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RESEARCH ARTICLE

COMPARITIVE EVALUATION OF WEAR RESISTANCE OF 3 TYPES OF TOOTH COLORED RESTORATIVE MATERIALS ON THE BASIS OF WEAR RESISTANCE

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ABSTRACT

Aim: To compare and evaluate wear resistance of three tooth coloured restorative materials on the basis of wear resistance.
Background: Tooth colored restorative materials are very prone to wear due to abrasion and erosion by the various constituents of saliva, food consumed and other factors. Therefore it is important to determine the best material for class 1 restoration on the basis of wear resistance.

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INTRODUCTION

Tooth colored fillings, also called white fillings, are dental fillings that restore and mimic the natural appearance of tooth structure. In addition to restoring teeth that have fractured or decayed, tooth colored fillings may also be used cosmetically to change the size, color and shape of teeth.Esthetically acceptable tooth colored restorative materials have been formulated in recent years and steadily improved especially as regards their physical properties. Recently, there have been a lot of advances in GICs. The new resin modified GIC have better strength and hardness as compared to the conventional GICs. More recently, there has been a further development by manufacturers to develop paste/paste systems. The GIC is usually a RM-GIC but can be light-cured or chemically (self-)cured. By having a paste/paste system, again the best physical properties can be attained as well as being able to be dispensed in small quantities. Each manufacturer has developed its own system with some of those materials that were originally dispensed as a powder and liquid being modified to a paste/paste system, making it simpler to mix and use. The GIC type 9 Fuji has increased strength and wear resistance. The inclusion of resin into the cement seems to show improved strength but also tends to make the cement slightly less brittle in nature. These have features such as chemical adhesion with the tooth, similar thermal expansion as tooth structure producing minimal stress on the marginal seal, strontium based fluoride releasing formulation contributing to internal remineralization within tooth structure as well as increasing surface strength over time, high compressive and flexural strength. On the other hand, RM-GICs are also susceptible to erosion. Water has been demonstrated to have an erosive effect on the surface of RM-GICs. Another modification of RM-GIC is the Equia Forte GIC with hybrid glass filler particles. EQUIA Forte doesn't require any layering, is non sticky and packable, and adapts nicely to the cavity walls. The use of a rubber dam is optional and the chemical adhesion eliminates complicated bonding procedures.There is no need for any complex finishing and polishing since only a single application of EQUIA Forte Coat is required. Composite on the other hand is known to have highest strength among the tooth colored restorative materials. The new composite charisma is really easy to handle and, through its vital shades, allows simple single-shade layering techniques for natural everyday restorations, the ability to form layered structures helps reduce air entrapment. This study aims to find the best-suited restorative material on the basis of wear resistance.

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MATERIALS AND METHODS

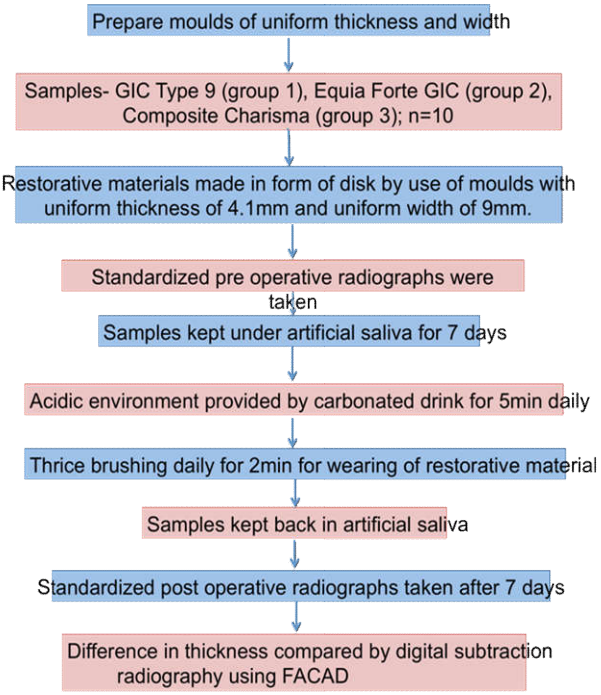
Three types of tooth colored restorative materials- Composite charisma, Equia Forte and GIC Type 9 fuji were taken as samples. Figure 1 lists the differences in properties of these 3 materials.

PROPERTIES	GIC Type 9	Equia Forte GIC	Composite Charisma
WORKING TIME	1min 25sec	1min 15sec	
SETTING TIME	2min 30sec	2min	
FILLER PARTICLES	nano filler particles	nano filler particles with additional hybrid glass technology	nano filler particles
FLUORIDE RELEASE	present	maximum fluoride release	absent
CURING TIME	20sec ; bulk restoration	20sec ; bulk restoration	10sec ; incremental build up

Figure 1.

Specimen preparation

Thirty acrylic cylindrical molds with a socket, 9 mm in diameter, were prepared for each thickness 4.1mm to standardize the samples. They were divided into three groups- Composite charisma, Equia Forte and GIC Type 9 fuji (n = 10). The materials were dispensed into the moulds, manipulated and polymerized on thin glass slides according to the manufacturers' instructions. The top surfaces were then covered with another glass slide to make the surface flat. Polymerization was then carried out using a LED light curing unit (BluePhase, Ivoclar Vivadent Inc., Amherst, NY, USA; light intensity of 1,200 mW/ cm^2) for 20 seconds in contact with the top surface of the specimens. Preoperative radiographs were taken using a standardized frame for all the samples. The samples were subjected to daily 6 min of brushing with horizontal strokes to account for abrasion during normal brushing by a normal person. The samples were also kept in carbonated drink for 5 min daily to account for the acidic environment. After 1 week of testing, post operative radiographs of the samples were taken and measured for the wear by comparing pre operative to post operative radiographs through a softwarecalled FACAD.



Statistical analysis

	A	B	C
1	group 1	group 2	group 3
2	3.8	4	4
3	3.8	3.8	4
4	3.7	3.9	4
5	3.9	3.9	4.1
6	3.8	4	4.1
7	3.9	3.9	4
8	3.7	4	4.1
9	3.8	4	4
10	3.8	3.8	4
11	3.9	3.9	4.1
12			
13	3.81	3.92	4.04
14	0.073786	0.078881	0.05164

Figure 4

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.264666667	2	0.132333333	27.69767442	2.88E-07	3.354130829
Within Groups	0.129	27	0.004777778			
Total	0.393666667	29				

Figure 2

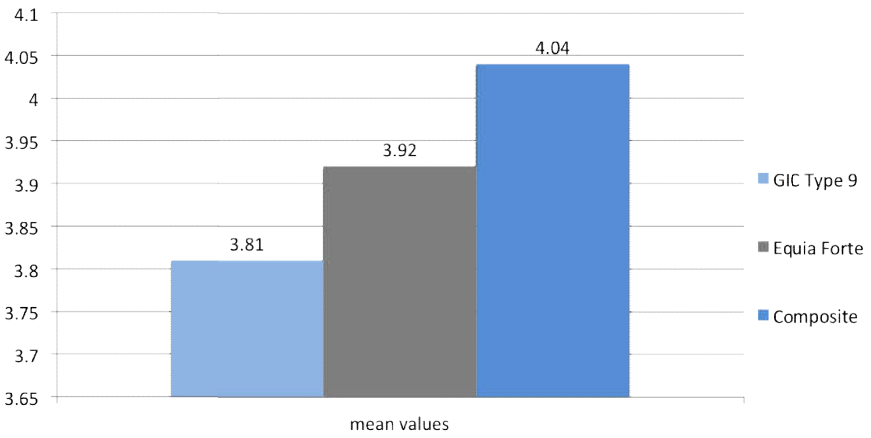


Figure 3.

RESULTS

Figure 2 shows the mean value of each group along with their standard deviation. Group A (GIC Type 9 fuji) had a mean of 3.81mm, Group B (Equia Forte) had a mean of 3.92mm and Group C (composite) had a mean of 4.04mm. According to the three way ANOVA test (Figure 3), the F is > than F critical and p value> 0.05, so we can reject the null hypothesis that there is no difference between the means of the group. Since there is a significant difference, hence the null hypothesis is not acceptible.

DISCUSSION

The loss of tooth structure due to erosive or acidic materials has become a significant issue (Kitasako *et al*., 2015). The matrix of the GIC is the most susceptible part of the set cement when exposed to acids. Acids such as acetic, citric and lactic have all been used to evaluate erosion (Crisp *et al*., 1980; Matsuya *et al*., 1984; Fukuzawa *et al*., 1987). The conventional GICs are sensitive to water exposure in saliva shortly after placement. The water will damage and erode the surface of the GIC if it is left unprotected on insertion (Oilo, 1984). In the present study, Equia Forte GIC was found to have more wear resistance as compared to GIC Type 9 (Figure 4). This can be because of the hybrid glass filler particles present in Equia Forte GIC that makes it more resistant to wear. Composite charisma smart was however found to have the most wear resistance as compared to Equia Forte and GIC Type 9 fuji. This is because it conatins higher proportion of resin component in the composition. The results of this study are found to be similar to the result obtained in a study done by Honório *et al*. in which pH cycling over a 35-day period using a cola drink and artificial saliva showed that both the conventional GIC and RM-GIC displayed greater amounts of erosion compared with amalgam and resin composite. In another study done by Soares *et al*. investigated the effects of erosion of a resin composite, conventional GIC and RM-GIC placed into root dentine cavity. It was observed that the acid erosion severely degraded the GIC surfaces as compared to resin composite. In other studies performed, for the RM-GICs, the incorporation of the resin was not shown to improve the abrasion resistance. In fact, a number of studies have reported that the abrasion resistance is decreased and that the RM-GIC materials will abrade more rapidly than conventional GICs (Pelka *et al*. 1996; Momoi *et al*., 1997; Peutzfeldt *et al*., 1997; Xie *et al*., 2000; Sunnegårdh-Grönberg *et al*., 2002). The reason for this reduction in abrasion resistance is thought to be due to the glass particles being bonded loosely to the matrix in association with a nonuniform distribution of the glass particles throughout the set cement (Xie *et al*., 2000). When a polyacid-modified resin composite (PAMRC) was compared with an RM-GIC clinically, it was also noted that the abrasion resistance was lower for the RM-GIC (Chinelatti *et al*., 2004).

Conclusion

From the study performed we can conclude that resin composite charisma has the maximum wear resistance as compared to Equia Forte and GIC type 9 fuji havinf the least wear resistance among the 3 materials tested.

REFERENCES

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Crisp *et al*. 1980
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Oilo 1984; Gemalmaz *et al*. 1998
Honório *et al*. 2008

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