Differences in Radiopacity Value of RMGIC, GIC and Composite Resin Materials with Secondary Caries using Conventional and Digital Radiography

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Keywords: Radiopacity, Materials, Secondary Caries, Conventional Radiography, Digital Radiography

Abstract: Radiopacity is an important feature of the restorative material because the ability of the dentist differs in interpreting a lesion or caries on a radiograph. The purpose of this study is to determine the differences in radiopacity value of RMGIC, GIC and bulkfill composite resin materials with secondary caries as well as to evaluate the radiographic technique used to obtain the radiograph. This type of research is descriptive analytics by using comparative group design. The samples in this study were dental radiographs filled with RMGIC, GIC and bulkfill composite resin materials produced from conventional and digital radiographic sampling. Then conventional and digital radiographs are measured using Image J software to distinguish the respective radiopacity of restoration materials and secondary caries. Using RMGIC average restorative materials on conventional radiographs of 191,226 ± 17,908 and on digital radiographs of 187.490 ± 11.734. Using the average GIC restoration material on conventional radiographs of 191,063 ± 52,527 and on digital radiographs of 186,809 ± 15,663. Using a bulkfill resin composite resin on average radiopacity on a conventional radiograph of 177.960 ± 39.147 and on a digital radiograph of 192.293 ± 11.704. The mean secondary caries radiodencity on conventional radiographs was 195,651 ± 10,191 and the digital radiograph was 104,293 ± 15,114. Furthermore, the data were analyzed by using T test with significance value p <0,05. There was no significant difference in radiopacity value of RMGIC, GIC and bulkfill composite resin materials on secondary caries using conventional radiography. There are significant differences in the radiopacity value of RMGIC, GIC and bulkfill composite resin materials on secondary caries using digital radiography.

1 INTRODUCTION

Radiopacity is a physical property of restorative materials that have no specific standard for use in dental restorations I and II (ISO, 2000). Manufacturers of ingredients add radiopacity ingredients to the dental resins. Adequate radiation will make the material distinguishable from enamel and dentin tissue on the radiograph so as to facilitate the dentist in diagnosing secondary caries. Radiopacity of resin material is related to the percentage of barium, strontium and zirconia content in volume or weight (Power JM, 2006).

The thickness of the material also affects the radiopacity of the radiograph. By considering the system used, there is a significant relationship between the type of material used and the diagnosis. (Pedrosa, 2011).

The presence of restorative materials may affect the diagnosis of a carious lesion on a radiograph. Enforcement of secondary caries diagnoses is a challenge for dentists because they are often fooled by low-radiation-grade restorations. On radiography, to be able to diagnose the presence of secondary caries, several factors can affect such a close distance between lesions with restoration, size and orientation of the lesion and geometry and projection (Nair MK, 2001).

By using a charge coupled divice (CCD) and with a phosphor plate, the secondary caries image looks similar, but when contrast and brightness are increased it is superior to the image obtained with the phosphor plate without additional(Nair MK, 2001). The aim of this study was to evaluate conventional and digital radiographs in assessing the radiopacity of GIC restoration materials and bulkfill composite

Manja, C. and Harahap, K.
Differences in Radiopacity Value of Rmgic, Gic and Composite Resin Materials with Secondary Caries using Conventional and Digital Radiography.
DOI: 10.5220/0010078505680571
In *Proceedings of the International Conference of Science, Technology, Engineering, Environmental and Ramification Researches (ICOSTEERR 2018) - Research in Industry 4.0*, pages 568-571
ISBN: 978-989-758-449-7

resins to distinguish them from secondary caries features.

2 METHODOLOGY

This type of research is descriptive analytics by using comparative group design. The study was conducted in dental practice, Pramitha clinic

laboratory and dental radiology clinic hospitals teeth and mouth University of Sumatera Utara. The samples in this study were dental radiographs that had been restored with RMGIC, GIC and bulkfill composite resin materials and obtained from conventional and digital radiography systems. Inclusion criteria were a) conventional and digital radiographs with details and contrast of teeth clearly visible from the occlusal surface to the root tip, b) for secondary caries, visible radiolucent images under the fillings. Exclusion criteria are conventional and digital radiographs that are blurred and experience cone cutting. A sample size of 18 divided into six groups, each group consisting of three radiographs, namely:

1. Group of conventional dental radiographs restored with RMGIC.
2. Group of conventional dental radiographs restored with GIC.
3. Group of conventional dental radiographs restored with bulkfill composite resins.
4. Group of digital dental radiographs restored with RMGIC.
5. Group of digital dental radiographs restored with GIC.
6. Group of digital dental radiographs restored with bulkfill composite resins.

Assessment of the radiopacity of conventional radiograph groups using the indirect method of conventional radiographs scanned and digital photographs was obtained. The radiopacity assessment of the digital radiograph group uses a direct method where an optical density value is directly obtained by using a direct photo analysis.

Assessment of radiopacity of GIC, bulkfill composite resin and RMGIC restoration Material and secondary caries radiodensity using Image J software by:

Choosing a radiograph that will be analyzed, then giving a sign to the restoration area and secondary caries found on the tooth.

1. Open the Analyze menu and select the Histogram menu.
2. The mean value and standard deviation will come out computerized.
3. Calculate the average value for the entire radiograph based on the restoration material and the radiographic technique used.

Furthermore, a comparison of each restoration material with secondary caries was used using T test analysis to see significant differences.

Figure 1. Digital radiograph with Class I restoration on 36.

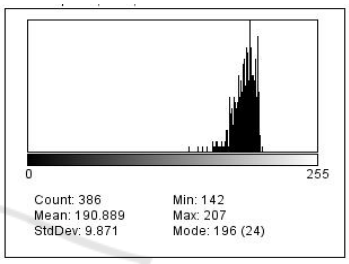

Figure 2. Histogram analysis using Image J software.

Figure 3. Conventional radiograph with Class I restoration on 36.

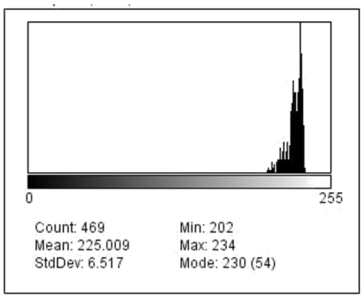

Figure 4. Histogram analysis using Image J software.

Table 1: The average radiopacity value of restoration material and radiodensity of secondary caries.

Types	Digital Radiography		Conventional Radiography	
	Mean	Std. Dev	Mean	Std. Dev
GIC	186.809	15.663	191.063	52.527
Bulkfill RC	192.293	11.704	177.960	39.147
RMGIC	187.490	11.734	191.226	17.908
Secondary Caries	104.293	15.114	195.651	10.191

Table 2: Comparison of RMGIC and secondary caries with conventional radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Conventional Radiography	RMGIC	3	191.226	17.908	10.339	.729
	Secondary Caries	3	195.651	10.191	5.884	

Table 3: Comparison of GIC and secondary caries with conventional radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Conventional Radiography	GIC	3	191.063	52.527	30.326	.889
	Secondary Caries	3	195.651	10.191	5.884	

Table 4: Comparison of bulkfill composite resins and secondary caries with conventional radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Conventional Radiography	Bulkfill RC	3	177.960	39.147	22.601	.491
	Secondary Caries	3	195.651	10.191	5.884	

Table 5: Comparison of RMGIC and secondary caries with digital radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Digital Radiography	RMGIC	3	187.490	11.734	6.774	.002
	Secondary Caries	3	104.293	15.114	8.726	

Table 6: Comparison of GIC and secondary caries with digital radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Digital Radiography	GIC	3	186.809	15.663	9.043	.003
	Secondary Caries	3	104.293	15.114	8.726	

Table 7: Comparison of bulkfill composite resins and secondary caries with digital radiography.

Group Statistics						
		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Digital Radiography	Bulkfill RC	3	192.293	11.704	6.757	.001
	Secondary Caries	3	104.293	15.114	8.726	

3 DISCUSSION

Radiopacity of dentistry is very important to distinguish the dental curing material with the tooth tissue and its surroundings. Radiopacity is a property needed for dental materials, including restorative materials, cavities, core enhancers, adhesives, adhesives for root canal fillers, temporary crowns, bridges and ceramics (Anusavice KJ, 2013). Material radiopacity will increase with increasing particles containing high atomic number elements (Powers JM, 2006).

Radiopacity of dentistry material is defined as the value of optical density of a material (Candeiro, 2012). Factors that can influence the radiopacity of dental materials are the thickness and chemical composition of dental materials (Pekkan, 2016). Another factor is the setting of exposure to light, X-ray beam angulation, the distance of the film to the light source and the exposure method used. Radiopacity of the restoration material used does not have sufficient radiopacity on the radiograph including some glass ionomer cement, so the dentist must know about it (Tsuge, 2009). Restorative materials vary in radiographic appearance depending on the thickness, density, atomic number and x-ray energy rays used to make the radiograph (Eric, 2013).

The results showed that the RMGIC, GIC and bulkfill composite resin materials using conventional radiography had different radiopaquality values with secondary but not significant caries. On conventional radiographs it is difficult to distinguish the image of restoration materials with secondary caries. Diagnosis of secondary carious lesions seen using imaging is influenced by the type of restoration material (Antonijevic, 2014).

This may be due to factors such as variations in the film positioning technique and X-ray rays can greatly affect the picture of the carious lesion, the lighting factor may produce marks that affect the overall contrast of the radiograph thus affecting the shape or size of the carious lesions on the radiograph and the exact position of the carious lesion for example buccal / lingual or caries expansion into buko-lingual (Eric, 2013).

Another thing that can affect is the distance between the caries lesion and the pulp horn where these two shadows can be close together or even visually interconnected but may not be in the same plane. The presence of a carious lesion and the density of the enamel top layer may obscure the decalcification zone. The presence of secondary caries and existing patches may coat thoroughly the existing carious lesions causing errors in interpreting. The imaging system affects the image of the restoration. Restoration material with radiopacity is greater than enamel, will be beneficial for true-negative diagnosis (Antonijevic, 2014). The radiopacity value of the restoration material which is between the enamel and dentin values, or lower than dentin, tends to create confusion in the test and is susceptible to false positive diagnosis of secondary carious lesions (Pedrosa RF, 2011).

The results showed that the RMGIC, GIC and bulkfill composite resin materials using digital radiography had significantly different radiopaquality values with secondary caries. This is probably because digital radiographs use detectors that can show significant changes in how we acquire, store, retrieve, and display images (White and Pharaoh, 2009).

Digital detectors have the characteristics of contrast resolution that is the ability to distinguish radiographic image density and space resolution ie the capacity to distinguish in detail (Gu, 2006). The sensitivity of the detector has the ability to respond to a small amount of radiation. The International Organization for Standardization classifies the sensitivity of intraoral films based on speed (ISO, 2000).

The usefulness of digital receptor sensitivity is influenced by a number of factors including detector efficiency, pixel size and noise system (White and Pharaoh, 2009).

4 CONCLUSIONS

The conclusion of this study is that there is no significant difference in radiopacity value of RMGIC, GIC and bulkfill composite resin materials on secondary caries using conventional radiography. There are significant differences in radiopacity value of RMGIC, GIC and bulkfill composite resin materials on secondary caries using digital radiography. It is better to conduct further research using different restorative materials in the posterior and anterior tooth regions.

ACKNOWLEDGEMENTS

This research was funded by the University of North Sumatra in accordance with the TALENTA Research Contract of the University of North Sumatra 2018 Fiscal Year Number: 2590 / UN5.1.R / PPM / 2018 dated March 16, 2018

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