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Clinical performance of some resin-based materials in restoring non-carious cervical lesions

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ABSTRACT

Objectives. The objective of the study was to investigate the clinical performance of two different resin-based materials 6 months after their placement in dental non-carious cervical lesions (NCCL). This study also aimed to evaluate the effects of the materials on periodontal tissues in terms of clinical changes of several periodontal parameters.

Material and methods. NCCLs characteristics (localization, morphology, dimensions) were preoperatively recorded. The clinical behaviour of the restorations based on the modified United States Public Health Service (USPHS) criteria and periodontal parameters (plaque index, bleeding index, probing depth, and attachment loss) were assessed at baseline and after 1, 3 and 6 months.

Results. No significant modifications were recorded for the modified USPHS criteria 6 months after the placement of NCCL restorations excepting postoperative hypersensitivity which was associated with 4 restorations after 6 months. Significant improvements of plaque and bleeding indices were recorded, while no significant modifications were noted for the other periodontal parameters.

Conclusions. Considering the clinical success related to the good clinical behaviour and the positive effect of the restorations on the periodontal status, the experimental conventional composites and giomers could be considered as a good therapeutic option for the restoration of NCCLs.

Keywords: composite resins, hypersensitivity, periodontal indices, dental restoration

Abbreviations:

NCCL – Non-carious cervical lesion
PRG – Pre-reacted glass technology
USPHS – United States Public Health Service
LPI – localized plaque index
GBI – gingival bleeding index
CAL – clinical attachment level
PD – probing depth
MB – mesial-buccal
CB – central-buccal
DB – distal-buccal
Bis-GMA – bisphenol-A-diglycidyl methacrylate
TEGDMA – triethyleneglycol dimethacrylate
UDMA – urethane dimethacrylate
Bis-MPEPP – bisphenol A polyethoxy dimethacrylate
TMPTMA – trimethylolpropanetrimethacrylate
Bis-EMA – ethoxylate bisphenol A dimethacrylate
BF – Beautiful II LS®
BFL – Beautiful Flow Plus® F03
DF – Dynamic Plus® (D), Dynamic Flow®

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INTRODUCTION

Although non-carious cervical lesion (NCCL) restorations are very common in dental practice, they are associated with a relatively reduced long-term survival rate [1]. The restorative treatment of NCCLs through direct techniques is still a challenge for dental practitioners due to difficulties in obtaining proper isolation and access to the sub-gingival margins of the cavity during the material placement, modelling and finishing steps [1]. In addition, some histological changes of dental cervical tissues may compromise the quality of the adhesive interface, thus contributing to the reduced retention of the restoration [1-3]. Moreover, material-related factors such as polymerization shrinkage or elastic modulus could also influence the durability of cervical restorations [4,5].

Currently, literature does not provide a universally accepted therapeutic guide on the working protocol, the ideal materials, or the best timing in restoring NCCLs [6]. However, there are some opinions indicating early restorative treatment for NCCLs associated with caries, hypersensitivity or significant tissue loss that may hamper the integrity, vitality, or functionality of the affected teeth [7]. Restorative treatment is also indicated when NCCLs have sub-gingival margins which can impair the personal plaque control or when the patient has important aesthetic requirements [7]. While early intervention on NCCLs is recommended to stop their progression and improve the tooth prognosis in terms of structural and functional integrity, some studies suggest monitoring the lesions until the development of clinical complications [1].

Dental materials indicated for the restorative treatment of cervical lesions should have good biological and mechanical properties that ensure their resistance to tooth flexion and provide long-term retention and marginal sealing [8]. Considering that NCCLs are found frequently on the vestibular surfaces of frontal teeth and premolars [5,9,10], they should be restored with aesthetic materials that provide the possibility of excellent finishing, polishing and color matching. The proximity of periodontal tissues requires the use of biocompatible materials with no harmful effects on gingival cells.

Nowadays, the most commonly used materials in restoring NCCLs are the resin composites, the conventional glass-ionomers and the resin-modified glass-ionomers [11-14]. However, due to their aesthetic, adhesive and mechanical qualities, resin composites became a preferred alternative for NCCL restorative treatment [1]. Despite their growing popularity and their constantly improvement, resin composites are still associated with some disadvantages such as polymerization shrinkage and the release of chemical toxic compounds which may impair their clinical performance and biocompatibility [8,15-17]. Moreover, composite resin restorations can adversely affect periodontal health through plaque retention [18] and iatrogenic-related deficiencies such as over-contouring, poor polishing, overhanging or sub-gingival components [19].

To improve certain drawbacks associated with conventional dental materials, new modern materials such as giomers have been developed. The giomer concept is based on the pre-reacted glass technology (PRG) which involves the pre-reaction of fluoroaluminosilicate glass fillers with the polyacrylic acid to form a stable phase (wet siliceous hydrogel) which is then prepared according to a strict protocol to obtain PRG fillers [11]. Giomers are hybrid materials that combine the increased wear resistance and the aesthetic properties of resin composites with glass-ionomers fluoride release and recharge capacity [11,20]. Due to the PRG technology that ensures their fluoride release and recharge qualities, giomers can reduce the risk of secondary caries and marginal discolorations, thus being considered intelligent materials [11,21]. However, the clinical performance of giomers when compared to resin composites it is still a controversial topic. Giomers can be successfully used in many clinical situations, but their long-term behavior is still controversial [22-24].

The aim of the present study was to evaluate the performance of NCCL restorations in terms of biological influences on periodontal tissues and clinical restorative parameters, by comparing giomers with conventional resin composites, both of condensable and flowable consistency, in single or combined applications. The null hypothesis stated was that there were no significant differences regarding the biological behavior in terms of periodontal parameters and clinical performance between the different restoration types placed in NCCL, after 6 months.

MATERIAL AND METHOD

Study design, eligibility criteria and experimental materials

The present study was carried out at the Ambulatory of Periodontology, Discipline of Periodontology, Faculty of Dentistry, Iuliu Hatieganu University of Medicine and Pharmacy after obtaining the agreement of the Ethical Bord of *Iuliu Hatieganu* University (No.268 of 30.07.2019) and the Ethical Board of County Emergency Hospital of Cluj-Napoca (No.41271/B/29.09.2021) and was performed in conformity with the guidelines of the Declaration of Helsinki. The purpose of the study, the working protocol and the therapeutic implications were explained to the patients, who agreed to participate by signing the informed consent.

This clinical study focused on follow-up examinations of the periodontal status and clinical behavior of two different types of resin-based materials (giomer and resin composite), both in condensable and flowable consistency after 1, 3 and 6 months of their placement in NCCLs.

Inclusion criteria were as follows: 1) patients with at least one NCCL requiring restorative treatment on vital/non-vital permanent teeth with radiological confirmed adequate endodontic treatment; 2) good periodontal prognosis of the involved tooth; 3) patients with good oral hygiene. Exclusion criteria were as follows: 1)patients with treated or not requiring restorative treatment of NCCLs; 2)teeth with poor dental and periodontal prognosis; 3)patients with severe systemic diseases contraindicating dental treatment; 4)patients with allergies to dental materials; 6)patients with poor oral hygiene.

Four experimental resin-based materials were used in the present study (Table 1).

NCCLs were distributed in four groups based on the lesion depth and the material used for their restoration; there was a random allocation between the two similar groups (Table 2).

TABLE 1. The composition of experimental materials

Trade name	Code	Characteristics
Beautifil II® LS, Shofu Dental Corporation, JAPONIA	BF	**Giomer** – *Organic matrix*: Bis-GMA, TEGDMA, UDMA, Bis-MPEP – *Inorganic filler* (83%): fluoro-barium-alumino-silicate glass
Beautifil Flow Plus® F03, Shofu Dental Corporation, JAPONIA	BFL	**Giomer** – *Organic matrix*: Bis-GMA, TEGDMA – *Inorganic filler* (67%): fluoro-barium-alumino-silicate glass
Dynamic Plus®, President Dental, GERMANIA	D	**Microhybrid composite** – *Organic matrix*: Bis-GMA, TEGDMA – *Inorganic filler* (80%): fluoro-barium-alumino-silicate glass, fumed silica
Dynamic Flow, President Dental, GERMANIA	DF	**Microhybrid composite** – *Organic matrix*: Bis-GMA, TMPTMA, UDMA, Bis-EMA – *Inorganic filler* (<60%)*:* barium-aluminium silica

LS = low shrinkage; Bis-GMA = bisphenol-A-diglycidyl methacrylate; TEGDMA = triethyleneglycol dimethacrylate; UDMA = urethane dimethacrylate; Bis-MPEPP = bisphenol A polyethoxy dimethacrylate; TMPTMA = trimethylolpropanetrimethacrylate; Bis-EMA = ethoxylate bisphenol A dimethacrylate; BF = Beautiful II LS®; BFL = Beautiful Flow Plus® F03;D = Dynamic Plus®; DF = Dynamic Flow®

Evaluation of periodontal parameters

The *localized plaque index (LPI)* was performed by scraping technique using the UNC 15® probe (University of North Carolina, Hu Friedy). The *gingival bleeding index (GBI)* was recorded 30 seconds after carefully introducing the periodontal probe to the bottom of the sulcus/pocket with controlled force and gently moving the probe once on the vestibular surface of each examined tooth. Both LPI and GBI were assessed in three areas (mesial-buccal=MB, central-buccal=CB, distal-buccal=DB) on the experimental tooth and two neighboring teeth, mesialy and distally located. Each index score was expressed as a percentage.

The *probing depth* (PD) and the *clinical attachment level* (CAL) were measured with the UNC 15® probe in the same above-mentioned areas.

All clinical periodontal parameters were recorded at the baseline (T0) and 1 (T1), 3 (T2) and 6 months (T3) after the restorative procedure.

TABLE 2. Distribution of restorative materials by NCCL group category

NCCL depth	Group	Material
Shallow lesions (<1 mm)	Group 1	Beautifil Flow Plus® F03,
	Group 2	Dynamic Flow,
Deep/medium lesions (≥1 mm)	Group 3	Beautifil Flow Plus® F03 + Beautifil II® LS,
	Group 4	Dynamic Flow + Dynamic Plus®,

NCCL= non-carious cervical lesion; LS= low shrinkage

Restorative procedure

The anatomical form of NCCLs was appreciated based on literature recommendations, thus distinguishing saucer-shaped lesions from wedge-shaped and superficial lesions [7,25]. According to their depth, NCCLs were classified in superficial (<1 mm), medium (1-2 mm) and deep (>2 mm) lesions [26].

The experimental teeth were restored according to the manufacturer's instructions corresponding to each type of material. The dentin surface was roughened carefully under local anesthesia with low-speed round carbide burs depending on the cavity size (H1SEM.204.012, H1SEM.204.014, H1SEM.204.016 Komet Dental, Lemgo, Germany). The coronal enamel margins were bevelled 1-1.5 mm at 45° using a high-speed diamond finishing bur (8368L.314.016, Komet Dental, Lemgo, Germany). Experimental teeth were isolated with a retraction cord without any hemostatic agent (Retraflex, Biodinamica Dental Products LDA, Figueiró Dos Vinhos, Portugal). The enamel was selectively etched for 30s with 36% phosphoric acid (Blue Etch®, Cerkamed, Stalowa Wola, Poland) before applying the bonding agent.

After rinsing the etchant and drying the cavity surface, all-in-one adhesives systems were used for all restoration, according to the manufacturer's recommendation for each material. The conventional composites were associated with Prebond SE (President Dental, Germany) adhesive and the giomers were applied together with BeautiBond (Shofu Dental Corporation, Japan) adhesive.

Two layers of flowable material were applied for each cavity belonging to the Groups 1 and 2. Deep cavities (groups 3 and 4) were restored with a first layer of flowable material that was covered with a condensable correspondent material. A conventional curing light (Demetron A2 light-curing unit, Kerr Corporation, Middleton, WI, USA) was used. The restorations were polished with high-speed diamond finishing burs, silicone polishers and polishing diamond pastes.

Evaluation of NCCL restorations

The clinical behavior of the restorations was appreciated using the USPHS guidelines, involving the assessment of certain criteria, such as: marginal discoloration and adaptation, surface texture, abrasion, post-operative sensitivity and secondary caries. The corresponding scores for each criterion are shown in Table 3. All restorations were assessed at the baseline and 1, 3 and 6 months after their placement.

TABLE 3. The modified USPHS criteria [27]

Category	Score	Criteria
Marginal discoloration	Alfa (A) Bravo (B) Charlie (C)	Absence of marginal discoloration Slight marginal discoloration Visible marginal discoloration
Marginal adaptation	Alfa (A) Bravo (B) Charlie (C)	Good adaptation without visible gap Visible gap with probe penetration Visible gap exposing the dentin
Surface texture	Alfa (A) Bravo (B) Charlie (C)	Smooth, glazed or glossy surface Slightly rough surface Very rough surface
Abrasion	Alfa (A) Bravo (B) Charlie (C)	Continuous Discontinuous, without dentin exposure Discontinuous, with dentin exposure
Post-operative sensitivity	Alfa (A) Charlie (C)	Absent Present
Secondary caries	Alfa (A) Charlie (C)	Absent Present

USPHS= United States Public Health Service

Statistical Analysis

The statistical analysis was performed using MedCalc® Statistical Software version 20.111 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2022). Continuous values were expressed as means ± standard deviations, and qualitative variables were expressed as frequency and percentage. For the comparative analysis of the quantitative variables, the ANOVA test for repeated measurements was used. For the analysis of the qualitative variables, the marginal homogeneity test was used. A value of $p<0.05$ was considered statistically significant. Intra-group comparisons analysed the modification of parameters in time. Inter-group comparisons appreciated the evolution of parameters between different experimental groups.

RESULTS

The present study evaluated the influences on periodontal status and the clinical behavior of four resin-based materials placed in NCCLs, in 17 subjects with the mean age of 43 years. Only 15 patients were finally available for control visits for which a total of 40 NCCL, divided in 4 groups each comprising 10 lesions were restored and evaluated at baseline and after three follow-up moments. The majority of teeth were premolars and most NCCLs were saucer-shaped. Twenty one NCCLs were classified as superficial (<1 mm depth) and 19 as deep lesions (>1 mm depth). Almost 77% of the lesions were <2.5 mm width and 72% of them were >2.5 mm height. The distribution of NCCLs according to their characteristics and localization is described in Figure 1.

Inter-group comparisons showed that both plaque and bleeding indices were associated with statistically significant improvements from T0 to T3, for all the subjects (p'=0.00). On the other hand, inter-group comparisons identified no significant differences of the two indices with respect to the type of the material. No significant modifications of the PD and CAL on the MB, CB and DB surfaces were identified from T0 to T3. A small, but not significant improvement of CAL was observed on the CB surface after 6 months (p'=0.1). No significant differences were identified between group 1 and group 2, or between group 3 and group 4 when comparing the modifications of the periodontal parameters from T0 to T3.

Intra-group comparisons showed significant improvement of the plaque index from T0 to T3, for group 1, 3 and 4 (p=0.02, p=0.05, p=0.01, respectively). Significant improvements were also found for the bleeding index in all four experimental groups: group 1 (p=0.00), group 2 (p=0.02), group 3 (p=0.00) and group 4 (p=0.02). Intra-group comparisons showed no other significant modifications for the other examined periodontal parameters.

The comparative analysis regarding the influence of the restoration group on the periodontal status are shown in Table 4.

The clinical behavior of NCCL restorations was monitored at three moments after their placement based on the scores (A=Alfa, B=Bravo, C=Charlie) of each criterion of the modified USPHS. No significant modifications were observed after 6 months regarding the marginal integrity and discoloration, the surface texture, the abrasion, and the presence of secondary caries for the evaluated restorations. As for the post-operative sensitivity, the statistical analysis revealed significant modifications from T0 to T3 (p=0.04) in all groups (4 restorations associated with post-operative hypersensitivity at T3).

TABLE 4. The comparative analysis of the periodontal parameters

Periodontal parameter		T0	T1	T2	T3	p	p´	p"
LPI(%)	Gr 1	51.8±0.313	39.6±0.238	38.6±0.305	35.3±0.308	**0.02**	**0.00**	0.9
	Gr 2	45.1±0.210	30.3±0.193	33.1±0.248	30.9±0.261	0.1		
	Gr 3	34.2±0,331	26.4±0.284	24.2±0.296	22.0±0.254	**0.05**		
	Gr 4	39.7±0,267	27.5±0.188	29.7±0.226	25.3±0.214	**0.01**		
GBI(%)	Gr 1	38.5±0.289	18.7±0.226	16.0±0.218	18.7±0.214	**0.00**	**0.00**	0.2
	Gr 2	30.8±0.301	23.2±0.250	18.8±0.214	16.5±0.157	**0.02**		
	Gr 3	25.3±0.279	16.5±0.181	11.0±0.146	9.9±0.141	**0.00**		
	Gr 4	13.2±0.144	9.9±0.150	5.5±0.139	5.5±0.106	**0.02**		
PD-MB(mm)	Gr 1	2.40±0.966	2.30±0.823	2.30±0.823	2.40±0.966	0.5	0.5	0.7
	Gr 2	2.10±0.738	2.10±0.738	2.10±0.738	2.10±0.738	-		
	Gr 3	2.10±0.568	2.10±0.568	2.10±0.568	2.10±0.568	-		
	Gr 4	1.9±0.876	1.90±0.876	1.90±0.876	1.90±0.876	-		
PD-CB(mm)	Gr 1	1.00±0.000	1.00±0.000	1.00±0.000	1.00±0.000	-		
	Gr 2	1.20±0.422	1.20±0.422	1.20±0.422	1.20±0.422	-		
	Gr 3	1.20±0.316	1.20±0.316	1.20±0.316	1.20±0.316	-		
	Gr 4	1.10±0.316	1.10±0.316	1.10±0.316	1.10±0.316	-		
PD-DB(mm)	Gr 1	2.10±0.876	2.10±0.876	2.10±0.876	2.10±0.876	-	0.2	0.6
	Gr 2	1.90±0.568	1.90±0.568	1.90±0.568	1.90±0.568	-		
	Gr 3	2.50±0.707	2.50±0.707	2.40±0.516	2.40±0.516	0.4		
	Gr 4	2.30±0.823	2.30±0.823	2.30±0.823	2.20±0.632	0.4		
CAL-MB(mm)	Gr 1	2.00±2.539	2.00±2.539	2.00±2.539	2.10±2.726	0.4	0.2	0.6
	Gr 2	2.00±1.563	2.00±1.563	2.00±1.563	2.00±1.563	-		
	Gr 3	1.30±2.406	1.30±2.406	1.40±2.547	1.40±2.547	0.4		
	Gr 4	0.90±2.025	0.90±2.025	0.90±2.025	0.90±2.025	0.4		
CAL-CB(mm)	Gr 1	1.30±1.636	1.40±1.838	1.40±1.838	1.40±1.838	0.4	**0.1**	0.7
	Gr 2	1.90±1.287	1.90±1.287	1.90±1.287	1.90±1.287	-		
	Gr 3	1.00±2.160	1.00±2.160	1.00±2.160	1.00±2.160	-		
	Gr 4	0.70±1.160	0.80±1.398	0.80±1.398	0.80±1.398	0.4		
CAL-DB(mm)	Gr 1	1.80±2.251	1.90±2.470	1.90±2.470	2.00±2.625	0.2	0.3	0.4
	Gr 2	2.80±1.687	2.80±1.687	2.80±1.687	4.80±6.268	0.4		
	Gr 3	0.70±1.889	0.70±1.889	0.70±1.889	0.70±1.889	0.4		
	Gr 4	0.90±1.729	0.90±1.729	0.90±1.729	0.80±1.619	-		

T0 = pre-operarive; T1 = 1 month post-operative; T2 = 3 months post-operative; T3 = 6 months post-operative; LPI = localised plaque index; GBI=gingival bleeding index; PD = probing depth;CAL = clinical attachment loss; MB = mesio-buccal; CB = centro-buccal; DB = distal-buccal; p = statistical significance of measurements; p = statistical significance of intra-group and inter-group measurements; p´ = statistical significance of repeated measurements irrespective to the material type; p" = statistical significance of repeated measurements with respect to the material type. Missing p-values are asociated with the constancy of parameters over time.

TABLE 5. The comparative analysis of the modified United States Public Health Service (USPHS) criteria

Criteria	Score	T0	T3	*p*
MD	A B	40 -	37 3	0.08
MA	A B	40 -	38 2	0.1
ST	A B	40 0	37 3	0.08
A	A B	40 -	40 -	
PS	A C	40 -	36 4	**0.04**
SC	A C	40 -	40 -	

T0 = pre-operative; T3 = 6 months post-operative; USPHS = United States Public Health Service; MD = marginal discoloration; IM = marginal adaptation; TS = surface texture; A = abrasion; SP = post-operative sensitivity; SC = secondary caries; A = Alfa score, B = Bravo score, C = Charlie score; p = statistical significance of inter-group measurements.

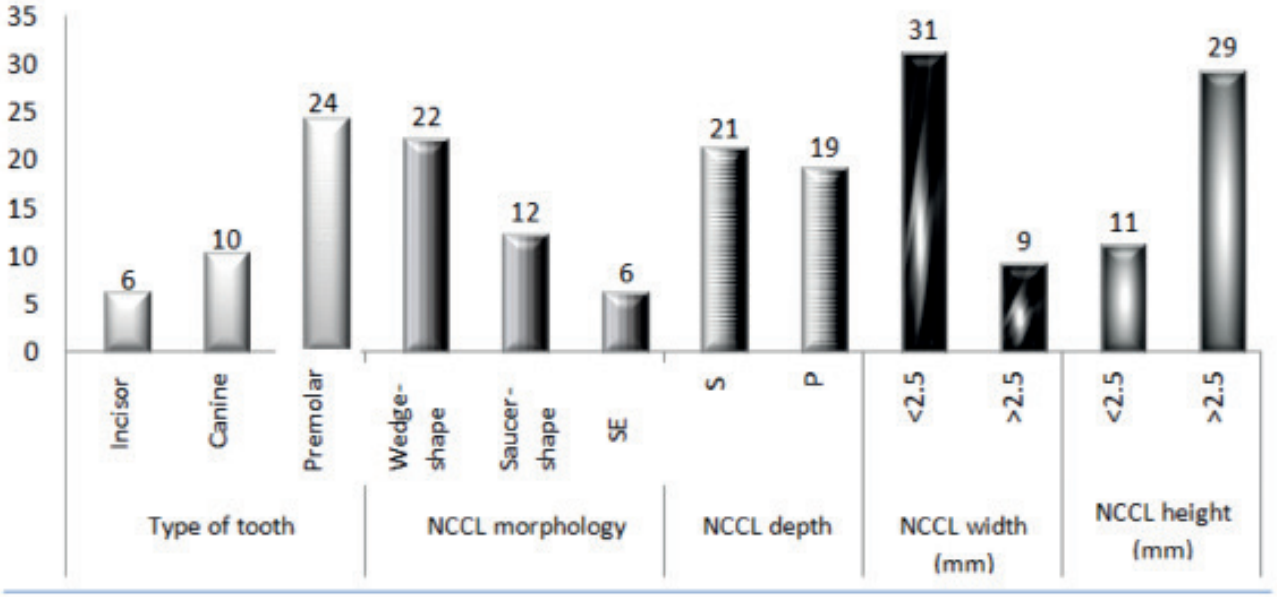

FIGURE 1. NCCL (no.) distribution according to their characteristics.

Abbreviation: NCCL = non-carious cervical lesions; SE = superficial erosion; S = superficial; D = deep

The comparative analysis of the clinical behavior of the restoration types is shown in Table 5.

DISCUSSION

The appreciation of the evolution of periodontal and restorative parameters generally revealed no statistically significant modifications in time, or statistically significant differences between different experimental products, excepting the postoperative sensitivity. Thus, the null hypothesis is accepted since the four materials seemed not to have a negative clinical impact on the surrounding tissues. Moreover, there is an equal evolution of each restorative appreciation criterion for all experimental restorative materials.

The plaque and the gingival bleeding indices were significantly improved 6 months after the placement of NCCL restorations, irrespective to the material type. We also observed a little but not significant improvement of the attachment level, on the central-buccal area of the experimental teeth. The other clinical periodontal parameters were not significantly modified after 6 months. The improved periodontal status in terms of plaque control and gingival inflammation may be due to the restoration of tooth emergence profile meantime eliminating the areas of plaque retention. Furthermore, removing the associated dentine hypersensitivity can increase patient comfort during personal brushing.

According to some data in literature, even though NCCLs are considered plaque retention factors which can contribute to gingival/periodontal conditions, there is no strong scientific proof to demonstrate the association [18]. Furthermore, there are some concerns regarding the impact of cervical restorations on periodontal tissues. The presence of dental plaque, gingival inflammation, gingival recessions and deep periodontal pockets were reported in association with cervical restorations with a subgingival component [28].

The strict restorative protocol and the use of flowable products may explain the good behavior of the restorations. Also, according to recent recommendation [14] our clinical protocol included the preparation of the dentin surface, the enamel bevelling and a supplementary etching of the enamel margins. Roughening the dentin surface may improve the bonding strength by removing the superficial sclerotic dentin which is more resistant to etching than normal dentine [1,4,29,30]. NCCL restorations placed without preparing the dentin surface were associated with a reduced survival rate after 7 years [31]. Bevelling the enamel margins expands the area of the bonding surface, thus increasing the quality of the adhesive interface and the aesthetic appearance of the restoration [32]. Moreover, enamel etching prior to the application of the bonding system may improve the marginal adaptation and the enamel bonding strength [33]. Even though the positive effects of enamel bevelling on cervical restorations were often demonstrated [34,35], there are some studies reporting no significant long-term advantages [32,36,37]. The retention rate of NCCLs restorations was not significantly different between a group of lesions for which the bevelling was performed and those restored without prior bevelling the enamel after 12 months [32] and 18 months [38] respectively.

Flowable materials were used in the present study due to their "flexibility" needed to overcome

the flexural forces in the cervical area and capacity to absorb a part of the stress related to polymerization shrinkage [39,40], which would positively influence the material and adhesive interface stability as compared with conventional resin composites [41]. The stratified approach applied by us in deep lesions would have reduced polymerisation shrinkage and preserve adhesion. The first layer of each material was placed at the gingival wall to reduce the risk of a poor cervical dentin sealing, considering that enamel adhesion is stronger, more stable, and predictable [1]. However, the opinions on the best layering technique when restoring NCCLs are still controversial [1]. The restoration of deep NCCLs using both a flowable and a condensable material had in view to sum the advantages of the layering technique, the elastic behavior of flowable composites and the good wear resistance of condensable products [14].

Although the restorations were applied through a rigorous protocol, the development of postoperative sensitivity could not be avoided. Four restorations developed post-operative sensitivity 6 months after their placement in NCCLs. This may be the result of the proximity of the lesion base to the dental pulp in wedge-shaped and deep NCCLs [42].

The positive pattern of clinical behavior related to the other parameters may be explained by the short observation time, which could be considered a limitation of the present study. According to literature, the real performance of restorative materials can only be appreciated through long-term clinical studies [43]. Due to the significant stress generated by the occlusal loading in the cervical area of the teeth [43], the sensitivity of the clinical protocol [1], and the histological/anatomical features of the remaining tissues [32] NCCL restorations are associated with a high retention loss [1,43]. Thus, these lesions allow a real evaluation of the adhesive efficiency of resin-based materials, being frequently considered as the ideal dental lesions for assessing the clinical behaviour of direct dental restorations [43].

As for other modified USPHS criteria used to appreciate NCCL restorations, most of them had the same score after 6 months. The marginal integrity was compromised for only 2 restorations, for which we identified a visible gap with probe penetration (score B). The impaired marginal adaptation may be the result of the polymerization shrinkage and the occlusal cervical stress [44]. Considering the short follow-up period, the absence of secondary caries it's explainable, as in other similar studies [44-46].

According to some clinical studies, giomers have ideal properties which sustain their recommendations in restoring NCCLs [22,23]. The most important advantages associated with these materials such as high wear resistance, great flexibility and aesthetic properties ensure their stability and survival in the oral cavity [11,20], meantime providing the natural aspect of the restorations.

Another limitation of this clinical study is the relatively small number of restorations.

CONCLUSION

The thorough restorative protocol of NCCLs including an effective isolation, the restoration of morphological and anatomical features in compliance with those of natural teeth and proper finishing/polishing steps may contribute to the good clinical behaviour of the restorations and the maintenance of the gingival health.

The restoration of NCCLs improved the personal plaque control and reduced gingival inflammation.

Both giomers and conventional composites had a good clinical performance in restoring NCCLs.

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