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Clinical evaluation of a universal adhesive in total-etch and selective-etch modes in the restoration of non-carious cervical lesions in Nigerian adults

Temitope Olabisi Omosebi[1], Adenike Ololade Awotile, Cyril Ilemobade Adegbulugbe[3], Lillian Lami Enone[4], Gbenga Emmanuel Adebayo[5]

[1] Associate Lecturer/Consultant, Department of Restorative Dentistry, Lagos State College of Medicine/Lagos State University Teaching Hospital, Ikeja, Lagos-state, Nigeria
[2] Associate Professor/Honorary Consultant, Department of Restorative Dentistry, Lagos State University College of Medicine/Lagos State University Teaching Hospital, Ikeja, Lagos-state, Nigeria
[3] Associate Professor/Honorary Consultant, Department of Restorative Dentistry, College of Medicine, University of Lagos/Lagos University Teaching Hospital, Idi-Araba, Lagos-State, Nigeria
[4] Lecturer I/Honorary Consultant, Department of Restorative Dentistry, Lagos State University College of Medicine/Lagos State University Teaching Hospital, Ikeja, Lagos-state, Nigeria
[5] Consultant Conservative Dentist and Endodontist, Department of Dental services, Federal Medical centre, Ebute-metta, Lagos-state, Nigeria

Abstract

Background: Non-carious cervical lesions (NCCLs) are among the most frequent pathologies that affect dental structures affecting the middle-aged and elderly population, compromising their aesthetics and function (dentinal hypersensitivity). Objectives: To determine clinical performance of a universal adhesive in total-etch and selective-etch modes in the restoration of non-carious cervical lesions in adult teeth. Materials and Methods: This randomized controlled clinical study was carried out at the Conservative Clinic of the Department of Restorative Dentistry, Lagos State University Teaching Hospital, Ikeja, Lagos State. Thirty teeth were studied for each intervention; they were randomized into two groups based on the application modes: total-etch and selective-etch. The researcher diagnosed, selected (conforming to inclusion criteria) and treated the patients, but evaluated by examiners. Scotchbond Universal was used and Filtek supreme ultra-universal composite resin was used as the final restorative material. The restorations were evaluated at baseline, 3, 6 and 12 months for marginal staining, retention, marginal adaptation, patient's view, post-operative sensitivity and recurrence of caries using FDI criteria. Patients and evaluators were blinded Data were analyzed using SPSS, IBM version 25.0. Chi-square test and Fischer's exact test were used to assess association between categorical data, while clinical outcome at different follow up interval were assessed using McNemar test. P-value was set at 0.05. Results: Restorations in total-etch and selective-etch groups were comparable in their clinical performances in marginal staining, but at 6 and 12 months in the total-etch group, there was a score 3 in marginal staining. There was a score of 3 in retention at 12 months in selective-etch. The patient's view was relatively the same throughout the study in both groups. Statistically, there was no significant difference in any of the parameters evaluated for both groups ($P \geq 0.05$). Conclusion: The clinical performance of universal adhesive in both total-etch and selective-etch modes were both satisfactory in the restoration of non-carious cervical lesions throughout the evaluation period. Both techniques are suitable for the placement of resin composites in non-carious cervical lesions 'restoration.

Keywords: Clinical Evaluation, Universal Adhesives, Total-Etch, Selective-Etch, Non-Carious Cervical Lesions.

***Corresponding author:**
Dr. Temitope Olabisi Omosebi
Department of Restorative Dentistry, Lagos State College of Medicine/Lagos State University Teaching Hospital, Ikeja, Lagos-state, Nigeria
Email: topeisokay@yahoo.com

INTRODUCTION

Among the prevalent dental pathologies, non-carious cervical lesions (NCCLs) are frequently observed, and severity has been associated with aging [1]. It has been reported that most of individuals having NCCLs are found among the middle-aged and elderly population groups [2]. Several predisposing/etiological factors that have been suggested for NCCLs include: aging, sex, oral hygiene habits, saliva production, consumption of acidic beverages, intensity of tooth-brushing, periodontal condition, number of teeth and occlusion [1].

The aesthetics of dentition may be compromised by the presence of NCCLs and many patients experience sensitivity, ranging from mild to severe. Non-carious loss of dental hard tissue at the cervical region is used as a clinical model to evaluate the efficacy of dentin bonding agents in tooth restorations, as recommended by the American Dental Association (ADA) [3].

Resin adhesives have been employed for several decades in the restoration of non-carious cervical lesions

focusing on improving aesthetics and patient comfort; replacing the lost tissue thereby restoring the structural integrity of the teeth [4]. Evidence suggests that the restoration of these lesions using bonded resin composite is more effective than no treatment or topical desensitization [5].

Principles of adhesive dentistry date back to 1955 by Buonocore who reported the benefits of acid etching as a surface treatment before application of the resins [6]. With advancement of technology, dental adhesives have evolved from no-etch to total-etch (4th and 5thgeneration) to self-etch (6th, 7th and 8th generation) systems [6]. In the late 1960s, Buonocore proposed that the adhesion of resins to acid-etched enamel was primarily due to the formation of resin tags [7].

Adhesive systems have been revolutionized and are routinely used in operative dentistry, aimed at improving the retention, sealing properties and aesthetics of resin-based materials [8]. In the early 1990s, the water "wet bonding" approach was introduced to address the issue of collagen collapse following acid-etching, thereby facilitating improved resin infiltration into the acid-etched dentin [9].

The new adhesive system known as "universal adhesives" which may be used as self-etch adhesives, total-etch adhesives, or as selective-etch adhesives are tailored to a specific clinical situation [10]. The introduction of universal adhesives has enabled clinicians the choice of total-etch, self-etch or selective-etch application from a single-bottle adhesive [11]. The composition of dentin and enamel substrates varies, necessitating the use of various bonding protocols. Some practitioners have suggested a "selective-etch" procedure, wherein the enamel and dentin are subjected to different etching processes [12].

In the clinical evaluation of cervical restorations, no difference was reported in the retention when a universal adhesive was used in total-etch, self-etch, or selective modes after 6 months or 18 months but found a notably higher number of restorations applied in a self-etch mode had marginal imperfections [13,14]. These self-etch adhesives entail fewer steps, showing less sensitivity to technical problems, and eliminate the necessity for application of phosphoric acid and rinsing [15]. Clinical trials have shown that self-etch adhesives have higher rates of marginal discoloration compared to total-etch systems and adversely affects aesthetic appearance of the restorations [15]. Due to the inadequate etching of self-etch adhesives, selective-etch adhesives have been recommended in which only the enamel margins are etched with phosphoric acid prior to the application of self-etch adhesives [16]. The universal adhesives in selective-etch mode eliminate post-operative hypersensitivity and marginal discoloration; they are more retentive compared to total-etch which has been associated with post-operative hypersensitivity [6]. A majority of universal adhesives consist of acidic functional monomers, like 10-methacryloyloxydecyl dihydrogen phosphate (MDP). This monomer is made up of a polymerizable methacrylate group along with a phosphate group that can form a stable salt with the calcium in hydroxyapatite [11]. Research has shown that stability of this calcium salt has been linked with the high bond strength of MDP to enamel and dentin [17,18].

There has been a quest for an adhesive system that would give a good clinical performance in the restoration of NCCLs; one that combines the benefits of self-etch (less post-operative pain) [6] and total-etch (more retentive and less marginal staining) [6]. Based on the development of Universal bottle, different etch-modes (Total-etch, self-etch or selective-etch) can be used [19,20].

However, little is known of the clinical performance of universal adhesive in the restoration of non-carious cervical lesions in Nigeria and the West-Africa sub-region. Thus, the aim of this study was to compare the clinical performance of universal adhesive in total-etch, and selective-etch modes in the restoration of non-carious cervical lesions in an adult Nigerian population.

MATERIALS AND METHODS

This interventional study was done at Department of Restorative Dentistry, Lagos State University Teaching Hospital, Ikeja after obtaining ethical approval from the Health Research Ethics committee of the Lagos State University Teaching Hospital (LREC/06/10/1278). A written informed consent was taken from all subjects prior to the inclusion into the study. Subjects aged 18 years and above with non-carious cervical lesions of between 1mm and 3mm depth extending beyond enamel to dentin were included in the study. Subjects with rampant uncontrolled caries, advanced untreated periodontal diseases, tooth with periapical pathology, non-vital tooth or previous root canal therapy and evidence of severe bruxism, clenching and temporomandibular disorder were excluded. Sixty teeth that met the selection criteria were included in the study using convenience sampling. Thirty teeth were selected for each intervention; they were randomized using computer generated table of random numbers into two groups based on the application modes which were total-etch group and selective-etch group. Subjects and evaluators were blinded to the adhesive modes that were used. Prior to the placement of restorations, the following information was recorded; lesion morphology (predominantly saucer-shaped or predominantly wedge-shaped), degree of sclerosis ranging from 1-4 [21,22], and pre-operative sensitivity to a blast of air using Schiff Cold Air Sensitivity Scale ranging from 0-3 as a standard index [23].

Operative procedure

Tooth shade selection was performed with the Vita shade guide under natural light prior to the restorative procedure while the teeth were moist. The teeth were treated under local anaesthesia (2% xylocaine HCL 1:80,000) as needed and isolated with rubber dam (Uno dent®). Prior to the treatment, the teeth were cleaned using pumice and a prophylaxis brush for about 10 seconds.

In total-etch group, both the enamel and dentin were etched for 15 seconds with 34% phosphoric acid (Scotchbond™ Phosphoric Etchant, 3 M ESPE) applied with dispensing tip, rinsed for 10 seconds and subsequently air dried for 2 seconds to keep the dentin moist in line with the manufacturer's instructions, while this etchant gel was carefully placed only on enamel margin in selective-etch group. One coat of the Scotchbond universal adhesive (3M ESPE) was applied to the enamel and dentin in the two groups for 20 seconds with agitation, air dried for 5 seconds, and light cured for 10 seconds as stated by the manufacturer.

In both total-etch and selective-etch groups, Filtek supreme ultra-universal (3 M ESPE) composite resin was placed in 1.5 mm incremental depth in dentin and cured for 40 seconds and the 1.5mm incremental depth in enamel was cured for 20 seconds according to manufacturer's instructions using Ultra-Lite LED Curing light (Rolence®) (with output 400-1000 mW/cm2). The gross excess were removed with carbide finishing burs (7404, OS-1, OS-2, Brasseler). Afterwards, polishing was carried out using aluminium oxide polishing paste (Henry Schein ®) and rubber cup (Shofu®) on a slow hand piece under irrigation immediately after placement of restorations.

Clinical evaluation and follow up

All the restorations were evaluated by two blinded experienced and calibrated dentists with the two different etching modes evaluated at baseline, 3 months, 6 months and 12 months for the following characteristics (subcategories); Marginal staining, Retention, Marginal adaptation, Patient's view, Post-operative sensitivity, and recurrent caries using FDI clinical Criteria [24].

The characteristics recorded by the examiners were scored in a range of 1 to 5. Score 1-Clinically excellent/very good; Score 2- Clinically good; Score 3- Clinically sufficient/satisfactory; Score 4- Clinically unsatisfactory (but reparable); Score 5-Clinically poor (replacement

necessary). Thereafter, the overall rating or final score was determined by the subcategory with worst scores. Clinical evaluation was done using Loops with 4x magnification (Lactona®), dental mirror and probe.

Data management and analysis

Data entry and analysis were done using the Statistical Packages for Social Sciences (SPSS IBM) version 25.0. Categorical variables were presented using frequencies and percentages while numeric data were presented using mean and standard deviation for normally distributed data. Normality assumption was carried out using Kolmogorov-Smirnov test. Chi-square test and Fischer's exact test were used to assess association between categorical data, while clinical outcome at different follow up interval was assessed using McNemar test. Inter-examiner reliability was measured using Cohen's Kappa coefficient. The level of significance was set at 5% (95% confidence interval).

RESULTS

A total of sixty (60) teeth, with non-carious cervical lesions from 30 subjects were enrolled for the study. Two groups of thirty (30) teeth with non-carious cervical lesions were restored using total-etch mode and selective-etch mode respectively. The subject recall rate was 100%, with all subjects available for follow up periods.

The majority 16(53.3%) of the subjects belonged to the 41-50 years age group, 7(23.3%) were in the age range of 51-60 years, 5(16.7%) were ≤ 40 years, while the least, 2(6.7%) were 60 years and above. The mean age of the subjects was 47.43±7.1 years (Table 1). There were 21 (70.0%) males and 9(30.0%) females (Table 1). The first premolars 26(43.2%) were the most commonly restored teeth, followed by canines 13(21.7%). The central incisors and first molars had the same frequency 4(6.7%) each, while lateral incisor 1(1.7%) was the least (Figure 1).

Evaluation and comparison of the aesthetic properties of restorations

All the restorations (total-etch mode restorations and selective-etch mode restorations) evaluated for marginal staining had scores of 1 at baseline and 3 months. At 12 months, there was a drop to 26(86.7%) and 28(93.3%) in the total-etch and selective-etch groups respectively (Table 2). No statistically significant difference was observed in aesthetic properties evaluated for both groups (p>0.05).

Evaluation and comparison of the functional properties of restorations

Both total-etch mode and selective-etch mode restorations recorded similar results for marginal adaptation at baseline. At 12 months, 14(46.7%) restorations in the total-etch group had score of 1, while 12(40.0%) restorations in the selective-etch group had score of 1. All the restorations were clinically acceptable (Table 3). In retention, total-etch group had a higher percentage of score 1 (73.3%) than selective-etch group (66.7%) at 12 months. In patient's view, the restorations in the total-etch group had 100% score of 1, while selective-etch group had 93.3% at 12 months (Table 3). There was no statistically significant difference in functional properties between the 2 groups, but the total-etch group had a better clinical performance

Evaluation and comparison of the biological effects of restorations

Restorations in the selective-etch group had 100% scores 1 in post-operative sensitivity throughout the evaluation period. However, in the total-etch group, restorations had a drop from 100% at baseline to 96.7% at 3, 6 and 12 months (Table 4). All restorations in both the total-etch and the selective-etch groups scored 1 at baseline, 3 months, 6months and 12 months in recurrent caries. (Table 4).

Table 1: Socio demographic characteristics of subjects

Age Group (years)	Male (n=21) No. (%)	Female (n=9) No. (%)	Total	Statistic	p-value
≤40	4(19.0)	1(11.1)	5(16.7)	1.871**	0.600
41-50	10(47.6)	6(66.7)	16(53.3)		
51-60	6(28.6)	1(11.1)	7(23.3)		
>60	1(4.8)	1(11.1)	2(6.7)		
Mean±SD	48.43±8.3	45.80±6.7	47.43±7.1	-0.409*	0.685

**Fisher's exact test; *Independent student t test; SD=Standard deviation

Table 2: Aesthetic properties of universal adhesives in total-etch and selective-etch modes in the restoration of non-carious cervical lesions

	Baseline			3 Months			6 months			12 months		
FDI Sc	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P
	Marginal staining											
1	30(100.0)	30(100.0)	1.000	30(100.0)	30(100.0)	1.000	28(93.3)	29(96.7)	0.602	26(86.7)	28(93.3)	0.529
2	0(0.0)	0(0.0)		0(0.0)	0(0.0)		1(3.3)	1(3.3)		3(10.0)	2(6.7)	
3	0(0.0)	0(0.0)		0(0.0)	0(0.0)		1(3.3)	0(0.0)		1(3.3)	0(0.0)	

Fisher's exact use

Sc = Scores

Scores: 1 = clinically excellent/ very good, 2 = clinically good, 3 = clinically sufficient/ satisfactory

P = P value; significant < 0.05

Table 3: Functional properties of universal adhesives in total-etch and selective- etch modes in the restoration of non-carious cervical lesions

	Baseline			3 Months			6 months			12 months		
FDI Sc	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P
	Marginal adaptation											
1	30(100.0)	30(100.0)	1.000	22(73.3)	21(70.0)	0.774	14(46.7)	12(40.0)	0.761	14(46.7)	12(40.0)	0.846
2	0(0.0)	0(0.0)		8(26.7)	9(30.0)		15(50.0)	16(53.3)		13(43.3)	14(46.7)	
3	0(0.0)	0(0.0)		0(0.0)	0(0.0)		1(3.3)	2(6.7)		3(10.0)	4(13.3)	
	Retention											
1	30(100.0)	30(100.0)	1.000	29(96.7)	30(100.0)	0.313	28(93.3)	24(80.0)	0.129	22(73.3)	20(66.7)	0.562
2	0(0.0)	0(0.0)		1(3.3)	0(0.0)		2(6.7)	6(20.0)		8(26.7)	9(30.0)	
3	0(0.0)	0(0.0)		0(0.0)	0(0.0)		0(0.0)	0(0.0)		0(0.0)	1(3.3)	
	Patient's view											
1	29(96.7)	28(93.3)	0.554	28(93.3)	30(100.0)	0.150	30(100.0)	29(96.7)	0.313	30(100.0)	28(93.3)	0.150
2	1(3.3)	2(6.7)		2(6.7)	0(0.0)		0(0.0)	1(3.3)		0(0.0)	2(6.7)	

Fisher's exact use

Sc = Scores

Scores: 1 = clinically excellent/ very good, 2 = clinically good, 3 = clinically sufficient/ satisfactory

P = P value; significant < 0.05

Table 4: Biological effects of universal adhesives in total-etch and selective-etch modes in the restoration of non-carious cervical lesions

	Baseline			3 Months			6 months			12 months		
FDI Sc	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P	Total etch	Selective etch	P
	Post-operative sensitivity											
1	30 (100.0)	30 (100.0)	1.000	29 (96.7)	30 (100.0)	0.313	29 (96.7)	30 (100.0)	0.313	29 (96.7)	30 (100.0)	0.313
2	0(0.0)	0(0.0)		1(3.3)	0(0.0)		1(3.3)	0(0.0)		1(3.3)	0(0.0)	
	Recurrent caries											
1	30 (100.0)	30 (100.0)	1.000	30 (100.0)	30 (100.0)	1.000	30 (100.0)	30 (100.0)	1.000	30 (100.0)	30 (100.0)	1.000

Fisher's exact use

Sc = Scores

Scores: 1 = clinically excellent/ very good, 2 = clinically good

P = P value; significant < 0.05

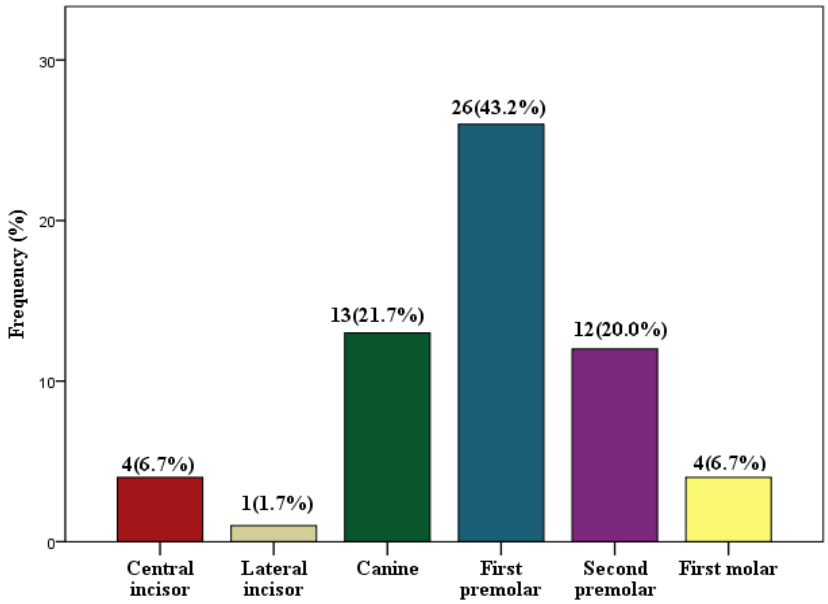

Figure 1: Simple Bar chart showing distribution of restorations placed by tooth types

DISCUSSION

This present study evaluated the clinical performance of a universal adhesive in selective-etch, with total-etch as a control in the restoration of non-carious cervical lesions of permanent teeth in a Nigerian population over a 12-month duration. This study recorded a one hundred percent subject recall rate, and no restoration was lost throughout the evaluation period. A similar study by Dilsad et al. [15] had

a 100% recall rate over the 12 months, but dropped to 89.1% at the 24-month evaluation.

It was observed in this study that most (70.0%) of the participants were males which was in agreement with some other studies [25-27], but in contrast to a study by Dilsad et al. [15], that recorded more females than males. This might be attributed to the fact that males tend to use more of hard textured toothbrush, with excessive brushing force, thus predisposing to increased wear of the cervical buccal surfaces. The majority of the subjects belonged to the 41-50years age group, followed by 51-60-year olds which is similar to a study by Tar et al. [28]; however, this is expected among older patients due to their teeth being predisposed to the pertinet aetiologic factors for a considerable longer period compared to younger patients [29]. The prolonged use of hard textured toothbrush over the years might be the reason it is more observed among older patients in this study.

In marginal staining, there was no statistically significant difference between the 2 groups throughout the study duration. A study by Atalay et al. [26] also showed no statistically significant difference between total-etch and selective-etch groups with similar results over the study duration. A study by Perdigão et al. [14] showed that the selective-etch technique in restoring non-carious cervical lesions could produce composite restorations with better aesthetics i.e. lower marginal staining and better marginal integrity. It agrees with the findings of this study; however, the result was not statistically significant. The good performances for both the total-etch and selective-etch groups might be due to the micro-retentive and adequate enamel etching by phosphoric acid. This study shows that marginal adaptation in the total-etch group appears better than the selective-etch group, but no significant differences were detected between these two groups. The changes in marginal adaptation in restorations over time could be attributed to biomaterial-tooth interfaces which are subjected to chemical and mechanical degradation [30].

In retention, a score 3 was only noted at 12-month assessment in the selective-etch group. The present study recorded no restoration was lost throughout the 12 months evaluation, but in a similar study [14], one restoration in the total-etch group was lost at 6 months and one restoration in selective-etch group was lost at 18 months. In this study, retention in the total-etch group appears better clinically than in selective-etch group; this might be due to the fact that while avoiding the contact of etchant with dentin; the enamel might not have been adequately etched thereby affecting the bonding system in selective-etch group. The key parameter for evaluating NCCL restorations has been attributed to retention; if the restorations are lost, all the other criteria would be impossible to be evaluated [14]. Patient's view in this study according to FDI criteria [24] was based on aesthetics, functions i.e. minor roughness, tongue irritation and pain. The total-etch group recorded 96.7% at baseline, which later increased to 100% (score 1) at 6 and 12 months; this might be due to subjectivity of patient's view in conforming to the appearance of the restoration overtime.

Post-operative sensitivity in this study was recorded for only the total-etch group at 3, 6 and 12 months with a 3.3% score of 2 (minor hypersensitivity for a limited period of time). In contrast, a similar study [15] reported no post-operative sensitivity throughout the evaluation period for the total-etch group, but in the selective-etch group it was observed at 6 and 12 months; the difference between the two groups was not statistically significant. Post-operative sensitivity has been attributed to incomplete marginal seal as a result of chip fractures at the margin [31]. The present study recorded no recurrent caries. Yaman et al. [32] stated that patients diagnosed with NCCLs often have a low caries index and maintain good oral hygiene, particularly when motivation and training precede the restorative interventions.

Despite the selection of teeth with sclerotic dentin, there was no retention failure in this present study. This might be because of the use of bonding systems with stronger etching ability that is advantageous in adhesion to cervical sclerotic lesions. Tsai et al. [33] reported that bond strength to cervical sclerotic dentin was lower than sound dentin, due to the difficulty of etching the hypermineralized layer of sclerotic dentin. The major findings of this randomized control trial showed that all restorations were successfully retained and rated clinically acceptable one year post-placement with no significant difference observed between the total-etch and selective-etch groups. These might be attributed to unique feature of the Scotchbond Universal adhesive employed in this study. The results of a systematic review and meta-analysis by Josic et al. [34] revealed no notable differences in the retention loss risk between total-etch and selective-etch groups. This finding implies that selective-etch mode could be considered a potential alternative to total-etch mode since the use of phosphoric acid is confined to enamel only, thereby preserving a mineralized dentin [34]. The unique feature of the Scotchbond Universal adhesive is that; it is more hydrophobic than previous simplified adhesives and contains the MDP and polyalkenoic-acid co-polymer, that both have the ability of bonding to calcium, while MDP forms nano-layers with calcium present in the hybrid layer.

For adhesive systems to be considered clinically effective, the restorations should be kept in place and provide a complete seal around the tooth or margins of the cavity to prevent the entry of microorganisms and oral fluids [35]. A failure to achieve a complete marginal seal can result in post-operative sensitivity, marginal staining and eventual development of recurrent caries; these are still the most common findings contributing to the clinical failure of adhesive restorations [31].

CONCLUSION

The aesthetic properties, functional properties and biologic effects showed acceptable clinical performance of the universal adhesive in total-etch and selective-etch groups in restoring non-carious cervical lesions in Nigerian adults. However, the restorations in selective-etch group had a better clinical performance in aesthetic properties and restorations in total-etch group had a better clinical performance in functional properties, but no statistically significant difference was detected between the two groups throughout the evaluation periods. The use of universal adhesives is recommended for composite restoration in NCCLs; they have performed excellently in both modes of placement in this study.

Conflicts of Interest

The author reports no conflicts of interest.

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Clinical trial registration

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ORCID ID

Temitope Olabisi Omosebi: https://orcid.org/0009-0006-8643-8346
Adenike Ololade Awotile: https://orcid.org/0000-0003-4561-0999
Cyril Ilemobade Adegbulugbe: https://orcid.org/0000-0002-7560-1201
Lillian Lami Enone: https://orcid.org/0000-0003-1612-5484
Gbenga Emmanuel Adebayo: https://orcid.org/0000-0001-9299-0627

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