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"Comparative Evaluation of Compressive Strength of a Hybrid Composite Cured with Halogen Light Curing Unit and Three Different Modes of Blue-Light Emitting Diode: An in Vitro Study".

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KEYWORDS

Comparative Evaluation, Compressive Strength, Hybrid Composite Cured

ABSTRACT:

INTRODUCTION: The increasing use of composite restorative materials has led to rapid rise in the number of light activation units1. The visible light curing units usually use tungsten halogen light source and still it is the most popular method of delivering the blue light. There are worries with the nature of restoring when traditional quartz tungsten halogen (QTH) light units are utilized. A lessening in light yield with time and with separation may bring about a low level of change and a shallow profundity of fix, which thusly decrease the nature of the last restoration2. To defeat these disadvantages, RW Mills1 proposed strong state light producing diode. Driven innovation uses gallium nitride blue LEDs and produce slender range of light. The properties of composite restoration thus get influenced by the light source and its intensity, so it is of thorough importance to have a proper knowledge about them.

AIM: To evaluate the compressive strength of submicron hybrid composite cured with halogen light curing unit in comparison with three different modes of blue light emitting diode.

METHOD: 40 cylindrical composite specimens are prepared using hybrid composite. Out of which, 10 samples (group 1) are cured with halogen light. For the remaining thirty specimens, three different phases of LED are used.10 samples with soft start curing mode (group 2), 10 samples with pulse

curing mode (group 3) and 10 samples with continuous curing mode (group 4). These samples are then checked for compressive strength using universal testing machine. The data is statistically analyzed using one way ANOVA test.

RESULT: the mean value of soft start (298.33) is highest followed by halogen(298.249),pulse start(278.122) least in continuous(277.676).

CONCLUSION: The specimens cured with soft start mode of blue light emitting diode showed the highest values of compressive strength.

INTRODUCTION

The increasing use of composite restorative materials has led to rapid rise in the number of light activation units[1]. The visible light curing units usually use tungsten halogen light source and still it is the most popular method of delivering the blue light. There are worries with the nature of restoring when traditional quartz tungsten halogen (QTH) light units are utilized. A lessening in light yield with time and with separation may bring about a low level of change and a shallow profundity of fix, which thusly decrease the nature of the last restoration[2]. To defeat these disadvantages, RW Mills[1] proposed strong state light producing diode. Driven innovation uses gallium nitride blue LEDs and produce slender range of light.

Light emitting diodes (LEDs), for example, those experienced as pointers in vehicle dashboards, have lifetimes of more than 10,000 hours and experience little corruption of light yield over this time, an unmistakable preferred position when contrasted and halogen bulbs[3]. Moreover, LEDs require no channels to create blue light. LEDs are impervious to stun and vibration and their moderately low power utilization makes them appropriate for versatile use[4].

With a power yield of 7 mW per LED, in any case, these were too frail to possibly be considered for relieving sap based materials. In 1995, all the more dominant 3 mW blue LEDs dependent on gallium nitride innovation were developed[4].This improvement spoke to a more than 400-crease increment in power, contrasted and silicon carbide innovation. The yield of these blue LEDs falls chiefly inside the assimilation range of the camphorquinone photoinitiator (400 nm–500 nm) of most dental composites.

In view of these improvements one of the creators proposed blue light radiating diodes for restoring composites in dentistry[5]. The long lifetime and steady light yield of LEDs contrasted and halogen sources guarantee the dental specialist the potential for continued nature of relieving. Driven relieving lights can work on battery control and expend little energy[6]. They produce a scope of wavelengths from 410 nm to 490 nm, which matches the focal retention pinnacle of the regular photoinitiator, camphorquinone[7,8]. While both LED and incandescent lamps are accepted fit for restoring gum based composites, a few contrasts are seen in the exhibition of relieved resin[9,10]. Hence the purpose of the study was to evaluate the compressive strength of hybrid composite when cured with halogen light in comparison to three different modes of blue light emitting diode. Null hypothesis: the compressive strength of composite specimen is not affected by the curing light used.

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METHOD

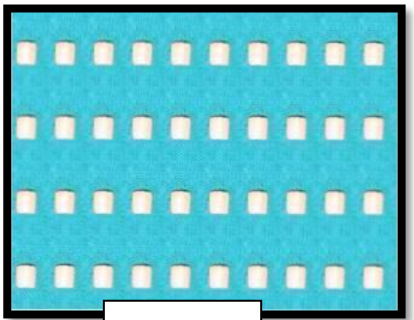

Fig 1

Study was done in the department of conservative dentistry and endodontics, Karnavati University using 40 cylindrical composite specimens (Fig 1) made with BRILLIANT EverGlow™(Coltene/Whaledent AG Altstatten, Switzerland).The measurements of the cylindrical block were 4mm in diameter and 6mm in depth. The specimens were prepared by filling the plastic mould with composite BRILLIANT EverGlow™(Coltene/Whaledent AG Altstatten, Switzerland) (Fig 2) and excess was squeezed by placing microscope slides on top and bottom surface of the composite specimens.

The composite BRILLIANT EverGlow™(Coltene/Whaledent AG Altstatten, Switzerland)specimens were light cured from the top surface for 40 seconds with the tip of light source held 2mm from the composite resin.

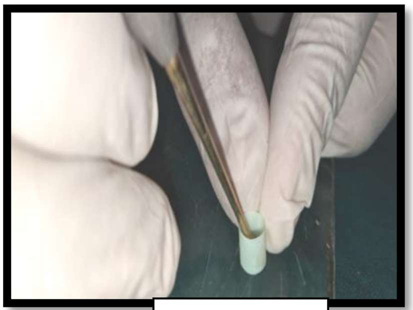

Fig 2

The 40 samples were then divided into 4 groups with 10 samples in each group according to the type and mode of light curing unit involved.

Group 1: 10 composite specimens were cured with halogen light curing unit (DENTSPLY®Caulk QHL75™) (Fig 3)

Group 2: 10 composite specimens were cured with soft start curing mode of blue light emitting diode (BlueShot, Shofu,Kyoto, Japan) (Fig 4)

Group 3: 10 composite specimens were cured with pulse curing mode of blue light emitting diode (BlueShot, Shofu,Kyoto, Japan)

Group 4: 10 composite specimens were cured with continuous curing mode of blue light emitting diode. (BlueShot, Shofu,Kyoto, Japan)

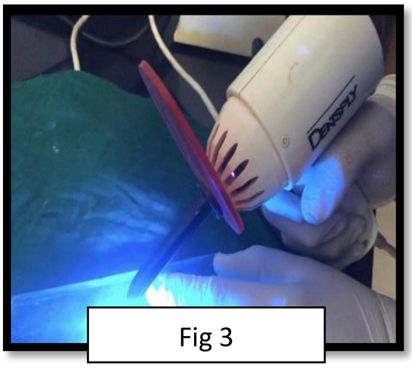

Fig 3

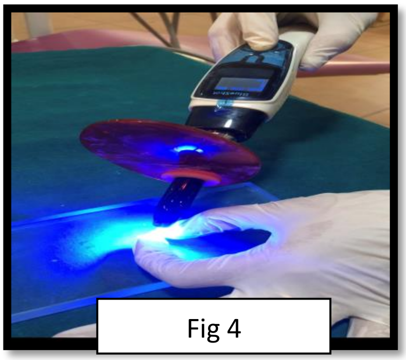

Fig 4

These specimens were then checked for compressive strength in universal testing machine (capacity 250KN), with one end of the specimen facing the machine and load applied in vertical

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direction. A compressive load was applied to the specimens at the cross head speed of 1 mm/minute. The testing apparatus was connected to calibrated drive charts which yield the result of individual specimens.During the testing procedure, the values of compressive strength was recorded in MPa unit.

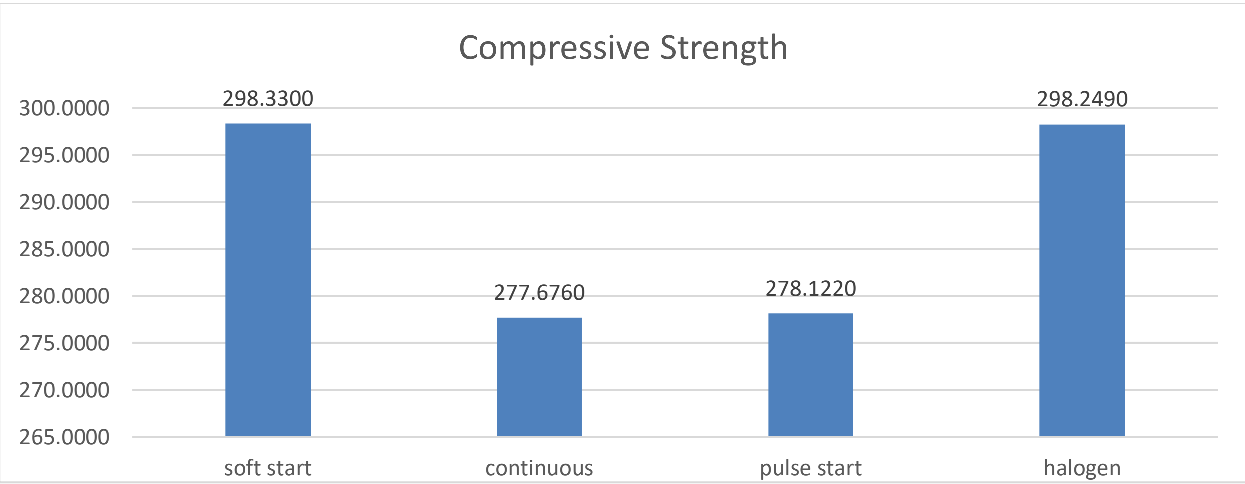
The data was then statistically analysed using one way ANOVA and post hoc tukey test using SPSS software V7 for windows, Chicago, Illinois.

RESULT

Comparison of the compressive strength using one way anova and posthoc tukey test

Table 1

		N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	p value
Compressive Strength	soft start	10	298.33	2.76607	96.755	18.534	≤0.001
	Continuous	10	277.676	5.48824			
	pulse start	10	278.122	4.18754			
	Halogen	10	298.249	1.74692			
	Total	40	288.0943	10.95911			



Graph 1

Post hoc tukey test

Table 2

Dependent Variable	COMPARISON GROUP	COMPARED WITH	MEAN DIFFERENCE	Std. Error	P VALUE
Compressive Strength	soft start	continuous	20.65400*	1.7082	≤0.001
		pulse start	20.20800*	1.7082	≤0.001

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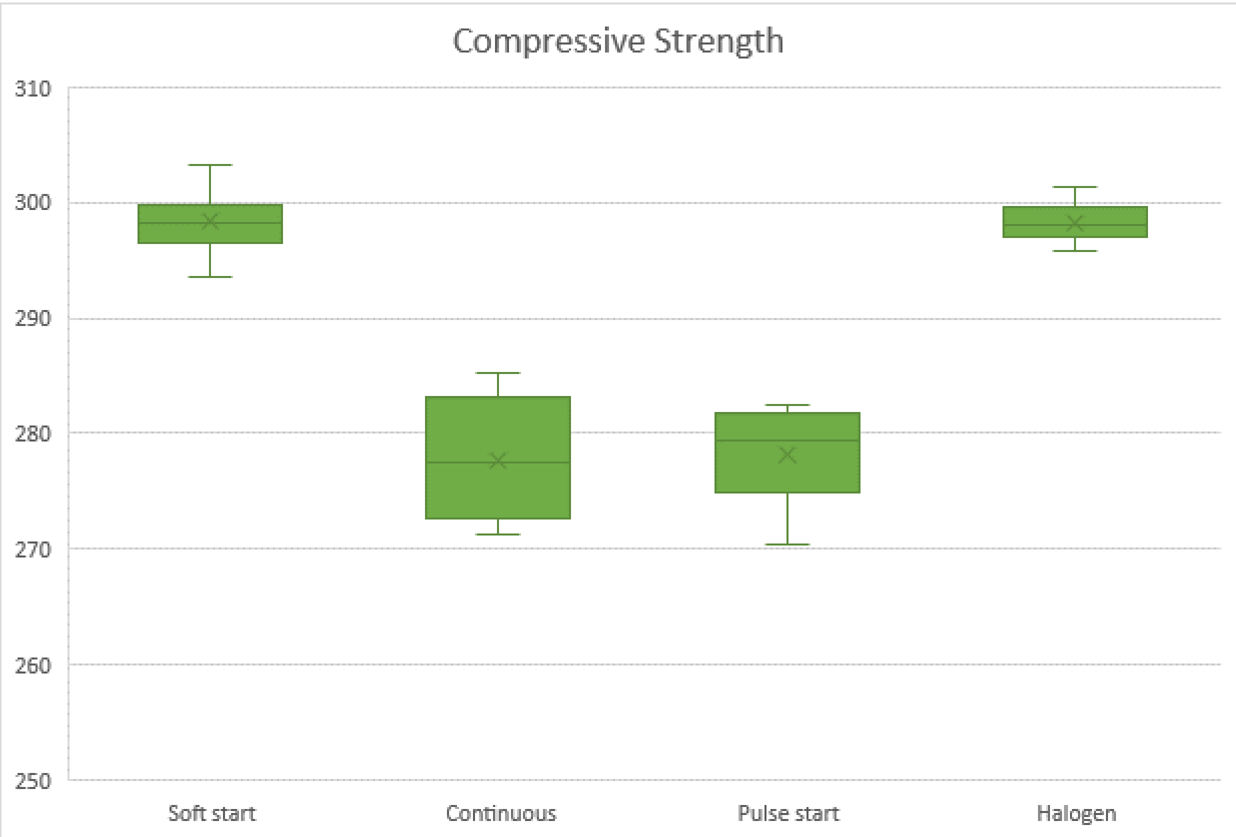
		halogen	0.081	1.7082	1
	continuous	pulse start	-0.446	1.7082	0.994
		halogen	-20.57300*	1.7082	**≤0.001**
	pulse start	halogen	-20.12700*	1.7082	**≤0.001**

Comparison of Compressive Strength using one way ANOVA test(table 1 and graph 1) shows that the mean value of soft start (298.33) is highest followed by halogen(298.249),pulse start(278.122) least in continuous(277.676). This difference is statistically significant with a test value of 18.534 and p value of <0.001. Post hoc Tukey test(table 2 and graph 2) shows that the difference between soft start and continuous is statistically significant with a mean difference of 20.65400* and p value of <0.001. The difference between soft start and pulse start is statistically significant with a mean difference of 20.20800* and p value of <0.001. The difference between soft start and halogen is NOT statistically significant with a mean difference of 0.081 and p value of 1. The difference between continuous and pulse start is NOT statistically significant with a mean difference of -0.446 and p value of 0.994. The difference between continuous and halogen is statistically significant with a mean difference of -20.57300* and p value of <0.001. The difference between pulse start and halogen is statistically significant with a mean difference of -20.12700* and p value of <0.001.



Graph 2

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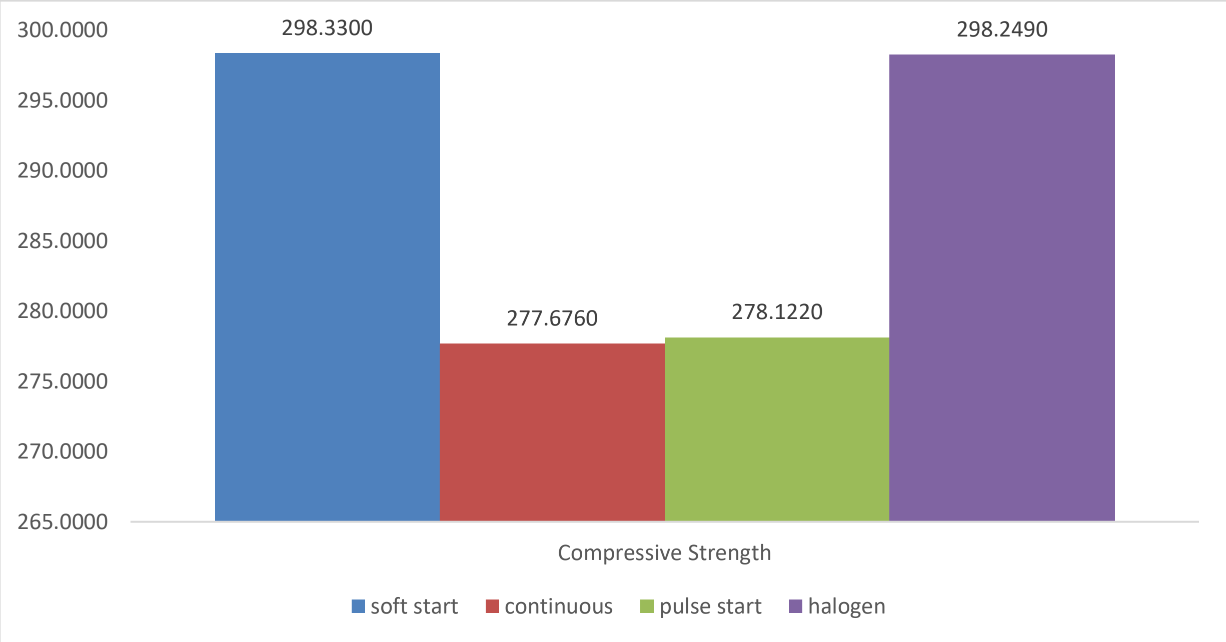

Graph 3

DISCUSSION

The main purpose of this study was to assess the compressive strength of composite resin. The forces which are generated during mastication are compressive in nature. Thus it is necessary for any restorative material to have a good compressive strength. Compressive strength gives an indication of how well a composite performs under a very high single load as encountered when unexpectedly biting on a hard object[11].

BRILLIANT EverGlow™(Coltene/Whaledent AG Altstatten, Switzerland) being nanohybrid composite resin has filler particle size of less than 1 micron and also contains prepolymerized fillers of glass and nanosilica. Further, the fillers' anchoring has been further optimised to prevent plucking. The formulation has been adjusted without compromising neither the good handling characteristics of the composite paste or the mechanical strength of the cured composite[12].

The composite specimens were made of 4mm depth to have a maximum depth of composite restoration that would be possible in a clinical scenario.

Sufficient polymerization was one of the most important factors that affected the physical properties and clinical performance of the resin-based composite. Insufficient composite polymerization leads to problems like: poor physical, mechanical and biological properties, greater stain uptake, a decrease in the retention of composite filling, the risk of hypersensitivity and pulpal inflammation; this entire problem can have an effect on the clinical behavior of dental composite[13].

The results showed that the highest value of compressive strength was obtained using soft start mode of LED light curing unit (BlueShot,Shofu, Kyoto, Japan) which was not statistically significant compared to that obtained by halogen light curing unit (DENTSPLY®Caulk QHL75™).In the soft start mode the curing begins at low intensity and finishes with high intensity. This allows for slow initial rate of polymerization and a high initial level of stress relaxation during early stages and it ends at the maximum intensity once the gel point has been reached. This drives the curing reaction to the highest possible conversion only after much of the stress has been relieved due to a longer pre gel phase, which in turn improves the physical properties of the composite giving it better compressive strength[14]. Halogen light curing unit showed good results. . This fact might be associated to a higher heat generation by this unit, which may speed up the polymer chain induction process in composite[10].

The results of group 3 and group 4 showed statistically significant results when compared to group 1 and 2. But the intergroup comparison of groups 3 and 4 were non significant. This might be due to decreased time available for stress relaxation leading to stress buildup. Also, the flashes of light in pulse start mode might have led to increased polymerized shrinkage due to peak and decline of exposure in intermediate flashes, not giving the composite enough time to reduce the polymerization stresses and thus reducing the mechanical properties of compressive strength.

CONCLUSION

According to the finding and within the limitations of this study, it can be concluded that composite specimens cured with soft start mode of blue phase light and those cured with halogen light showed better compressive strength values compared to other two groups. However, various other affecting factors do come in play and thus should be considered.

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