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RESEARCH ARTICLE

AN IN VITRO COMPARISON OF COMPRESSIVE STRENGTH AND MICROHARDNESS OF LIGHT ACTIVATED BULK-FILL COMPOSITE AND NEWER BULK FILL

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ABSTRACT

Objective: The aim of this study is to measure and compare the compressive strength and micro hardness of Bulk-fill composite-light cure (Ivoclar vivadent)) with Cention-N-dual cure (Ivoclar vivadent) **Material and methods:** In this in vitro study, two different types of bulk-fill composites are used: **Group 1:** Bulk-fill composite (Ivoclar vivadent)-light activated (blue phase). Group 2-Cention-N (Ivoclar vivadent)-light activated (blue phase). Group 3-Cention-N (Ivoclar vivadent)-self cured. Ten samples of 4 mm height and 6 mm diameter in each group were made using a mold. The composites filled in the mold were photo polymerized using light-emitting diode (LED) light-curing unit for 20 seconds from top for group1 and group2.Specimens in Group 3 were kept for 4 minute for self curing. The compressive strength of the samples were tested on top surface using universal testing machine (Instron 3366, UK) at a cross-head speed of 1.0 mm/minute. The micro hardness value of each sample will be evaluated using Vicker's micro hardness tester on top .Micro indentation was carried out using a 100 mN load with a 15 seconds dwell time. Then the data will be collected, tabulated and subjected to statistical analysis. **Result:** In this study we found that compressive strength of the Cention-N (270) (Light-cure) > Cention-N (215) (Self-cure) > Bulk-fill (129). Microhardness values of Cention-N (147) (Light-cure) > Bulk-fill (112) > Cention-N (82) (Self-cure). CONCLUSION: In this study Cention-N (Light-cure) had the highest compressive strength and microhardness. Cention-N (Self-cure) had more compressive strength than Bulk-Fill ,but had lowest microhardness. Bulk-Fill composite had the lowest compressive strength, they had micro hardness more than Cention-N (Self-cure). Cention-N also has anticariogenic activity, it prevents the secondary caries formation of the restored tooth. The future of restorative dentistry appears to be smarter and faster in the coming years with the advent of Cention-N.

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INTRODUCTION

The aim of a dental restorative material is to simulate the biological, functional, and esthetic properties of healthy tooth structure. Silver amalgam and gold alloys, which have a long record of clinical success, have been used as dental restorative materials for more than 100 years, especially as a posterior restorative materials because of their good mechanical properties. Because of high esthetic properties of composite resins, their use in restorative dentistry has greatly increased in past decades (Ilie *et al.,* 2013). None of the available dental composite resins are able to meet both esthetic required for anterior tooth and functional needs of posterior restorations. Thus, manufactures are trying to increase the filler content and decrease the size of particles to improve the physical properties (Ilie *et al.,* 2013). A newclass of resin-based composite, the so called "bulk-fill" composites have been introduced into the dental market with the purpose of time and thus costsavings (Kishore, 2016).

The unique advantage of this new material is it can be placed in a 4 mm thickness bulk to be cured in one step instead of the current incremental placement technique, without adverse effect on polymerization shrinkage, cavity adaptation, or degreeof conversion. Furthermore, the manufacturers stated that the polymerization shrinkage of those materials is even less than that of commonly used flowable and conventional resin-based composites (Kishore, 2016). Substantial surface micro hardness of the restoration is one of the main requirements especially in posterior stress-bearing areas[1].As wear is due to abrasion, surface hardness is an essential property. It is the mechanical property most frequently used to characterize the wear resistance of materials. A material that have a higher surface hardness, in general, considered to be more wear resistant (Kishore, 2016). It is said that compressive strength is the most important mechanical property of posterior restorative materials. A restorative material with lower compressive strength than the tooth tends to fail, fractures, and it ends with periodontal problems or extraction of the broken tooth (Ilie *et al.,* 2013).

The aim of this study is to evaluate and compare the compressive strength and micro hardness of bulk-fill(light-cured) with bulk-fill (dual-cured) composite resin.

MATERAILS AND METHODS

In this *in vitro* study, two different types of bulk-fill composites are used:

Group 1: Bulk-fill composite (Ivoclar vivadent)-light activated (blue phase).

Group 2: Cention-N (Ivoclar vivadent)-light activated(blue phase).

Group 3: Cention-N(Ivoclar vivadent)-self cured.

Composition of CENTION-N

MONOMER	FILLER
Urethane dimethacrylate	Barium aluminium silicate glass
Tricycodecan-dimethanol dimethacrylate	Ytterbium trifluoride
Tetramethyl-xylyendiurethane dimethacrylate	Isofiller
Polyethylene glycol 400 dimethacrylate	Calcium barium aluminium fluorosilicate glass
	Calcium fluorosilicate glass.

MONOMER	FILLER
Bisphenol-A-diglycidyl dimethacrylate	Barium aluminium silicate glass
Ethoxylated bisphenol-A-dimethacrylate	Isofiller
Urethane dimethacrylate	Ytterbium fluoride, spherical oxide

Comparison of Vickers Hardness number between 03 study groups using one-way ANOVA test

Groups	N	Mean	SD	Min	Max	F	P-Value
Group 1	10	147.50	4.25	142	156	807.981	<0.001*
Group 2	10	112.10	3.48	107	117		
Group 3	10	82.50	3.03	78	87		

Multiple comparison of mean differences for Vickers Hardness between 04 study groups using Tukey's HSD post hoc Analysis

(I) Group	(J) Group	Mean Diff	95% CI of the Diff		P-Value
			Lower	Upper	
Group 1	Group 2	35.40	31.39	39.41	<0.001*
	Group 3	65.00	60.99	69.01	<0.001*
Group 2	Group 3	29.60	25.59	33.61	<0.001*

Comparison of Compressive Strength [in Mpa] between 03 study groups using one-way ANOVA test

Groups	N	Mean	SD	Min	Max	F	P-Value
Group 1	10	270.00	10.38	252	286	807.981	<0.001*
Group 2	10	128.80	3.94	123	135		
Group 3	10	214.90	8.62	201	231		

Multiple comparison of mean differences for Compressive Strength between 04 study groups using Tukey's HSD post hoc Analysis

(I) Group	(J) Group	Mean Diff	95% CI of the Diff		P-Value
			Lower	Upper	
Group 1	Group 2	141.20	132.20	150.20	<0.001*
	Group 3	55.10	46.10	64.10	<0.001*
Group 2	Group 3	-86.10	-95.10	-77.10	<0.001*

* - Statistically Significant

Note: Group 1 - Cention N Light Cure - LC, Group 2 - Bulkfill, Group 3 - Cention Self cure

Ten samples of 4 mm height and 6 mm diameter in each group were made using a mold. The composites filled in the mold were photo polymerized using light-emitting diode (LED) light-curing unit for 20 seconds from top for group1 and group2.Specimens in Group 3 were kept for 4 minute for self curing. The compressive strength of the samples were tested on top surface using universal testing machine (Instron 3366, UK) at a cross-head speed of 1.0 mm/minute. The micro hardness value of each sample will be evaluated using Vicker's micro hardness tester on top .Micro indentation was carried out using a 100 mN load with a 15 seconds dwell time. Then the data will be collected, tabulated and subjected to statistical analysis.

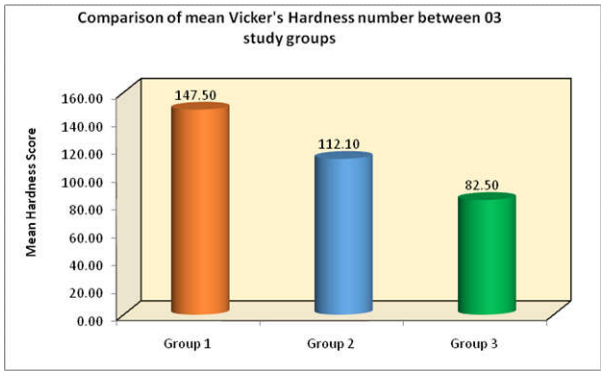
RESULTS

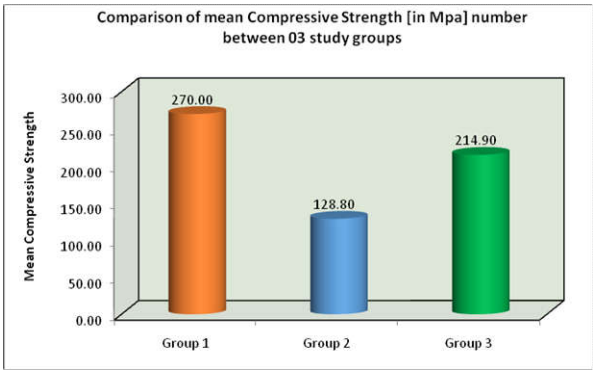
In this study we found that compressive strength of the Cention-N(270)(Light-cure)>Cention-N(215) (Self-cure) > Bulk-fill (129). Microhardness values of Cention-N(147) (Light-cure)>Bulk-fill (112)> Cention-N(82)(Self-cure).

DISCUSSION

Microhardness is defined as the blocking resistance that prevents the creation of permanent deformation and hardness is the most important feature contributes the success of clinical utilizations. A high microhardness value eventuates increasing the scratch and abrasion resistance (Abed *et al.,* 2015).

compressive strength is the most important mechanical property of posterior restorative materials. A restorative material with lower compressive strength than the tooth tends to fail, fractures, and it ends with periodontal problems or extraction of the broken tooth (Ilie *et al.,* 2013). The compressive strength has an important role in the mastication process since several of the masticatory forces are of a compressive nature (Didem, 2014). The bulk-fill technology has obvious advantages:1) fewer voids may be present in the





mass of the material, since all of it is placed at one time; 2) the technique would be faster than placing numerous increments if curing times were identical; 3) It may be easier than numerous increments (Didem, 2014). Bulk-fill composite materials, namely increased depth of cure, which probably results from higher translucency, and low polymerization shrinkage stress are related to modifications in the filler content and/or organic matrix with the help of advanced technology (Kishore, 2016).
TP is a parameter that can indicate the translucency of resin composites. The translucency of resin composites depends on their thickness as well as the scattering and absorption coefficients of the resin, filler particles, pigments and opacifiers. Tetric-n ceram bulk-fill besides having a regular camphorquinone/amine initiator system, it has introduced an 'initiator booster' (Ivocerin) that can polymerize the material in depth (Kamalak, 2016). In our study we found that CENTION-N has better mechanical properties than BULK-FILL composites. Due to the sole use of cross-linking methacrylate monomers in combination with a stable, efficient self-cure initiator, Self-curing systems are always made up of two components, which are kept separate to prevent any premature reaction.

The self-curing process is based on an initiator system consisting of a copper salt, a peroxide and a thiocarbamide. The liquid part of Cention N contains the hydroperoxide and the standard filler in the powder part of the product is coated with the other initiator components. The copper salt accelerates the curing reaction. Cention N exhibits a high polymer network density and degree of polymerization over the complete depth of the restoration. This gives Cention-N better mechanical properties than Bulk-fill composites. Monomer of Cention-N has a combination of UDMA, DCP, an aromatic aliphatic-UDMA and PEG-400 DMA, interconnects (cross-links) during polymerization resulting in strong mechanical properties and good long-term stability than Bulk-fill composite. Cention-N has calcium barium aluminium fluorosilicate glass in addition to Barium aluminium silicate glass, that improves the mechanical properties of Cention-N.

Filler loading in weight % more for Cention-N (78.4%wt) and Bulk-fill (61%wt) this gives better mechanical properties for Cention-N than Bulk-fill composites. Translucency of Cention-N is more than Bulk-fill, this increases the polymerization and gives better mechanical properties for Cention-N. Cention-N self-cure have low micro hardness as it is not light cured.

Conclusion

In this study Cention-N(Light-cure) had the highest compressive strength and microhardness .Cention-N(Self-cure) had more compressive strength than Bulk-Fill ,but had lowest microhardness.Bulk-Fill composite had the lowest compressive strength , they had microhardness more than Cention-N(Self-cure). Cention-N also has anticariogenic activity,it prevents the secondary caries formation of the restored tooth.The future of restorative dentistry appears to be smarter and faster in the coming years with the advent of Cention-N.

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