ORIGINAL RESEARCH

In Vitro Comparative Evaluation of Change in Mass, pH and Fluoride Release of Cention-N and Glass–Ionomer Cement

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Abstract

Objective: Type IX GIC is a preferred permanent restorative material in primary teeth for its tooth-colored restorative material, chemical bonding to tooth structure, better physical properties and fluoride release. This comparative study was done to evaluate physical properties of Cention-N with type IX GIC as manufacturer's claims better properties over GIC.

Materials and methods: About 100 samples of 10 mm diameter and 3 mm thickness were made from Type IX GIC and CN using Teflon molds and stored in artificial saliva at pH (5.5) and stored individually in sterile plastic container at a constant temperature during the entire experiment. They were divided into two equal groups (group A and B). Samples from group A were used to determine the change in mass and pH and group B were used to determine fluoride release at different time intervals of 1 week and 1 month and was evaluated using electronic weighing machine, digital pH meter, and spectrophotometer.

Results: Statistically significant pH and fluoride release were observed in CN both at the end of 1 week and 1 month, and a significant change in mass was observed in Type IX GIC at the end of 1 month.

Conclusion: Cention-N can be a better alternative as it demonstrated an increase in pH and fluoride release than Type IX GIC.

Keywords: Cention-N, Glass ionomer cement, Ions, pH, Saliva.

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Introduction

Primary tooth restoration materials differ in terms of their biocompatibility, longevity, and safety. Recent developments have brought resinous and polyalkenoate-based materials as alternatives to amalgam restorations.[1,2] It is essential to keep primary teeth through younger ages in order to preserve natural functions and space.[1] The mechanical qualities of the repair are affected by texture, dehydration, early moisture sensitivity, extended setting reaction times, and clinical failure are only a few of the disadvantages associated with conventional GICs. Many GIC modifications, including high-viscosity glass ionomers, resin-modified glass ionomer cements (RMGICs), and polyacid-modified composite resins (PMCRs) have been created to get around these problems.[3]

A tooth-colored composite material called Cention-N (CN) uses alkaline fillers that release ions that neutralize acids. It is radiopaque, self-curing, and comes in tooth shade A2. Extra light curing is optional. Blue light with a wavelength of roughly 400–500 nm is used for optional light curing. 78.4% of Cention-N's weight is made up of inorganic filler, while 24.6% is alkaline glass counts. This results in significant fluoride ion release levels that are similar to those of conventional glass ionomer cements. Furthermore, the alkaline glass releases calcium and hydroxide ions, which stop demineralization even further. When comparing Cention-N to ordinary GIC, the long-term release of calcium and fluoride ions in an acidic environment is greater.[4] Therefore, in type IX GIC and CN, a comparative assessment of the change in mass, pH, and fluoride release was taken into consideration in this investigation.

Materials and Methods

Using Type IX Glass Ionomer cement (control group A) and CN (experimental group B), circular mold samples with 10 mm diameter and 3 mm thickness were created. The cement is blended in accordance with the manufacturer's recommendations. A total of 200 molds were made, each including 100 type IX GIC and 100 CN molds. To prevent early moisture contamination or desiccation, the mixed restorative materials were inserted under consistent pressure into Teflon molds, with mylar strips on both sides of the mold. Following setting, the pellets were taken out of the mold, and any extra material was cut off with a Schwann-Morton blade. Varnish was then applied, and the pellets were split into two equal groups.

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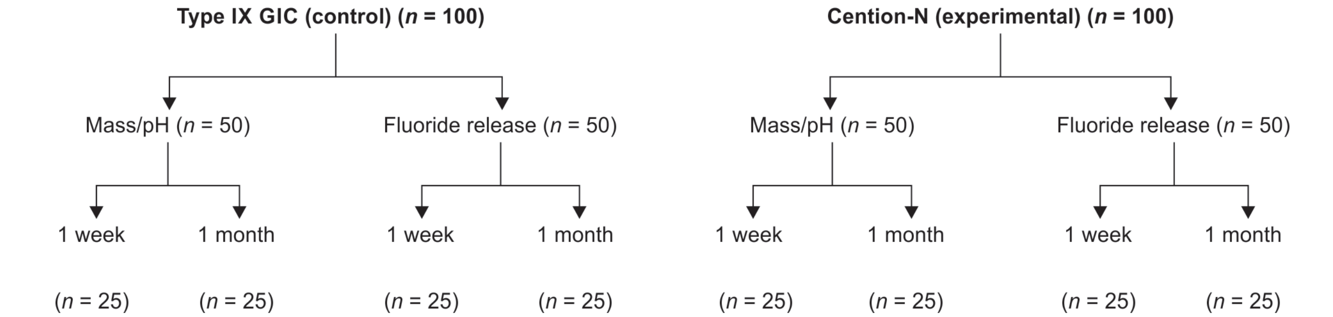
Flowchart 1: Flowchart of samples used



1. GIC Molds ($n = 100$) – Group A (Control)

The samples were randomly divided into two equal parts and were coded to prevent contamination of samples:

Group A–M ($n = 50$) for the determination of change in mass and pH.

Group A–F ($n = 50$) for the determination of fluoride release.

2. Cention-N ($n = 100$) – Group B (Experimental)

The samples were randomly divided into two equal parts and were coded to prevent contamination of samples:

Group B–M ($n = 50$) for the determination of mass and pH.

Group B–F ($n = 50$) for the determination of fluoride release.

Determination of Change in Mass

Using an electronic weighing machine, each of the 50 Type IX GIC and CN molds was weighed before being submerged in artificial saliva that had been adjusted to a critical pH of 5.5. The molds were then kept in sterile plastic containers with labels that were airtight and kept at a constant temperature for the duration of the experiment.

After a week, 25 specimens from Type IX GIC and CN molds were taken out, individually blot dried, and weighed again with an electronic scale. After a month, the final 25 Type IX GIC and CN molds were taken out and weighed again.

The numbers from the original measurement were deducted from the values obtained after 1 week and 1 month in order to calculate the change in mass, which was then tabulated.

Determination of Change in pH

To measure the pH change, the artificial saliva used for storage of the specimens of type IX GIC or CN was used in the mass assessment. Pre-pH salivary values were recorded with digital pH meter. After the artificial saliva was soaked with the type IX GIC/CN mold, the mold was removed after 1 week and 1 month respectively. The change in pre-pH and post-pH values were then subtracted and calculated.

Determination of Fluoride Release

Molds of Type IX GIC ($n = 50$) and CN ($n = 50$) selected for the assessment of fluoride release were stored in artificial saliva for the intervals of 1 week and 1 month.

At the end of 1 week and 1 month artificial saliva used to store the molds were used to assess the fluoride release using spectrophotometer, a standard method of determination of fluoride ion release. The fluoride release displayed on its digital monitor in ppm were recorded and tabulated (Flowchart 1).

Table 1: Descriptive statistics showing the change in mass in Type IX GIC and Cention-N at different time intervals

Mass changes	*Mean*	*Standard deviation*	*t*	*Significance*
GIC				
After 1 week	0.0196	0.00841	–4.930	0.000 (H.S)
After 1 month	0.0376	0.01615		
Cention				
After 1 week	0.0192	0.00862	–4.571	0.000 (H.S)
After 1 month	0.0320	0.00913		

Table 2: Descriptive statistics of change in mass between Type IX GIC and Cention-N at different time intervals

Mass changes	*Mean*	*Standard deviation*	*t*	*Significance*
After 1 week				
GIC	0.0196	0.00841	0.166	0.869 (N.S)
Cention	0.0192	0.00862		
After 1 month				
GIC	0.0376	0.01615	1.510	0.005 (H.S)
Cention	0.0320	0.00913		

Results

The change in mass and pH in Type IX GIC and CN were observed as either increase or decrease from its initial recorded values and the increased values were expressed as (+) and decrease as (–). The recorded values were tabulated and subjected to statistical analysis using paired *t*-test.

Change in Mass

Highly significant increase in mass was observed in both Type IX GIC and CN at the end of 1 week and 1 month (Table 1). Increased gain in mass in type IX GIC was observed. On comparison of change in mass between type IX GIC and CN at the end of 1 week was not significant whereas at the end of 1 month was highly significant (Table 2).

Change in pH

Cention-N has shown an increase in pH toward alkalinity both at the end of 1 week and by the end of 1 month, whereas in Type IX GIC, the marginal increase in pH at the end of 1 week and 1 month was observed. On comparison of change in pH between CN and Type IX GIC at the end of 1 week and 1 month it was found to be statistically highly significant (Table 3).

Table 3: Descriptive statistics showing the change in pH between Type IX GIC and Cention-N at different time intervals

pH change	*Mean*	*Standard deviation*	*t*	*Significance*
After 1 week				
Cention	0.4548	0.09824	18.500	0.000 (H.S)
GIC	0.0812	0.02333		
After 1 month				
Cention	0.7172	0.25924	12.045	0.000 (H.S)
GIC	0.0896	0.02574		

Table 4: Descriptive statistics showing the fluoride release in Type IX GIC and Cention-N at different time intervals

Fluoride release in ppm	*Mean*	*Standard deviation*	*t*	*Significance*
After 1 week				
GIC	30.3688	1.77748	–6.466	0.000 (H.S)
Cention	33.5108	1.65652		
After 1 month				
GIC	28.9548	2.02543	–6.489	0.000 (H.S)
Cention	32.1104	1.34553		

Fluoride Release

The fluoride release was observed both in CN and Type IX GIC at the end of 1 week followed by slight decrease by the end of 1 month. Cention-N has shown an increase in fluoride release both at the end of 1 week and 1 month. On comparison with Type IX GIC and was found to be statistically highly significant (Table 4).

Discussion

Artificial saliva, adjusted to a critical pH of 5.5, was used as the storage medium. If the solution is higher than the critical pH, then it is supersaturated, and more mineral tends to precipitate out, whereas if the solution is lower than the critical pH it is unsaturated and the mineral will continue to precipitate out until the solution reaches saturation, which can lead to tooth demineralization. Type IX GIC showed increased mass in comparison to CN after storage in artificial saliva for 1 week and 1 month. This could be a sign of continuing "maturation" phase of GIC which occurs over time after initial setting due to slow reaction of aluminum ions.[5]

Type IX GIC showed an increase in mass in comparison to CN after storage in the artificial saliva for 1 week and 1 month. This could be a sign that the GIC is continuing to "mature" after initial setting.[6] The slow reaction of aluminum ions is responsible for this. Researchers have found that an increase in GIC mass when aqueously dissolved in solutions of water or lactic acid is associated with water sorption.[7,8] This would help to prevent the restorable material from shrinking and crazing, which would also increase its mass. The change of mass observed in this study was consistent with the findings found in the literature review. The paucity of review of variation of mass of CN could not be attributed to any cause. It is unclear what role water plays in setting of CN. In the present study, CN has shown a change in pH toward alkalinity.

The initial exposure of lactic acids and metal lactates in artificial saliva creates a buffer solution and leads to increase in pH, and results in net gain in mass by the cement as it takes up the water for maturation. A study evaluated the interactions of glass–ionomer cements used in atraumatic restorative treatment (ART-GICs) with an aqueous lactic acid solution. Atraumatic restorative treatment materials increase the pH of the lactic acid solution.[9–14]

The release of F- from dental materials is governed by intrinsic factors, such as composition, powder/liquid ratio, mixing time, temperature, specimen geometry, permeability, surface treatment and finishing, and extrinsic factors, such as storage medium, experimental design, and analytical methods.[15]

The release of fluoride ions is the notable characteristics of GICs. The presence of fluoride increases translucency, strength and improves handling properties. However, it is maximum in the first few days and decreases rapidly to a lower level over weeks, and maintains a low level over months. Glass–ionomer cement can be "recharged" with fluoride, resulting in a subsequent short-term boost in release. In the present study, CN has shown a significant increase in fluoride release when compared with GIC at the end of 1 week and 1 month.[16]

In a research study aimed at assessing and contrasting the fluoride ion release of Cention-N (self-cure and light-cure) and conventional GIC at various pH levels and time intervals, it was observed that the Cention-N (self-cure) demonstrated the highest potential for fluoride ion release in an acidic environment, while GIC exhibited this potential in a neutral environment. Fluoride ion release was higher in acidic pH compared with neutral pH for both Cention-N and GIC. Over time, the fluoride ion release decreased in both acidic and neutral pH for all groups, except for GIC in an acidic environment, where it remained constant. Additionally, the release gradually increased over time and contributed to the effects on the demineralization/remineralization interface.[6]

Conclusion

Cention-N has shown variation in pH toward alkalinity and increased fluoride release compared with Type IX GIC favors remineralization. The increase in mass was observed in Type IX GIC when compared with CN. Marginal increase in mass would result in water sorption and prevent restorative material from shrinkage and crazing. Cention-N can be a better restorative properties than Type IX GIC in primary dentition.

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