Original Article

A comparative evaluation of compressive strength and antimicrobial efficacy of Fuji IX and Amalgomer CR: An in vitro study

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ABSTRACT

Purpose: To evaluate and compare the compressive strength and antimicrobial efficacy of Amalgomer CR and Fuji IX.

Method: 40 restorative pellets were taken for evaluating compressive strength and 40 blood agar petridishes for antimicrobial efficacy. 40 restorative pellets were fabricated from the tested materials according to manufacturer instructions. Then the pellets were subjected to compressive strength testing using Instron Universal Testing machine. Antibacterial activity of Amalgomer CR and Fuji IX was assessed using the agar diffusion test. The powder and liquid of each test material was mixed and inserted in the punched wells (6 mm × 2 mm) in agar petridishes. An empty well was taken as control to authenticate the results. The agar plates were incubated at 37 °C for 24 h for *Streptococcus mutans* growth and then size of the inhibition zones was measured using vernier caliper.

Results: Amalgomer CR had shown significantly higher Compressive Strength but comparable antimicrobial efficacy to GIC Fuji IX.

Conclusion: Amalgomer CR can be recommended as a permanent restorative material based on its better compressive strength and comparable antimicrobial efficacy to GIC Fuji IX.

1. Introduction

Dental caries is a global public health challenge, especially among young children. Caries can begin early in life, progresses rapidly in those who are at high risk and often goes untreated.¹ Once dental caries occurs, restoring the carious lesion becomes mandatory. The most widely used material for restoring the deciduous teeth is glass ionomer cement. It has been shown to be a very useful adjunct to restorative dentistry because of its unique abilities like fluoride release, coefficient of thermal expansion similar to tooth, chemical bonding to enamel and dentin, excellent biocompatibility and esthetics.²

They are, however, susceptible to fracture and exhibit low wear-resistance. These drawbacks have limited their use, and made them unsuitable for high-stress areas such as class I and II restorations. Because of their low compressive strength, fracture toughness and brittleness, a variety of modifiers have been added to conventional glass-ionomers, to improve their mechanical properties. Recently, a new ceramic-reinforced glass ionomer (Amalgomer CR) has been introduced to the dental market. This tooth-coloured product is proposed by the manufacturer to combine the high strength of a metallic

restorative and the aesthetics and other advantages of glass ionomers.¹

Considering the importance of compressive strength, antibacterial property of restorative material, the purpose of the study undertaken was to evaluate and compare the compressive strength and antibacterial efficacy of Amalgomer CR and GIC Fuji IX.

2. Materials and method

This study was carried out in the Department of Pedodontics and Preventive Dentistry, D. J. College of Dental Sciences and Research, Modinagar. The restorative materials tested were Amalgomer CR (Advanced Health Care pvt ltd) and GIC Fuji IX (GC Tokyo, Japan).

For Compressive strength evaluation, standardized 40 cylindrical autoclavable plastic molds were prepared and were considered as Group I.

2.1. Group I (compressive strength)

40 molds in Group I were randomly divided into the following two groups and color coded accordingly (Fig. 1).

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Fig. 1. Restorative pellets.

GpIA- (Pink) molds were filled with Amalgomer CR. (n = 20).
GpIB – (Green) molds were filled with Fuji IX. (n = 20).

2.1.1. Group I A (Amalgomer CR)

Amalgomer CR powder and liquid was mixed according to the manufacturer's instructions. The mix was completed within a total of 30s. The mixed restorative cement was carried with the plastic filling instrument and placed into the mold. The restorative cement was condensed using a round condenser. The mold was then covered with a mylar strip (cellulose strip) and compressed together with the glass slab on both sides, so that excess material is removed.

2.1.2. Group I B (GIC Fuji IX)

The mixing of restorative material and restoration of molds was done similarly as it was done in Group I A (Amalgomer CR).

The obtained restorative pellets were then stored in distilled water to allow the restorative material to attain its complete strength. Incubation was done to simulate oral conditions for 24 h. Thereafter, post incubation restorative pellets from both the groups were subjected to compressive strength evaluation using Instron Universal Testing Machine (Fig. 2).

2.2. Group II (Antibacterial efficacy)

On 40 blood agar petridishes *Streptococcus mutans* was cultured by streaking method. Thereafter with the help of inoculating tip, wells measuring 6 mm in diameter and 2 mm in depth were made. 3 wells were made in each petridish, one each for Amalgomer CR and Fuji IX respectively and one empty well was kept as a control to authenticate

Fig. 2. Compressive strength evaluation.

Fig. 3. Placement of restorative materials in punched wells.

the result (Fig. 3).

The collected 40 petridishes were randomly divided into the following three groups and color coded accordingly.

Gp II A- (Pink) samples were filled with Amalgomer CR. (n = 40).

Gp II B- (Green) samples were filled with Fuji IX. (n = 40).

Gp II C - (Red) samples were left empty. (n = 40).

Petridishes were handled under aseptic conditions and post restoration of the wells with respective restorative material were incubated for 24 h at 37 °C. Zones of *Streptococcus mutans* growth inhibition around the wells were measured in milli meters with a vernier calliper. For each test material, 6 measurements were made and mean of that was calculated (Fig. 4).

Data for Compressive Strength and Antimicrobial Efficacy were collected and send for statistical analysis.

3. Result and observations

The data was statistically analysed using Independent *t*-test, ONE WAY- ANOVA and Tukey's test and the following results were obtained.

The mean value of the compressive strength was statistically higher in Group I A (Amalgomer CR) then Group I B (Fuji IX) (Table 1) (Graph 1).

The mean value of the antimicrobial Inhibition zones was 5.095 mm for Group II A (Amalgomer CR), 3.68 mm for Group II B (Fuji IX) and 0.00 for Group II C (Control) (Table 2) (Graph 2).

Inter comparison of various groups for antimicrobial efficacy was done using Tukey's test. All inter group comparisons between the mean values of various groups was found to be statistically significant except between Group II A and Group II B (Table 3).

Fig. 4. Inhibition zones.

Table 1

Mean value of compressive strength of the studied groups.

Group I**	N	Mean	Std. Deviation	Std. Error Mean	P value* (Gp I A vs Gp I B)
Gp I A	20	77.750	5.3715	1.2011	0.000
Gp I B	20	33.190	3.9867	0.8914	0.000

**Gp I A- Amalgomer CR.

**Gp I B- Fuji.

*P value ≤ 0.05 (Significant).P value ≥ 0.05 (Non Significant).

4. Discussion

Compressive stress results when the body is subjected to two sets of forces in the same straight line but directed toward each other. Thus compressive strength of a material is important mechanical property to prevent fracture of a material when occlusal load is applied. In addition to mechanical properties antibacterial efficacy is equally important because culture studies have demonstrated a strong association of *Streptococcus mutans* with caries. Complete excavation of the caries is not possible in all cases usually in rural settings. Hence, the antibacterial property of the material used for restoring the tooth becomes important.¹

In the present study, the mean value of compressive strength was significantly higher in Amalgomer CR (Group I A) than Fuji IX (Group I B). The reason might be because the filler content which is mainly quartz in Glass Ionomer Cement is reinforced by ceramic particles in Amalgomer CR and according to the manufacturer the ceramic filler is able to react partially with the matrix, which may produce some bonding³ and thus increases the overall strength of the restoration while in Glass Ionomer Cement Fuji IX no such reinforcement of filler particles is reported. Study done by Yan Wang, B. W Darvell³ (2009) in which Hertzian load-bearing capacity of a ceramic-reinforced glass ionomer cement stored wet and dry in which he concluded that the load bearing capacity of Amalgomer CR was stable in air, but no statistically significant trend over time. Naveen M Ayad, Salwa A. Elnogoly, Osama M. Badiein 2008 did similar in-vitro study to check physico-mechanical properties of a new esthetic restorative versus dental amalgam and

Table 2

Mean values of the antimicrobial efficacy in various groups.

Group II**	N	Mean	Std. Deviation	Std. Error Mean
Gp II A	40	5.095	0.2364	0.0374
Gp II B	40	3.688	0.7265	0.1149
Gp II C	40	0.000	0.0000	0.0000

**Gp II A- Amalgomer CR.

**Gp II B- Fuji IX.

**Gp II C- Control.

concluded that physico-mechanical properties of the tooth-coloured ceramic-reinforced glass ionomer were so close and sometimes significantly superior to dental amalgam.⁴

The antimicrobial property was found to be more in Amalgomer CR (Group II A) than Fuji IX (Group II B). The inhibitory action of Amalgomer CR may be attributed to the coarse nature of ceramic particles contributing to fluoride release.⁵

By reinforcing the filler particles by ceramic the effective surface area of restorative material might be getting increased thus increasing the effective surface area available for elution of fluoride.

Once the initial set of GIC is complete it contracts minimally in its dimension.⁶ Thus reducing the surface area available for fluoride release. This might be a reason for GIC type IX to show little less but comparable antimicrobial efficacy of Amalgomer CR. This is supported by DeSchepper et al., in 1991 who observed that the coarse silver alloy particles in Argon (a metal reinforced glass ionomer), which are not bound to the cement-matrix, result in an increase in microporosity of the cement, thus increasing the effective surface area available for elution of fluoride⁷

Empty well in the agar petridish was taken as control (Group II C) to authenticate the results and there was no inhibition zones seen around the empty wells.

Thus Amalgomer CR can be recommended as a permanent restorative material on account of its Compressive Strength and with comparable properties to Fuji IX. Many long term studies are required to authenticate the results.

Graph 1. Graphical analysis of the Compressive strength of the various groups.

Graph 2. Graphical analysis of the Microbial efficacy of the various group.

*Gp II C: Control (empty well, there was no inhibition zone and value is zero).

Table 3

Multiple group comparison of the antimicrobial efficacy of various groups.

(I) group**	(J) group	Mean Difference (I-J)	Std. Error	P value*	95% Confidence Interval	
					Lower Bound	Upper Bound
Gp II A	Gp II B	1.4075	.0986	0.06	1.168	1.647
	Gp II C	5.0950	.0986	0.000*	4.855	5.335
Gp II B	Gp II A	-1.4075	.0986	0.059	1.647	1.168
	Gp II C	3.6875	.0986	0.000*	3.448	3.927
Gp II C	Gp II A	-5.0950	.0986	0.000*	5.335	4.855
	Gp II B	-3.6875	.0986	0.001*	3.927	3.448

**Gp II A- Amalgomer CR.

**Gp II B- Fuji IX.

**Gp II C- Control.

*P value ≤ 0.05 (Significant).

P value ≥ 0.05 (Non Significant).

5. Conclusion

Following conclusions were drawn:

- When inter group comparison for Compressive Strength was done,

Compressive strength of Amalgomer CR was found to be statistically significantly higher than Fuji IX.

- The Antimicrobial efficacy (Inhibition zones) of Amalgomer CR and Fuji IX was found comparable.
- When inter group comparison for the antimicrobial efficacy was done, the antimicrobial efficacy (Inhibition zones) of Amalgomer CR and Fuji IX was found to be statistically non-significant.

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