

Evaluation of Clinical Efficacy of Tooth Colored Restorative Materials in Primary Teeth

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Abstract

Aim: The objective of the study is to evaluate clinical efficacy of tooth colored restoration- glass ionomer cement, resin modified glass ionomer cement and composite resin material in deciduous dentition.

Methods: Total of 150 class I cavity in deciduous second molar tooth were divided into three groups and restored with glass ionomer cement, resin modified glass ionomer cement (RMGIC) and composite resin restoratives following cavity preparations. Clinical efficiencies were evaluated by modified USPHS rating criteria- marginal integrity, surface texture and recurrent caries in 3, 6 and 12 months recall intervals. Data was obtained and analyzed by Chi-square test.

Results: Glass ionomer, RMGIC and composite resin exhibit similar criteria in 3- and 6-months recall intervals and there were no significant differences were found. At 12 months recall interval, significant differences were found in marginal integrity ($p=0.03$) and recurrent caries ($p=0.00$). However, surface texture remains similar for all restoratives, and no significant differences were detected ($p=0.11$).

Conclusion: All 3 restorative materials exhibit good performances in out in vivo study on deciduous dentition. Composite resin and RMGIC exhibit better efficiencies in marginal integrity while glass ionomers dominate in recurrent caries control.

Keywords: Composite resin, Dental caries, Glass ionomer, Primary teeth, Restorative materials

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Introduction

Dental caries believed to be a progressive disease that causes destruction of tooth materials unless they intervene by surgical or restorative approach.¹ With increasing demands of tooth-colored restorative materials on restoration of primary molars, glass ionomer cement and composite resin-based cements outgrown conventional amalgam restorations.² Amalgam restoratives were used over 150 years due to its advantages like durability, strength and convenient operating procedure.³ But now a days the use of amalgam restoratives are restricted due to some serious issues like potential mercury release and environmental pollution.⁴ Thus the popularity of alternative restorative materials are gaining popularity in restorative cases.³

Glass ionomer cement has got several advantages like physicochemical adhesion, low shrinkage, release of fluoride, biocompatibility etc. which can be used as good alternative to amalgam in case of restoration of primary molars.⁵ On the contrary, it is associated with some disadvantages to such as lack of strength, moisture sensitivity, low wear resistance that can cause dislodgment or fracture of restoratives and failure of the treatment.⁶ The recent advancement of glass ionomer restoratives includes resin infiltration which improves the strength, wear resistance and handling characteristics of the material.⁷ Chemical adhesion to enamel and dentin provides extra advantages like dimensional stability, good marginal integrity, resistance to microleakage etc.⁸ Composite materials are frequently used alternative material and recognized for many advantages such as high strength, durability and superior wear resistance.⁹ However, it is influenced by certain factors which determines it's success as restorative materials.¹⁰ Composite resin materials are excellent choice for restoration of posterior tooth by taking consideration of proper moisture control, technique sensitivity and secondary caries formation.¹¹

Restoration of primary teeth is quite different from permanent teeth due to their unique morphological features as well as maintaining favorable work field of pediatric patients.¹² The objective of the study is to evaluate clinical efficacy of tooth colored restoration- glass ionomer cement, resin modified glass ionomer cement and composite resin material in deciduous dentition.

Materials and Methods

The present study was a clinical comparative study administered in a private dental clinic of Dhaka, Bangladesh. 150 patients of same age group with well-defined criteria were selected for the study. The inclusion criteria include-

- Healthy patients with not known any compromised health conditions.
- Age between 3 to 6 years
- Class I cavity of primary deciduous second molar.
- Restorable tooth condition.

There were certain conditions of the subjects or field that were considered as exclusion criteria stated below-

- Patients with medically compromised conditions.
- Tooth with deep caries lesion.
- Non restorable tooth.
- Presence of sinus tract or periapical lesions.

- Cases of restoration with lost follow-up.

The samples were divided into 3 groups-

- Group 1- Included fifty teeth of 50 patients with class I cavity preparation in primary deciduous second molars were restored with glass ionomer cement- Fuji II.
- Group 2- Included fifty teeth of 50 patients with class I cavity preparation in primary deciduous second molars were restored with resin modified glass ionomer cement (RMGIC)- Fuji II LC.
- Group 3- Included fifty teeth of 50 patients with class I cavity preparation in primary deciduous second molars were restored with composite resin- Clearfil AP-X.

Methods

The study was conducted on 150 teeth with three different restorative regimes on posterior deciduous second molar teeth in a private dental clinic of Dhaka, Bangladesh. The inclusion criteria were evaluated thoroughly before selection of teeth for study. The cavity was prepared by air rotor handpiece with straight fissure diamond burs according to the size of the cavity with sufficient water coolant. The deeper portion of the carious lesions were removed, and debridement was completed by slow speed handpiece with round bur. Following the cavity preparation, it was cleaned with water and dried with air. If the cavity is deeper and preparation is close proximity to the pulp (approximate 0.5 mm of pulp chamber), suitable calcium hydroxide liner was placed before final restoration. The cavity was filled with selected restoratives following their manufacturer instructions.

For glass ionomer cement- Fuji II (Group 1), following cavity preparation, isolation was maintained by cotton rolls, high volume evacuator and cheek retractor. Glass ionomer cement was prepared and mixed according to the manufacturer instructions followed by restoration of the cavity. Post operative instruction was given and recall date has been confirmed.

For RMGIC- Fuji II LC (Group 2), the prepared cavity was conditioned with GC cavity conditioner for 10 seconds. Following conditioning, RMGIC was mixed and placed on cavity under adequate isolation with cotton rolls, high volume evacuation and cheek retractor. The restoration was cured for 20 seconds and finishing and polishing was conducted thereafter.

For composite resin- Clearfil AP-X (Group 3), after preparation of cavity, isolation was maintained very carefully using above-mentioned techniques. The self-etching primer gel was applied with syringes, and cavity was etched for 15 seconds. The cavity was rinsed with water and dried with air after etchant application. After drying, bonding agents were applied using applicator tip and cured for 20 seconds. Thereafter, cavities were filled with composite resin and cured for 20 seconds followed by finishing and polishing.

After completion of the restoration procedure, post operative instruction for each restorative material was given and patients were advised to recall appointments at 3,6 and 12 months. During recall examinations, the efficacy of restorations was evaluated in three categories- marginal integrity, surface texture and recurrent caries using modified USPHS rating criteria (table 1).¹³

Table 1: Modified USPHS rating criteria for restorative materials

Category	Grade	Evaluation criteria
Marginal integrity	M1	Closely adapted, no visible crevice
	M2	Visible crevice, explorer will penetrate
	M3	Crevice in which dentin is exposed
Surface texture	S1	As smooth as the surrounding enamel
	S2	Rougher than surrounding enamel
	S3	Very rough
Recurrent Caries	C1	No caries present
	C2	Caries present

The efficacy of three restorative materials was evaluated; data was analyzed using SPSS (Statistical Package for the Social Sciences) 27 and Chi-square test was carried out to figure out any significant differences between these restorative materials.

Results

The demographic information of the participants and morphological variations are given in table 2 and table 3.

Table 2: Demographic information of the study (n=50)

		Glass ionomer cement (n)	RMGIC (n)	Composite Resin (n)	Mean $\pm$ SD
Gender	Male	22	24	28	N/a
	Female	28	26	22	N/a
Age Group	3-4 years	10	8	12	4.8 $\pm$ 1.16
	4-5 years	22	16	14	
	5-6 years	18	26	24	

Table 3: Morphological variations of the study

Restorative Material	Sample Size	Maxillary deciduous		Mandibular deciduous	
		second molar		second molar	
		Left	Right	Left	Right
Glass ionomer cement	50	10	14	18	8
RMGIC	50	12	10	16	12
Composite Resin	50	14	10	14	12

The efficacy of restorative materials was evaluated clinically during 3, 6 and 12 months follow-up periods. Total 25 teeth of 75 patients with each restorative category teeth were evaluated for study. The restorative tooth was

cleaned with pumice and evaluation criteria was examined with dental mirror and explorer.

Table 4: Evaluation of efficacy of different restorative materials in 3, 6 and 12 months follow-up periods

Evaluation criteria	Number of teeth studied	Evaluation period	Evaluation grade	Group 1 Glass ionomer cement (n=25)	Group 2 RMGIC (n=25)	Group 3 Composite resin (n=25)
Marginal integrity	150	3 months	M1	42	40	46
			M2	8	8	4
			M3	0	2	0
		6 months	M1	36	38	40
			M2	10	6	8
			M3	4	6	2
		12 months	M1	30	34	34
			M2	6	6	10
			M3	14	10	6
Surface texture	150	3 months	S1	46	46	48
			S2	4	2	0
			S3	0	2	2
		6 months	S1	44	42	46
			S2	4	6	2
			S3	2	2	2
		12 months	S1	38	34	40
			S2	8	8	6
			S3	4	8	4
Recurrent caries	150	3 month	C1	49	48	50
			C2	1	2	0
		6 months	C1	48	44	46
			C2	2	6	4
		12 month	C1	46	42	40
			C2	4	8	10

Table 4 showing marginal integrity, surface texture and recurrent caries status of restorative regimes in 3 months, 6 month and 12 months follow-up.

Table 5: Comparison of efficacy of Glass ionomer cement, RMGIC and composite resin restorative materials in 3, 6 and 12 months follow-up periods.

Evaluation criteria	Evaluation period	Chi-square test value	P-value
Marginal integrity	3 months	2.381	0.30
	6 months	6.140	0.18
	12 months	15.68	0.03*
Surface texture	3 months	0.378	0.82
	6 months	1.299	0.86
	12 months	7.43	0.11
Recurrent caries	3 months	2.50	0.50
	6 months	0.284	0.59
	12 months	16.75	0.00*

* Statistical significance $p \leq 0.05$

Table 5 showing the comparison of different restorative materials in 3, 6 and 12 months recall intervals.

Discussion

The present study was carried out to evaluate clinical efficacy of different tooth-colored restorative materials in posterior deciduous molar. Recently, lots of research is being conducted on different restorative regimes to identify their efficacy on primary teeth.¹⁴ In this study, clinical potency- marginal integrity, surface texture and recurrent caries status of glass ionomer cement, RMGIC and composite resin restoratives on primary teeth were studied.

Marginal integrity was assessed in all restoratives, and similar results were found in case of glass ionomer and RMGIC, while better efficacy was seen in composite resin. In our study no significant differences were figure out in 3 months and 6 months follow up periods, but better efficiency found in composite resin and RMGIC on 12 months follow-up ($p=0.03$). Rozniatowski *et al.* reported similar efficacy of composite resin in their studies on permanent teeth.⁹ They concluded that, glass ionomers have higher risk of marginal adaptation deterioration than composite resin.⁹ RMGIC showed improved adaptive properties like previously studied by Prabhakar *et al.*¹⁵ Krishnakumar *et al.* compared high viscosity glass ionomer and composite resin in primary teeth in systematic review and found satisfactory outcomes on both restoratives.¹⁶ In our study, all restorative materials exhibit satisfactory quality when they were evaluated primary dentition.

In our study, surface texture of all restorative materials was assessed in 3, 6 and 12 months follow up periods. Composite resin exhibits better texture in all recall periods when compared to glass ionomer or RMGIC, but the difference was not significant. A relevant study by Das *et al.* studied in restorative materials comparing anatomic forms of restoratives are alike the results of our study.¹² They have found out good performances of composite resin than other restoratives while the difference was not significant.¹² Yehia *et al.* studied on RMGIC restorative materials and found out their better texture quality and explained the phenomenon might be due to their resilient resin matrix with energy-absorbing elastomeric components.¹⁷

Recurrent caries status at 3 months follow-up seems to be very few, but some extent of difference detected after 6 months follow-up. During evaluation, Composite resin and RMGIC encountered several cases of recurrent caries while Glass ionomer cement showed only couple of cases where differences were not significant ($p= 0.59$). Recurrent caries status showed higher in Composite resin compared to rest of the regimes after 12 months follow-up. The difference was found significant ($p=0.00$) at 12 months recall period evaluation. Study by Choudhary *et al.* showed similarities with result of our study where glass ionomer cement and RMGIC showed better results when compared to resin composite.¹⁸ They

have noted chemical adhesion might be the reason for lower initiation of recurrent caries.¹⁸ The phenomenon might be due to higher fluoride release capability of glass ionomer restoratives.^{19,20}

Hamie *et al.*, concluded their study that the glass ionomer restoratives exhibit more convenient form in case of primary teeth with numerous effects, while composite resin recognized for their superior performances.¹⁴ In our study, we have also found similar results when comparing their performances in deciduous molar. Fluoride release from glass ionomer restorative could have a great role on prevention of initiation of secondary caries as well as remineralization of tooth structure.⁸ Besides, adaptation levels seem to be better in case of composite resin restoratives.²¹ Wilde *et al.* found out that the performances of RMGIC was satisfactory despite their isolation method.²² However, it is necessary to evaluate for longer terms to figure out survival of restorative materials in primary dentition.²³

In our study, clinical efficacy of restorative materials was evaluated by their marginal integrity, surface texture and secondary caries initiation. Further studies can be carried out on retention or fracture, postprocedural hypersensitivity or vitality and surface discoloration. Moreover, the longer period of study can illustrate longevity of restorative materials on dynamic oral conditions.

Conclusions

In our study, all restorative materials- glass ionomer, RMGIC and composite resin exhibit satisfactory results in clinical efficacy on primary dentition. Among those glass ionomer showed higher reputation in prevention of secondary caries formation while composite resin showed higher success rate in marginal integrity. However, RMGIC has got satisfactory results in all parameters.

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