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COMPARATIVE EVALUATION OF GIOMER HYBRID COMPOSITES AND BIOACTIVE RESIN-MODIFIED GLASS IONOMER CEMENT FOR RESTORATION OF CLASS I CARIES IN PRIMARY MOLARS

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ABSTRACT

Aim The present study aimed to comparatively evaluate the giomer hybrid composite to resin-modified GIC (glass ionomer cement) for restoration of Class I caries in primary molars.

Methods: 200 molars from 100 child subjects were divided into split-mouth fashion into two groups where controls of Group I were restored with giomer and Group II subjects were restored with bioactive resin-modified GIC. The restorations were assessed using modified United State Public Health Service criteria immediately, 6, and 12 months postoperatively.

Results: At the 12-month recall assessment, 132 teeth showed attrition of 32%. A non-significant difference was seen for the color match in the two groups. At 6 months, retention, anatomic form, and marginal integrity and discoloration had a non-significant difference, whereas a significant difference was seen at 12 months with respective p-values of <0.001, 0.03, >0.001, and 0.03. No sensitivity was seen at 12 months in each group.

Conclusion: In child subjects, resin-modified GIC with enhanced properties is an effective restorative material, especially in subjects having excessive salivary flow.

Keywords: Composite, caries, Glass Ionomer Cement, Giomer, molars

INTRODUCTION

An imbalance in the development of the oro-maxillofacial complex with teeth crowding is seen in subjects with premature loss of primary teeth. This also leads to malocclusion, skeletal deformities, and deleterious habits (1). Restoring carious primary teeth is challenging in children requiring both restorative and preventive aspects either by teeth restoration or fluoride application with material showing a bond to dentin and enamel and to take masticatory force (2).

Recently, with the latest techniques, new restorative materials have emerged that indirectly or directly interact with oral cavity changes and are termed smart materials. Other types are bioactive materials that get a response from cells, organisms, or living tissues including hydroxyapatite formation (3). Bioactive materials solubilize proteins from exposed dentin to materials like the acidic solution used in the dentin bonding agent, Mineral Trioxide Aggregate [MTA], and calcium hydroxide leading to gene expression modulation in odontoblasts causing dentin bridge formation (4).

A large variety of restorative materials are available for the restoration of primary and permanent teeth. Among these direct and indirect restorative materials, one direct restorative dental material

is a composite resin which is considered to be the most esthetic dental material having acceptable functional properties which can be attributed to its widespread use globally including the Indian dental clinical scenario (5,6).

Composite resin restorative material was considered as a resin mixture comprising different inorganic and organic particles by S. R Schricker. These organic and inorganic particles comprise various agents including the coupling agent, the initiator for the chemical reaction in the composites, the filler particles, and the resin matrix. These components present a unique combination where the indication and properties of the new material are evaluated with the proportion in which the components of the composite are mixed (7).

Composite resins are unique restorative material that helps in achieving the esthetic results after restoration and lads to conservative and minimal tooth preparation leading to a smaller loss of the tooth structure. This minimal preparation of the affected tooth helps in making a dental restoration without the help of a laboratory or the need for any laboratory equipment for the restoration (8). Composite restorative materials have other added advantages including the low or minimal cost of the restorative material, the ability to get repaired in the intraoral environment, can be replaced intraorally by indirect composite restorations or ceramic restorations, good marginal integrity, and holding wear resistance and almost similar to the natural teeth present in the dentition (9).

Another class of restorative materials widely used in dentistry, especially in child subjects is fluoride-releasing restorative materials. These restorative materials have added advantage of being in close contact with the oral fluids constantly that have a large impact on the protective ability and properties with recharge and release of the fluoride ions from the restoration (10). One such fluoride-releasing cement that is widely popular is glass ionomer cement which can adhere to tooth structure by chemical means. This property further helps in preventing fluid microleakage from the restoration and prevents ingress of microorganisms from the oral cavity to the restoration teeth interface. However, one disadvantage associated with glass ionomer cement is the very weak mechanical resistance of this restorative material (11).

Owing to the various advantages and few disadvantages of the composite esthetic restorative material and glass ionomer cement, the combination of the characteristics associated with the two restorative materials led to the development of the hybrid cement named giomers that have additional properties of both the restorative materials. The giomers are a class of restorative materials presenting the composites and provide excellent esthetic results, functional outcomes, and protection against caries. Giomers had superior properties attributed to the incorporation of glass fillers that are pre-reacted and embedded in the composite material matrix (12).

Giomer is smart hybrid material having a stable glass-ionomer phase on a glass core causing an acid-base reaction in polycarboxylic acid and fluoride-containing glass in PRG (pre-reacted glass-ionomer) filler that prevent expansion and water absorption tendency seen in restoring the first-generation giomer made of fully-reactive PRG filler (13). Another bioactive bulk filling material is enhanced RMGI (resin-modified glass ionomer) which reduces the time taken and several increments. RMGI has chemical and physical properties resembling natural teeth (14).

The present study aimed to comparatively evaluate the giomer hybrid composite to resin-modified GIC (glass ionomer cement) for restoration of Class I caries in primary molars.

MATERIALS AND METHODS

The present split-mouth clinical study was done to comparatively evaluate the giomer hybrid composite to resin-modified GIC (glass ionomer cement) for restoration of Class I caries in primary molars. Informed consent, in both written and verbal form, was collected from the guardians to ensure study participation.

The study included 200 subjects from both genders 56 males and 44 females in the age group of 5 years to 9 years with a minimum of two occlusal caries lesions on the primary molars on either maxillary or mandibular arches. The inclusion criteria for the study were teeth with no periapical or periodontal lesions, teeth with no developmental defects such as fluorosis, hypoplasia, or hypo mineralization, asymptomatic teeth, teeth with no pulpal involvement, and mouth with bilateral occlusal caries with cavities on either maxillary or mandibular molars. The exclusion criteria were subjects who did not sign consent for study participation, uncooperative subjects, anxious subjects, and subjects with medical diseases or conditions.

Occlusal caries were identified using Criteria Manual: International Caries Detection and Assessment System (ICDAS II) (15) and code 4,5, whereas, the restorations were assessed using modified USPHS (modified United State Public Health Service) criteria. The included sides were randomly divided into the control and experimental group where the investigator and participants were blinded to the randomization.

As the study was split-mouth, in every subject one side was considered the control site and the other on the experimental side. The teeth included in the study were randomly divided into two groups based on the restorative material used where controls of Group I were restored with giomer and Group II subjects were restored with bioactive resin-modified GIC and were considered as the experimental group. Shofu Beautifil Injectable, Company: Shofu Dental India, Private Limited, Packaging Type: Packet

To restore the teeth, the conventional method was used and the manufacturer's instructions were followed. The restorations were assessed by the examiners immediately after restoration, 6 months, and 12 months after restoration following the modified USPHS criteria. The data gathered were assessed with statistical analysis using the chi-square test. The statistical significance was kept at $p<0.05$.

RESULTS

The study assessed 48% (n=96) females and 52% (n=104) males. There were 27% (n=54) second molars from the maxillary and 49% (n=98) mandibular second molars. The study included 10% (n=20) maxillary and 14% (n=28) mandibular first molars (Table 1).

Immediate postoperatively, in Group I restored with giomer, retention, anatomic form, marginal integrity, marginal discoloration, and the color match was seen in 51% (n=102), 44% (n=88), 50% (n=100), 50% (n=100), and 42% (n=84) subjects respectively, whereas, in Group II subjects restored with bioactive resin-modified GIC, these parameters were respectively reported in 49%

(n=98), 44% (n=88), 50% (n=100), 48% (n=96), and 43% (n=86) subjects respectively. These differences were statistically non-significant (Table 2).
At 6 months follow-up, retention, anatomic form, marginal integrity, marginal discoloration, and color match were noted in 23.5% (n=47), 16.5% (n=33), 23% (n=46), 21.5% (n=43), and 15.5% (n=31) subjects from Group I and 22.5% (n=45), 18% (n=36), 21% (n=42), 21% (n=42), and 19% (n=38) subjects from Group II (Table 2). Retention and color match were significantly higher in group I with respective p-values of 0.02 and 0.03.

At 12 months of assessment, retention, anatomic form, marginal integrity, marginal discoloration, and color match were seen in 15.5% (n=31), 9.5% (n=19), 11.5% (n=23), 11.5% (n=23), and 8.5% (n=17) subjects from Group I and 15% (n=30), 14% (n=28), 15.5% (n=31), 14.5% (n=29), and 11% (n=22) study subjects from Group II. All parameters for Group I (giomer) were significantly better compared to Group II (bioactive resin-modified GIC) with respective p-values of <0.001, 0.02, <0.001, and 0.03 except for color match with p=0.4 (Table 2).

On Intergroup comparison of various parameters at baseline and 12 months, in Group I, retention, anatomic form, marginal integrity, marginal discoloration, and the color match were seen in 66, 56, 66, 66, and 52 subjects at baseline and 58, 36, 44, 48, and 32 subjects at 12 months postoperative. The difference was statistically non-significant. In Group II, retention, anatomic form, marginal integrity, marginal discoloration, and color match were seen in 46, 62, 66, 64, and 58 subjects immediately post-operatively and 66, 58, 64, 52, and 46 subjects 12 months postoperatively (Table 3).

DISCUSSION

Maintenance of primary teeth is vital for overall health and chewing, preventing aberrant habits, craniofacial structure development, space maintenance, phonetics, and esthetics as reported by Anil S et al (16) in 2017. The study assessed the efficacy of bulk-fill RMGIC and giomer hybrid resin in restoring the occlusal surface of primary teeth.

The study showed that no difference was seen in the color match of the two restorative materials at all the assessment times. These results were in contrast to the study by Bagheri R et al (17) in 2005 where authors reported a significant change in the color of the restorative materials following food exposure after some time. The greater discoloration was reported with restorative materials having a large number of fillers.

On intergroup comparison concerning marginal integrity, better results were seen with the RMGIC compared to giomer hybrid resin composite material at 12 months assessment time. A study by Parveen S et al (18) in 2017 showed that among ormocer and giomer hybrid resin composite, lesser microleakage was seen with the ormocers which was consistent with the results of the present study.

The study results showed no statistical difference in the two study groups when compared in immediate postoperative and 6 months. However, at 12 months, less ability to maintain contour was seen with giomer compared to resin-modified GIC. These results were in agreement with Priyadarshini BI et al (19) in 2017 wherein in an in-vitro study, the abrasive pattern and wear of resin-modified GIC was similar to resin composite and superior to GIC.

At 12 months assessment time, retention was better for resin-modified GIC compared to giomer hybrid resin composite with statistically significant results with $p<0.001$. These results were consistent with the studies of Van Dijken JW et al (20) in 2019 where authors reported poor retention with giomer.

The study had limitations of weak recording of changes in marginal discoloration, marginal integrity, color match, anatomic form, and retention that were not accurately assessed. Also, the study had a short follow-up not judging the long-term results.

CONCLUSION

The study concludes that marginal discoloration and color change were acceptable in both restorative materials. Better marginal integrity, retention, and anatomic form are seen with resin-modified glass ionomer cement owing to its better sealing ability. Hence, bioactive resin-modified glass ionomer cement is an effective restorative material in children with hypersalivation. However, further long-term, in-vivo, and longitudinal studies are needed to reach a definitive conclusion.

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TABLES

Characteristics	**Number (n=200)**	**Percentage (%)**
Gender		
Females	96	48
Males	104	52
Second molar		
Maxilla	54	27
Mandible	98	49
First molar		
Maxilla	20	10
Mandible	28	14

Table 1: Demographic data of study participants

Assessment time	**Parameter**		**N=200**	**%**	**p-value**
Immediate	Retention	Group I	102	51	-
		Group II	98	49	
	Anatomic form	Group I	88	44	0.7
		Group II	88	44	
	Marginal integrity	Group I	100	50	-
		Group II	100	50	
	Marginal discoloration	Group I	100	50	-
		Group II	96	48	
	Color match	Group I	84	42	0.93
		Group II	86	43	
6 months	Retention	Group I	47	23.5	0.02
		Group II	45	22.5	
	Anatomic form	Group I	33	16.5	0.7

		Group II	36	18	
	Marginal integrity	Group I	46	23	0.08
		Group II	42	21	
	Marginal discoloration	Group I	43	21.5	3.5
		Group II	42	21	
	Color match	Group I	31	15.5	0.03
		Group II	38	19	
12 months	Retention	Group I	31	15.5	<0.001
		Group II	30	15	
	Anatomic form	Group I	19	9.5	0.02
		Group II	28	14	
	Marginal integrity	Group I	23	11.5	<0.001
		Group II	31	15.5	
	Marginal discoloration	Group I	23	11.5	0.03
		Group II	29	14.5	
	Color match	Group I	17	8.5	0.4
		Group II	22	11	

Table 2: Intergroup comparison of various parameters at different time intervals

Groups	**Parameter**	**Immediate post-op (n)**	**12 months (n)**	**p-value**
Group I	Retention	66	58	-
	Anatomic form	56	36	2.84
	Marginal integrity	66	44	-
	Marginal discoloration	66	48	3.81
	Color match	52	32	10.44
Group II	Retention	46	66	-
	Anatomic form	62	58	7.97
	Marginal integrity	66	64	-
	Marginal discoloration	64	52	-
	Color match	58	46	9.42

Table 3: Intergroup comparison of various parameters at baseline and 12 months