



A Study of Composite Surface Hardness When Cured Using Special Accessories with a Curing Light

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Abstract

The study was carried out to compare the Vickers Micro-Hardness (VHN) of composite resin of different diameters (6 mm and 10 mm) prepared in a split mold. The 6 mm and 10 mm diameter composite resin samples were cured with the tip of a fiber optic light. Additional sample for same size were cured with the same tip after a mirror or a lens accessory was mounted to it. All the specimens were cured for 40 seconds. The hardness was calculated for both top and bottom at the center and the periphery. The results showed that the hardness of top surface was higher than that at the periphery. The mean hardness value for specimens cured with the light tip was higher than the hardness of specimens cured with their accessory. Conclusion mirror or lens didn't potentiate light but distribute the energy to a larger area, resulting in less energy applied to the same small surface area, which reduced the hardness.

Keywords: Vickers micro-hardness, Composite resin, Dentistry.

Introduction

Visible light-cured resin systems have expanded the versatility of composite resin in dentistry. Since many large restoration composites such as veneers are being placed. Adequate polymerization of the entire restoration is a major concern. Also, it is very important for the dentist to cure restorations in the minimum time possible to maximize office productivity without compromising the long term success of the restorations [1].

A major disadvantage of the available light generating units is the small diameter of light tip, typically 5-7 mm which results in small area of cure. Curing the entire restoration at one time instead of increments would help to solve lamination problems, and reduce the time needed to restore an esthetics veneer. Light cure a large area of composite restoration by scanning the composite resin surface results in a cure which is lower in hardness than cured with fixed illumination. A small tip diameter may deliver a high radiant existence; multiple exposures may be required to completely cover the restoration [2-4].

The purpose of this research was to compare the micro-hardness of composite surfaces of 6 and 10 mm diameter specimens cured after a large diameter a highly polished metal ring (3M company, USA, St, Paul) (Figure 1) that collect all the scattered rays from the light tip, expected to increase the energy to cure composite resin, or the (Kulzer Translux CL photo cure attachment lens) (Figure 2). Which will focus the rays in the center and concentrate it to increase the potency of the rays expect more composite cure were mounted, to a light unit rod to those cured with the light cure unit rod without accessories.

The null hypothesis is that, resin composite light curing unit with the accessories give the same test of Vickers hardness as without when curing large diameter composite.



Figure 1: Mirror, a highly polished metal ring (3M Company, USA, St, Paul).

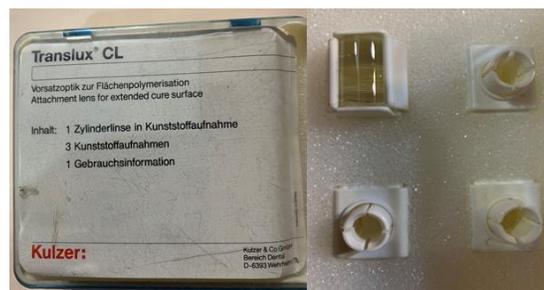


Figure 2: Kulzer Translux CL photo cure attachment lens was attached. (kulzer &CO. GMBH, wehrheim-Germany)

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Material and Methods

A universal color of microfilmed composite (Helio Progress) was used. Thirty specimens 10 mm in diameter and 2 mm thick and thirty specimens of 6 mm in diameter and 2 mm thick were prepared in a split mold. The split mold was placed between two Mylar strips and covered with a glass slide to assure a smooth surface which could be a measured accurately. The mold cavity was overfilled with composite and pressed against the Mylar strip and glass slide to remove the excess. Ten specimens of 6 mm diameter (Group I) and ten of 10 mm diameter (Group IV) were exposed for 40 seconds to light from a light cure unit (Vislux, 3M Company, USA, St. Paul). Ten specimens of composite with 6 mm diameter (Group II) and ten specimens of 10 mm diameter (Group V) were exposed to light from the same light cure unit for 40 seconds, after the mirror, a highly polished metal ring was attached. Ten additional specimens of composite with 6 mm diameter (Group III) and ten specimens of 10 mm diameter (Group VI) were exposed to light from the same light cure unit, after was attached. kulzer and CO. GMBH, wehrheim-Germany) (Figure 3) a box of four frames to be used alternatively during sterilization while the lens attached to one frame.



Figure 3: 3M lens attached to the lens.

All the three groups were subdivided according to the surface measured. The top surface of the 6 mm specimens was labeled “a”, and the bottom surface was labeled “b” similarly the top of the 10 mm specimens were labeled “c” and the bottom “d”. The tip of the fiber optic light unit alone and with added accessories mirror or with lens were placed in contact with the glass slide over the mold to cure the corresponding group of the three composite resin groups.

All the cured specimens were kept in a light proof container until the hardness test was performed. The vicker’s micro-hardness test was performed. Micro-hardness tester (Vickers Shimadzu-Seisa Kusho Ltd. Micro-hardness Tester, Kyoto, Japan), by measuring three indentations left by 100 gm sustained for 16 seconds. A diamond shaped indenting needle was used and each diagonal was measured. The mean value was calculated, that correlate the hardness with mean of diagonals obtained at the center and periphery.

Results

The mean VHN hardness value of 6 mm diameter for the three groups is shown in Table 1. A multi factorial ANOVA performed for comparison of hardness of the three groups at 1-a, 2-a, 1-b and 2-d areas ($F = 33.10, P < 0.05$). The Duncan test shows that the mean hardness value for group I is significantly higher than that for group II and III. The mean hardness values of 10 mm diameter for the three groups are shown in Table 2. A multi factorial ANOVA was performed for comparison of hardness of three groups at 1-c, 2-c, 1-d, and 2-d areas ($f = 33.10, p < 0.05$). The Duncan test shows that the mean for group I and II is significantly higher than group III and the difference between that I and II is not significant. Hardness comparison of 6 and 10mm diameter of the six groups by performing a multi factorial ANOVA showed that there are significant differences in

values between individual cases ($F = 48.86, P < 0.05$) (Table 3). The Duncan test shows that the mean for Group I is significantly higher than that for all groups. Similarly, the mean for hardness values of Groups II, IV, and V are significantly higher than that of Groups III and VI. However, there are no significant differences between the mean hardness values of Groups II, IV, and V. There are no significant differences between the mean hardness values of Groups III and VI.

Group /Area	a-1 Top center	a-2 Top periphery	b-1 Bottom center	b-2 Bottom periphery	F
I Tip Alone	29.27	27.46	19.52	14.99	39.24
II Mirror added	27.4	26.3	12.9	8.15	
III Lens Added	24.3	22.20	7	6	

Table 1: The mean Vickers hardness value for the three group of 6 mm diameter.

Group /Area	c-1 Top center	c-2 Top periphery	d-1 Bottom center	d-2 Bottom periphery	F
IV Tip Alone	26.4	24.6	12.2	9.2	33.1
V Mirror Added	27.5	25.34	13.5	10.06	
VI Lens Added	25.65	23.11	4.97	0	

Table 2: The mean Vickers hardness value for the three group of 10 mm diameter.

Group /Area	Top surface		Bottom surface		F
	Center	Periphery	Center	Periphery	
II 6 mm Tip Alone	29.27	27.46	19.52	14.99	48.86
II 6 mm Mirror added	27.4	26.3	12.9	8.15	
III 6 mm Lens Added	24.3	22.3	7	6	
IV 10 mm Tip Alone	26.4	24.6	12.2	9.2	
V 10 mm mirror Added	27.5	25.34	13.5	10.06	
VI 10 mm Lens Added	25.05	23.11	4.97	0	

Table 3: Comparison of the six groups of 6 and 10 mm Diameter.

Discussion

The hardness of all 6 and 10 mm specimens shows that the hardness of 6mm specimen cured with the light unit rod showed the highest of all. This might be because direct light shows the maximum effect especially when direct contact with the specimens and is without Intervening accessories this agreed with Leonard et al [5] who found that fixed and direct contact of small light tip with is essential to perform good composite resin cure.

Addition of accessories to the unit tips although it is try to collect the scattered light waves and concentrate at the center it but showed reduced in cure as indicated by the resulted hardness obtained this might be due to that the light tips away by distance from direct contact with composite resin this agreed with Gabriel et al [6] who stated that increase the distance of light tip by more than 5mm will affect the depth of cure of composite resin material. And S Zhu and J Platt [7] who found that increased the distance inversely proportion with the distance.

The results of this study showed descending gradation in hardness in all the specimens tested, from center to the periphery, from top to bottom, and from small light curing unit rod to a larger (added accessories), this may because light from the curing unit is a sort of the



energy in a cone form concentrated at the center helping to activate inactive molecules. that the light generation produced a conical pattern of hardness at the center and gradually drop off toward the periphery of the tip increasing the polymerization, decreasing the conical effect of polymerization with the confined diameter of the light tip local hardness values of the specimens are plotted as hardness maps, this agreed with Pires, et al [8] who stated that the hardness decreased from center to periphery and from top to bottom. Also Price and McLeod [9] who stated that light is a sort of energy that decreased away from the light curing tip margins or distance.

Our results showed that when accessory with larger diameter are added to the light unit of 6 mm diameter, a decrease in Vickers hardness of composite resin. The lens shows least hardness of all. This may be due to the fact that the light cure unit emits light with the same energy for all the Specimens that reduced as it passed through the lens and its thickness that increases the distance to the specimens. This agreed with Sobrinho CL et al [10] agreed that The Use of wide diameter curing light tip from outside the cavity may result in incomplete curing.

Our results showed that 10 mm diameter specimens that were cured with attached lens, has a significant decrease in hardness to the extent that its measurements couldn't be performed. This suggests that light energy is reduced as it passed through the lens it was not enough to cure the bottom surface. This agreed with Thomé T et al [11] who agreed that the degree of polymerization of light activated composite increased with direct and more exposure to the photo activating light. Also Kwon PC and Park WJ [12] who stated that the top surface of cured composite resin is harder than the bottom.

Conclusion

Within the limit of this study it is concluded that:

- Maximum composite resin cure which is essential to obtain successful restorative material was demonstrated by its increased in hardness.
- Light is sort of energy which helps to cure of composite resin and gets higher hardness allow energy concentrated at the smaller tip than larger ones at its center.
- The hardness of resin composite at the center of top surface and focused light was higher than that at the periphery of the light unit tip.
- Curing of composite restorative material showed hardness of the top surface faced light curing tip at both center and periphery were higher than the bottom surface away from it whether at bottom center or periphery in all the composite resin specimens.
- Curing of larger diameter of composite resin than the curing light tip showed reduced hardness than smaller diameter of composite resin as indicated by its hardness when not fixed the light unit tip on the field of cure.
- The mean hardness value for specimens cured with light tip was higher than the hardness of specimens cured with both added accessories trying to reflect the scattered rays or by focus it on the composite resin specimens.

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