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Comparative Evaluation of Compressive Strengths of Glass Ionomer Cement, Composite and Cention-N Restorative Materials: An In-Vitro Study

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Abstract

Background: *Glass ionomers have good biocompatibility and the ability to adhere to both enamel and dentin. However, they have certain demerits, mainly low tensile and compressive strengths. Centon-N, a recently launched, tooth-colored, basic filling material, is an on-going effort to find the best restorative material. It is basically a subgroup of composite resin and is a "alkasite" UDMA-based restorative material like compomer or ormocer.*

Aim: *The objective of the current study was to assess and compare the compressive strengths of Composite, Cention-N and Glass Ionomer cement as a restorative material.*

Material and Method: *Customized cylindrical moulds with dimensions of 6 mm in height by 4 mm in diameter were used to create ten samples of each of the following materials: Cention N (Ivoclar Vivadent), Fuji II GIC (GC, Tokyo, Japan), and Composite Resin (Filtek Z-250). Samples were put through a compressive strength test on a Universal Testing Machine (UTM). The force applied to the samples was constantly recorded by a load measurement cell at a crosshead speed of 0.5 mm per minute until the samples fractured. The outcomes were tallied and statistically examined.*

Result: *The composite had the highest mean compressive strength, followed by Cention-N, and GIC had the lowest mean compressive strength, which is statistically significant (p 0.05).*

Conclusion: *Given the limitations of this investigation, it can be said that Composite, Cention-N can be utilized for restoration in place of GIC Type II because it has a much higher compressive strength. However, long term clinical studies are required to draw any substantial conclusion.*

Keywords: *Glass Ionomer Cement, Cention-N, Composite, Compressive Strength.*

Introduction

One of the most frequent causes of tooth structure loss is dental caries, which affects the shape and function of the tooth. Various restorative materials can be used to repair teeth affected by dental caries. A restorative substance restores the biological, functional, and aesthetic qualities of the tooth structure. Dental manufactures provide a variety of direct filling materials, including amalgam, glass ionomer cement (GIC), and aesthetic composite.**[**1,2**]**

Wilson and Kent first described the usage of glass ionomer cements (GICs), which were created in 1969. They are made of polyalkenoic acid and aluminosilicate glass. Glass ionomer cements are special because they are biocompatible, elastic like dentin, have an anticariogenic effect from the release of fluoride, and can be directly bonded to the tooth structure.**[**3,4**]** On the other hand, clinical constraints such low wear resistance, low fracture toughness, low mechanical characteristics, extended setting rate, and high early moisture sensitivity have also been reported for GICs. Because of these restrictions, conventional GICs cannot be used in places that experience a lot of stress, such the posterior teeth.**[**5**]**

Due to their great aesthetic qualities and conservative preparation, composites are tooth-colored restorative materials that are frequently employed for anterior and posterior restoration. But the composite restoration takes a long time.**[**6**]**

Centon N (Ivoclar), a recently launched, tooth-colored, basic filling material, is an on-going effort to find the best restorative material. It is basically a subgroup of the composite resin and is a "alkasite" UDMA-based restorative material like compomer or ormocer. It has optional added light-curing property and self-curing powder/liquid, thus it can be used for bulk placement in retentive preparations with or without the use of an adhesive.**[**7,8**]** Hence the present study was conducted with the objective to assess and compare the compressive strengths of Composite, Cention-N and Glass Ionomer cement as a restorative material

Material and Method

This in vitro study was conducted after obtaining approval from institutional ethical committee. The study was done to evaluate the compressive strength of restorative materials. Three Restorative material i.e. Cention N (Ivoclar Vivadent), Fuji II GIC (GC, Tokyo, Japan), and Composite Resin (Filtek Z-250) were used in present study.

A total of 30 cylindrical test specimens of 6 mm in height by 4 mm in diameter were prepared from a custom-made Teflon mold using Glass ionomer Cement, Composite and Cention N. A thin layer of petroleum jelly was coated on the lateral walls of the mold to prevent material adhesion. The powder and liquid of the conventional GIC were mixed according to the manufacturer's instructions and placed in the molds. The composite resins are placed in cylindrical recesses. The composites are covered with a mylar strip. A glass slide is then placed over composites and pressure is applied to accommodate the material into the mold and to extrude excess material. After removing the glass slide, the composites were then cured from the top and bottom surfaces through the mylar strip as per the manufactures instructions using the light curing unit. The specimens are taken out of the mould and light cured in the middle of the specimen at opposing sides. Similarly Cention N was manipulated as per manufacture instruction filled in mold. Then sample was covered with mylar strip, followed by covering with glass slab. The samples were then de-molded, and finishing was done using finishing burs. (Fig 1)

All restored teeth were stored in distilled water at 37°C for 24 hours. Later, they were subjected to thermocycles at 5°C and 55°C lasted for 30 seconds to simulate the variation in oral thermal condition. Then, samples were tested for evaluation of compressive strength using Universal Testing Machine. This was connected to a load measuring cell, which continuously recorded the load applied to the samples at a crosshead speed of 0.5 mm per 1 minute till the samples fractured. The data collected were tabulated accordingly and were subjected to statistical analysis using Statistical Package for the Social Sciences -version-22-(IBM SPSS Statistics.)

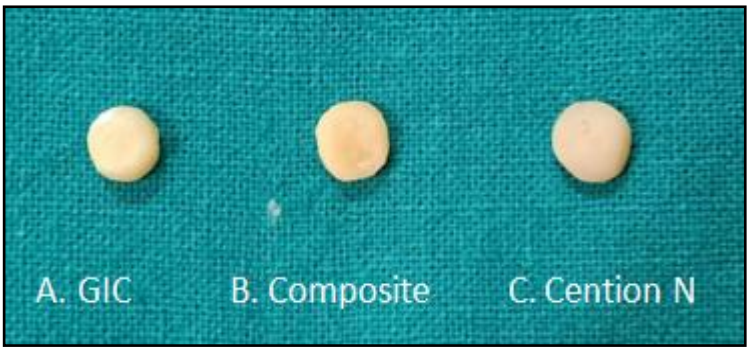

Fig 1: Test Samples

Result

Glass ionomer cement showed the lowest compressive strength 149.02 ± 3.67 Mpa and the composite resin showed the highest mean compressive strength 240.38 ± 2.75 MPa while the mean compressive strength of Cention-N was 201.01 ± 1.57 MPa.

Table no 1: Mean Compressive Strength

Group	Mean ± SD	P Value	Significant groups at 5% level
GIC (*n*=10)	149.02 ± 3.67 MPa	< 0.05	III Vs I
Composite (*n*=10)	240.38 ± 2.75 MPa		III Vs II
Cention-N (*n*=10)	201.01 ± 1.57 MPa		II Vs I

Discussion

The maintenance of the craniofacial complex, teeth, and gums, as well as the tissues of the face and head that surround the mouth, is a crucial component of overall health. The ability of the human tooth to regenerate is minimal. As a result of the organic acids created by the bacterial fermentation of carbohydrates, dental caries is a chronic disease of the teeth that demineralizes the enamel and dentin. It is a complex disease, with host variables like food, plaque, and tooth surface, saliva, and pellicle playing a major role.[9,10]

The choice of material for tooth restoration depends on the material's strength and the region of application so that it can withstand intraoral forces during functional and parafunctional movements of the jaw. Under occlusal load, materials with low compressive strength relative to the tooth will fracture the restoration, whereas materials with extremely high compressive strengths will cause tooth structure to fail. Therefore, for a harmonious interaction with the surrounding tissues, its compressive strength should be equal to that of the tooth.[11]

Modern dental professionals have access to a variety of direct filling materials, including bulk fill composites and silver amalgam. The key issues with these materials' performance right now relate to their resilience to stress, durability, integrity of marginal sealing, and aesthetics.[12] Since its introduction by Wilson and Kent, glass ionomer cement (GIC) has been popular in dentistry due to its biocompatibility, anticariogenic properties due to fluoride release, and usage in non-traumatic restorative techniques.[13,14] Furthermore, it chemically adheres to the enamel and dentin, obviating the necessity for a retentive cavity preparation and making the material effective for both minimally invasive and maximum tooth structure preservation.[15]

Composites with aesthetic bonds have performed better when used as restorative materials. Resin composites have one drawback, though: polymerization shrinkage causes marginal differences that can lead to microleakage, which frequently causes postoperative sensitivity, marginal discoloration, and secondary caries. In addition, a good isolation is necessary for composite restoration; failure to do so could result in the restoration's failure. [16-18]

A brand-new basic filling material called Cention N (Ivoclar) is tooth-colored.[16] It is essentially a subgroup of the composite resin and is a restorative substance with a "alkasite" UDMA foundation, like compomer or ormocer. It features self-curing powder or liquid and an optional additional light-curing property, making it suitable for bulk placement in retentive preparations with or without the use of an adhesive.[8]

Dental restorative materials' ultimate objective is to replicate the biological, practical, and aesthetically pleasing qualities of healthy tooth structure.[19] Several dental restorative materials have been used for restoration procedures like GIC, amalgam, composite since many years.[20] During the last decade, due to high esthetic demands from patients, resin composites have gained popularity. But just like superior aesthetics, strength is a crucial factor that must be taken into consideration when choosing a restorative material for a given clinical situation. Stronger materials resist deformation and fracture in a better way, provide more equitable stress distribution, greater stability, and greater probability of clinical success.[21] Among mechanical properties, compressive strength, flexural strength and diametral tensile strength are useful and have been used widely to evaluate the clinical performance of various dental restorative materials.[22] Compressive strength of restorative material is important because restorative material replace part of tooth structure and they should provide sufficient strength to resist intraoral com pressive and tensile forces that are produced in function and parafunction.

The present study was conducted to compare and evaluate the compressive strength of cention N with other basic restorative materials namely GIC, resin composite. In this study, compressive strength in composite was significantly higher than Cention N and glass ionomer cement. Compressive strength in cention N was significantly higher than GIC but lesser than composite. It may not have a comparable micromechanical link to the tooth structure, which is the likely explanation. The manufacturer advises preparing the teeth like it would be for conventional amalgam, with retentive characteristics, if cention N is restored without the use of an adhesive. Contrary to composite, Cention N is offered as two-part powder/liquid systems, therefore changes in the powder: liquid ratio could have an impact on the outcome.[23]

Results of our study were also consistent with the results of study done by Iftikhar N et al.[24] and Agrawal et al.[25] resin composites and Cention N exhibited compressive strengths more than that of other glass Ionomer cement.

Cention N had higher strength values may be due to the thick polymer network and the degree of polymerization. The fillers are found in the powder of a material consisting of glass filler barium aluminum silicate, ytterbium trifluoride, isofiller (technology Tetric N-Ceram), glass filler calcium barium aluminum fluorosilicate, and glass filler calcium fluorosilicate and alkaline. These fillers are responsible for providing sufficient strength. [26-28]

Clinical Significance:

In the current investigation, specimens repaired with test materials were used to test in vitro. Before doing clinical studies on patients, it is crucial to carry out preliminary and safety investigations in vitro since they would provide conclusive proof for the clinical application of the restorative materials. It is important to use caution when extrapolating in vitro results to clinical situations and keep in mind the limitations of in vitro research.

Conclusion

Within the limitation of our study we can concluded that, composite had the highest compressive strength then other tested restorative materials. Cention N, however, is a basic restorative material that can be used in a variety of restorative dental procedures and has the esthetic potential to match teeth. It also has good equivalent mechanical qualities, and unlike composite, it is more affordable for patients.

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