Research Article

Evaluation of compressive strength between Cention N and high copper amalgam - An *in vitro* study

S. Arun Kumar*, P. Ajitha

ABSTRACT

Aim: The aim of the study was to compare and evaluate the compressive strength of Cention N and high copper amalgam using a universal Instron testing machine. **Background:** For years, amalgam has been used successfully within their indications as filling materials; nonetheless, there is a considerable demand for an alternative filling material due to its color and mercury as one of its components. Cention N an alkasite group of material has been developed as an alternative to amalgam. Tooth color, inexpensive and high flexural strength and refer to a new category of filling material. **Conclusion:** There is no statistically significant difference between Cention-N and amalgam on the evaluation of compressive strength. The alkasite Cention N, thus, redefines the basic filling, combining bulk placement and durability in a dual-curing, esthetic product.

KEY WORDS: Cention N, Compressive strength, High copper amalgam

INTRODUCTION

Mechanical properties of restorative materials have important role inefficacy and longevity of the tooth and restoration. A badly broken down tooth in the anterior or posterior region of the oral cavity which has happened due to caries or root canal therapy needs to be restored with a suitable restorative material which can resist complicated forces of mastication.[1,2] Since the majority of mastication forces in the posterior region are particularly compressive, there stored endodontically treated tooth or the complex and extensive restoration should bear these kinds of forces.[2,4] It is said that compressive strength is the most important mechanical property of posterior restorative materials. A restorative material with lower compressive strength than tooth, tends to fail, fracture and it ends with periodontal problems or extraction of the broken tooth.[3,4] Compressive strength is a useful property to compare materials which are brittle and generally weak in tension such as amalgams, cement, or composite resins. Dental amalgam was introduced before 150 years, inspite of its longitivity, is always been a problem with esthetics and the clinical success of an amalgam restoration depends on various factors including: appropriate cavity preparation involving undercuts due to the non-retentive nature of amalgam, condensation technique, anatomical characteristics, and final finish. Amalgam can also expand or contract, depending on how it has been manipulated. Severe contraction can lead to microleakage, plaque accumulation, and secondary caries and excessive expansion can cause protrusion, put pressure on the pulp and cause post-operative sensitivity.

In recent years, dentists have long sought after a real alternative to amalgam or glass ionomer cement (GIC), a cost-effective, fluoride releasing product that is quick and easy to use without complicated equipment and that offers both strength and good esthetics. Cention N is a new basic filling material offering these characteristics plus other advantages over both amalgams and GIC. It is a resin-based, self-curing powder/liquid restorative, an alkasite group of material; it has been developed as an alternative to amalgam it is tooth colored, inexpensive and has high flexural strength. Alkasite refers to a new category of filling material, which like compomer materials are essentially a subgroup of the composite material class. This new category utilizes an alkaline filler, capable of releasing acid-neutralizing ions.[5-7]

Access this article online

Website: jprsolutions.info | ISSN: 0975-7619

Department of Conservative dentistry and Endodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

***Corresponding author:** Dr. P. Ajitha, Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, No 162, Poonamallee High Road, Chennai – 60007, Tamil Nadu, India. Phone: +91-9444174551. E-mail: ajitharijesh@gmail.com

Received on: 18-08-2018; Revised on:21-09-2018; Accepted on: 28-10-2018

Cention N is a tooth-colored, basic filling material for direct restorations it is self-curing with optional additional light-curing. Cention N is radiopaque, releases fluoride, calcium, and hydroxide ions. As a dual-cured material, it can be used as a full volume (bulk) replacement material.

The aim of this study was to compare the compressive strength of high copper amalgam and Cention-N using a universal Instron testing machine.

MATERIALS AND METHODS

Cylindrical sample of dimension 6 (±1) mm × 4 (±1) mm was fabricated using straw and glass slab, a total of 20 samples, amalgam (n = 20) and Cention N (n = 20) were tested for compressive strength using a universal Instron testing machine of a crosshead speed of 0.75 ± 0.25 mm minus one till the samples fractured.

Groups	Restorative material
Group-1	High copper amalgam
Group-2	Cention N

Testing Method

All prepared specimens were tested for fracture toughness within 24 h, using a universal loading device (5848 microtester, Instron, Norwood, Ma, USA), each test was performed at a crosshead speed of 2 mm/min and load was applied using a 4.8 mm diameter Stainless Steel Ball Sphere Stylus which was positioned at the center of the samples.

Measurement of Compressive Strength

Ultimate compressive strength (UCS) was calculated from the formula $UCS=4f/\pi d^2$, where F is maximum applied load (N) and D the cylindrical specimen diameter (mm).[3,4,12]

Statistical Analysis

Mean and Standard Deviations were estimated from the sample for each study group. The mean values were compared by *t*-test.

RESULTS

Independent samples *t*-test to compare mean fracture values between groups.

Variable	Groups	*n*	Mean±SD	*t*-value
Compressive strength	1	10	1052±190.5	1.1
	2	10	1131±166.5	

Mean and standard deviation were estimated and show no significant difference between Cention N and high copper

DISCUSSION

Amalgam materials were first introduced to western dentistry in the 19th century around 1970s amalgam is an alloy that contains mercury as one of its constituents and combination of metals, containing silver, tin, and copper in varying amounts. Amalgam fillings are usually indicated for Class I and Class II restorations and tend to be preferred large posterior load-bearing fillings in permanent posterior dentition where esthetic appearance is less important. The clinical success of an amalgam restoration depends on various factors including: Appropriate cavity preparation involving undercuts due to the non-retentive nature of amalgam, condensation technique, anatomical characteristics, and final finish. Amalgam can also expand or contract, depending on how it has been manipulated; severe contraction can lead to microleakage, plaque accumulation, and secondary caries; and excessive expansion can cause protrusion, put pressure on the pulp, and cause postoperative sensitivity.[9-11] Amalgams offer unparalleled longevity and strength but are coupled with poor esthetics and controversial ingredients. Dentists have long sought after a real alternative to amalgam a cost-effective, fluoride releasing product that is quick and easy to use without complicated equipment and that offers both strength and good esthetics. The search for a new material that has the fluoride-releasing capability of GIC and durability of composites led to the introduction of polyacid-modified composite or compomer.[13] This introduces Cention N, a new basic filling material offering these characteristics plus other advantages over amalgams. Cention N is a basic, resin-based, and self-curing powder/liquid restorative. In its mixed state (powder + liquid), Cention N contains 78.4% wt inorganic filler, the alkaline glass accounts for 24.6% in weight of the final material, and this releases substantial levels of fluoride (f-) ions - comparable to those released by traditional glass ionomers. The alkaline glass also releases hydroxide and calcium (OH^- and Ca^{2+}) ions which can further help prevent demineralization of the tooth substrate. The release of ions depends on the pH-value in the oral cavity.[14-22] Cention N offers greater mechanical strength than glass ionomers, good handling, and better esthetics than both amalgam and glass ionomers.

Among mechanical properties compressive strength of restorative materials is important to resist intraoral compressive and tensile forces that are produced in function and parafunction. Material should have the same mechanical properties as tooth structure. A material with the higher or lower amount of a property will adversely affect on longevity of the tooth structure, and the restoration and premature failure of each will happen. Compressive strength is the ability of a material to resist compression in the dental field; this method is often applied to test the strength of cement which set through an acid-base reaction. As Cention-N is a full volume replacement material that includes a self-curing initiator system, compressive

strength tests were also carried out with the material the advent of new restorative material, together with new adhesive has brought enormous benefits notably in terms of esthetics and strides toward minimally invasive dentistry. A study by Kovarik *et al*. compared amalgam, GIC and composite materials and they found that amalgam had the lowest failure rate and that more than 1 million cycles were required to produce the median fatigue life of the amalgam. Hence, due to its superior mechanical properties and longer function, amalgam is used for direct posterior restoration.[8]

Due to the fact that Cention N is self-curing, the curing depth is theoretically unlimited. Cention N is a full volume replacement material, designed to be applied quickly and conveniently in bulk; it is important that the material exhibit low polymerization shrinkage and low shrinkage force. Problems associated with polymerization shrinkage can include marginal discoloration, marginal gaps, cracking, and hypersensitivity. Cention N includes a special patented filler (partially functionalized by silanes) which keeps shrinkage stress to a minimum. This isofiller, which is also used in Tetric N-Ceram Bulk Fill, acts as a shrinkage stress reliever which minimizes shrinkage force, whereas the organic/inorganic ratio, as well as the monomer composition of the material, is responsible for the low volumetric shrinkage. When the material polymerizes, either in self-cure modus or through additional light-curing, the monomer chains located on the fillers together with the silanes begin a cross-linking process and forces between the individual fillers come into play which (if the restorative has been placed adhesively) place stress on the cavity walls. This stress is influenced by both volumetric shrinkage and the modulus of elasticity of the material. The silanes bonded to the filler particles improve the bond between the inorganic filler (glass and quartz particles) and the monomer matrix as they are able to establish a chemical bond between the glass surface and the matrix. Ultimately, the volumetric shrinkage and shrinkage stress in Cention N are reduced during polymerization - allowing bulk increments to be placed and an increase in compressive strength.

CONCLUSION

Within the limitations of this *in vitro* study, it can be concluded that the compressive strength of Cention N is significantly equal that of high copper amalgam and it can be used in stress-bearing posterior region; long-term clinical studies need to be carried out to substantiate the results of this study.

REFERENCES

1. Combe EC, Shaglouf AM, Watts DC, Wilson NH. Mechanical properties of direct core build-up materials. Dent Mater 1999;15:158-65.
2. Cho GC, Kaneko LM, Donovan TE, White SN. Diametral and compressive strength of dental core materials. J Prosthet Dent 1999;82:272-6.
3. Yüzügüllü B, Çiftçi Y, Saygılı G, Canay Ş. Diametral tensile and compressive strengths of several types of core materials. J Prosthodont 2008;17:102-7.
4. Levartovsky S, Kuyinu E, Georgescu M, Goldstein GR. A comparison of the diametral tensile strength, the flexural strength, and the compressive strength of two new core materials to a silver alloy-reinforced glass-ionomer material. J Prosthet Dent 1994;72:481-5.
5. Bonilla ED, Mardirossian G, Caputo AA. Fracture toughness of various core build-up materials. J Prosthodont 2000;9:14-8.
6. Saygili G, Mahmali SM. Comparative study of the physical properties of core materials. Int J Periodontics Restorative Dent 2002;22:355-63.
7. Coelho Santos G Jr., El-Mowafy O, Rubo JH. Diametral tensile strength of a resin composite core with nonmetallic prefabricated posts: An *in vitro* study. J Prosthet Dent 2004;91:335-41.
8. Kovarik RE, Breeding LC, Caughman WF. Fatigue life of three core materials under simulated chewing conditions. J Prosthet Dent 1992;68:584-90.
9. Lo CS, Millstein PL, Nathanson D. *In vitro* shear strength of bonded amalgam cores with and without pins. J Prosthet Dent 1995;74:385-91.
10. Oliva RA, Lowe JA. Dimensional stability of silver amalgam and composite used as core materials. J Prosthet Dent 1987;57:554-9.
11. Piwowarczyk A, Ottl P, Lauer HC, Büchler A. Laboratory strength of glass ionomer cement, compomers, and resin composites. J Prosthodont 2002;11:86-91.
12. Manhart J, Kunzelmann KH, Chen HY, Hickel R. Mechanical properties and wear behavior of light-cured packable composite resins. Dent Mater 2000;16:33-40.
13. Leinfelder KF, Bayne SC, Swift EJ Jr. Packable composites: Overview and technical considerations. J Esthet Dent 1999;11:234-49.
14. Mitra SB, Wu D, Holmes BN. An application of nanotechnology in advanced dental materials. J Am Dent Assoc 2003;134:1382-90.
15. ADA. Core materials: Laboratory testing methods. ADA Prod Rev 2008;3:1-12.
16. Lakshmi S, Krishna VG, Arunkumar S. Prosthodontic considerations of endodontically managed teeth. J Conserv Dent 2006;9:104-9.
17. Upadhyay NP, Kishore G. Glass ionomer cements-the different generations. Trends Biomater Artif Organs 2005;18:158-65.
18. Fukui Y, Komada W, Yoshida K, Otake S, Okada D, Miura H. Effect of reinforcement with resin composite on fracture strength of structurally compromised roots. Dent Mater 2009;28:602-9.
19. Shenoy A. End of road for amalgam. J Conserv Dent 2008;11:99-107.
20. Kerby RE, Knobloch L, Thakur A. Strength properties of visible-light-cured resin-modified glass-ionomer cements. Oper Dent 1997;22:79-83.
21. Asmussen E, Peutzfeldt A. Influence of UEDMA bisGMA and TEGDMA on selected mechanical properties of experimental resin composites. Dent Mater 1998;14:51-6.
22. Annusavice KJ. Phillips' Sciences of Dental Materials. 11th ed. St. Louis: Elsevier; 2004.

Source of support: Nil; Conflict of interest: None Declared