentino TA, Borges GN, Borgres LH, Visal j, Martins LRM, Correr-Sobrinho LC. Dual resin cement knoop hardness after different activation modes through dental ceramics. *Braz Dent J*. 2010; 21(2):104-110
17. Lee JW, Cha HS, Lee JH. Curing efficiency of various resin-based materials polymerized through different ceramic thicknesses and curing time. *J Adv prosthodont*. 2011; 3:126-31.
18. Miranda CB, Pagani C, Bottino MC, Benetti AR. A comparison of micro-hardness of indirect composite restorative materials. *J Appl Oral Sci*. 2003; 11(2): 157-161.
19. Pick B, Gonzaga CC, Junior WS, Kawano Y, Braga RR, Cardoso PEC. Influence of curing light attenuation caused aesthetic indirect Dentistry restorative materials on resin cement polymerization. *Eur Journal of Dent*. 2010; 4: 314-321.
20. Heffernan MJ, Aquilino SA, Diaz-Arnold AM, Haselton DR, Stanford CM, Vargas MA. Relative translucency of six all-ceramic systems. Part I: core materials. *J Prosthet Dent*. 2002; 88(1): 4-9.
21. Power JM, Sakaguchi RL. Craig's Restorative Dental Materials, 12th Ed., St. Louis, Mosby Co., 2006, 459.