

Radiographic analysis of various restorations on teeth – An *in vitro* study

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ABSTRACT

Introduction: Radiographs are very essential diagnostic aids in the field of dentistry. The radiopacity of the restorative materials plays an important role in distinguishing the material from the surrounding hard tissues. The aim of this study is to test the ability of dental students to identify radiographs of various dental restorations on maxillary premolar teeth. **Materials and Methods:** A total of 30 natural maxillary premolar teeth were collected from clinics. Class 1 cavity preparation was done using a 245 bur. The teeth were then randomly allocated into three groups of 10 each and restored with amalgam, composite, and glass ionomer cement, respectively. Standard radiographs of the teeth were taken. A questionnaire was then prepared and distributed to 210 dental students of various dental colleges. The obtained results were then subjected to statistical analysis. **Results:** Only 75% of the final years answered amalgam as the right option. About 70% of the final years and 90% of the interns answered composite as the right option. About 82% of the postgraduates, 72% of the interns and 60% of the final years answered guaranteed investment contract as the right option. **Conclusion:** The ability of the Final year students to identify the correct restoration was lower than that of the Interns and Post graduates. There was no significant difference between the Interns and Post graduates in identification of the restorations.

KEY WORDS: Amalgam, Composite, Glass ionomer cement, Radiographs, Restorations

INTRODUCTION

The radiographs are essential diagnostic tools in the field of dentistry. The relative radiopacity of restorative materials is an important aid in diagnosing secondary caries, detecting excess restorative material on the cervical margins of proximal surfaces, determining the proximal contour of the restoration as well as its contacts with adjacent teeth,^[1,2] and also, distinguishing restorative materials from gaps or voids.^[3,4]

The radiopacity of restorative materials has been established as an important requirement because it regulates the material reflection degree, allowing a proper contrast from the tooth structure on a radiograph. Adequate radiopacity permits assessment of marginal overhangs, open gingival margins, interproximal contour as well as recurrent caries in the gingival areas.^[5]

The radiopacity of glass ionomer-based dental materials is totally variable^[6-9] and their radiopacity may be sufficient to use them as a base or liner material.

The use of less radiopaque materials than dentin as a base under restorative materials could be easily mistaken radiographically for decalcified or carious dentin. The first glass ionomer cements were radiolucent, providing limitation in its use as a restorative material. Recently, flowable composite, compomer, and chemical-cured composites have been advocated to reduce the adverse effects of polymerization shrinkage.^[5]

Defective restorations are associated with a higher prevalence of secondary caries^[4] and periapical lesions.^[5,6,8,9] Moderately radiopaque materials are preferable to those with a high degree of radiopacity, since the latter may obscure caries adjacent to restorations. Restorative materials that have radiopacity values similar to or higher than that of enamel have better performance.

El-Mowafy and Benmergui stated that materials having radiopacity values greater than or equivalent to the radiopacity of enamel can be used as inlay

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cement.^[10] Prévost *et al.* also concluded that the application of materials less radiopaque than dentin should be avoided as base or liners.^[6]

Requirements for the radiopacity of dental restorative resin established by organization for standards (ISO/DP 4049)^[11] specifies that the radiopacity of a 2 mm thick specimen of the material should be equal to that of a 2 mm or larger thickness of aluminum.^[12] One of the techniques used to evaluate radiopacity of dental materials has been comparing the specific thickness of composite to aluminum step wedges under controlled radiographic conditions. The radiopacity of a dental material specimen is usually expressed in terms of equivalent aluminum thickness (in millimeters) using a reference calibration curve^[6,13,14] In addition, the American Dental Association also requires commercial dental restorative resins to have a radiopacity at least equal to that of aluminum.^[15] This study aims at testing the ability of the dental students to identify the types of restorations radiographically.

Aim

The aim of the study was to test the ability of dental students to identify radiographs of various dental restorations on maxillary premolars.

MATERIALS AND METHODS

This study is a single-blinded trial. Thirty natural maxillary premolar teeth were collected from clinics. They were sterilized in sodium hypochlorite solution for 24 h.

Class 1 cavity preparation was done using a 245 bur [Figure 1]. The prepared teeth were randomly divided into three groups with block randomization with Groups 1, 2, and 3 being restored with amalgam, composite, and glass ionomer cement, respectively. In the first group of teeth was restored with amalgam, the second group of teeth with composite, and the third group of teeth were restored with glass ionomer cement.

Standard radiographs of the individual teeth were taken in the same order of labeling.

A questionnaire was then prepared with the question “identify the restoration” in which the 30 radiographs were arranged with the options being (a) amalgam; (b) composite; (c) glass ionomer cement; and (d) unrestored.

The questionnaire was distributed to 210 dental students of various dental colleges, 70 final year BDS, 70 interns, and 70 MDS students answered the questionnaire. The results were then subjected to statistical analysis.

RESULTS

About 75% of the final years answered amalgam as the right option. However, the remaining 25% mistook amalgam restorations to be composite. All the PG’s and interns marked amalgam as the right option [Figures 2 and 3].

About 70% of the final years and 90% of the interns answered composite as the right option [Figure 4].

Among the final years, 70% marked composite as the right option and the remaining 30% mistook it for Glass ionomer cement (GIC) restoration. Among the



Figure 1: Class 1 cavity preparation on maxillary premolar

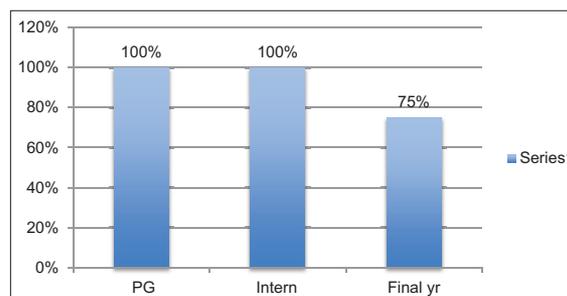


Figure 2: Students who chose amalgam as the right option

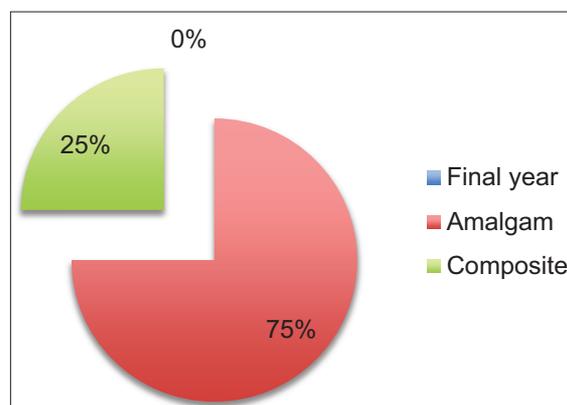


Figure 3: Students who mistook amalgam restorations to be composite

interns, 90% marked composite as the right option and the remaining 10% [Figure 5].

Among the final years, 70% marked composite as the right option and the remaining 30% mistook it for GIC restoration. Among the interns, 90% marked composite as the right option and the remaining 10% [Figure 5]. 60% of final year students, 72% of Interns and 82% of the Post graduates identified Glass Ionomer cement restorations correctly [Figure 6].

Among the students that did not mark GIC, from final years, 15% mistook the restoration to be unrestored and 25% to be composite. Among the interns, 10% mistook the restoration to be unrestored, and 18% to be composite. Among the PG's, 8% mistook the restoration to be unrestored and 10% to be composite [Figure 7].

DISCUSSION

The present study revealed no significant difference between the Interns and Post graduates in identification of the restorations. However, the ability of the Final year students to identify the correct restoration was lower than that of both, the Interns and Post graduates.

Radiopacity is an important property of restorative materials which enables correct distinction among dental hard tissues and dental materials.

In the study conducted, 15% of final year students mistook GIC restorations to be unrestored due to the similarity in the opacity of GIC and dentin. The radiopacity of glass ionomer materials is quite variable. The use of a poor radiopaque material as

a base under other restorative materials can mislead dentists to a diagnosis of recurrent decay.^[6] Optical density provides a measure of how dark the developed film can appear, as perceived by the human eye.^[6] It is a logarithmic measure of the ratio of transmitted to incident light through the film image and depends not only on the inherent X-ray absorption properties of the materials but also on the characteristics of the film, its exposure parameters, and processing conditions.^[17] It is not possible to differentiate the radiographic images of enamel and dentin at a thickness of up to 1.5 mm. The lining materials must not be used at a thickness between 1.5 and 2.0 mm in cases where there are similar thicknesses of dental structures, as it is not possible to differentiate the radiographic images.^[18]

The relative radiopacity of restorative materials against tooth structure allows the diagnosis of secondary caries, the detection of voids, gaps, and excess restorative material in the cervical area. The evaluation of the proximal contours of the restoration and their contacts with adjacent teeth can also be evaluated with the use of radiographs. Thus, it is recommended that restorative materials be radiopaque.^[1,2]

Identification of restorations helps us diagnose cases that we cannot observe clinically.

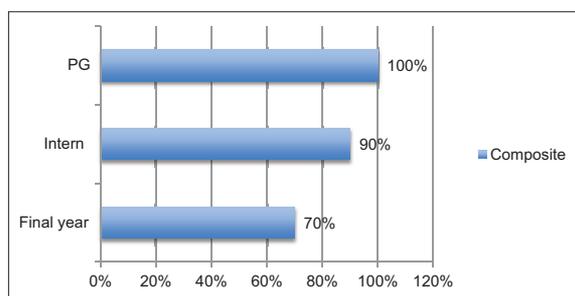


Figure 4: Students who chose composite as the right option

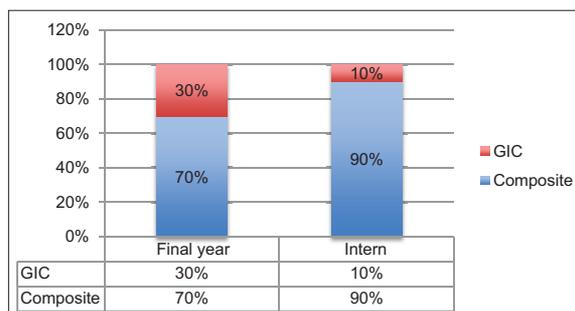


Figure 5: Students who did not identify composite as the right option

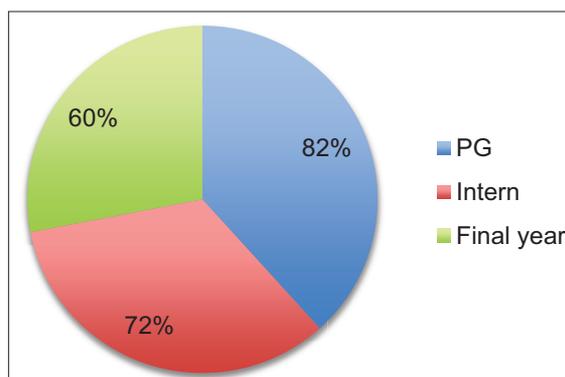


Figure 6: Students who chose glass ionomer cement as the right option

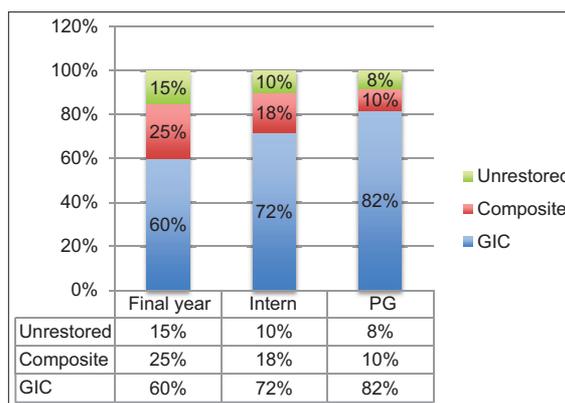


Figure 7: Students who did not identify glass ionomer cement as the right option

A fractured restoration can be an amalgam or a composite, but a more gross fracture is seen in the case of amalgam.^[19] Pain in a composite filled tooth would usually indicate it being nonvital and pain in an amalgam-filled tooth would generally indicate pulp stones.

Teeth and restorations are the most durable parts of the human body. They can survive for long periods, even if the body is immersed in acid or affected by other factors such as water and fire and can be used as aids in the identification process.^[20] Amalgam exhibits globule formation at temperatures as low as 200°C, which might be due to alloy dissociation, where the mercury evaporates from the alloy conglomerate.^[21] At 600°C the composite resin changes to a grayish black, possibly due to the combustion of the acrylic matrix,^[22] and a chalky white color is observed at 800°C. Teeth restored with GIC showed discoloration, loss of marginal seal, and cracks till 600°C.^[23]

According to Keiser-Nielson (1980), restored tooth surfaces may serve as the smallest units to consider in the comparison of dental restorations for identification purposes.^[24] Most previous studies have evaluated amalgam restorations with very high radiopacity that causes an observational error and reduced detection of details. Composite resins, on the other hand, possess lower radiopacity^[25] and have rapidly superseded amalgam due to their desirable physical properties, feasibility, and of course, esthetic features.^[26]

Knowledge of the ability to distinguish restorations on radiographs must be focused on. This knowledge comes in handy in cases where the patient cannot be evaluated clinically. This can also be used in forensic sciences to identify patients based on their dental records. Hence, identification of restorations radiographically plays a very important role.

CONCLUSION

The ability of the Final year students to identify the correct restoration was lower than that of the Interns and Post graduates. There was no significant difference between the Interns and Post graduates in identification of the restorations. Identification of restorations through radiographs aid us in diagnosing patients that we cannot observe clinically. They also play a major role in forensic sciences in identification of a person based on the restorations done. The knowledge of the students on identification of restorations by radiographs is fair and can be improved.

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