Stereomicroscopic evaluation of the adaptability of different retro filling materials (in vitro study)

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ABSTRACT

Background: The purpose of this in vitro study was to evaluate the marginal interfaces between tooth structure and the retrofilling materials.

Materials & Methods: Thirty teeth were divided into six groups of five for each. The teeth were instrumented to a minimum of size no. 45 k-file, obturated with gutta percha, resected perpendicular to their long axes and prepared to receive a retrofilling. The teeth were filled with amalgam, glass ionomer cement or chemical-cured composite resin. Each filling material was either applied with dentin adhesive or without dentin adhesive. Photomicrographs were made & examined by four evaluators.

Results: Composite resin had better marginal adaptation than the amalgam & the glass ionomer cement, but the difference was non significant ($p>0.05$). In addition, the adhesive groups together had less marginal adaptation than the other groups and the difference was significant ($p<0.05$).

Conclusion: Composite resin retrofilling material had better marginal adaptation than other materials used and the dentin adhesive may have no effect on the quality of the adaptation.

Key words: Adaptation, retrofilling, amalgam. **(J Bagh Coll Dentistry 2008; 20(2):45-49)**

INTRODUCTION

When non surgical endodontic techniques are impractical or have failed to resolve periapical lesions of endodontic origin, periapical surgery with a root-end filling is the preferred type of treatment. The apical seal of a retrofilling material has been considered to be an important factor for successful periradicular surgery [(1)]. Amalgam had been considered the retrofilling of choice until investigators pointed out its inadequacies for such use. Oynick & Oynick[(2)] expressed concern over the content of free mercury in direct contact with the periapical tissues. Leakage studies [(3,4)] have shown poor results, and concern has been expressed with electrochemical reactions[(5)] from amalgam. In a scanning electron microscopic study, Moodnik et al [(6)] demonstrated interface gaps between amalgam and the prepared root ranging from 6μ to 150μ. Consequently, researchers have proposed the use of many alternative materials for retrofillings that vary from composite resin and glass ionomers to cavit, IRM and super EBA[(4, 7, 8)] .

MATERIALS AND METHODS

Samples preparation. Thirty extracted human single-rooted premolars were utilized in this study.

All teeth were autoclaved then stored in physiologic saline before use and throughout the experiment, because saline has been shown to preserve the morphologic and structural characteristics of the inorganic material [(9)].

Canal preparation. All teeth had cleaned from the caries lesions and canals were verified by passing a # 10 k-file through the apex. Working lengths were established 1.0 mm short of the anatomic apex by visually identifying the # 10 file at the apical foramen and subtracting 1.0 mm. All canals were instrumented to minimum 45k master apical file using a continuous tapered preparation [(10)] and flushed with 2.5% sodium hypochlorite after each file. The canals were then dried with sterile paper points and obturated using laterally condensed gutta-percha (Dia-dent, Korea) and N2 sealer. The coronal access openings were sealed with readymade ZnO-eugenol cement (Dorident USA).

Root-End preparations. The root ends were then resected perpendicular to the long axes of the teeth using a high speed handpiece and air water spray with a tapered fissure bur (Komet, Germany) 2-4 mm from the anatomic apex. They were prepared for a retrofilling with the straight fissure bur (Komet, Germany) under water spray and tips. The teeth were prepared to a minimum depth of 3 mm because this is currently the accepted depth to ensure an apical seal of all resected tubules and provide enough material to prevent apical microleakage along the interface between the retrofilling material and the canal wall [(11)] . The retro cavities were rinsed with saline and dried with paper points. The teeth were then randomly divided into six groups of five.

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Root-End Fillings. Teeth in group 1 were filled with glassionomer cement, mixed according to manufacturer's recommendations, condensed into the preparation and the surface burnished with a ball burnisher. Group 2 was filled in the same manner as group 1 after application of the syntac single component adhesive and cured with light-cure unit according to the manufacturer's instructions. Group 3 was filled with chemical-cured composite resin (alpha-dent, USA), mixed according to manufacturer's instructions, condensed into the preparation and surface finished with finishing bur. Group 4 was filled in the same manner as group 3 after application of the syntac adhesive. Group 5 was filled with spherical amalgam alloy (Megalloy, Dentsply, USA), triturated according to the manufacturer's recommendations, condensed into the preparation and surface burnished with a ball burnisher. Group 6 was filled in the same manner as group 5 after application of the syntac adhesive. Each sample was stored in saline until the examination.

Stereomicroscopic examination. All samples were air dried, and examined under stereosopic microscope at 40 x of the tooth/retrofilling interface.

Evaluation. Postoperative stereophotomicrographs were made of each specimen to compare the interface between the finished retrofilling material and the prepared root surface. Photomicrographs of specimens were viewed at 40 x, because this magnification appeared to reveal the most detail while maintaining the entire retrofilling / tooth interface. The photomicrographs were evaluated by four independent observers, three experienced endodontists (Master of Science degree in conservative dentistry), and one second-year postgraduate student. An attempt was made to standardize each evaluator before viewing the photomicrographs to reduce evaluator subjectivity. Each examiner evaluated the photomicrographs at three different periods in an effort to test intrajudge reliability. Photographs were projected for the examiners to evaluate in a random order. The examiners were not aware of the group from which any sample was taken.

Rating Scale. The interface was graded from 0 to 3 (0 =no space between the dentin wall & the retro filling material), (1=1-4 microns of space between the dentin wall and the retrofilling material), (2=4-8 microns of space present), and (3=>8 microns of gap present between the dentin and the retrofilling). The data were then statistically evaluated nonparametrically using Kruskal-Wallis one-way analysis of variance.

RESULTS

The Retrofilling Materials. The rating scale for each sample and the rating for each group are presented in tables 1 and 2. By using Kruskal-Wallis one-way analysis of variance, the chemical cured composite resin retrofilling material (group 3 and 4) had showed lower score than the amalgam and glassionomer cement groups and amalgam groups (group 5 and 6) had showed lower score than the glassionomer cement groups (group 1 and 2), however , the difference was non significant ($p>0.05$) (Figure 1) .

The Dentin Adhesive. By using Kruskal-Wallis one-way analysis of variance, the adhesive groups together (groups 2, 4 and 6) had showed higher score than the nonadhesive groups (groups 1,3 and 5), and the difference was significant ($p<0.05$). For the glassionomer coment groups, the group 2 (with dentin adhesive) had showed higher score than the group 1 (without dentin adhesive) and the difference was significant ($p<0.05$).

For the chemical-cured composite resin groups, the group 3 (without adhesive) had showed higher score than group 4 (with adhesive), however the difference was non significant ($p>0.05$). For the amalgam groups, there was no difference in the scores between group 5 and 6 (Figure 2).

DISCUSSION

Marginal adaptation as an indirect method of determining a retrofilling material's sealability as has been established by Stabholz etal [12]. The criteria of our study used this indirect method along with the presence of space to evaluate the sealing ability of various materials. It appears that composite resin had excellent marginal adaptation & all the evaluators consistently rated these samples in the 0 or 1 category. These findings seem to agree with the premise of Abdal & Retief [4]. The excess material extending on to the resected root surface obscured the marginal interface in every sample to a varying degree, resulting in the evaluators making a more subjective rating of the samples. This subjectivity was amplified in these samples because the photomicrographs were only two-dimensional representations of three-dimensional object. The evaluators had trouble determining marginal adaptation from overfilling of the preparation because only one plane was visible. One problem with the stereomicroscopic studies is that the teeth are dehydrated, which may lead to many cracks in the resected & filled root-end surfaces. When these teeth were evaluated a determination should be made between what was artifact & what was caused by the procedure itself. At higher magnification it was determined that the root fractures & large interface gaps in this study were artifact and occurred after the retrofilling was placed. We arrived at this conclusion because the retrofilling material interface & the canal walls were mirror images of one another. The large gaps were only seen along fracture lines or fracture planes. Therefore, many larger gaps that were present were not considered in the rating of the samples. This was also conveyed to the evaluators; examples were shown to clarify this problem before viewing the photomicrographs.

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Table 1: Rating Scale For each sample

Groups	Sample	1st evaluator			2nd evaluator			3rd evaluator			4th evaluator		
Scores		I	II	III	I	II	III	I	II	III	I	II	III
I (GIC)	1	1	1	1	0	0	0	1	1	1	0	0	1
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	1	1	1
55	4	1	1	1	1	1	1	1	1	1	1	1	1
	5	1	1	1	1	1	1	1	1	1	1	1	1
II (GIC+DBA)	1	2	2	2	2	2	2	2	2	2	2	2	2
	2	3	3	3	3	3	3	3	3	3	3	3	3
	3	1	1	1	1	1	1	1	1	1	1	1	1
111	4	2	3	3	2	2	2	2	2	2	2	2	2
	5	1	1	1	1	1	1	1	1	1	1	1	2
III (COMPOSITE)	1	1	1	1	0	0	0	0	0	0	0	0	0
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	1	1	1
76	4	2	2	2	2	2	2	2	2	2	2	2	3
	5	2	2	2	2	2	2	2	2	2	2	2	2
IV (COMPOSITE DBA)	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	1	1	1
51	4	1	1	1	0	0	0	1	1	1	1	0	1
	5	1	1	1	0	0	0	1	1	1	0	1	0
V (Amalgam)	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	1	1	1
73	4	1	1	1	1	1	1	1	1	1	1	1	1
	5	2	2	3	2	2	2	2	2	2	2	2	2
VI (Amalgam+DBA)	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	1	1	1	1	1	1	1	1	1	1	1	1
72	4	1	1	1	1	1	1	1	1	1	1	1	1
	5	1	1	1	1	1	1	1	1	1	1	1	1

Table 2: Rating Scale for each group

Groups	Sample	Sample scale	Group Scale	
			Mean scores	Mean
I. (GIC)	1	1	5	1
	2	1		
	3	1		
	4	1		
	5	1		
II.(GIC+DBA)	1	2	9	2
	2	3		
	3	1		
	4	2		
	5	1		
III. (composite)	1	0	6	1
	2	1		
	3	1		
	4	2		
	5	2		
IV.(composite+DBA)	1	1	6	1
	2	1		
	3	1		
	4	1		
	5	2		
V .(amalgam)	1	1	6	1
	2	1		
	3	1		
	4	1		
	5	2		
VI .(amalgam+DBA)	1	1	6	1
	2	2		
	3	1		
	4	1		
	5	1		

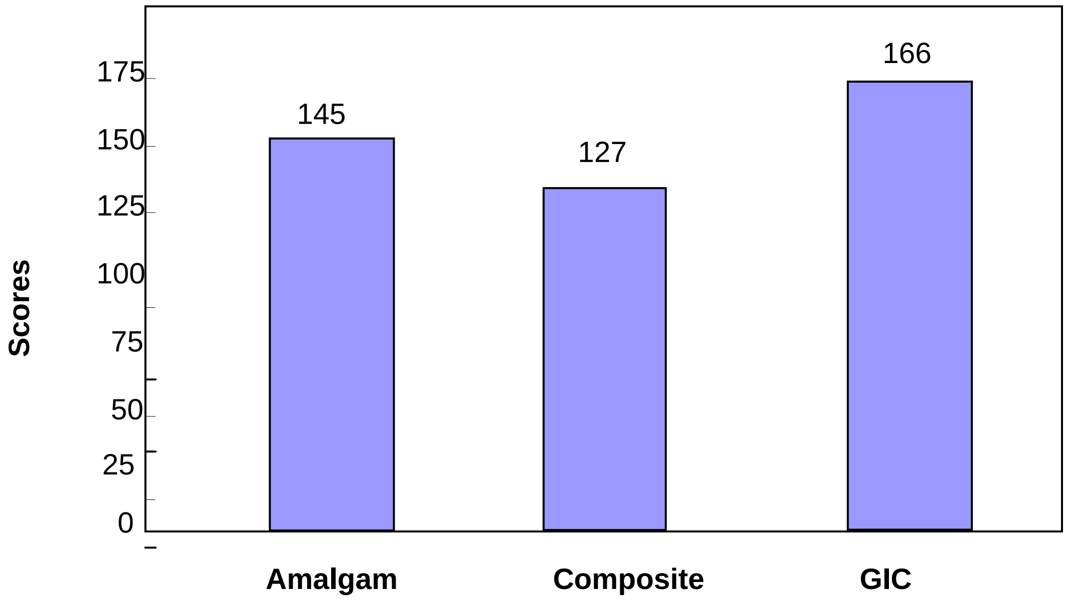

Figure 1: Differences between retrofilling materials

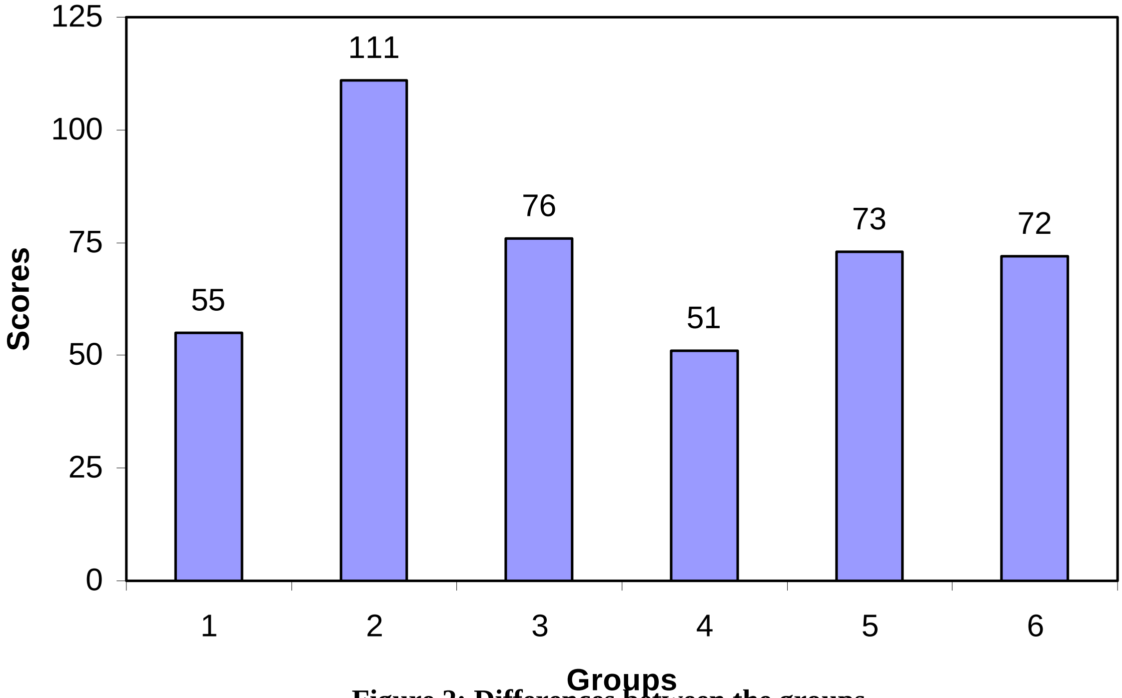

Figure 2: Differences between the groups