ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 4, Issue – 2, March - 2021, Page No. : 85 - 93

Comparative Clinical and Radiographic Evaluation of Conventional GIC with A New Alkasite Restorative Material (Cention N) In Primary Molar

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Citation of this Article: Dr. Vaishali Mangotra, Dr. Parminder Dua, Dr. Ritu Mangla, Dr. Sunny Sharma,“ Comparative Clinical and Radiographic Evaluation of Conventional GIC with A New Alkasite Restorative Material (Cention N) In Primary Molar”, IJDSIR- March - 2021, Vol. – 4, Issue - 2, P. No. 85 – 93.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The purpose of this study to compare clinical and radiographic evaluation of conventional GIC with a new alkasite restorative material in primary molars.

Materials and methods : A total of 31 patients aged 4-9 year old were selected. Class I cavities were prepared on the oculusal surface of primary molars. The two restorative materials, Ketac Molar (Group I) and Cention N (Group II)) were randomly placed in a split mouth design. The restorations were evaluated using FDI Criteria after 3, 6 and 9 months. Data were subjected to statistical analysis.

Results: Statistical difference was observed in surface lustre and translucency. However, no statistical significant difference was observed in surface staining, anatomic form, contact point, radiographic examination, recurrence of caries, contact point, patient’s view, tooth integrity, postoperative hypersenstivity, marginal adaptation, wear, periodontal response, adjacent mucosa and oral and general health.

Conclusion: Cention N was found to be the best restorative materials in terms of surface lustre and translucency. Radiographically, Ketac Molar and Cention N did not show any pathology, secondary caries and marginal gap.

Keywords: Dental caries, Restoration, Ketac Molar (Glass Ionomer Cement), Cention N (Alkasite restorative material), FDI criteria.

Introduction

Dental caries has been a highly prevalent and costly disease in the world, representing the most common infectious disease in the paediatric population.[1] Untreated caries in primary teeth will progress rapidly leading to acute inflammation of the dental pulp, ultimately inducing spontaneous pain and infection.[2] So, severely carious tooth can lead to the early loss of primary teeth. Because of early loss of primary teeth due to dental caries their may be malocclusion of permanent dentition which may reduce arch length required for the succeeding tooth and hence predisposes to crowding, rotation and impaction of the permanent teeth.[3] Thus, the restoration of decayed primary teeth could be an option to solve these problems.[4]

A number of esthetic restorative materials are used to restore primary teeth have grown exponentially in the past years.[5] Glass ionomer cement was used as a suitable alternative restorative material for restoring primary teeth.[4] It was developed by Wilson and McLean at the Laboratory of the Government Chemist in England in 1965.[6] It was first launched in Europe in 1975 and first marketed in the United States in 1977.

Conventional GIC used by dentists because of its biocompatibility, low cytotoxicity, fluoride release and limited microleakage. It also have less-desirable physical and mechanical properties such as poor polishability, susceptibility to dehydration and moisture contamination during intial setting and low fracture toughness and flexural strength.[7] Glass ionomer cement, esthetically more pleasing than metallic restorations.[8] Fluoride ion release and uptake and the chemical adhesion to both enamel and dentin are the main advantages of GIC. GIC is recommended in situations such as Class I, II, III and V restorations in primary teeth. Class III and V restorations in permanent teeth, interim therapeutic restorations and in atraumatic restoration technique. Today, a new generation of glass ionomers may provide better aesthetics, stronger bonding and long term results, lasting years rather than months.[6]

Ketac molar, a latest contribution to the development of GIC. It has excellent compressive and flexural strength and thus is able to counteract occlusal loading, preventing restoration fracture.

Cention N is an another new filling material which belongs to Alkasites group of materials. It is self-curing with optional additional light-curing. It is a recently introduced tooth colored, alkasite, basic filling material which can be used as alternative restorative material in primary teeth for bulk placement in retentive preparation. Cention N thus redefines the basic filling, combining bulk placement, ion release, and durability in a dual-curing, esthetic product -satisfying the demands of both dentists and patients[9]. It also includes special patented filler (Isofiller) which act as a shrinkage stress reliever and due to its low elastic modulus this shrinkage stress reliever within Cention N reduces polymerisation shrinkage and microleakage.[10] Its highly crosslinked polymer structure is responsible for high flexural strength.[11]

Thus, this present in-vivo study was carried out to evaluate the clinical and radiographic performance of Ketac Molar and Cention N in occlusal restorations in primary molars.

Materials and Method

A total of 31 patients aged 4-9 years who fulfilled the inclusion criteria which include vital teeth, bilateral matched pair of primary molars with occlusal surface caries and fair oral hygiene were selected. Before the treatment, children and their parents were informed about

procedures and consent letter was obtained. Teeth which showed the presence of fistula or edema, interrupted lamina dura, widened periodontal ligament space, exposed pulp and abnormal tooth mobility were excluded from the study. The participants were equally divided into two groups : Group I : Class I Restoration were filled with Ketac Molar and Group II : Class I Restoration were filled with Cention N.

Cavity preparation

Using a split mouth design, bilateral sides of the oral cavity of the same patient were selected. Caries lesions in both cavities were assessed by visual inspection with mirror and probe. Preoperative clinical photographs and radiographs were taken for both the cavities as shown in Fig 1. An appropriate rubber dam isolation was applied during the procedures. Class I occlusal cavities were prepared using No.245 tungsten carbide bur in high-speed airotor handpiece (NSK, Japan) with water spray. A conservative removal of carious enamel and dentine was done. The preparation was widened to give access to all carious dentin and to remove any unsupported enamel. After complete removal of carious lesions, finishing of the external walls and margins were done.

Restorative procedure in **Group I :** After water spray and dried with cotton pellet, Ketac Molar was mixed according to the manufacturers' instructions (1 level scoop of powder to 1 drop of liquid). Standard amounts of powder and liquid were dispensed onto the mixing pad. By using an agate spatula, we divided the powder into two parts. The first part of the powder was incorporated into the liquid and spatulated for 10 seconds and later, the remaining portion of the powder was incorporated and mixed thoroughly for 10 - 15 seconds. The working time together with the mixing was 3 min. Material was then applied to the cavity. During the hardening process, the material was sensitive to moisture so it was insulated with petroleum jelly. **Group II:** After water spray and dried with cotton pellet, tooth was etched with 37% phosphoric acid, washed with water jet and dried again with cotton pellet leaving a moistened surface. A layer of bonding agent (3M ESPE Adper^{TM} single bond 2) resin-based filling material) powder and liquid were mixed. (P:L 4.6:1 parts by weight, which corresponds to 1 measuring scoop of Powder + 1 drop of Liquid). Dosing, mixing and restoration of the cavity were strictly according to manufacturer instructions. Before setting, the material was condensed and carved using Teflon coated instrument and cured for 20s in occlusal direction. After the application of these restorative materials, rubber dam was removed and occlusion was checked by using articulating paper. Finishing of the restorations was conducted on the same visit using finishing burs. Post operative instructions were given to the patient. Immediately, a baseline clinical photograph and radiographs using RVG were obtained as shown in Fig. 2. Clinical and Radiographic assessment was carried out at baseline, 3, 6 and 9 months. Clinical photograph and radiographs using RVG were obtained. Clinical parameters were evaluated by visual inspection with mirror and explorer where as radiographic parameter was evaluated by using radiographs. Follow up visits were scheduled at 3, 6 and 9 months. Restorations were evaluated according to *FDI criteria***[4]** for clinical observation and radiographic evaluation and recorded on the patient assessment sheet. [Annexure I]. For the evaluation purposes, 16 parameters were used; which include surface staining, surface lusture, translucency, anatomic form, fracture and retention, marginal integrity, wear, contact point, radiographic examination, patient's view, post operative hypersensitivity, recurrence of caries, tooth integrity, periodontal response, adjacent mucosa, oral and general health.

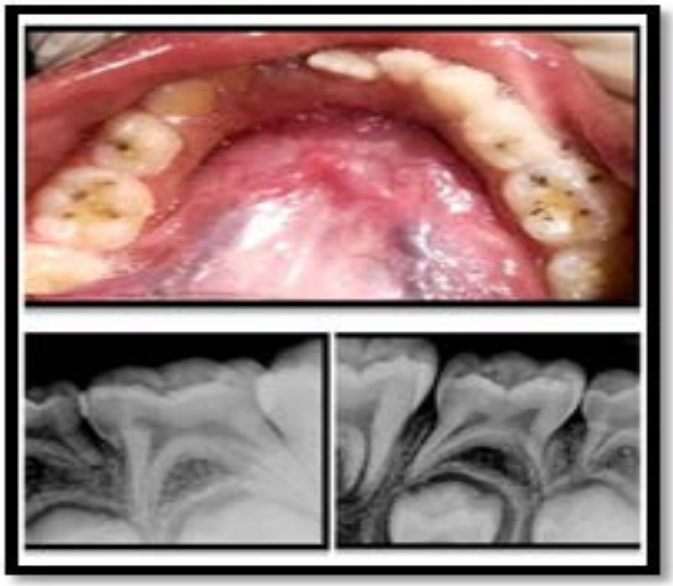

Fig 1: a. Preoperative photographs. Caries wrt 74,75,84,85

b. RVG- 85 (left side), 75 (right side) Caries wrt C.

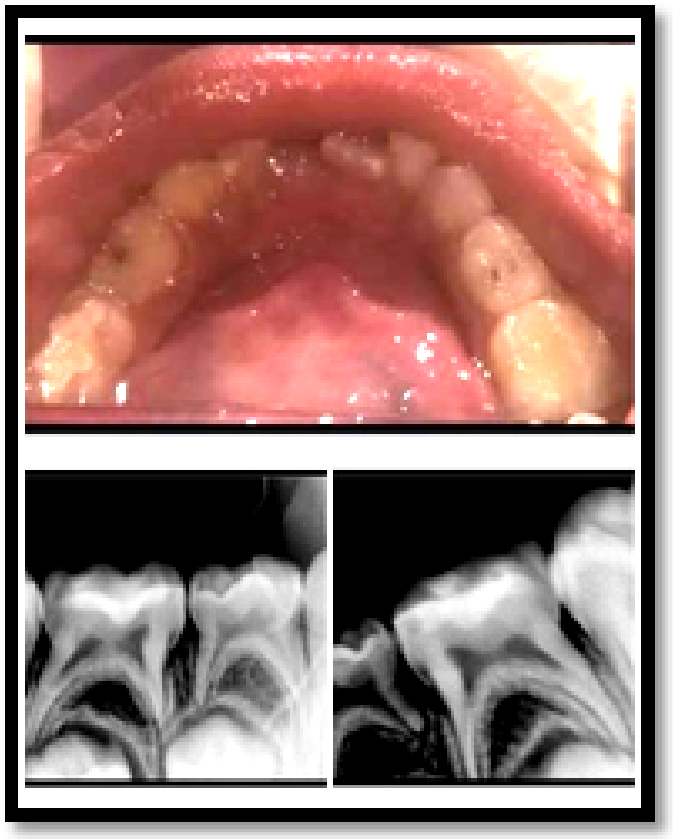

Fig 2: a. At baseline. Ketac Molar wrt 85, Cention N wrt 75.

b. RVG- Ketac Molar wrt 85 (right side) Cention N wrt 75 (left side)

Result

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS for Windows, SPSS Inc. Version 16, USA). Data were computed as number and percentage. Fisher's exact test was used to compare the study variables between the two groups. The level of significance for the present study was fixed at a p-value of less than 0.05. Ketac Molar and Cention N did not showed any statistical difference in surface staining, anatomic form and fracture and retention, wear, patient's view, periodontal response. At baseline, 3 month and 6 month, no surface staining (100%) was seen in both the groups. At 9 months, minor staining (12.9%) was observed in Ketac Molar. In case of anatomic form, at baseline, 3 and 6 months, ideal anatomic form (100%) was seen in both the groups and at 9 months, anatomic form was affected in Ketac molar (3.2%). In case of fracture and retention at baseline, 3 month and 6 month restorations were retained (100%) in both the groups. However, at 9 months, hairline crack (3.2%) was seen in Ketac Molar where as Cention N showed no crack (0%). In case of wear, at baseline and 3 month, both the groups were same as enamel (100 %) and at 6 month, wear (16.1%) was observed in both the groups. At 9 month, Ketac molar (32.3%) showed more wear (32.3%) as compared to Cention N (25.8%). In case of patient's view, at baseline, patients were entirely satisfied with Cention N (93.5%) as compared to Ketac Molar (90.3%). At 3 month and 6 month, patients were satisfied with both the groups. At 9 month, patients wanted to get improve their restorations (3.2%) in both the groups. In case of periodontal response no plaque, inflammation or pocket (100%) was seen at baseline and 3 month in Cention N and Ketac Molar. However, at 6 month and 9 month, little plaque (3.2%) was observed in both the groups. Statistical difference was observed in surface luster and translucency. In case of surface luster,

at baseline, Ketac molar was (80.6%) was comparable to enamel where as Cention N showed (100%) result. At 3 month, Ketac molar was slightly dull (71%) & Cention N was (22.6%) slightly dull. At 6 month Ketac molar (51.6%) was dull but acceptable as compared to Cention N (0%) At 9 month, Ketac molar (77.4%) was more dull but acceptable as compared to Cention N (0%). In case of translucency, at baseline, good color match was seen in Cention N (100%) as compared to Ketac molar (80.6%). At 3 month (6.5%), 6 month (35.5%) and 9 month (48.4%), Ketac Molar was more opaque than Cention N (0%) which showed no opacity. Parameteres marginal adaptation, contact point, radiographic examination, post operative hypersenstivity, recurrence of caries, erosion and abfraction, tooth integrity, adjacent mucosa and oral and general health did not show any statistical difference at baseline (100%), 3 months (100%), 6 months (100%) and 9 months (100%) in both the groups.

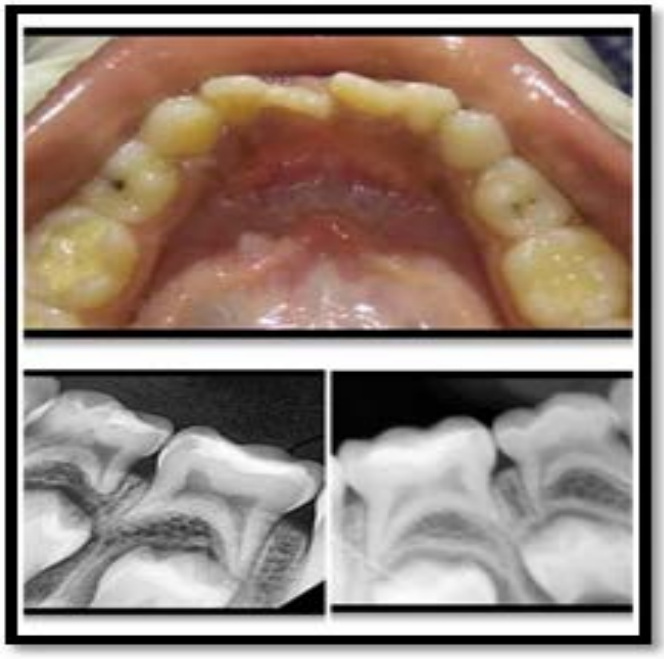

Fig 3: a. At 3 months. Ketac Molar wrt 85, Cention N wrt 75

b. RVG- Ketac Molar 85 (left side), Cention N wrt 75 (right side)

Fig 4: a. At 6 months. Ketac Molar wrt 85,
Cention N wrt 75

b. RVG- Ketac Molar 85 (left side), Cention N wrt 75 (right side)

Fig 5. a. At 9 months. Ketac Molar wrt 85, 74 & Cention N wrt 75, 84

b. RVG- Ketac Molar wrt 85 (left side) Cention N 75 (right side)

Discussion

A restorative material is one which reestablishes the esthetic, functional, and biological properties of the tooth structure.[12] Tooth colored restorative materials such as glass ionomer (GICs) and composite resins (CRs) have gained popularity due to increasing demand of eshetics.[13] Despite having good physical properties, the main shortcomings of composite resin material is - polymerization shrinkage resulting in marginal microleakage, postoperative sensitivity and secondary caries.[10] To over come these inadequecies, glass ionomer cement was developed in 1965 which was suitable alternative restorative material for restoring primary teeth[4] because of its high biocompatibility and ability to form chemical bond with the enamel and dentine.[14] It is also a fluoride releasing material, which makes it anticariogenic, and its coefficient of thermal expansion is seen similar to dentin.[15] In our study, split mouth design was chosen to expose the two restorative materials to nearly identical oral environmental conditions and to eliminate any bias due to patient variables. Restorations were assessed independently using FDI criteria (World Dental Federation evaluation criteria) as it is more sensitive to small variations in the clinical outcomes which include functional, biological and esthetic properties by using mirrors, probes and radiographs. The results of this study revealed teeth restored with Cention N exhibited better surface luster and translucency compared to those restored with Ketac Molar as shown in Table I. The probable reason could be that Cention N has lower filler particle size of 0.1–35 mm where as Ketac Molar has larger filler particles i.e 1-9 mm. This might be the reason for its lower surface smoothness and better translucency as compared to the Ketac Molar. Cention N is a more esthetic material due to its higher transparency of 11% in contrast to GIC which present transparency of 3-4%.[16] Minor staining was observed in Ketac Molar where as Cention N showed no staining at all as shown in Table 4. The probable reason could be that under acidic conditions, dental restorative materials may suffer erosion which can lead to surface roughness.[17] Surface roughness will influence bacterial adhesion by increasing plaque retention and cause staining. Anatomic form was affected in Ketac Molar where as in Cention N no anatomic form was affected as shown in Table 4. The reason behind this the excessive dehydration of GICs can result in chalky, crazed or a cracked surface leading to considerable marginal leakage. Fracture resistance is also an important property directly related to cracking, so concluded that under compressive loading, the use of Cention N restorative material significantly strengthen teeth after preparation and restoration.[18] No significant differences were observed in functional and biological properties. Hairline crack was observed in Ketac Molar where as no crack was seen in Cention N as shown in Table 4. And the probable reason for Ketac Molar that it has poor mechanical properties such as low fracture strength, toughness and higher occlusal wear where as Cention N has highly crosslinked polymer structure which is responsible for its high flexural strength. Marginal adaptation between the two groups showed good marginal adaptation shown in Table 4 and the probable reason is that in Ketac Molar, there is formation of strong chelation reaction with the calcium on the tooth surface and there are chemicals interactions of polyalkenoic acids and hydroxyapatite which produce adeaquate marginal sealing[19] where as organic/inorganic ratio as well monomer composition of the Cention N is responsible for the low volumetric shrinkage leading to least microleakage.[20] Ketac molar showed more wear as compared to Cention N shown in Table 4 and the reason could behind that Ketac Molar exhibit acid-basereaction results in a matrix,

compromising an ionically a weaker cross-linked polyalkenoate network [21] where as Cention N is cross-linked matrix material, which imparting high strength and wear resistance to the material.[22] Radiographic findings between the two groups showed no marginal gaps, pathology or secondary caries shown in Table 4. The probable reason could be that the Ketac molar and Cention N chemically bond to the tooth structure and presence of patented isofiller in Cention N acts as a stress reliever, minimizes shrinkage force. Hence, no microleakage was observed. Another reason could be that fluoride releasing restorative materials inhibit the secondary caries. Both the groups showed good contact points shown in Table I. The probable reason for CentionN is it's the high polymer rnetwork density and degree of polymerisation over the entire depth of restoration. Recurrence of caries and abfraction was not observed in both the groups as both the materials release fluorides which promotes the inhibition of secondary caries. No postoperative hypersenstivity was observed in both the groups, the probable reason for postoperative hypersensitivity is microleakage, so the presence of ivocerin based patented isofiller technology in Cention N acts as a stress reliever, keeps the shrinkage stress to a minimum and the probable reason for Ketac Molar is its better sealing properties to tooth surface. Both the groups showed good integrity of the tooth, probable reason could be the highest flexural strength (100mPa) of Cention-N (that can be attributed to higher filler loading) and (37±6mPa) of Ketac molar. Both the groups showed good periodontal response, adjacent mucosa and oral and general health. The reason could be that both the materials release fluoride that has antibacterial properties which reduces the formation of cariogenic acid (lactic acid) in plaque bacteria such as streptococcus mutans, by altering the bacterial absorption of glucose, the glycolysis and may help to reduce the growth and activity of the bacteria.[23]

In case of patient's view, children selected in our study were young aged. Due to their age, they could not differentiate as much about the difference between the two restorations. Mostly the major concern was discoloration and food lodgement in the tooth which affects their mastication.

Table 1: Success rate (%) of Ketac Molar and Cention N at baseline.

Studied Criterion	Criterion Categories	Ketac Molar	Success rate(%)	Cention N	Success rate(%)	*P*	Significant difference
	Studied period (at baseline)						
Esthetic Properties	Surface Staining	31	100	31	100	-	NO
	Surface Luster	31	80.6	31	100	0.024	YES
	Translucency	31	80.6	31	100	0.024	YES
	Anatomic Form	31	100	31	100	-	NO
Functional Properties	Fracture and Retention	31	100	31	100	-	NO
	Marginal Adaptation	31	100	31	100	-	NO
	Wear	31	100	31	100	-	NO
	Contact Point	31	100	31	100	-	NO
	Radiographic Examination	31	100	31	100	-	NO
	Patient's view	31	90.3	31	93.5	1.000	NO
Biological Properties	Postoperative Hypersenstivity	31	100	31	100	-	NO
	Recurrence of caries	31	100	31	100	-	NO
	Tooth Integrity	31	100	31	100	-	NO
	Periodontal response	31	100	31	100	-	NO
	Adjacent Mucosa	31	100	31	100	-	NO
	Oral and General Health	31	100	31	100	-	NO

Table 2: Success rate (%) of Ketac Molar and Cention N at 3 months

Studied Criterion	Criterion Categories	Ketac Molar	Success rate(%)	Cention N	Success rate(%)	*P*	Significant difference
	Studied period (after 3 months)						
Esthetic Properties	Surface Staining	31	100	31	100	-	NO
	Surface Luster	31	19.4	31	77.4	<0.001	YES
	Translucency	31	19.4	31	83.9	<0.001	YES
	Anatomic Form	31	100	31	100	-	NO
Functional Properties	Fracture and Retention	31	100	31	100	-	NO
	Marginal Adaptation	31	100	31	100	-	NO
	Wear	31	100	31	100	-	NO
	Contact Point	31	100	31	100	-	NO
	Radiographic Examination	31	100	31	100	-	NO
	Patient's view	31	87.1	31	87.1	1.000	NO
Biological Properties	Postoperative Hypersenstivity	31	100	31	100	-	NO
	Recurrence of caries	31	100	31	100	-	NO
	Tooth Integrity	31	100	31	100	-	NO
	Periodontal response	31	100	31	100	-	NO
	Adjacent Mucosa	31	100	31	100	-	NO
	Oral and General Health	31	100	31	100	-	NO

Table 3: Success rate (%) of Ketac Molar and Cention N at 6 months

Studied Criterion	Criterion Categories	Ketac Molar	Success rate(%)	Cention N	Success rate(%)	P	Significant difference
	Studied period (after 6 months)						
Esthetic Properties	Surface Staining	31	100	31	100	-	NO
	Surface Luster	31	0	31	41.9	<0.001	YES
	Translucency	31	0	31	61.3	<0.001	YES
	Anatomic Form	31	100	31	100	-	NO
Functional Properties	Fracture and Retention	31	100	31	100	-	NO
	Marginal Adaptation	31	100	31	100	-	NO
	Wear	31	83.9	31	83.9	1.000	NO
	Contact Point	31	100	31	100	-	NO
	Radiographic Examination	31	100	31	100	-	NO
	Patient's view	31	83.9	31	87.1	1.000	NO
Biological Properties	Postoperative Hypersenstivity	31	100	31	100	-	NO
	Recurrence of caries	31	100	31	100	-	NO
	Tooth Integrity	31	100	31	100	-	NO
	Periodontal response	31	100	31	100	-	NO
	Adjacent Mucosa	31	100	31	100	-	NO
	Oral and General Health	31	100	31	100	-	NO

Table 4: Success rate (%) of Ketac Molar and Cention N at 9 months

Studied Criterion	Criterion Categories	Ketac Molar	Success rate(%)	Cention N	Success rate(%)	P	Significant difference
	Studied period (after 9 months)						
Esthetic Properties	Surface Staining	31	87.1	31	100	0.113	NO
	Surface Luster	31	0	31	6.5	<0.001	YES
	Translucency	31	0	31	29	<0.001	YES
	Anatomic Form	31	96.7	31	100	1.000	NO
Functional Properties	Fracture and Retention	31	96.8	31	100	1.000	NO
	Marginal Adaptation	31	100	31	100	-	NO
	Wear	31	67.7	31	74.2	1.000	NO
	Contact Point	31	100	31	100	-	NO
	Radiographic Examination	31	100	31	100	-	NO
	Patient's view	31	77.4	31	80.6	1.000	NO
Biological Properties	Postoperative Hypersenstivity	31	100	31	100	-	NO
	Recurrence of caries	31	100	31	100	-	NO
	Tooth Integrity	31	100	31	100	-	NO
	Periodontal response	31	100	31	100	-	NO
	Adjacent Mucosa	31	100	31	100	-	NO
	Oral and General Health	31	100	31	100	-	NO

Conclusion

Cention N was found to be the best restorative material in terms of surface lusture and translucency. Radiographically, Ketac Molar and Cention N did not show any pathology, secondary caries and marginal gap. However, further more studies should be conducted in vivo conditions to correlate the present day.

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