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Retention of class V restorations placed by dental students: a retrospective evaluation

Restaurações classe V realizadas por estudantes de odontologia: avaliação retrospectiva

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ABSTRACT

Objective: The aim of this study was to evaluate the clinical performance of class V restorations made by undergraduate students and determine the factors that might influence retention of restorations. **Material and Methods:** A survey of the clinical records created between 2007 and 2009 was used to collect data on patients with dental restorations. The USPHS (United States Public Health Service) criteria were used to perform evaluations by direct clinical observation. Statistical analyses were performed using Fisher's exact test, Chi-square test, and Logistic regression analysis. **Results:** Clinical records were analyzed, of which 282 (21.3%) described class V restorations performed on a total of 781 teeth. These patients were contacted, and 67 (23.76%) attended the clinic for assessment. Out of the 221 (28.3%) evaluated teeth, 37 restorations were replaced and 184 were analyzed. The logistic regression analysis showed that gingival bleeding index (GBI), decay-missing-filled teeth (DMFT) index, and pulpal protection influenced the retention of the restorations. The association tests demonstrated superiority of the composite resin over the glass ionomer cement with regard to retention, wear, and anatomical form. **Conclusion:** In this study, retention of cervical composite resin restorations was higher than that of the glass ionomer cement restorations when performed by undergraduate students.

KEYWORDS

Composite resins; Glass ionomer cements; Retrospective study.

RESUMO

Objetivo: O objetivo deste estudo foi avaliar o desempenho clínico de restaurações classe V realizadas por alunos de graduação e determinar os fatores que podem influenciar a retenção destas restaurações. **Material e Métodos:** Prontuários clínicos criados entre 2007 e 2009 foram utilizados para coletar dados sobre os pacientes e suas restaurações cervicais. Os critérios USPHS (United States Public Health Service) foram usados para realização de avaliações observacionais clínicas diretas. As análises estatísticas foram realizadas utilizando o teste exato de Fisher, teste qui-quadrado e análise de regressão logística. **Resultados:** Os prontuários clínicos foram analisados, dos quais 282 (21,3%) apresentaram restaurações classe V realizadas em um total de 781 dentes. Esses pacientes foram contatados, e 67 (23,76%) compareceram a clínica para avaliação. Dos 221 (28,3%) dentes avaliados, 37 restaurações foram substituídas e 184 puderam ser analisadas. A análise de regressão logística mostrou que o índice de sangramento gengival (ISG), índice de ocorrência de cárie dentária (CPOD), e proteção pulpar influenciou a retenção das restaurações. Os testes de associação demonstrou superioridade da resina composta sobre o cimento de ionômero de vidro no que diz respeito à retenção, desgaste, e forma anatômica. **Conclusão:** Neste estudo, a retenção de restaurações cervicais de resina composta foi maior do que a das restaurações de cimento de ionômero de vidro quando executados por estudantes da graduação.

PALAVRAS-CHAVE

Resinas compostas; Cimentos de ionômero de vidro; Estudo retrospectivo.

INTRODUCTION

In an era when people retain their natural teeth, there is a clear need for the restoration of cervical lesions. [1,2] Approximately 25% of the population presents with cervical injuries, which predominate at an advanced age and typically affect the pre-molar teeth. [3] The etiological factors are diverse and include incorrect habit of brushing, excessive consumption of acidic or carbonated drinks, tension resulting from traumatic occlusion, and carious lesions. [1,4] For non-carious cervical lesions (NCCL), which seem to be more frequently occurring on the buccal surfaces, tooth-colored restoratives should be considered as the materials of choice. [5] These materials typically include composite resin and glass ionomer cement (GIC). [5]

The characteristics of glass ionomer as biocompatibility, fluoride release, coefficient of thermal expansion similar to that of natural tooth structure, and the chemical adhesion of GIC make it one of materials of choice for treatment of cervical lesions. [6,1]

Nevertheless, composite resins are still considered to be suitable for class V direct restorations, because resin-based adhesives have recently shown considerable improvement in retention when used in NCCL restorations. [1] In vitro studies have suggested that current composite resins, in combination with dentin bonding agents, can achieve very high bond strengths. [7] However, a precise and careful technique is required to achieve the full potential of these materials. [7]

The superior performance of composite resins in the context of their high retention rates in class V restorations has been previously reported. [8,9] On the other hand, some investigators have observed better effectiveness of GIC when restoring such cavities; [5,2] however, others found no significant difference between these two materials. [10,11]

Given the variety of materials that has been indicated for the restoration of class V cavities, selection of the optimal method might present a challenge for the clinician. [1] This retrospective clinical study compared the clinical performance of composite resin and GIC class V restorations performed by undergraduate dental students and investigated the factors influencing restoration retention.

MATERIALS AND METHODS

Study population

Direct cervical restorations made by the third-year undergraduate students of the Araçatuba School of Dentistry were evaluated. Patients who had received class V restorative treatments in the Department of Restorative Dentistry between 2007 and 2009, and revisited the Department from May 05, 2013 to December 12, 2013, were enrolled in this study. The local Ethics Committee approved the project (#634.675), and all patients written informed consent was obtained prior to the beginning of any procedure.

Information regarding patients' general health and harmful habits was collected by means of a questionnaire. Patients with severe disability, uncontrolled diabetes mellitus, impaired immune function, periodontal disease without treatment, severe bruxism with more than 50% of wear, and dental treatment received outside of the facility after the recorded date of the cervical restoration were excluded. Permanent teeth in patients over 20 years of age were selected.

The original reasons for the restorative treatment were unknown. The treatment typically involved restoration of carious and non-carious cervical lesions and replacement of the previous restorations. The restorative materials evaluated in this retrospective, clinical study were divided into two categories commonly used in cervical restorations, composite resin and GIC, regardless of the restorative techniques. Moreover, all the materials used in the restorative procedures were recorded by

the students, including when calcium hydroxide and/or GIC was used as a lining material before the final restoration.

Survey procedures

The evaluation was performed by direct clinical observation through visual and tactile inspection, with the help of a dental mirror and periodontal probe, using the dental light reflector. Prior to evaluation of restorations, a clinical examination was conducted. Visible plaque index (VPI), gingival bleeding index (GBI), and the decayed, missing, and filled teeth (DMFT) index were assessed. To determine VPI, every tooth from the right side was evaluated. For GBI assessments, every first permanent molar, the maxillary right central incisor, and the mandibular left central incisor were evaluated. From each tooth, three different areas were examined: two buccal and one lingual surfaces. At the buccal surface, the medial and central points of the cervical portion were evaluated, while at the lingual surface, just a central point of the cervical portion was assessed. If visible plaque or bleeding at the first ten seconds after probing were observed, a score of 1 was given. Scores of 0 indicated the absence of plaque or bleeding. When the tooth was not present in the oral cavity or was impossible to examine, a score of 9 was given. This method was chosen to provide a quantitative assessment of the patient's oral condition.

Two calibrated examiners independently evaluated the restorations according to the modified USPHS criteria (Table 1). If there was a disagreement between the observers, it was resolved by consensus. A simulation was performed using images from cervical restorations and assigned scores were used for calibration prior to the examination.

Restorations that received a score of "Charlie" for retention were analyzed based on dentin sclerosis (Table 2). Dimensions and geometry of cavities were registered using a

Table 1 - Modified USPHS criteria rating system used in this study

Category	Rating – criteria
Retention	Alfa - present; Bravo - partial loss; Charlie - absent.
Marginal integrity	Alfa - closely adapted, no visible crevice; Bravo - visible crevice, explorer will penetrate; Charlie - crevice in which dentin is exposed.
Marginal discoloration	Alfa - no discoloration; Bravo - superficial staining (without axial penetration); Charlie - deep staining (with axial penetration).
Surface texture	Alfa - smooth and highly shiny, similar to enamel; Bravo - smooth and satin, highly reflective; Charlie - rough and shiny, satin, somewhat reflective; Delta - rough and dull or satin, not reflective.
Wear	Alfa - continuous; Bravo - discontinuous, no dentin exposed; Charlie - discontinuous, dentin exposed.
Anatomical form	Alfa - restoration's contour is continuous with existing anatomical form and margins; Bravo - restoration is slightly over contoured or under contoured; Charlie - marginal overhang or tooth structure (dentin or enamel) is exposed; Delta - restoration is missing, traumatic occlusion or restoration causes pain.
Recurrent caries	Alfa - no caries present; Charlie - caries present.
Surface staining	Alfa - absent; Bravo - partial present; Charlie - present in entire surface.
Soft tissue health	Alfa - excellent response, no inflammation; Bravo - slight inflammation of gingival tissue; Charlie - moderate to severe gingival inflammation.

periodontal probe. Height, width, and depth were recorded in millimeters with considerations for the greatest measure observed. Angulation of cavities was classified as follows: 45°- 90°, 90°- 120°, or >120°.

Table 2 - Scale of sclerotic dentin

Category	*Description
Category 1	Absence of sclerosis. Dentin is light yellow or whitish with little pigmentation. Opaque with little transparency or translucency.
Category 2	Greater than the category 1, however to a lesser amount in relation to the categories 3 and 4.
Category 3	Less than category 4, nearest compared in relation to the categories 1 and 2.
Category 4	Presents sclerosis. The dentin is dark yellow or discolored (brown), looks glassy, with significant translucency or clear transparency.

*Source based on the scale developed by Dr. Steven E. Duke, the University of the Health Sciences Center in San Antonio, Texas (USA).

The procedure for measuring the salivary flow required the patient to chew rubber and discard the saliva in the first minute, then chew the rubber for 5 more minutes while collecting the produced saliva into a graduated container. The salivary flow was then measured in milliliters. For the analysis of buffering capacity, 1 mL of the collected saliva was mixed with 3 mL of 0.005 M of hydrochloric acid; the mixture was stirred and incubated for 10 min at room temperature. The pH was measured using pH test strips.

Statistical Analysis

The Kappa test was employed to verify intra- and inter-examiner reproducibility. The Multivariate Logistic Regression analysis was used for evaluate the effect of the variables related to patients and teeth on the retention of restorations.

Data were submitted for descriptive analysis to show the prevalence of satisfactory and unsatisfactory restorations. Various aspects were evaluated using Chi-square or Fisher's exact test with a 95% confidence interval.

RESULTS

Sixty and seven patients were examined, 35 (52.2%) were female and 32 (47.76%) were male. Data for 221 cervical restorations were collected using the survey. According to patient records, 37 (16.7%) restorations had been retreated or further treated, allowing the analysis of 184 (83.3%) restorations. The subjects were 33 through 80 years of age with a mean age of 54 (±11.7) years.

Among the restorative materials employed for the cervical restorations, composite resin (n = 116, 63.0%) was the most frequently used, followed by GIC (n = 68, 37.0%). Seventy-seven (41.9%) restorations were rated Alpha for all the clinical criteria. Data from clinical evaluations using the USPHS criteria are shown in Table 3. The Chi-square or Fisher's exact tests showed the superiority of the composite resin restorations over those of GIC with regard to retention, wear, and anatomical form (Table 3).

The characteristics of the evaluated restorations, including tooth type and location, presence or absence of liner, restorative material used, longevity of the restoration, and patient gender can be found in Table 4. Also shown in Table 4 is the information on the frequency of the retention successes or failures. Thus, the majority of teeth treated for cervical lesions were lower jaw premolars followed by molars. The lifespan of the restorations ranged from 4 to 6 years. Equal numbers of female and male patients were involved in this study (Table 4).

The Multivariate Logistic Regression analysis showed that the GBI, DMFT index, and pulpal protection influenced the retention of restorations (Table 5). Other variables had no significant effect on the retention rate of the restorations. In addition, the retention rate of cervical restorations was independent of the VPI, patient´s age, salivary flow, buffering capacity, teeth type, restorative material, and the lifespan of the restorations.

Table 3 - Comparison of the clinical performance among restorations filled with composite resin and GIC. Values are numbers with percentages in parentheses

Category		Criteria				Chi-Square / Fisher Exact	
	Material	Alpha	Bravo	Charlie	Delta	x^2	p
Retention	RC	88 (47.8)	-	28 (15.2)	-	7.928	0.0048
	GIC	38 (20.7)	-	30 (16.3)	-		
Marginal integrity	RC	66 (52.4)	20 (15.9)	2 (1.6)	-	-	0.8408
	GIC	30 (23.8)	7 (5,5)	1(0.8)	-		
Marginal discoloration	RC	55 (43.7)	30 (23.8)	3(2.4)	-	-	0.1999
	GIC	30 (23.8)	7(5,5)	1(0.8)	-		
Surface texture	RC	83 (65.9)	5(3.9)	-	-	-	0.0941
	GIC	32 (25.4)	5(3.9)	1(0.8)	-		
Wear	RC	82 (65.0)	4 (3.2)	2 (1.6)	-	-	0.0416
	GIC	30 (23.8)	4 (3.2)	4 (3.2)	-		
Anatomical form	RC	83 (65.9)	1 (0.8)	3 (2.4)	1 (0.8)	-	«0.0001
	GIC	28 (22.2)	6 (4.7)	1 (0.8)	3(2.4)		
Recurrent caries	RC	86 (68.2)	-	2 (1.6)	-	-	10.000
	GIC	37 (29.4)	-	1 (0.8)	-		
Surface staining	RC	77 (61.1)	8 (6.3)	3 (2.4)	-	-	0.4561
	GIC	35 (27.8)	1 (0.8)	2 (1.6)	-		
Soft tissue health	RC	82 (65.1)	6 (4.7)	-	-	-	0.3466
	GIC	37 (29.4)	1 (0.8)	-	-		

Table 4 - Distribution of the data from evaluation of the restorations according to different variables success/failure for retention

	Retention		
	Total	Success	Failure
Tooth type			
Lower canine	17	13	4
Upper canine	9	8	1
Lower incisor	16	13	3
Upper incisor	2	2	0
Lower molar	17	11	6
Upper molar	17	10	7
Lower premolar	64	41	23
Upper premolar	42	28	14
Jaw			
Upper	70	48	22
Lower	114	78	36
Liner			
Present	119	90	29
No	65	36	29
Material			
RC	116	88	28
GIC	68	38	30
Year			
2009	112	83	29
2008	29	9	20
2007	43	34	9
Sex			
Female	92	61	31
Male	92	65	27

Table 5 - Contributions and Odds Ratios of variables that influenced the results of retention

Effect	Odds Ratio				
	OR	Estimate	95% CL		p
ISG	0.672	-0.3981	0.457	0.986	0.0424
CPOD	1.950	0.6677	1.039	3.659	0.0376
Liner	2.242	0.8074	1.132	4.441	0.0206

Fifty eight of the 184 restorations that were evaluated were given the "Charlie" rating for retention. These cavities were also evaluated for degree of sclerosis, with 1 and 2 being the most frequent (Table 6). The mean height was 3.9 (±1.8) mm; width, 4.8 (±2.2) mm; and depth, 3.1 (±0.9) (Table 6). The most common angulation observed was >120 (55.1%; Table 6).

Table 6 - Characteristics of class V restorations that failed for retention

Cervicoincisal height (millimeters)	
< 1.5	3 (6.1%)
1.5-2.5	8 (16.3%)
> 2.5	38 (77.6%)
Mesiodistal width (millimeters)	
< 1.5	0 (0%)
1.5-2.5	5 (10%)
> 2.5	44 (90%)
Cavity depth	
< 1.5	35 (71.45%)
1.5-2.5	11 (22.4%)
> 2.5	3 (6.1%)
Score on dentin sclerosis scale	
1	23 (46.9%)
2	16 (32.7%)
3	6 (12.2%)
4	4 (8.2%)
Shape (degree of angle)	
45-90	10 (20.4%)
90-120	12 (24.5%)
> 120	27 (55.1%)

DISCUSSION

Class V restorations are appropriate for evaluating the clinical performance of direct adhesive restorations, retention being one of the most important criteria for evaluating their longevity. [2]

The longevity of class V restorations placed by the undergraduate students using different restorative treatment options was evaluated in the present study. Randomized prospective clinical trials have the advantage of standardization of methods and calibration of the operators, allowing a more reliable comparison between different options for restorative treatments. [12] However, this type of study design does not reflect the situation where students follow a protocol under the supervision of a staff member. [13] In this context, retrospective clinical studies have been well accepted, since detailed patient files enabled the evaluation of a large number of restorations placed in clinics of the Dental School. The literature has shown that randomized clinical studies often presented better results than the retrospective studies. [9]

In a retrospective study conducted in general dental practice clinics, the longevities of RC and GIC used for cervical restorations were not statistically different. [9] However, the clinical performance of the composite resin was superior to GIC with regard to retention, marginal adaptation, and marginal discoloration and similar with regard to secondary caries, wear, and postoperative sensitivity. [9] In the present study, composite resin was statistically superior to GIC with regard to retention, wear and anatomic form, but for other criteria, both materials presented similar results. In this study, 16.7% of restorations were not evaluated due to various reasons, including replacement, tooth extraction, and prosthetic treatments. Another retrospective study showed a similar percentage (16.1%) of replaced restorations. [9]

In randomized prospective clinical trials that involved restorations of cervical lesions, both composite resin and GIC restorations performed well in short-term clinical evaluations. [10,11] However, composite resin restorations tend to fail with time and the retention rates for such restorations are markedly lower when longer evaluation periods are used. [8,14]

In contrast to the present study, prospective clinical trials showed superior performance of resin modified GIC restorations compared to the composite resin restorations, indicating that GIC restorations showed the highest success rate with regard to retention. [5,8,14] Composite resins presented a lower rate of retention in NCCL after more than 5 years in comparison with resin-modified GIC restorations. [2,14,15]

A systematic review revealed that GIC has a significantly lower risk of loss of an NCCL restoration compared to either a three-step etch-and-rinse or a two-step etch-and-rinse adhesive system. [16] However, new adhesive systems have recently shown considerable improvements in the retention of restorations placed in NCCL, despite the lack of long-term clinical trial data. [17]

Corroborating with the results of the present study, satisfactory retention rates (63.7% to 9.1%) have been observed for RC restorations placed in cervical lesions after 1 to 7 years. [2,9,11,15] Adhesive techniques have improved substantially during the last decades and are now involved in most of the clinical procedures. [17] Clinical performance of various adhesive systems have been reported and enamel-resin bonds after phosphoric acid etching have shown to be satisfactory and stable over time. [3] Although it was not possible to obtain the trademark of the materials used in the present study, it is known that the evaluated restorations were performed with two-step etch-and-rinse adhesive systems. It has been demonstrated that the three-step etch-and-rinse adhesive system has a significantly lower risk of loss in an NCCL restoration compared to a two-step etch-and-rinse adhesive system. [16] No significant difference could be observed in the risk of loss of a tooth-colored NCCL restoration between a three-step etch-and-rinse adhesive system and either a two-step self-etch or a one-step self-etch adhesive system. [16]

Regarding the wear and anatomic form, studies have corroborated that the cosmetic results and mechanical properties of GIC restorations were lower when compared to the composite resin restorations. [1] It is

important to emphasize that, similar to other retrospective studies, in the present study, a greater number of composite resin restorations was observed. [9] The most common reason for selecting either material is frequently based on practitioner's choice or clinically based evidence, demonstrating which material provides more durable restorations. [18] It has been observed that composite resins have been used more often due to their excellent esthetics, including shape, color, and gloss of the restoration achieved by finishing and polishing procedures and physical properties. [1]

The durability of a restoration is a multifactorial problem, since factors such as handling of the material, operator, degree of occlusal loading, and caries activity of the individual patient may play an important role. [1] The logistic regression analysis showed that such variables as GB and DMFT indexes and pulpal protection influenced the retention of restorations. It has been observed that patients' habits and oral hygiene as well as external factors such as smoking, food and drink intake, and the effects of staining substances might lead to superficial discoloration of restorations. [19] Oral hygiene, therefore, is an important factor in determining the survival of restorations. [13,19]

Furthermore, various factors such as tooth flexure, occlusal stress, dentinal surface characteristic, and elastic modulus of the restorative materials may affect the retention. [5] Regarding the presence of liner materials, randomized studies have suggested that materials with lower elasticity modulus can act as an elastic buffer, relieving tension of contraction stresses, improving the marginal integrity of restorations, and offsetting forces created by compression of the restoration during function. [8] In an in vivo study using the scanning electron microscope (SEM) replica technique, the sandwich technique showed significantly better adaptation than that achieved with only a resin composite restoration. [20] Similarly, in the current study, the logistic regression analysis showed that liner presence was significant to the success of restorations, because the use of materials with a low modulus of elasticity reduced the formation of cervical gaps and marginal leakage. [20]

Dentin in NCCLs tends to be sclerotic, which potentially would make bonding problematic due the presence of a hypermineralized layer on the dentin surface. [17] Unexpectedly, however, in the restorations that failed to show retention in the present study, the most common degree of sclerosis was low, corroborating with a prospective 8-year evaluation that observed significantly higher loss rates for non-sclerotic cervical lesions in comparison with sclerotic lesions with a mild two-step self-etch adhesive. [21] Other clinical study reported no significant differences in the retention of cervical restorations in sclerotic lesions versus non-sclerotic lesions. [22] On the other hand, depending on the bonding system, dentin with a high degree of sclerosis seemed to cause an inferior bonding with retention loss. [23] In fact, little is known about long-term bonding to this specific substrate. [3]

Large cervical lesions are often exposed for extended periods to the oral environment and, therefore, are more likely to exhibit advanced sclerosis. [23] In the current study, the majority of restorations that failed to show retention were made in large cervical lesions. On the other hand, a clinical trial demonstrated that the shape, size, and location of NCCLs did not affect the clinical performance of cervical restorations. [24]

The different results observed in clinical studies may have been influenced by many factors, including the bonding capacity of restorative systems, curing techniques used, several patient-dependent factors, hydrolytic degeneration of the material, different operators, operative techniques, and sample size or other factors. [25] In the present study, it is possible that the inferior performance of GIC restorations was due to the lack of training by students for handling GIC material. The chemical interactions between the carboxyl

groups with hydroxyapatite of the glass ionomer cements have been considered to be important factor for the performance of these materials on NCCLs. [16] These interactions are dependent on the correct powder-to-liquid mixing ratios that vary considerably from those recommended by the manufacturer due to inter-operator variability. [26] In clinical practice, dental cements are routinely hand-mixed by the operator to a desired consistency. Encapsulated GIC may be a promising alternative to avoid the operator variability associated with hand-mixed GIC. [26] Future research is needed to see if improvements in training and skills for the appropriate manipulation and use of GIC will lead to different results when compared to those obtained with composite resins in a University environment.

CONCLUSION

The retention rate of cervical restorations made with composite resin was higher than that of glass ionomer cement, when performed by the undergraduate students. However, the presence of lining materials, such as glass ionomer cement, was a factor determining for the longevity of restorations.

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