IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 6 Ser.9 (June. 2023), PP 52-58
www.iosrjournals.org

Effects Of Various Bleaching Agents On Microhardness Of Cention-N And Zirconomer

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Abstract:
Background: Several methods were described in the literature to enhance the aesthetic aspect of teeth. Among them, the bleaching procedure is the more conservative one for changing the colour of teeth. Most tooth-bleaching procedures utilize hydrogen peroxide or carbamide peroxide as a bleaching agent. As dental whitening has become more accessible, many patients choose this remedy for aesthetic reasons.
Objective: This in-vitro study aims to compare and evaluate the effect of bleaching with 16% carbamide peroxide and 35% hydrogen peroxide on the microhardness of Cention N and Zirconomer.
Materials and Methods: Sixty disc-shaped samples of size 10mm x 2mm were included in this study and randomly assigned to two groups (n = 30) based on the type of restorative material used: Group 1: Cention-N; and Group 2: Zirconomer was used. Based on the application of the bleaching agent, each group was again divided into three subgroups (n = 10): Subgroup a (Control): 10 samples were tested without a bleaching procedure; 10 samples were tested with 16% carbamide peroxide for two weeks, and 10 samples were tested with 35% hydrogen peroxide for two weeks. After bleaching, all the samples were subjected to Vicker's microhardness test.
Results: Microhardness values decreased after the bleaching process of both restorative materials. Cention-N exhibited the highest microhardness values compared to Zirconomer.
Conclusion: Using bleaching agents decreases the microhardness of Cention N and Zirconomer. The most popular choice for patients looking to improve their dental aesthetics is tooth bleaching. According to reports, bleaching techniques may alter the colour, surface and subsurface microhardness, surface roughness, and surface topography of restorative materials.
Key Words: Bleaching agents, microhardness, restorative materials, tooth bleaching**,** Zirconomer

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Date of Submission: 09-06-2023 Date of Acceptance: 19-06-2023

I. Introduction

Several methods were described in the literature to enhance the aesthetic aspect of teeth. Among them, the bleaching procedure is the more conservative one for changing the colour of teeth.[1] Most tooth bleaching procedures utilize hydrogen peroxide or carbamide peroxide as a bleaching agent. As dental whitening has become more accessible, many patients choose this remedy for aesthetic reasons.

Silver amalgam has a lengthy record of clinical success. It has steadily declined over the years because of public perception of mercury toxicity and partly growing demand for aesthetic reasons. So far, various composites have been introduced. However, alternatives like Cention-N and Zirconomer have recently gained popularity as aesthetic restorative materials. In a study by Mazumdar et al., Cention N outperformed silver amalgam, type 2 GIC, and nanohybrid composites regarding microhardness qualities. [2] According to the manufacturer, Zirconomer is a strong and safe substitute that combines the advantages of glass ionomers with the strength of amalgam. [3]

Patients seeking tooth bleaching may often have Cention-N and Zirconomer restorations in their teeth. Many authors found that both hydrogen peroxide and carbamide peroxide, the two most commonly used bleaching products, can change the physical properties of restoration materials, such as their colour, surface roughness, hardness, and ion leakage. [4] Since the effect of hydrogen peroxide and carbamide peroxide has not been evaluated on the microhardness of Cention-N and Zirconomer, the current study was carried out to assess the effect of bleaching agents on the microhardness of Cention-N and Zirconomer.
Objective: To compare and evaluate the effect of bleaching with 16% carbamide peroxide and 35% hydrogen peroxide on the microhardness of Cention N and Zirconomer.

II. Material And Methods

Study site: Department of conservative dentistry and Endodontics KIMS, Amalapuram, Andhra Pradesh, India

Study duration: Three months: December 2022 to February 2023

Sample size: 60 samples were taken as the study was time-bound- in three months' duration, we have prepared 60 samples.

Groups:
Sixty disc-shaped samples of size were randomly assigned to two groups (n = 30) based on the type of restorative material used:
Group 1: Cention-N; and Group 2: Zirconomer.
Based on the application of the bleaching agent, each group was again divided into three subgroups (n = 10):

Subgroup a (Control): 10 samples were tested without a bleaching procedure; subgroup b 10 samples were tested with 16% carbamide peroxide for two weeks, and subgroup c- 10 samples were tested with 35% hydrogen peroxide for two weeks.

Ethical considerations:
Institutional ethical committee approval was obtained before conducting the study.

Methodology:

In this in vitro study, the following restorative materials and bleaching agents were used: Cention-N (Ivoclar Vivadent, Schaan, Liechtenstein), Zirconomer (Shofu Inc., Kyoto), 16 percent carbamide peroxide (Prevest Denpro Ltd.), and 35% hydrogen peroxide (Pola Office, SDI, Australia). (Table-1)
Sixty-disc shaped samples were prepared using a silicone mold with 10mm X 2mm dimensions. Based on the type of restorative material, the samples are assigned to 2 groups(n=30)

- Group 1: Cention-N
- Group 2: Zirconomer

For each restorative material employed, 30 test samples were made by mixing the materials according to the manufacturer's instructions, transferring the material into the molds using a spatula, and gently packing the material into the mold. A transparent matrix band was placed on each mold, and then a glass slab was placed on it to produce a smooth surface. After their final set, all the samples were retrieved from the molds. Then all the samples were subjected to a polishing procedure to get a smooth surface using a low-speed handpiece with polishing burs (Shofu). Then, polished samples were cleaned in an ultrasonic device with distilled water for one minute to eliminate debris. After polishing, all samples were incubated in distilled water at 37 °C for one week.
The samples were randomly distributed into three subgroups (n = 10):

- Subgroup a: control (without bleaching),
- Subgroup b: bleaching with 16% Carbamide Peroxide,
- Subgroup c: bleaching with 35% hydrogen peroxide

In subgroup a, samples were used as controls and stored in distilled water at 37 °C for 14 days without exposure to the bleaching agent.

In subgroup b, the samples underwent a bleaching procedure using 16% carbamide peroxide for 8 hours daily for two weeks.

In subgroup c, the samples underwent a bleaching procedure using 35% hydrogen peroxide in two sessions, one week apart, three times per session, and for 15 minutes each time (a total of 90 minutes), as described by Mohammadi N et al. in their study.

In subgroups b and c, the bleaching agents were applied to sample surfaces to treat each sample's surface with an adequate amount of bleaching agent. After each bleaching session, the samples were rinsed with distilled water and incubated in distilled water at 37 ºC until the following bleaching process. Distilled water was used daily.

After two weeks of treatment, the experimental and control samples were analyzed in a Vickers microhardness meter (Economet VH-1 MD).

Microhardness values were calculated by measuring the diameter of the rhomboid indentation using the following formula: HV = 1.854(F/D2). The Vickers indenter was placed on the surface of each sample at room temperature for 20 seconds using a 100-gram force at a distance of 1 mm from the margins, and the other two indentations were created randomly. Then, the mean of these 3 points was calculated as the surface microhardness of each sample.

Statistical analysis: Data were analyzed using SPSS 23.3 software. One-way ANOVA test used to compare data between three groups. Students t test was used to compare mean hardness between controls and non controls. P value below 0.05 is considered significant.

III. Results

Hardness of samples:

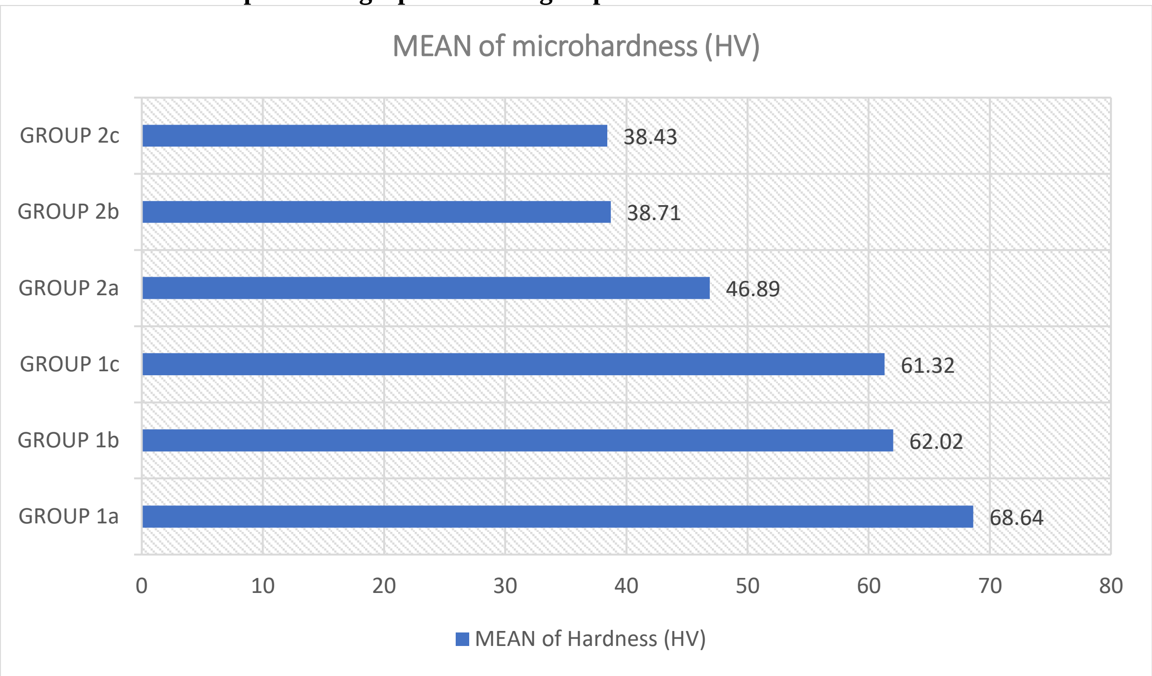
Table 1 summarizes the data on the mean and standard deviation of the samples and the results of comparisons made between the groups and subgroups.

Hardness was found to be maximum for group Ia. Hardness was found to be least for group 2c.

Table 1: Mean harness of all samples

GROUPS	MEAN of microhardness (HV)	STANDARD DEVIATION
GROUP 1a	68.6400	0.7
GROUP 1b	62.0200	0.8
GROUP 1c	61.3200	1.0
GROUP 2a	46.8900	1.1
GROUP 2b	38.7100	0.9
GROUP 2c	38.4300	1.1

Graph 1: Bar graph of all the groups' mean microhardness values.



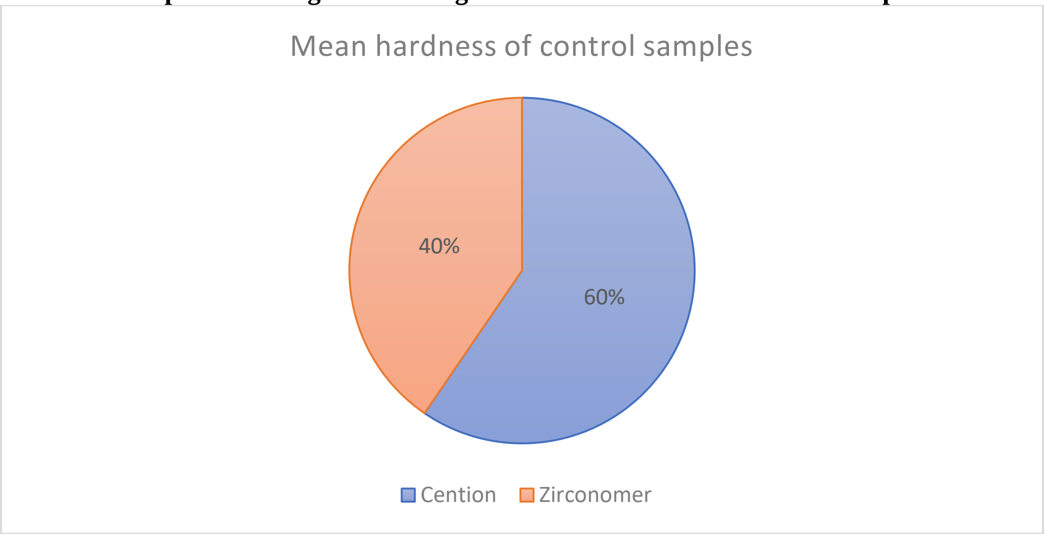
The means of microhardness values among the study groups were compared using a one-way ANOVA. There is significant difference in the mean hardness values between groups, as evident from p-value (0.00).

Table 2: ANOVA analysis and p-value of microhardness of all samples

SS (Sum of squares)		Df (degree of freedom)	MS (Mean squares)	F	p
Between groups	8,483.535	5	1,696.707	1,899.299	0.000
Within groups	48.240	54	0.893		
Total:	8,531.775	59			

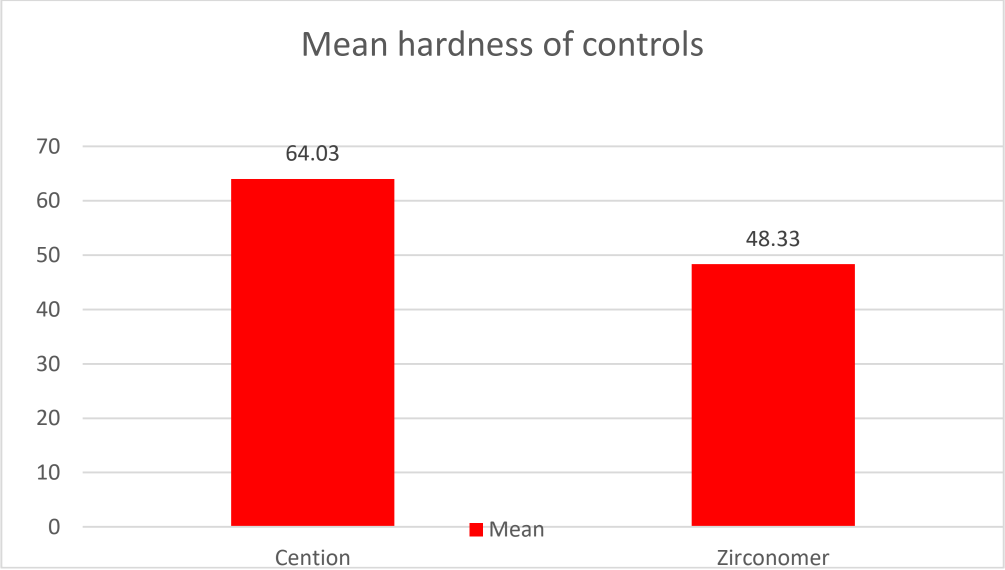
Comparison with control:
Among the groups, mean values were higher for the control samples in Cention-N (68.64 ± 2.22) and Zirconomer (46.89 ± 3.51).

Graph 2: Pie diagram showing mean microhardness of control samples



Among the two groups of restorative material, the mean value was higher in Cention-N than in Zirconomer.

Graph 3 shows comparison between mean microhardness between cention-N and zirconomer



In comparison to the control (unbleached) subgroup, the microhardness of the 16% carbamide peroxide and 35% hydrogen peroxide subgroups in both restorative groups were significantly lower (P<0.005).

Table 3 shows p value of microharness between -control and non-control in cention-N group

Parameters	Non control group	Control group	P value
Mean hardness	61.67±0.8	68.64±0.7	0.0001

Table 4 shows p value of microharness between -control and non-control in Zirconomer group.

Parameters	Non control group	Control group	P value
Mean hardness	38.57±1.0	46.89±1.1	0.0001

Image 1: Zirconomer

Image 2: Cention-N

Image 3: Filling material-cention-N

Image 4: Glass Ionomer- Zirconomer

IV. Discussion

Bleaching is a treatment modality involving an oxidative chemical that alters a material structure's light-absorbing and/or light-reflecting nature, thereby increasing its perception of whiteness.[5] Hydrogen peroxide, carbamide peroxide, and sodium perborate whiten the discolored tooth. Bleaching agents can alter tooth structure, including minor surface changes visible under an electron microscope and changes in microhardness and fracture toughness; they can also modify restorative materials.[2,6] Since surface hardness reflects the compressive strength and wear resistance and is one of the most important physical properties of restorative materials, the present study evaluated the effect of tooth bleaching with 16% carbamide peroxide and 35% hydrogen peroxide on the surface microhardness of Cention-N and Zirconomer.

According to the current study results, bleaching with 16% carbamide peroxide and 35% hydrogen peroxide significantly reduces the microhardness of Cention-N and Zirconomer. The findings on the influence of bleaching agents on the surface hardness of glass ionomers are consistent with the findings of Hao et al., which reported that the surface hardness of conventional glass ionomers was reduced after the use of 10% carbamide peroxide.[7] Hao et al. found contradictory results in another investigation that 15% carbamide peroxide increased the surface microhardness of glass ionomer cement.[8] Other studies have reported no considerable changes in the surface microhardness values of restorative materials.[9] The discrepancies are probably attributed to differences within the substrates and using different bleaching regimens. Different bleaching materials, bleaching regimens, and restorative materials could produce contradictory results in other studies.[10] The differences in the dimensions of the samples might be another reason for the discrepancies.[2]

The mechanism of surface softening due to bleaching agents is still not understood precisely; however, it is known that upon contact with water, Carbamide Peroxide breaks down into hydrogen peroxide and urea.[11] Ten percent of carbamide peroxide liberates up to 3.6 % of hydrogen peroxide. The hydrogen peroxide is very unstable and produces free radicals and induces oxidative cleavage of polymer chains, which affects the pigment macromolecules and resin filler interface, resulting in debonding.[12,13,14] The free radicals produced by bleaching agents affect the resin-filler interface by creating microcracks.[5] Therefore, bleaching agents can affect the resin matrix and the filler-matrix interface.

The polymer chains, double bonds of composite resins, and the organic matrix of glass ionomers are all impacted by the free radicals generated from hydrogen peroxide during the bleaching process.[2] As long as unreacted double bonds are assumed to be the most vulnerable parts of the polymer, a reduction in surface microhardness due to polymer chain cleavage and organic matrix erosion is the result.[5,15]

The organic matrix of Cention-N contains urethane dimethacrylate (UDMA) and low-viscosity dimethacrylates, such as tricyclodecane-dimethanol dimethacrylate (DCP) and polyethylene glycol 400 methacrylates (PEG-400 DMA), and Cention is bisphenol A-glycidyl methacrylate (Bis-GMA)-free.[2,16,17] The decrease in the microhardness after the two bleaching regimens appears due to the effect of free radicals on the organic matrix of Cention N and its chemical softening.[2]

The microhardness values of the Cention-N groups were higher than the Zirconomer groups.

Zirconomer-reinforced glass ionomer cement's reduced surface hardness may be explained by heterogeneous phases within this cement, but scanning electronic microscopy photomicrographs are required for a better understanding of the correlation between Vicker's microhardness number value and GIC's structure.[11]

In the present in vitro study, statistically, no significant differences were found between the effects of the two bleaching agents on microhardness, despite 35 percent hydrogen peroxide having a higher concentration than 16 percent carbamide peroxide. According to reports, the procedure duration and bleaching agent concentration are crucial. The adverse effects of long-term bleaching procedures with low concentrations of bleaching agents may be comparable to or even more severe than those of short-term bleaching procedures using high concentrations.[2,18]

In this in vitro study, the control samples were stored in distilled water the whole time to simulate oral conditions as closely as possible.[2] The bleaching agent and restorative materials in this investigation were not in contact with saliva or other debris that could have acted as a buffer for the bleaching agent. Simulating the environment in the oral cavity requires more research.

Considering the findings of the current investigation, practitioners should inform patients that bleaching techniques may cause changes in the microhardness of Cention-N and Zirconomer and that it may be essential to replace any existing restorations.

V. Conclusion

Within the limitations of this in vitro study, using 16% carbamide peroxide and 35% hydrogen peroxide bleaching agents decreased the microhardness of Cention N and Zirconomer. No statistically significant difference was noted in the microhardness between the 16% carbamide peroxide and the 35% hydrogen peroxide. It should be pointed out that surface hardness is only one of the critical considerations when evaluating restorative materials; therefore, additional research is required to assess other mechanical qualities.

References

[1]. Naik PL, Valli K. Comparative study of effects of home bleach and laser bleach using digital spectrophotometer: An invitro study. J Conserv Dent 2022; 25:161-5.

[2]. Mohammadi N, Kimyai S, Ghavami Lahij Y, Bahari M, Ajami AA, Abed Kahnamouei M, Daneshpooy M. Comparison of the effect of bleaching with 15% carbamide peroxide and 35% hydrogen peroxide on flexural strength of Cention N in selfcured and dual-cured polymerization modes. J Dent Res Dent Clin Dent Prospects 2020; 14:105-9.

[3]. Mazumdar, P., Das, A., Guha, C. 2018. Comparative evaluation of hardness of different restorative materials (restorative GIC, Cention N, nanohybrid composite resin and silver amalgam) – an invitro study. Int J Adv Res 6:826-32.

[4]. Abdulsamee, Nagy, Ahmed Elkhadem. Zirconomer and Zirconomer Improved (White Amalgams): Restorative Materials for the Future. Review. (2017).

[5]. Kimyai S, Bahari M, Naser-Alavi F, Behboodi S. Effect of two different tooth bleaching techniques on microhardness of giomer. J Clin Exp Dent 2017;9: E249-53.

[6]. Feiz A, Samanian N, Davoudi A, Badrian H. Effect of different bleaching regimens on the flexural strength of hybrid composite resin. J Conserv Dent 2016; 19:157-60.

[7]. Yu H, Li Q, Cheng H, Wang Y. The effects of temperature and bleaching gels on the properties of tooth-colored restorative materials. J Prosthet Dent 2011; 105:100-7.

[8]. Yu H, Li Q, Hussain M, Wang Y. Effects of bleaching gels on the surface microhardness of tooth-colored restorative materials in situ. J Dent 2008; 36:261-7

[9]. Mujdeci A, Gokay O. Effect of bleaching agents on the microhardness of tooth-colored restorative materials. J Prosthet Dent 2006; 95:286-9.

[10]. Yu H, Li Q, Lin Y, Buchalla W, Wang Y. Influence of carbamide peroxide on the flexural strength of tooth-colored restorative materials: an in vitro study at different environmental temperatures. Oper Dent 2010; 35:300–7.

[11]. Sharafeddin F, Kowkabi M, Shoale S. Evaluation of the effect of home bleaching agents on surface microhardness of different glass-ionomer cements containing hydroxyapatite. J Clin Exp Dent 2017;9: e1075-80.

[12]. Geramipanah F, Rezaei SM, Jafary M, Sadighpour L. Comparison of flexural strength of resin cements after storing in different media and bleaching agents. Eur J Prosthodont Restor Dent 2015; 23:56–61.

[13]. Bhutani, N., Venigalla, B. S., Patil, J. P., Singh, T. V., Jyotsna, S. V., & Jain, A. Evaluation of bleaching efficacy of 37.5% hydrogen peroxide on human teeth using different modes of activations: An in vitro study. J Conserv Dent 2016;19:259-63.

[14]. Zuryati AG, Qian OQ, Dasmawati M. Effects of home bleaching on surface hardness and surface roughness of an experimental nanocomposite. J Conserv Dent 2013; 16:356-61.

[15]. Sharafeddin F, Shoale S, Kowkabi M. Effects of different percentages of microhydroxyapatite on microhardness of resin-modified glass-ionomer and zirconomer. J Clin Exp Dent 2017;9:E805–11.

[16]. Ilie N. Comparative Effect of self- or dual-curing on polymerization kinetics and mechanical properties in a novel, dental-resin-based composite with alkaline filler. Materials (Basel) 2018;11: pii E108.

[17]. Paul S, Raina A, Kour S, Mishra S, Bansal M, Sengupta A. Comparative evaluation of fluoride release and re-release and recharge potential of Zirconomer Improved and Cention. J Conserv Dent 2020; 23:402-6.

[18]. Yu H, Zhang CY, Wang YN, Cheng H. Hydrogen peroxide bleaching induces changes in the physical properties of dental restorative materials: Effects of study protocols. J Esthet Restor Dent 2018;30: E52–60.