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PHOTOSPECTROMETRIC ANALYSIS OF THE MICROLEAKAGE OF NEW RESTORATIVE MATERIAL (ACTIVA) AS COMPARED TO NANOFILLED COMPOSITE AND LIGHT CURING GIC: AN IN VITRO STUDY

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ABSTRACT:

Objectives: to evaluate and compare microleakage around class v cavities restored with activa, a nanofilled composite and lc gic

Materials And Methods: standard class v cavities were prepared around the buccal surface of 40 human mandibular premolars. Teeth were randomly divided into 4 groups depending upon the restorative material used, tetric n ceram, activa (used with bonding agent), activa (used without bonding agent) and lc gic. The restored teeth were thermocycled and then immersed in 2% rhodamine b dye under vacuum pressure for 48 hours. All teeth were then immersed in 35% nitric acid for dissolution. The solution was filtered and the supernatant solution was subjected to photospectrometric analysis for the evidence of light penetration. The data were analyzed using one way analysis of variance (anova)

Results: tetric n ceram showed the least values of microleakage around class v cavities. Tetric n ceram showed -94.1% light transmission followed by activa (used with bonding agent) -91.6%, activa (without bonding agent) 82.3% and the highest microleakage values were shown by lc gic with values of 75.2%.

Conclusion: activa (when used with a bonding agent) fared well in comparison with tetric n ceram in restoring class v cavities.

Keywords: Microleakage, Tetric N Ceram, ACTIVA, LC GIC, dye extraction

INTRODUCTION:

The demand for tooth-colored restorations has grown considerably since its introduction and developments in the technology.[1] Among the tooth-colored restorative materials, dental composite resins are most frequently used for the restoration of cervical lesions, especially for class V cavities where high configuration factor prevails, long-term performance of restorations is important.[2] The integrity and durability of the marginal seal is an important factor in the longevity of adhesive dental restorative materials, particularly for composite resins.[3]

One of the major shortcomings of the composite material is their polymerization shrinkage upon curing.[1] The shrinkage of composite resins during photo-polymerization induces stresses at the tooth/restorative interface and as an

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end result it may cause failures in the bond, generating gap formation (10–15 μm).[2] These microgaps allow the ingress of fluid or bacteria between the dentin pulp complex and the oral environment, leading to postoperative sensitivity and secondary caries formation.[2] There is a two-way interaction, that is the potential for leakage is influenced not only by the surface texture of the prepared tissues, but also by the composition and physical properties of the restorative materials applied to it.[3]

A range of different methods and materials have been proposed till date to minimize the negative effects associated with polymerization shrinkage of composites. Recently, Bioactive dental materials that are strong, esthetic and long-lasting offer an alternative to traditional composites that are without bioactive potential, and to glass ionomers, that are bioactive but have poor esthetics and undesirable physical properties.[4] It also adheres to dentin and does not require etching or bonding agents. Knowing the success and longevity of various adhesives enables practitioners to choose the most appropriate material for the clinical use.[5]

RMGIC and Nanocomposite are considered as gold standard materials in restoring the class V lesions. Several studies have been carried out and shown the conflicting results with regards to the degree of microleakage using various types of restorative materials. Thus, this study was conducted to evaluate microleakage around class V cavities restored with recently available BioACTIVE composite and compare it with the Nanohybrid composite resins and Resin modified GIC.

MATERIALS AND METHODS:

Forty non-carious freshly extracted human premolars were collected and stored in phosphate buffered saline solution at room temperature until use. Routine prophylactic procedure was carried out. The teeth with presence of fracture, crack or pigmentation were excluded. After autoclaving teeth samples, standardized Class V cavities were prepared on the buccal surface of all 40 premolars, using #245 carbide burs (Mani,Tochigi,Japan) in a high speed hand-piece with copious amount of water coolant. Bur was changed after each cavity preparation. Dimensions of the cavity preparation were kept exactly to: mesio-distal width of 3 mm, occluso-gingival height of 3 mm and depth of 2 mm. All cavity margins were kept in enamel. The depth of cavities was millimetrically standardized using a periodontal probe. All the preparations were performed by the same operator.

The teeth were then randomly assigned into 4 groups (n=10) depending on the restorative material used. Each sample was etched with 37% phosphoric acid.

- In Group I, bonding agent was applied first and light cured for 20 sec with QTH light curing unit (Elipar 2500, 3M ESPE, USA) at

1400mW/cm^2. All the samples were then restored with ACTIVA Bioactive Restorative (Watertown, MA, USA) material and light cured for 20 sec.

- In Group II, the samples were restored with the same material i.e ACTIVA Bioactive restorative but without the application of bonding agent (Pulpdent Corporation, Watertown, MA, USA).
- In Group III, bonding agent was first applied and light cured for 20 sec and then restored with Tetric N Ceram restorative material (Ivoclar Vivadent, Liechtenstein).
- In Group IV were restored with Resin Modified Glass ionomer cement (GC Gold Label, GC Corporation, Japan) and light cured.

Preparation: The restored teeth were subjected to thermo-cycling at 5°C and 55°C for 500 cycles, with 30 s dwell time at each bath. Samples from all the groups were coated with 2 coats of nail varnish leaving a window of 1 mm all around cavity margins. After application of nail varnish, the samples were allowed to air dry. A window of 1mm which was left uncoated was then immersed in 5ml of 2% Rhodamine B dye solution in 15ml screw capped bottle and stored at 37º±2º, at relative humidity in incubator for 72 hours. After that the samples were washed under running tap water to remove the traces of dye and the nail varnish was removed using ultrasonic scalers. The teeth were then cleaned and immersed and stored in freshly prepared 35% nitric acid for 72 hours in the centrifugal tube. After the teeth were completely dissolved the solution was filtered using fine grit filter paper into another centrifugal tube. The obtained sample solutions were finally centrifuged at 2000rpm for 1minute. The supernatant solutions thus collected were subjected to spectrophotometric analysis using a filter of 670 nm. The results were recorded as a measure of transmission of light (i.e more light transmission suggestive of less microleakage).

RESUTS:

The result was recorded as a measure of transmission of light. According to Lambert – Beer's law the magnitude of absorbance is directly proportional to the concentration of dye in the solution and inversely proportional to the percentage of light transmission. Thus, if the value of light transmission is less then it shows that the amount of dye penetrated in the samples is more.

In our study Tetric N Ceram showed the highest value of light transmission i.e 94.1% and light curing GIC with value of 75.2%. ACTIVA fared well in microleakage test with light transmission values of 91.6% and 82.3% when used with a bonding agent and when used without a bonding agent respectively.

Transmission values for each sample in all the four groups were compared and analyzed using ANOVA test. Microleakage values were presented as mean ± standard deviation. Median and range were also calculated. p – value<

0.05 was considered as statistically significant.

DISCUSSION:

Resin composites are providing an increased range of options for clinicians to restore teeth in a minimally invasive manner. However, these esthetic materials have limitations that restrict their use as universal restorative materials. In the present study teeth restored with Tetric N Ceram has shown the least microleakage, statistically significant than RMGIC. Results of our study, are in accordance with the other studies done by Bagis, Yamazaki, Palin and Al-Boni et al.[1] who stated that microleakage of silorane based compounds is lower than that of methacrylate-based. Also, Thalacker et al. reported that the silorane-based composite resin system showed a better marginal integrity on both enamel and dentin than the methacrylate-based composite resin system.[1]

There is a continuous search for the restorative materials and techniques that will provide optimal adhesion to tooth structure to minimize microleakage as well as have excellent mechanical and physical properties. Different microleakage test methods have been used for years to predict the performance of restorative materials at the tooth restoration interface. The present study utilized the dye extraction technique in vitro to study microleakage.

In the current study, lower microleakage scores obtained with Tetric-N-Ceram and highest microleakage was seen in LCGIC. This could be attributed to the ring opening chemistry of the silorane polymer but when the polymer is subjected to the wet environment it swells up due to presence of molecule's hydrophilic pendant group and absorbs water. Therefore, there is an increase penetration of fluids LCGIC. The silorane-based composite exhibits decreased water sorption and solubility compared to conventional methacrylate-based composites, which suggests better hydrolytic stability in water immersion. In resin-based silorane, functional groups of polymer network can contribute to greater free volume (due to the higher degree of freedom of the chain ends), which can enhance the penetration of the solvent; however, this penetration is reduced by the hydrophobic character of the molecule silorane. Moreover, silorane-based composite resins are esthetic materials. Since they have good polishbility, wear resistance and strength, these materials last long even against wear forces.[1]

Results in the present study also showed that ACTIVA when used with a bonding agent showed less microleakge than when used without a bonding agent. However ACTIVA when used with bonding agent showed comparable results with the Tetric group. Unlike traditional materials that are hydrophobic, repel water, and are designed to be passive, ACTIVA is moisture friendly and plays a dynamic role in the mouth. Only moisture friendly materials that are partly water-based or have phases or zones with significant water content can react to changes in the ambient conditions and are capable of this dynamic behavior.[4]

It has been stated that it adheres to dentin and does not require etching or bonding agents. ACTIVA BioACTIVE-RESTORATIVE combines the esthetics, strength and resilience of composites with bioactive properties and fluoride release that are superior to glass ionomers.[4] So in the present study we have tried to compare the microleakage of ACTIVA both with and without the application of bonding agent. ACTIVA when used with a bonding agent showed less microleakage when used without a bonding agent, and the difference between the two groups was statistically significant (Table 1).

The different techniques to test microleakage are dye penetration, dye extraction, bacterial penetration, radioisotope penetration and fluid infiltration technique's. Dye extraction is one of the method used to assess microleakage because of its sensitivity, ease of use, and convenience. In this method all the teeth were completely dissolved in acid, liberating all the dye from within, hence making possible to measure the total amount of dye extracted.[1]`

However, also it is essential to select a suitable dye solution to be used with tooth structure and restorative materials tested and other factor such as particle size of the dye solution should also be taken into consideration to prevent less reliable final results. Therefore, Rhodamine-B dye was used in this study to assess microleakage around class V restorations because of its small particle size, better penetration, water solubility, diffusability and hard tissue non-reactivity.[1]

Ultraviolet- visible spectrophotometric analysis of dye extraction is easy and have minimal human measurement errors and provides determination of volumes of leakage, rather than linear measurement as reported by Sangappa V et al (2005) and Meena Kumari C.

The use of ultraviolet – visible spectrophotometric analysis is more advantageous as it is simple, rapid, moderately specific and applicable to small quantities of compounds. Also it is one of the most frequently employed technique in pharmaceutical analysis. It involves measuring the amount of ultraviolet or visible radiation absorbed by a substance in solution. More comparative studies need to be carried out along with ultraviolet-visible spectrophotometer to rule out the errors and other disadvantages.

CONCLUSION:

The present findings suggest that in the challenging situation of the cervical restoration. All the restorative materials used in the study failed to prevent microleakage completely. Out of all the restorative materials Tetric N Ceram showed least microleakage, whereas LC GIC showed highest microleakage.

Concluding from the study the sealing ability can be summarized as

Tetric N Ceram < ACTIVA (used with bonding agent) < ACTIVA (without bonding agent) < LC GIC.

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FIGURES:

fig 1 – class v cavity

fig 2 – 2 mm cavity depth

Fig3 – occluso-gingival height of 3 mm

Fig 4- mesio-distal width 3mm

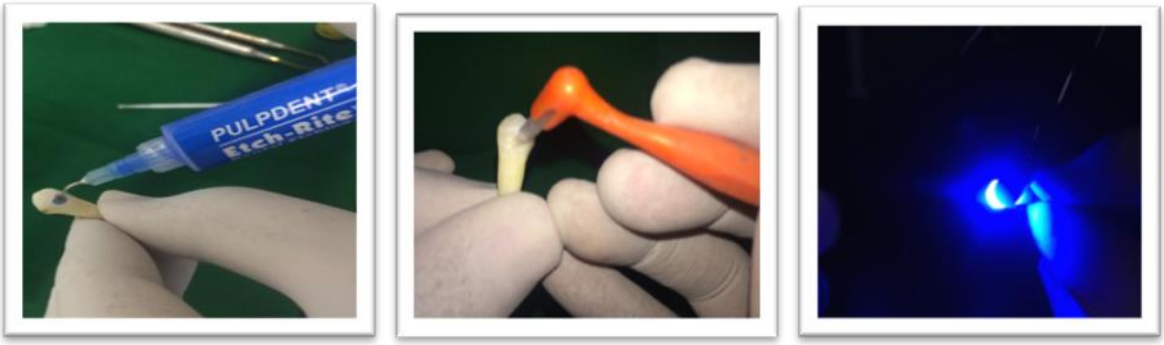

figure 5 – etching and bonding & curing of Restoration(s)