THE EVALUATION OF CONVENTIONAL AND DIGITAL RADIOGRAPH FOR RADIOPACITY ASSESSMENT OF RESTORATIVE MATERIALS

EVALUASI RADIOGRAF KONVENSIONAL DAN DIGITAL DALAM MENILAI RADIOPASITAS BAHAN RESTORASI

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Abstract

Radiopacity is an important characteristic for restorative materials as dentists have got different abilities in interpreting a lesion or caries in a radiograph. The enforcement of secondary caries diagnosis is a challenge for dentists because they often mistake the diagnosis for restorative materials with low radiopacity. This study aims to determine the differences in the average radiopacity values of certain restorative materials by using conventional and digital radiographs. Moreover, to know the right types of radiographs in distinguishing between radiopacity of certain restorative materials and radiodensity of secondary caries. This is an analytical descriptive study with cross sectional design. The sample was divided into 10 groups of 6, which is dental radiograph filled with glass ionomer cement, resin modified glass ionomer cement, nanofiller and micro hybrid composites as well as teeth with secondary caries which were obtained from conventional and digital radiographs. Next, conventional and digital radiographs were interpreted by observations of 5 dental specialists in which measurement was done by using Image J software to get the average radiopacity values of secondary caries and each restorative material. The results showed that the average radiopacity values for glass ionomer cement are 177.633 ± 6.465 and 187.879 ± 9.305, resin modified glass ionomer cement are179.498 ± 5.597 and 192.078 ± 11.006, composite nanofillers are 194.847 ± 4.952 and 184.401 ± 9.170, microhybridcomposites are 189.109 ± 4.251 and 179.585 ± 6.809, finally secondary caries are 161.772 ± 9.256 and 109.988 ± 7.684 for conventional and digital radiographs respectively. Then the data was analyzed by using T test with significance value of $p < 0.05$. As a conclusion, this study shows no significant difference in the radiopacity of four restorative materials if compared between conventional and digital radiographs while digital radiograph shows significant difference between radiopacity values of restorative materials and secondary caries. Whereas, conventional radiograph does not show significant difference between restorative materials and secondary caries.

Keywords: Radiography, conventional, digital, restoration material, radiopacity

INTRODUCTION

The utilization of radiograph in the enforcement of lesion and caries diagnoses in proximal has no doubts in dentistry. This is dependent of the interpretation result and decision from the observer. Every dentist has different experience in interpreting lesion and caries radiographs. The enforcement of secondary caries diagnosis is a challenge for dentists as they often mistake the diagnosis for restorative materials with low radiopacity. Restorative materials vary in radiography appearance as it depends on the thickness, density, atomic number and X-ray used in the making of radiograph.[1]

The diagnosis of secondary caries in radiograph is influenced by a number of factors such as the proxymity of lesion with the restoration, the size, geometry, photo projections and orientations of the lesion. Radiography evaluation and decision making based on the picture are important with the prevalence of secondary caries and the needs to change restoration in this case Restorative materials and

secondary caries projections are difficult to be differentiate in conventional radiograph. Antonijevic (2014) stated that restorative materials influence the imaging for secondary lesion caries diagnosis.[2] Digital detector is used in digital radiography with contrast resolution characteristic which is the ability to differentiate the density in radiography images and room resolution that allows capacity to be distinguished in details.

This research aims to evaluate conventional and digital radiographs in assessing radiopacity of restorative materials to distinguish them from secondary caries images.

MATERIAL AND METHODS

This study was done in Dentistry Radiology Installation in Dental and Mouth Hospital of Dentistry Faculty Universitas Sumatera Utara, a dentist private practice and Pramita Laboratory Medan. The research is an analytical descriptive study with cross sectional design.

The samples in this study are teeth radiographs which have been restored as Class 1 Black in posterior teeth with 4 different restorative materials such as glass ionomer cement, resin modified glass ionomer cement, nanofiller and micro hybrid composites as well as teeth with secondary caries which were obtained from conventional and digital radiographs. The inclusion criteria are a) conventional and digital radiographs with clear details and contrast of teeth from occlusal surface to root tip, b) for secondary caries, radiolucent image is shown from the bottom of patch. Exclusion criteria are blurred conventional and digital radiographs with cone cutting.

The size of sample is 60 which was divided into 10 groups, in which there are 6 radiographs in each group as follow: 1). Tooth conventional radiograph restored by glass ionomer cementgroup, 2). Tooth conventional radiograph restored by resin modified glass ionomer cement group, 3). Tooth conventional radiograph restored by nanofiller composites group, 4). Tooth conventional radiograph restored by micro hybrid composites group. 5). Tooth conventional radiograph with secondary caries group. 6). Tooth digital radiograph restored by glass ionomer cement group, 7). Tooth digital radiograph restored by resin modified glass ionomer cement group, 8). Tooth digital radiograph restored by bulk-fill resin composites group. 9). Tooth digital radiograph restored by solare resin composites group. 10). Tooth digital radiograph with secondary caries group

Radiopacity measurement for conventional radiographs groups used indirect method in which the radiographs were scanned to obtain digital imaged. Whereas radiopacity measurement for digital radiographs used direct method where the optical density was directly obtained from direct photo analysis.

Radiographs interpretation was done by 2 methods in this study: 1). Interpretation from observation: Interpretation was made by 5 observers who were given the sample and questionnaire which asked whether restorations and caries were observed. Every right answer was given 1 point. 2). Interpretation by using Image J software: All data obtained in this study was analyzed by using T test to observe the significant differences with $p < 0.05$.

RESULT

Table 1. The average radiopacity value of the restoration materialand secondary caries radiodensity

Types	Digital Radiography (DR)		Conventional Radiography (CR)	
	Mean	Std. Dev	Mean	Std. Dev
Glass ionomer cement (GIC)	187.88	9.31	177.63	6.47
Resin modified glass ionomer cement (RMGIC)	192.08	11.01	179.50	5.60
Nanofiller composites (NC)	184.40	9.17	194.85	4.95
Microhybrid composites (MC)	179.59	6.81	189.1	4.25
Secondary caries (SC)	109.99	7.68	161.77	9.26

Table 2. Comparison of digital and conventional radiographs on glass ionomer cements

	Type	N	Mean	Std. Dev	Std. Err Mean	Sig (2-t)
GIC	DR	6	187.878	12.284	5.015	.609
	CR	6	177.616	45.913	18.743	

Table 3. Comparison of digital and conventional radiographs of resin modified glass ionomer cements

	Type	N	Mean	Std. Dev	Std. Err Mean	Sig. (2-t)
RM GIC	DR	6	192.078	10.280	4.197	.213
	CR	6	179.498	20.780	8.483	

Table 4. Comparison of digital and conventional radiographs on nanofiller composites

	Type	N	Mean	Std. Dev	Std. ErrMean	Sig. (2-t)
NC	DR	6	184.401	15.131	6.177	.518
	CR	6	194.847	35.061	14.313	

Table 5. Comparison of digital and conventional radiographs on microhybrid composites

	Type	N	Mean	Std. Dev	Std. Error Mean	Sig (2-t)
MC	DR	6	179.585	9.837	4.016	.276
	CR	6	189.109	17.703	7.227	

Table 6. Comparison of digital radiographs of glass ionomer cement with secondary caries

	GIC and SC	N	Mean	Std Dev	Std Error Mean	Sig. (2-t)
DR	GIC	6	187.878	12.284	5.015	.000
	SC	6	109.988	28.717	11.724	

Table 7. Comparison of digital radiographs of resin modified glass ionomer cement with secondary caries

	RM GIC and SC	N	Mean	Std Dev	Std. Error Mean	Sig. (2-t)
DR	RM GIC	6	192.078	10.281	4.197	.000
	SC	6	109.988	28.717	11.724	

Table 8. Comparison of digital radiographs of nanofiller composite radiopacity with secondary caries

	NC and SC	N	Mean	Std. Dev	Std. Error Mean	Sig. (2-t)
DR	KN	6	184.401	15.131	6.177	.000
	KS	6	109.988	28.717	11.723	

Table 9. Comparison of digital radiographs microhybrid composite radiopacity with secondary caries

	MC and SC	N	Mean	Std. Dev	Std Error Mean	Sig (2-t)
DR	MC	6	179.585	9.837	4.016	.000
	SC	6	109.988	28.717	11.724	

10. Comparison of conventional radiographs of glass ionomer cement with secondary caries

	GIC andSC	N	Mean	Std Dev	Std. Error Mean	Sig (2-t)
CR	GIC	6	177.633	45.931	18.751	.493
	SC	6	161.772	29.511	12.048	

Table 11. Comparison of conventional radio-graphs of resin modified glass ionomer cement with secondary caries

	RM GIC and SC	N	Mean	Std Dev	Std. Error Mean	Sig(2-t)
CR	RM GIC	6	179.498	20.780	8.483	.257
	SC	6	161.772	29.511	12.048	

Table 12. Comparison of conventional radiographs of nanofiller composite with secondary caries

	NC and SC	N	Mean	Std Dev	Std. Error Mean	Sig (2-t)
CR	NC	6	194.846	35.062	14.314	.108
	SC	6	161.772	29.511	12.048	

Table 13. Comparison of conventional radiographs of microhybrid composite with secondary caries

	MC and SC	N	Mean	Std. Dev	Std. Error Mean	Sig (2-t)
CR	MC	6	189.109	17.703	7.227	.080
	SC	6	161.772	29.511	12.048	

Table 14. .Percentage of results of interpretation by observation

Types	N	Observer's Interpretation			
		DR		CR	
		Total Score	%	Total Score	%
GIC	30	24	80	15	50
RMGIC		20	66,67	13	43,33
NC		22	73,33	20	66,67
MC		18	60	17	56,67
SC		27	90	22	73,33

DISCUSSION

The comparisons made for radiopacity of restorative materials such as glass ionomer cement, resin mo-dified glass ionomer cement, bulk-fill and solare resins composites do not show significant differ-rences in both digital and conventional radiographs
($p > 0.05$). This result was obtained due to several factors that affect radiopacity in dental materials such as the thickness and chemical composition in dentistry.[4] Other factors are the settings of beam exposure, the angulation of X-rays, the distance between film and source of beam also the radiation method used. Other probabilities are that restorative materials vary in radiographs appearance following their thickness, density, atomic number and X-ray energy used to produce the radiographs.[1]

While significant differences ($p < 0.05$) are observed in digital radiographs of glass ionomer cement, resin modified glass ionomer cement, bulk-fill and solare resins composites towards secondary caries. This can

There are no significant differences ($p < 0.05$) observed in conventional radiographs of glass ionomer cement, resin modified glass ionomer cement, bulk-fill and solare resins composites towards secondary caries. This may be due to the existence of lesion caries and the density from the upper surface of enamel which blurred the declassification zones. The existence of secondary caries and patches is able to cover the entire lesion and caries occurred hence the misinterpretation. Imaging system also affects this.[6] Other things that may influence this is the distance between caries lesion and pulp horn where the two shadows can be adjacent or even connected but not at the same area/place. [1]

In this study, the interpretation results obtained from the observation of several dentists showed varied scores for secondary caries and each restoration ma-terials. Materials with bigger radiopacity and higher than enamel are advantageous for true negative diagnoses.[2] While resin with radiopacity values bet-ween enamel and dentin, or lower than dentine, tends to create confusion in images interpretation and it is prone to false positive diagnoses of second-dary caries lesion.[5,7]

The conclusion for this research done is that there is no significant difference in radiopacity of the four restorative materials if they are compared in conventional and digital radiographs. However, digital radiographs give significant differences in radiopacity of restorative materials and secondary caries while conventional radiographs do not.

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