

Comparative Evaluation of Two Esthetic Full Coronal Restorative Materials for Primary Incisors

Kanchan Kumari Dhaker¹, Sandeep Tandon², Ambika S Rathore³, Rinku Mathur⁴, Tripti S Rai⁵, Surbhi Sharma⁶

ABSTRACT

Aim: This study was designed to compare the clinical efficacy of two esthetic restorative materials, nanoceramic (Magma NT[®]) and giomer (Beautiful II[®]), as full coronal restoration in primary maxillary incisors.

Materials and methods: A total of 15 patients aged 3–5 years presenting with mutilated primary maxillary incisors due to caries or trauma were selected for the study using randomized simple sampling. A total of 40 maxillary incisors were randomly divided into two equal groups, with 20 teeth in each group. Teeth in group I (GP I) were restored with nanoceramic (Magma NT[®]) and group II (GP II) with giomer (Beautiful II[®]). The full coronal restorations were done using strip crowns (3M ESPE). The restorations were evaluated for gross fracture, marginal integrity, and secondary caries according to modified Ryge's criteria [United States Public Health Service (USPHS)] at baseline (immediate postoperative), 3, 6, and 9 months. Parental satisfaction with each type of restoration was also evaluated using the Likert 5-point scale.

Results: The data obtained was statistically analyzed using the Chi-squared test, and the level of significance, that is, the *p*-value, was determined. The Chi-squared test showed no significant changes to all modified USPHS criteria for each material at baseline and 3-month evaluation period. The changes recorded were after a 3-month follow-up between the two materials; nanoceramic (Magma NT[®]) restoration demonstrated marginally better than giomer (Beautiful II[®]) in terms of gross fracture and marginal integrity; however, there was no statically significant difference between them (*p* > 0.05), while giomer (Beautiful II[®]) was better than nanoceramic in terms of secondary caries (*p* < 0.05). Parental satisfaction for both entities was comparable in terms of color and durability; however, they were cost-ineffective.

Conclusion: Nanoceramic restoration demonstrated better results in terms of gross fracture and marginal integrity, while giomer was better in terms of secondary caries.

Clinical significance: Nanoceramics and gomers can serve as an alternative to conventional restorative materials in primary anterior teeth because of their improved qualities.

Keywords: Crown, Esthetic, Giomer, Gross fracture, Marginal integrity, Nanoceramic, Secondary caries.

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INTRODUCTION

Deciduous upper anterior teeth play an important role in the physical appearance,¹ and their destruction may result in the development of parafunctional habits, speech problems, psychological problems, reduced chewing efficiency, and loss of vertical dimension.² Hence, to maintain the integrity of primary dentition, it is imperative to restore the teeth destroyed by caries or trauma till the eruption of permanent teeth and their shedding. Patients often encounter the destruction of their deciduous anterior teeth due to issues such as early childhood caries, tooth fractures, hypoplastic defects, and malformations. In the past, the most common treatment was to extract the involved teeth because restoration of severely destroyed primary teeth was a challenging job. Mutilated upper incisor restoration has been facilitated by recent advancements in restorative materials, placement techniques, tooth preparation designs, and adhesive protocols to quite an extent.

The basic purpose of restorative materials is for the biological, functional, and esthetic properties of healthy tooth structure to be substituted.⁴ To ensure the success of restoration, microleakage must be prevented. This is achieved through proper bonding of the restorative material to the cavity walls. Secondary caries, sensitivity, and radicular infections result from the restorative materials' inability to achieve a complete marginal seal.⁵ So, newer restorative materials have been introduced with superior biomechanical properties, including better marginal integrity,

^{1–6}Department of Pediatric and Preventive Dentistry, RUHS College of Dental Science, Rajasthan University of Health Sciences (RUHS), Jaipur, Rajasthan, India

Corresponding Author: Kanchan Kumari Dhaker, Department of Pediatric and Preventive Dentistry, RUHS College of Dental Science, Rajasthan University of Health Sciences (RUHS), Jaipur, Rajasthan, India, Phone: +91 9414296365, e-mail: kanchandhaker53@gmail.com

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high strength, high polishability, anticariogenic properties, and biocompatibility, as the quest for better restorative solutions continues.

In the last three decades, composite materials have undergone stupendous improvements and advancements. The focus of these advancements has been on reducing polymerization shrinkage and enhancing mechanical properties. Filler and polymer technology in dental composite resins have advanced, resulting in a diverse array of composite materials to choose from, depending on the clinical situation.⁶ In restorative dentistry, nanotechnology makes a significant impact by refining the existing resin-based system.

Nanomer and nanocluster filler particles were expected to be useful for all restorative procedures in the formulation of these materials. The new restorative material, giomer, was introduced with the physical properties and biocompatibility of composite resin. It offers additional benefits such as high radiopacity, an antiplaque effect, and fluoride release similar to glass ionomer cement. With the use of surface prereacted glass-ionomer (S-PRG) filler technology, the matrix of resin in Beautifil II®, a type of giomer, assimilates prereacted glass particles to enhance its strength.^{8,9} In this new era, nanotechnology is significantly contributing to the production of restorative materials. These materials boast enhanced esthetics, bonding, and mechanical properties. The nanoceramic (Magma NT®) material, a radiopaque and light-curing substance, is utilized for the restoration of permanent and deciduous teeth.¹⁰ The current study offered the opportunity to clinically compare two restorative materials based on nanotechnology.

MATERIALS AND METHODS

Type of Study

This study was a split-mouth study.

Aim

To compare the clinical efficacy of Beautifil II® and Magma NT® as full coronal restoration in deciduous maxillary incisors.

Objectives

- To evaluate the gross fracture, marginal integrity, and secondary caries in primary maxillary incisors.
- To evaluate parental satisfaction level.

Ethical Considerations

- Approval from the Ethical Committee of RUHS College of Dental Sciences, Jaipur, Rajasthan, was obtained to carry out this study.
- The procedures and possible discomfort and benefits were explained to the parents of the children involved, and their written consent was obtained prior to treatment.

Methodology

A total of 15 patients aged between 3 and 5 years presenting with destroyed deciduous maxillary incisors due to dental caries were selected.

A total of 40 maxillary incisors were randomly divided into two groups, with 20 teeth in each group.

Inclusion Criteria

- Carious deciduous upper incisors indicated for pulpectomy.
- Dental caries affecting two or more surfaces.
- No radicular caries.
- Presence of at least two-thirds of the radicular structure.
- Presence of at least one-third of coronal structure.
- No mobility.
- No gingival recession.
- No hypoplastic tooth.
- No abnormal oral habits.
- Children with Frankl's behavior rating scale of 3 and 4.

Exclusion Criteria

- Any tooth near to shedding or nonrestorable.
- Medically compromised patient.
- Children with special health care needs.

Clinical Procedure

The procedure includes the removal of caries; teeth that were pulpally involved were treated with suitable endodontic treatment. The obturation was done with Metapex (Meta Biomed Co. Ltd., Republic of Korea), and the crown was sealed by glass ionomer cement (3M ESPE). After 7 days, the final restoration was done with one of the abovementioned restorative options. A suitable size strip crown was selected, and a core vent was made by piercing it with an explorer at the incisal angle. With a sharp and curved scissor, the gingival margin of the crown was trimmed to an appropriate level. The prepared tooth surface was isolated using Rubber dam isolation, and then etching and bonding were done. The prepared teeth were covered by strip crowns filled with nanoceramic (Magma NT®) and giomer (Beautifil II®). The process of etching, bonding, and curing was done according to manufacturer instructions. The teeth in group I (GP I) were restored using nanoceramic (Magma NT®) and group II (GP II) with giomer (Beautifil II®), and then the strip crown shell was removed using an explorer. This procedure was performed according to the review given by Kupietzky, 2002.¹¹ A little polishing was done, if required, with composite finishing disks and strips.

Armamentarium

Basic armamentarium (Fig. 1A):

- Disposable gloves and mouth mask.
- Disposable suction tip.
- Disposable syringes.
- Mouth mirror, probe, explorer, and tweezers.
- High-speed contra-angled handpiece.
- Cotton holder with cotton.
- Mirror armamentarium for strip crown technique.
- Rubber dam kit (API).
- Strip crown kit (3M-ESPE Dental Products, Saint Paul, Minnesota, United States of America).
- Restorative material (Magma NT® and Beautifil II®).
- Crown preparation burs: Straight fissure, tapered fissure, and round bur.
- Composite finishing burs.
- Finishing and polishing kit (Super-Snap Mini Kit).
- Composite filling instruments (Teflon-coated).
- Blue light-emitting diode.
- Strip crown-cutting scissors.

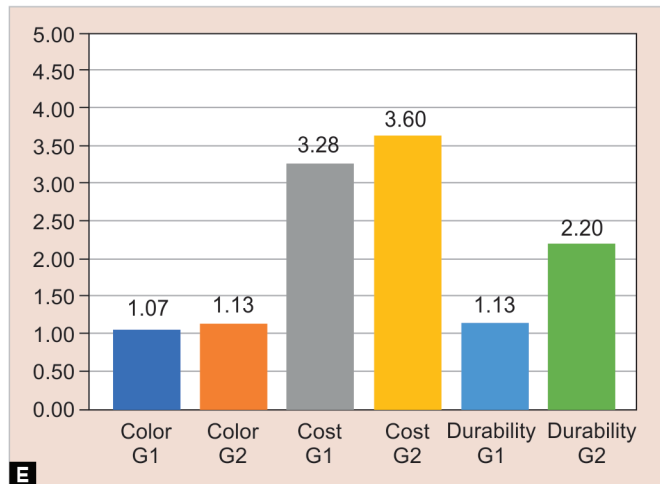
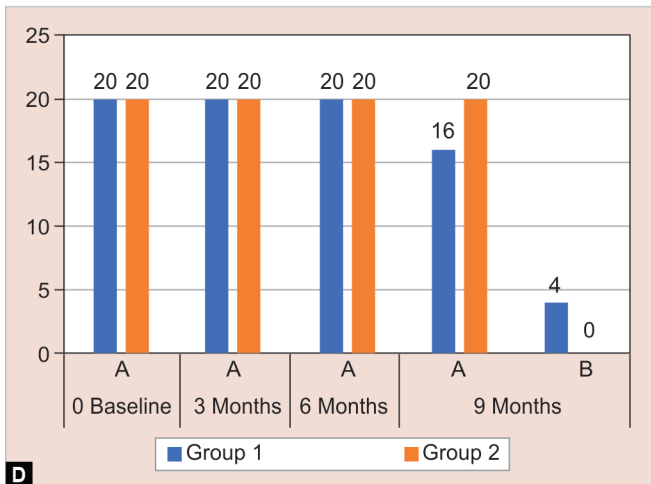
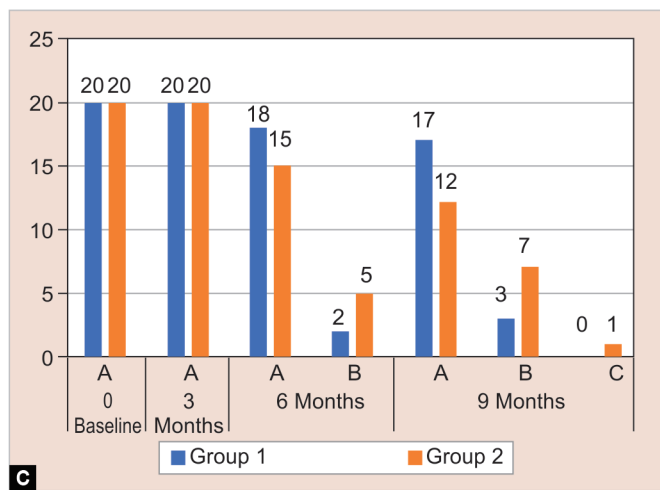
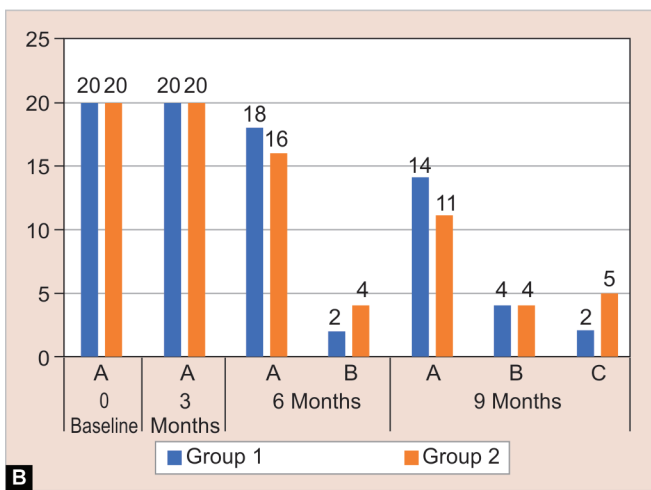
Statistical Analysis

Data were processed on a Microsoft Office Excel 2019 (v16.0.15831.20208, Microsoft Redmond Campus, Redmond, Washington, United States).

Gathered, processed, and statistically scrutinized the data as per test criteria. The statistical tests used to scrutinize the data were the level of significance and the Chi-squared test determined the *p*-value.

RESULTS

All the patients were recalled, and evaluation of the restoration was done for gross fracture, marginal integrity, and secondary caries according to modified Ryge's criteria [United States Public Health Service (USPHS)] at baseline (immediate postoperative), 3, 6, and 9 months. Parental satisfaction with each type of restoration was also evaluated using the Likert 5-point scale. To prevent bias, someone unaware of the details of the study was observed and evaluated.



Figs 1A to E: (A) Armamentarium; (B) Graphical presentation of gross fracture evaluation; (C) Graphical presentation of marginal integrity evaluation; (D) Graphical presentation of secondary caries evaluation; (E) Graphical presentation of parental satisfaction evaluation

Results of the study are presented in [Tables 1A to C](#) and [Figures 1B to E](#).

Important Observations and Results are Explained Below

For all the modified USPHS criteria for both materials, there weren't any significant changes as per the Chi-squared test at baseline ([Figs 2A to C](#)) and 3 months ([Fig. 3A](#)) evaluation. The changes

observed at 6 months ([Fig. 3B](#)) and 9 months ([Fig. 3C](#)) follow-up; nanoceramic (Magma NT®) restoration demonstrated marginally better than giomer (Beautifil II®) in terms of gross fracture and marginal integrity. However, there was no statistically significant difference between them ($p > 0.05$) [Tables 1A to C](#) and [Figs 1B to D](#). Parental satisfaction for both entities was comparable in terms of color and durability; however, they were cost-ineffective ([Fig. 1E](#)).

DISCUSSION

Primary maxillary anterior teeth play a crucial role in phonetics, esthetics, eating, and space maintenance for permanent teeth; hence, restoring destroyed crowns in deciduous dentition due to caries or

trauma is essential to preserve the integrity of the teeth and ensure the proper eruption of permanent teeth.¹ The restoration placed in deciduous teeth should maintain function and esthetics till natural exfoliation of the tooth. The factors that affect the longevity of restorations are characteristics of the tooth itself, the site and size of the carious lesion, patient cooperation, the dentist's skills and experience, and the materials used. An effective restoration should possess a higher survival rate and longer shelf-life. There are several restorations indicated for restoring carious deciduous teeth, such as glass-ionomer cements, composite resin, giomer, compomers, etc. The restorative material factors that influence the success of restoration are wear resistance, fracture, toughness, marginal breakdown, bonding to the tooth, and ease of manipulation.¹² Restoration of carious primary teeth is important for healthy development and growth of the child as well as for physiological development of the permanent dentition. For several years, glass ionomer cement has been mostly used as a restorative material in deciduous teeth. The glass ionomer cement restorative material has advantages such as chemical bonding to teeth, anticariogenic properties, biocompatibility, and esthetics. The drawbacks are long-setting reactions with susceptibility to moisture contamination and

Table 1A: Chi-squared test, statistical analysis used for intergroup comparison of gross fracture

		GP I	GP II	Chi-square value	p-value
Baseline	A	20	20	-	-
3 months	A	20	20	-	-
6 months	A	18	16		
	B	2	4	0.784	0.376
9 months	A	14	11		
	B	4	4		
	C	2	5	1.646	0.439

p > 0.05 is insignificant

Table 1B: Chi-squared test, statistical analysis used for intergroup comparison of marginal integrity

		GP I	GP II	Chi-square value	p-value
Baseline	A	20	20	-	-
3 months	A	20	20	-	-
6 months	A	18	15	1.558	0.212
	B	2	5		
9 months	A	17	12	3.462	0.177
	B	3	7		
	C	0	1		

p > 0.05 is insignificant

Table 1C: Chi-squared test, statistical analysis used for intergroup comparison of secondary caries

		GP I	GP II	Chi-square value	p-value
Baseline	A	20	20	-	-
3 months	A	20	20	-	-
6 months	A	20	20	-	-
9 months	A	16	20	4.444	0.035
	B	4	0		

p < 0.05 is statistically significant



Figs 2A to C: (A) Preoperative; (B) Preoperative IOPA; (C) Baseline



Figs 3A to C: (A) 3-month follow-up; (B) 6-month follow-up; (C) 9-month follow-up

poor mechanical properties.¹³ Therefore, there is a need for newer restorative material to restore primary teeth. Timely innovations in dentistry and a quest for the development of ideal material have led to the widespread use of resin-based composite to restore deciduous teeth.^{14,15} Major developments have occurred in resin composite technology over the last few decades. Long-term clinical data is rarely available for specific products due to the frequent introduction of improved versions.^{16,17} Giomers have been selected in the current study as they provide the anticariogenic properties of glass ionomers and the esthetics, physical characteristics, and handling of composite resins.^{18,19} Further, S-PRG filler particles acted as a fluoride reservoir in giomer. It recharges by rinsing and brushing with products containing fluoride.^{20,21} Acid-resistant film is formed by giomers; it inhibits bacterial adhesion and resists plaque formation.¹⁹⁻²² Giomers had a superior surface finish because of their fundamental composite resin nature, unlike resin-modified glass ionomers and glass ionomers.^{16,17} Clinical studies report the acceptance of first-generation Beautifil and second-generation Beautifil II²³ giomers for clinical performance in classes V, I, and II lesions over a period of 1–8 years. Magma NT[®] is a contemporary silica-zirconia nanoparticle-based universal hybrid composite with 80% filler loading. The particle size of the fillers facilitates high polishability and superior surface luster. Natural fluorescence and a superior chameleon effect create long-lasting, life-like restorations. It is a high-strength, visible, light-curable nanoceramic composite restorative material for anterior and posterior teeth. Thus, in the current study, two esthetic restorations for deciduous anterior teeth were evaluated and compared in terms of their clinical performance. At baseline and 3-month follow-up, no change was shown by any group. The evaluation of gross fracture (Table 1A) during the 6-month evaluation period recorded two Bravo scores out of the 20 restorations of nanoceramic restorations, and at the 9-month follow-up period, it had changed to four Bravo and two Charlie cases. While in giomer, restorations showed four Bravo at 6 and 9 months and five Charlie scores at the 9-month follow-up. Regarding marginal integrity (Table 1B), both nanoceramic and

giomer restorations showed some imperfect margins where the explorer was slightly caught. The evaluation of marginal integrity at the 6-month evaluation period recorded two Bravo scores out of the twenty restorations of nanoceramic restorations, and at the 9-month follow-up, it had changed to three Bravo scores. While in giomer restorations, the 6-month evaluation period recorded five Bravo scores, and at the 9-month follow-up period, it had changed to seven Bravo and one Charlie cases. Nano zirconium oxide filler particles in Magma NT[®] might be responsible for high strength and minimum gross fracture of the restoration. Magma NT[®] contains silanated fillers. 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 strong bond between the glass surface and the matrix. Ultimately, the volumetric shrinkage reduces during polymerization, ensuring a tight marginal seal. The resin with S-PRG filler had high filler content without bonding, which may be responsible for poor marginal integrity and high gross fracture in the giomer (Beautifil II[®]) material. Other glass fillers are present in giomer composite, so S-PRG should not be silanized. So, release and recharge and rerelease fluoride ions can be done by S-PRG.^{24,25}

Secondary carious lesions (Table 1C) around the margins of the restorations were observed at 9 months in nanoceramic restorations. At 9-month follow-up, giomer recorded 100% Alpha scores. Testing nanoceramic, out of the 20 restorations, 16 Alpha scores and four Bravo scores showed the recorded results; there was a statistically significant ($p < 0.05$) difference between both. Restoration failure is most commonly caused by secondary caries. The PRG filler in giomer (Table 2) allows the material to release fluoride and be recharged with fluoride, which is an excellent characteristic for long-term fluoride release. Fluoride is a well-documented anticariogenic agent. Fluoride-releasing restorative materials may be able to reduce recurrent caries at the restoration margins.²⁶⁻²⁹ Parental satisfaction regarding color, cost, and durability was evaluated by a questionnaire (using a Likert 5-point scale). Overall, parental satisfaction with the treatment was excellent; however, satisfaction with regard to cost

Table 2: The restorative materials used in this study

Material name	Composition	Manufacturer and website
Magma NT®	Bisphenol A-glycidyl methacrylate (Bis-GMA), bisphenol A diethoxy methacrylate, urethane dimethacrylate, triethylene glycol dimethacrylate (TEGDMA), silanated barium glass powder 0.2–2 µm, nano zirconium oxide powder, amorphous silica powder; total inorganic filler content: 80%	Prevest DenPro Limited www.prevestdenpro.com
Beautifil II®	Base resin: Bis-GMA (7.5 wt%)/TEGDMA (5 wt%) resin; filler: multifunctional glass filler and S-PRG filler based on fluoroaluminosilicate glass; filler loading: 83.3 wt% (68.6 vol%); particle size range: 0.01–4.0 mm; mean particle size: 0.8 mm; DL: camphorquinone	Shofu, Kyoto, Japan www.shofu.com

received the lowest rating. Limitations of the current study can be due to the shorter time period for recall evaluation, which was not sufficient to indicate the superiority of the restorations. In this study, the restorations were done in the form of strip crowns, so the results may vary in other forms of coronal restorations. Nanoceramics and giomers are both new materials and not many studies have been done till now, especially on primary teeth; further long-term clinical research is needed on a larger number of subjects to have a better vision of these new materials.

CONCLUSION

Nanoceramic restoration demonstrated better results in terms of gross fracture and marginal integrity, while giomer was better in terms of secondary caries. Parental satisfaction for both entities was comparable in terms of color and durability; however, they were cost-ineffective.

Clinical Significance

Nanoceramics and giomers can serve as an alternative to conventional restorative materials in primary anterior teeth because of their improved qualities.

ORCID

Rinku Mathur  <https://orcid.org/0000-0002-8687-3632>

Surbhi Sharma  <https://orcid.org/0000-0002-8226-4282>

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