

## Comparison of the clinical effect of the adhesive strategies of universal adhesives in the treatment of non-carious cervical lesions. Systematic review and meta-analysis.

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**Abstract:** Objective: To compare, through a systematic review and a meta-analysis, the clinical effect of the adhesive strategies of universal adhesives (UA) in the treatment of non-carious cervical lesions (NCCLs). Material and Method: A search of the literature was carried out up to January 2018, in the biomedical databases: Pubmed, Embase, Scielo, Science Direct, SIGLE, LILACS, BBO, Google Scholar and the Central Register of Cochrane Clinical Trials. The selection criteria of the studies were as: randomized clinical trials, with a maximum age of 5 years and which report the clinical effects (marginal adaptation, discoloration or marginal staining, presence of secondary caries, postoperative sensitivity, retention and fractures) of the UA in the treatment of NCCLs. The risk of study bias was analyzed through the Cochrane Handbook of systematic reviews of interventions. Results: The search strategy resulted in eight articles that reported no difference in marginal adaptation, discoloration or marginal staining, presence of secondary caries and postoperative sensitivity among the adhesive strategies of the UA; however they reported a difference between the retention and the presence of fractures, with the conventional adhesive strategy resulting in a better clinical effect. Conclusion: The reviewed literature suggests that the conventional adhesive strategy of UAs results in greater retention and absence of fractures in the treatment of NCCLs.

**Keywords:** universal adhesives; non-carious cervical lesion; review; meta-analysis.

### INTRODUCTION.

Non-carious cervical lesions (NCCLs) are hard tissue defects in the cervical region of the teeth that is not caused by a bacterial agent.<sup>1,2</sup> These lesions appear in various forms and have been found in living individuals as well as in skeletons and fossils at ancient sites.<sup>3</sup> It is among the most frequent pathologies that affect dental structures and its severity has been associated with aging. Epidemiological studies on the prevalence of NCCLs are still scarce in the literature, but there are reports that it affects up to 76% of the middle-aged adult population in China.<sup>1,2,4</sup>

Several studies have proposed several etiological factors for NCCLs, such as: aging, sex, oral hygiene habits, saliva, consumption of acidic beverages, teeth-brushing intensity, state of the periodontium, number of teeth, occlusion, occlusal contact area, occlusal erosion and attrition. However, these etiologies could converge to three fundamental mechanisms. One is wear by friction, which is the micro-deformation of the teeth surface caused by kinetic energy due to the brushing of teeth, dental floss,

toothpicks, parafunction, swallowing and chewing. Another is chemical-induced wear, which encompasses: chemical, biochemical and electrical erosion; and by acids and proteolysis. The last is microstructural loss by occlusal forces during parafunction, occlusion, swallowing and retention of objects in the mouth. Therefore, the NCCLs are multifactorial, and in addition to these three mechanisms, additional factors could facilitate their development.<sup>3</sup>

These types of lesions are treated by a restorative therapeutic approach and although restoration with composite resins does not address the etiology, it replaces the lost tissue thus restoring the structural integrity of the teeth, minimizing wear and, when present, dentine hypersensitivity, while also improving aesthetics.<sup>1,2,5</sup> Restorations of NCCLs are common in the clinical setting, and represent one of the least durable restorations, with a high rate of retention loss, marginal discoloration and marginal adaptation.<sup>1,5-7</sup> Issues in restoring NCCLs include the difficulty in controlling moisture and obtaining access to the subgingival margins, 1, 8 as well as selecting the best adhesive strategy for the restoration of such lesions.<sup>1,5,6</sup>

Dental adhesive can be classified into two groups according to the technical differences in the attachment to dental substrates: conventional adhesive strategies or etch-and-rinse systems, and self-conditioning adhesives such as self-etching systems.<sup>9</sup>

Taking into account the differences in professional criteria regarding adhesive strategies, some manufacturers have launched more versatile adhesive systems that give the dentist the opportunity to decide which strategy to use: conventional or self-etching. This new family of dental adhesives is known as "universal" or "multimode" and represents the latest generation of adhesives on the market.<sup>9,10-12</sup> They are designed under the "all-in-one" concept, already in place for the single-step self-etching adhesives, but also incorporate the versatility of being adaptable to the clinical situation at hand.<sup>9,12</sup> An adhesive that can be applied in both directions allows the dentist to decide on the most suitable adhesive protocol for the cavity under preparation.<sup>9</sup>

Despite the efforts of manufacturers in developing and bringing new materials to the market, the question remains whether dentists should consider the use of these new adhesives with a prior etching rather than using a

self-etching strategy. The differences in long-term follow-up for both these strategies using universal adhesives may be one of the reasons for such controversy, thus requiring further analysis of these studies to provide a clinical guide for dentists to use in daily practice. Therefore, the objective of this article was to compare the adhesive strategies of universal adhesives (UA) (conventional or self-etching) in the treatment of NCCLs.

## MATERIALS AND METHODS.

The development of this review was carried out in accordance with a research protocol previously prepared following the PRISMA guidelines.<sup>13</sup>

### Search:

A broad search strategy was carried out in the biomedical databases PubMed, Embase, SciELO, ScienceDirect, SIGLE (*System of Information on Grey Literature in Europe*), LILACS, BBO, Google Scholar and the Cochrane Central Register of Controlled Trials, as well as an additional manual search in the highest impact rehabilitation and aesthetic journals such as: *Caries Research*, *Journal of Oral Rehabilitation*, *Journal of Prosthetic Dentistry*, *Operative Dentistry*, *International Dental Journal*, *Journal of Prosthodontics-Implant Esthetic and Reconstructive Dentistry*, *Journal of Esthetic and Restorative Dentistry* and *Journal of Advanced Prosthodontics*, from January 2, 2013 to January 9, 2018; A combination of the following thematic headings using the following keywords was employed: ("universal adhesive" OR "universal adhesives" OR "adhesivo universal" OR "All-Bond Universal" OR "Prime & Bond Elect" OR "Xeno Select" OR "AdheSE Universal" OR "G-aenial Bond" OR "Clearfil Universal Bond" OR "Scotchbond Universal" OR "Futurabond U") AND ("non carious cervical lesion" OR "non carious cervical lesions" OR "cervical lesion" OR "cervical lesions" OR "class V" OR "class 5" OR "lesión cervical no cariosa" OR "lesión cervical" OR "clase 5")

### Selection criteria

#### Inclusion criteria:

- Articles that report the use of UA.
- Articles that report the clinical effects of UA in the treatment of NCCLs (marginal adaptation, discoloration or marginal staining, presence of secondary caries, postoperative sensitivity, retention and fractures).

-Articles not older than five years.

-Articles that are clinical trials, without language restriction, and with a follow-up time of six months or more.

Exclusion criteria:

-Articles from non-indexed journals.

Selection process and data extraction:

We reviewed the titles and abstracts of each of the studies obtained following the inclusion and exclusion criteria described above; the full texts of the studies that met these parameters were obtained in order to determine their risk of bias.

To assess the studies, a checklist was made in duplicate, in order to extract the information of interest and to collate the data. Two reviewers (CL and FC) independently carried out the evaluation of the articles regarding name, author, year of publication, type of study, number of patients (proportion of males and females), average age and age range of patients, follow-up time, country where the study was conducted, study groups, number of patients and teeth or restorations per study group, type of teeth per study group, UA employed, evaluation criteria used, marginal adaptation, discoloration or marginal staining, presence of secondary caries, postoperative sensitivity, retention and fractures, results, conclusions and bias risk. For the resolution of any discrepancy between the reviewers, they met and discussed with a third reviewer (HV) in order to reach concurrence.

#### Assessment of the studies bias risk

For assessing the risk of bias, each study was analyzed according to the Cochrane Handbook of Systematic Reviews of Interventions.<sup>14</sup>

#### Analysis of the results

The data of each study were introduced and analyzed in the RevMan 5.3 software (Cochrane Group, UK).

## RESULTS.

### Selection of studies

The initial search in the biomedical databases yielded a total of 411 titles, dated from January 2013 to January 2018, of which 49 were duplicated titles, thus leaving 362 unique titles. Titles were read and 323 were excluded, resulting in 39 titles, subsequently

the abstracts were read discarding those that did not meet the inclusion criteria. Finally, eight articles were selected for an exhaustive review of their content and methodology. None of the eight articles was discarded for the meta-analysis (Figure 1).

### Study characteristics and results

In all the included studies,<sup>15-22</sup> the number of patients ranged from 26 to 50, with a follow-up time between 6 and 36 months. One study<sup>19</sup> reported that the mean age of the patients was between 60.1 years. All studies<sup>15-22</sup> reported that the total number of patients in relation to their gender was 163 and 146 male and female respectively and that all patients were older than 19 years. Brazil<sup>15-18,20-22</sup> and the United States<sup>19</sup> were the countries where the studies took place. One study<sup>17</sup> reported that the patients who participated were classified into smokers and non-smokers. The UAs that were used included Scotchbond Universal,<sup>16-19</sup> Xeno Select,<sup>20</sup> Futurabond U<sup>22</sup> y Tetric N-bond Universal.<sup>21</sup> The clinical evaluation criteria were analyzed according to the modified criteria of Cvar and Ryge,<sup>19</sup> of the World Dental Federation<sup>15,16,18,20-22</sup> and of the United States Public Health Service.<sup>15-18,20,21</sup> In all studies<sup>15-22</sup> restorative treatments of NCCLs were performed with composite resins using UA and conventional and self-etching methodologies (Table 1).

The total number of treated patients was 309. In one study,<sup>19</sup> a control group was used. Within the evaluated clinical parameters it was observed that in all the studies<sup>15-22</sup> marginal adaptation, discoloration or marginal staining, postoperative sensitivity, retention and fracture of the restorations where UA was used were reported; in seven studies<sup>15,16,18-22</sup> the occurrence of secondary caries was reported in the restorations where UA was used; and one study<sup>19</sup> reported the mean and standard deviation of the incidence of postoperative sensitivity (Table 1).

### Analysis of the risk of bias of the studies

All studies<sup>15-22</sup> showed a low risk of bias (Figure 2).

### Summary of results (Meta-analysis)

Analysis of the clinical parameters evaluated in the comparison between the conventional and the self-etching adhesive system of the UA (Figure 3): The clinical parameters evaluated between the conventional and the

self-etching adhesive system of the UA were reported in all studies<sup>15-22</sup> revealing no significant difference, but favoring the conventional adhesive system.

#### Sub-group analysis

The marginal adaptation was determined in all the studies<sup>15-22</sup> revealing no significant difference, but favoring the conventional adhesive strategy. The absence of discoloration or marginal staining was reported in all studies<sup>15-22</sup> with no significant difference found, and without favoring an adhesive strategy. The absence of secondary caries was determined in seven studies<sup>15,16,18-22</sup> reporting that there was no significant difference, but favoring the conventional adhesive strategy. The absence of postoperative sensitivity was reported in seven studies<sup>15-18,20-22</sup> with no significant difference found, and without favoring an adhesive strategy. Retention and absence of fractures were reported in all studies<sup>15-22</sup> reporting that there was no significant difference, but favoring the conventional adhesive strategy.

#### Analysis of the clinical parameters evaluated in the comparison between the UA conventional adhesive systems and wet and dry dentin (Figure 4)

The clinical parameters evaluated between the UA conventional adhesive systems and wet and dry dentin were determined in five studies<sup>15,16,18,20,22</sup> and revealed no significant difference, although favoring the conventional adhesive strategy with dry dentin.

#### Subgroup Analysis

Marginal adaptation was determined in five studies<sup>15,16,18,20,22</sup> resulting in no significant difference found, but favoring the conventional adhesive strategy with dry dentin. The absence of discoloration or marginal staining, the absence of secondary caries and the absence of postoperative sensitivity were determined in five studies.<sup>15,16,18,20,22</sup> reporting no significant difference, without favoring a conventional adhesive strategy. Retention and absence of fractures were determined in five studies<sup>15,16,18,20,22</sup> reporting no significant difference, but favoring the conventional adhesive strategy with dry dentin.

#### Analysis of the clinical parameters evaluated in the comparison of the self-etching adhesive system of UA with and without selective etching enamel (Figure 5)

The clinical parameters evaluated in the comparison

between the self-etching adhesive system of UA with and without selective etching of the enamel were reported in five studies<sup>15,16,18,20,22</sup> revealing no significant difference, although favoring the self-etching adhesive strategy with selective engraving of the enamel.

#### Subgroup analysis

Marginal adaptation was determined in five studies<sup>15,16,18,20,22</sup> reporting no significant difference, favoring the self-etching adhesive strategy with selective engraving of the enamel. The absence of discoloration or marginal staining and the absence of secondary caries were determined in five studies<sup>15,16,18,20,22</sup> revealing that there was no significant difference, without favoring a self-etching adhesive strategy. The absence of postoperative sensitivity was determined in five studies<sup>15,16,18,20,22</sup> revealing that there was no significant difference, favoring the self-etching adhesive strategy without selective enamel etching. Retention and absence of fractures were reported in five studies<sup>15,16,18,20,22</sup> revealing that there was a significant difference, supporting the self-etching adhesive strategy with selective engraving of the enamel.

#### Analysis of the clinical parameters evaluated in the comparison of the conventional adhesive systems of the UA with dry dentine and self-etching with selective enamel engraving (Figure 6)

The clinical parameters evaluated between the conventional adhesive systems of UA with dry dentine and self-etching with selective etching enamel were reported in five studies<sup>15,16,18,20,22</sup> revealing no significant difference, without favoring an adhesive strategy.

#### Subgroup analysis

The marginal adaptation, the absence of discoloration or marginal staining and the absence of secondary caries were determined in five studies<sup>15,16,18,20,22</sup> reporting no significant difference, without favoring an adhesive strategy. The absence of postoperative sensitivity was reported in five studies<sup>15,16,18,20,22</sup> revealing no significant difference, but favoring the self-etching adhesive strategy with selective enamel etching. Retention and absence of fractures were assessed in five studies,<sup>15,16,18,20,22</sup> reporting no significant difference, but favoring the conventional adhesive strategy with dry dentine.

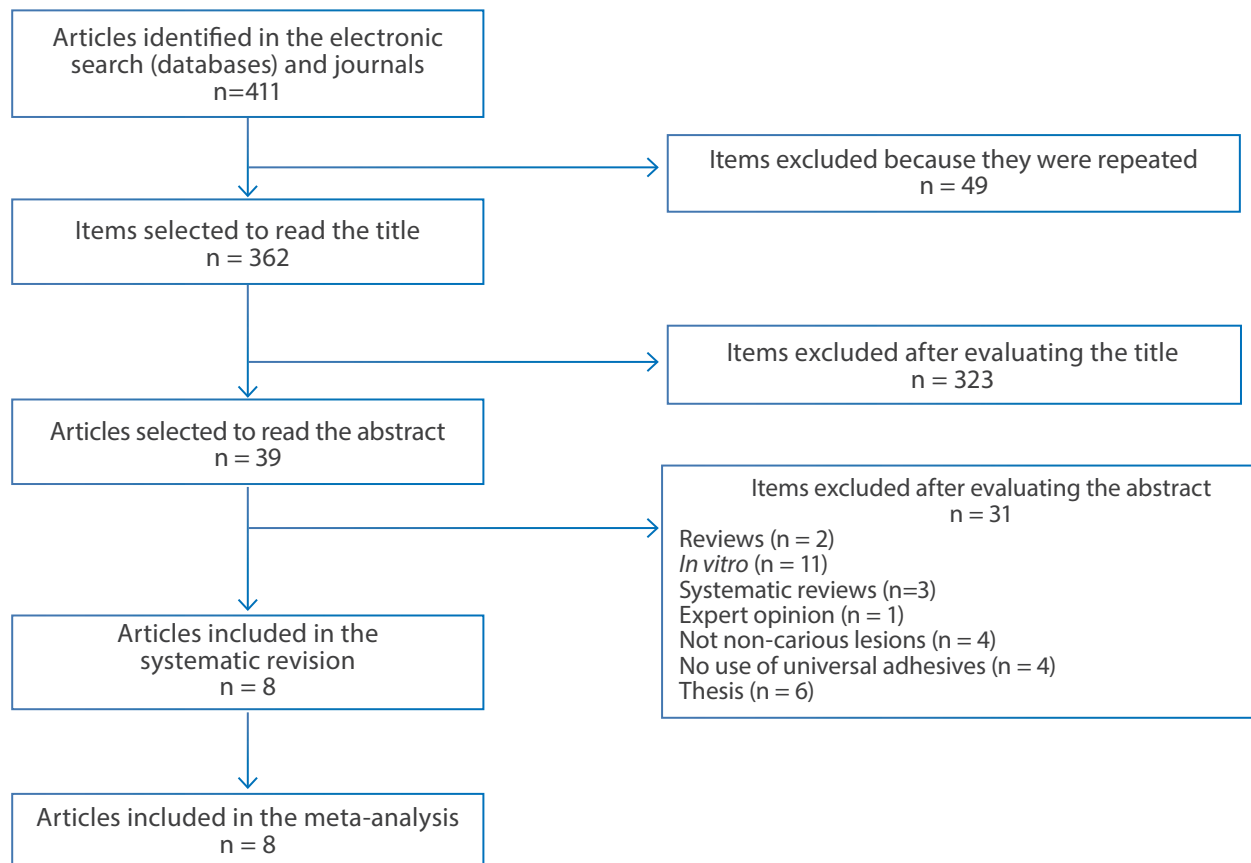
**Table 1.** Characteristics of included studies.

Author	Year	Type of study	No. Of patients (male/female)	Age: mean (range)	Follow-up time	Country	Universal Adhesive employed	Study groups	No. Patients per group	No. Restorations per group (start/end)	No and type of teeth per group	Clinical evaluation criteria	MA	DM	SC	PS	R	F
Mena-Serrano et al. <sup>18</sup>	2013	Double-blind crossover RCT	39 (24/15)	(>20)	6 months	Brazil	Scotchbond Universal (SU)	SU + conventional + wet dentin SU + conventional + dentin dry	39	50/50	Incisivos (2); Caninos (4); Premolars (32) and Molars (12)	World Dental Federation and the United States Public Health Service	50	0	0	0	49	1
								SU + self-etching + selective focus enamel SU + self-etching	39	50/50	Incisivos (2); Caninos (8); Premolars (26) and Molars (14)	the United States Public Health Service	50	0	0	0	50	0
									39	50/50	Incisivos (2); Caninos (6); Premolars (34) and Molars (8)		50	0	0	0	50	0
									39	50/50	Incisivos (2); Caninos (8); Premolars (28) and Molars (12)		50	0	0	0	47	3
Perdigão et al. <sup>19</sup>	2014	Double-blind crossover RCT	39 (24/15)	(>20)	18 months	Brazil	Scotchbond Universal (SU)	SU + conventional + wet dentin	39	50/49	Incisivos (2); Caninos (4); Premolars (32) and Molars (12)	World Dental Federation and the United States Public Health Service	49	0	0	3	48	1
								SU + conventional + dentin dry	39	50/49	Incisivos (2); Caninos (8); Premolars (26) and Molars (14)	the United States Public Health Service	49	0	0	3	49	0
								SU + self-etching + selective focus enamel	39	50/49	Incisivos (2); Caninos (6); Premolars (34) and Molars (8)	Service	49	0	0	2	48	1
								SU + self-etching	39	50/49	Incisivos (2); Caninos (8); Premolars (28) and Molars (12)		48	0	0	0	45	3
de Carvalho et al. <sup>20</sup>	2015	Double-blind crossover RCT	26 (13/13)	(>20)	12 months	Brazil	Scotchbond Universal (SU)	SU + non-smoking	NR	38/38	Incisivos (6); Caninos (5); Premolars (21) and Molars (6)	The United States Public Health Service	36	6	NR	0	38	0
								SU + self-tapping on non-smokers	NR	38/37	Incisivos (6); Caninos (4); Premolars (23) and Molars (5)	Health Service	34	4	NR	1	36	1
								SU + smoking	NR	38/38	Incisivos (8); Caninos (8); Premolars (21) and Molars (1)		36	6	NR	0	38	0
								SU + self-etching in smokers	NR	38/38	Incisivos (9); Caninos (8); Premolars (20) and Molars (1)		38	6	NR	0	38	0
Loguercio et al. <sup>21</sup>	2015	Double-blind crossover RCT	39 (24/15)	(>20)	36 months	Brazil	Scotchbond Universal (SU)	SU + conventional + wet dentin	39	50/44	Incisivos (2); Caninos (4); Premolars (32) and Molars (12)	World Dental Federation and the United States Public Health Service	44	0	0	0	43	1
								SU + conventional + dry dentin	39	50/44	Incisivos (2); Caninos (8); Premolars (26) and Molars (14)	the United States Public Health Service	44	0	0	0	43	1
								SU + self-etching + enamel selective etching	39	50/44	Incisivos (2); Caninos (6); Premolars (34) and Molars (8)	Service	44	0	0	0	43	1

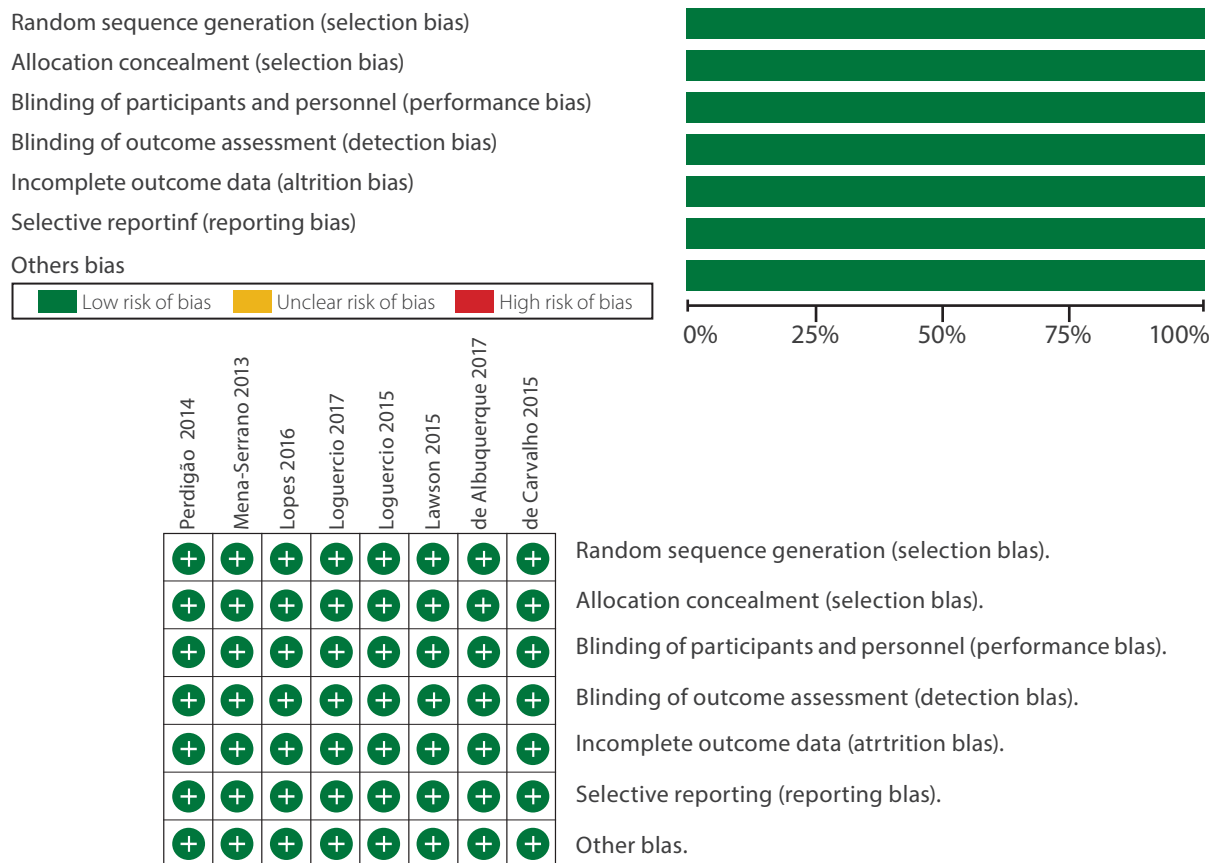
Lawson et al. <sup>22</sup>	2015	Double-blind parallel RCT	37 (17/20)	60.1 (>19)	24 months	United States of America	Scotchbond Universal (SU)	SU + self-etching	39	50/40	Incisors (2); Canines (8); Premolars (28) and Molars (12)	40	0	0	0	35	5
									NR	42/38	Previous teeth (17); Premolars (23) and Molars (2)	38	0	1	2±1.9	35	3
									NR	42/38	Previous teeth (13); Premolars (23) and Molars (6)	38	0	1	2.7±2.1	38	0
									NR	42/38	Previous teeth (14); Premolars (26) and Molars (2)	38	0	2	2.5±2.2	36	2
Lopes et al. <sup>23</sup>	2016	Double-blind crossover RCT	31 (15/16)	(>30)	6 months	Brazil	Xeno Select (XS)	XS + conventional + wet dentin	31	31/31	Incisors (7); Canines (4); Premolars (19) and Molars (1)	30	0	0	0	30	1
									31	31/28	Incisors (5); Canines (4); Premolars (22) and Molars (0)	28	0	0	0	25	3
									31	31/26	Incisors (3); Canines (4); Premolars (21) and Molars (3)	26	0	0	0	21	5
									31	31/25	Incisors (4); Canines (3); Premolars (19) and Molars (5)	25	0	0	0	19	6
Loguercio et al. <sup>24</sup>	2017	Double-blind crossover RCT	48 (23/25)	(>20)	18 months	Brazil	Tetric N-bond Universal (TU)	TU + conventional	48	48/46	Incisors (10); Canines (5); Premolars (28) and Molars (5)	46	0	0	0	44	2
									48	48/43	Incisors (9); Canines (6); Premolars (28) and Molars (5)	43	0	0	0	38	5
									48	48/43	Incisors (6); Canines (8); Premolars (27) and Molars (7)	43	0	0	0	38	5
									48	48/45	Incisors (8); Canines (9); Premolars (27) and Molars (4)	45	0	0	0	42	3
de Albuquerque et al. <sup>25</sup>	2017	Double-blind crossover RCT	50 (23/27)	(>20)	6 months	Brazil	Futurabond Universal (FU)	FU + conventional + wet dentin	50	50/48	Incisors (11); Canines (9); Premolars (21) and Molars (9)	48	0	0	0	45	3
									50	50/49	Incisors (10); Canines (10); Premolars (23) and Molars (7)	49	0	0	0	48	1
									50	50/49	Incisors (12); Canines (5); Premolars (24) and Molars (9)	49	0	0	0	48	1
									50	50/47	Incisors (9); Canines (8); Premolars (21) and Molars (12)	47	0	0	0	45	2

NR: No reportado. RCT: Random controlled trial. MA: Marginal adaptation. DM: Decoloración o tinción marginal. SC: Secondary caries. PS: Postoperative sensitivity. R: Retention. F: Fracture. SU: Scotchbond Universal. XS: Xeno Select. TU: Tetric N-bond Universal.

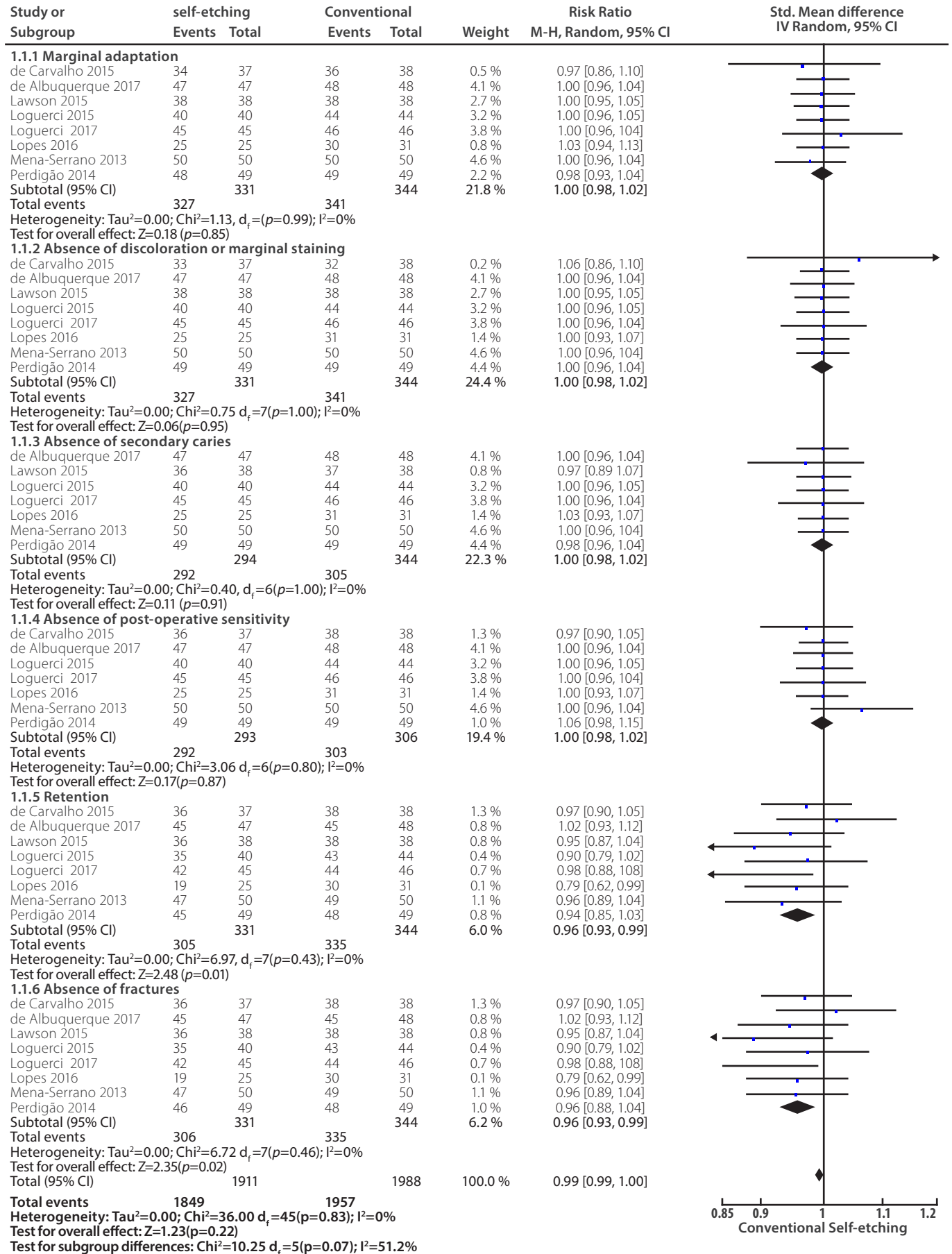
**Figure 1.** Article selection flowchart.



**Figure 2.** Risk of bias of articles.

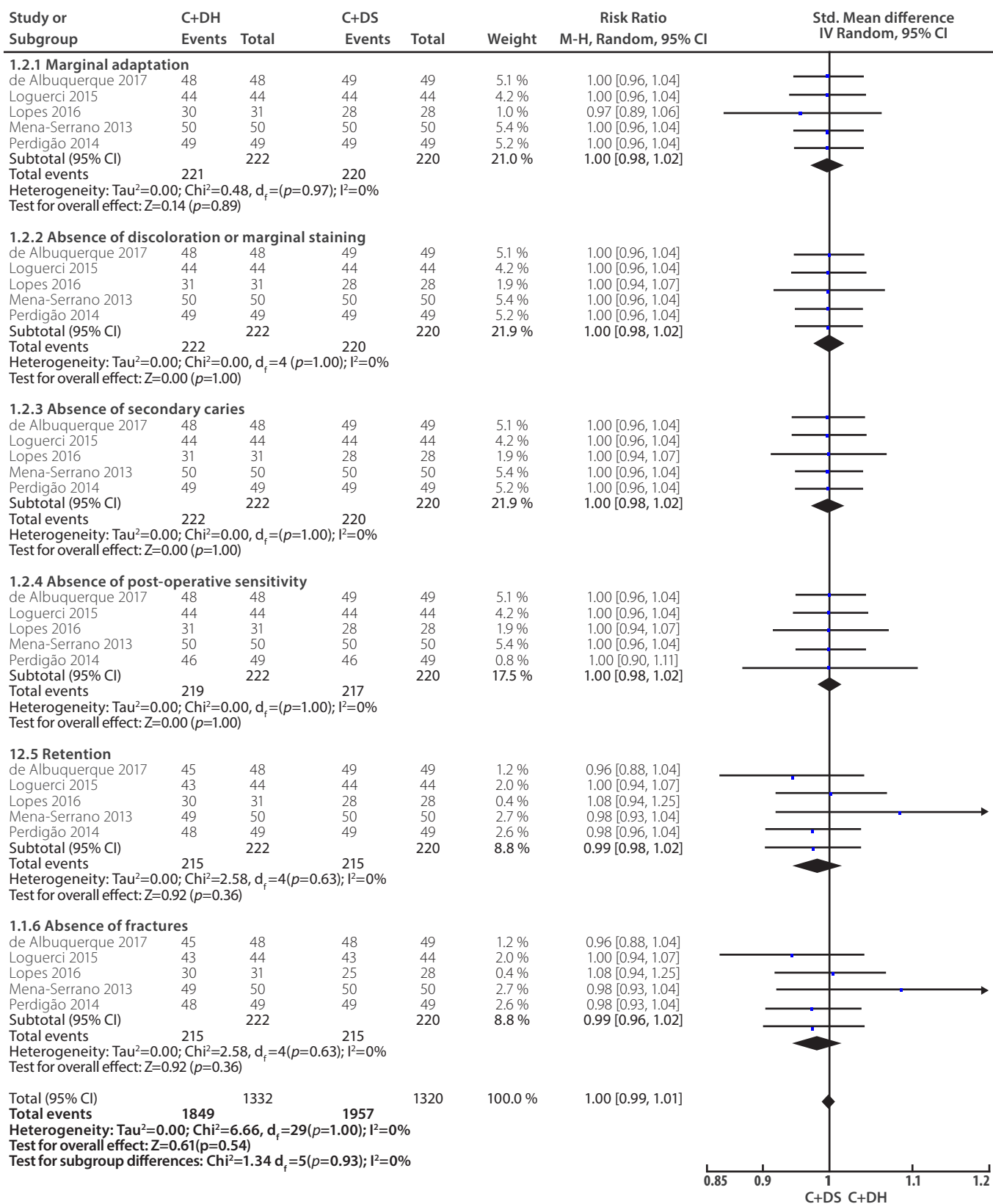


**Figure 3.** Forest plot of the event "Clinical parameters evaluated in the comparison between the conventional adhesive and self-etching strategy of UA"



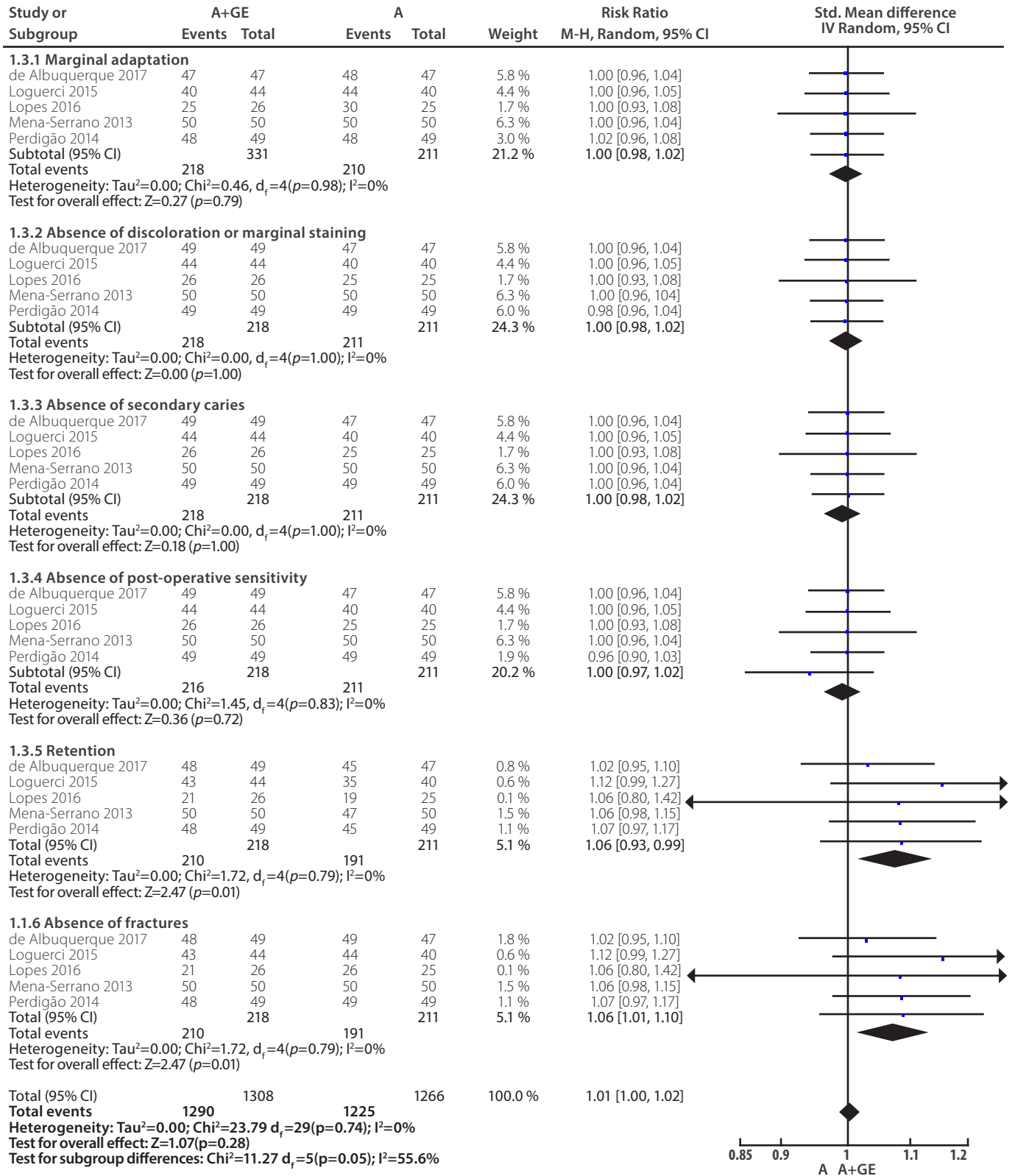


**Figure 4.** Forest plot of the event "Clinical parameters evaluated in the comparison between the conventional adhesive strategy of UA with moist and dry dentin"



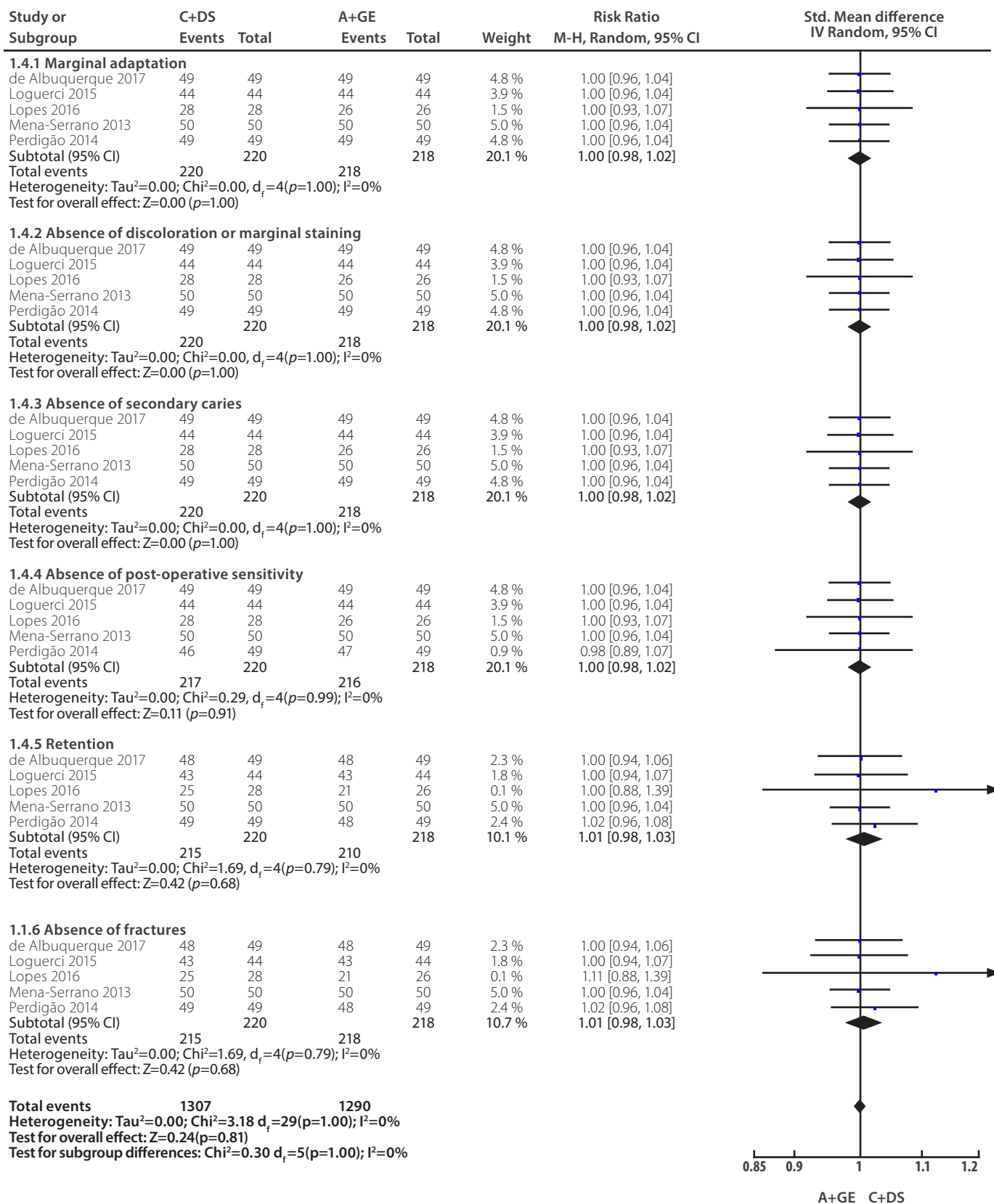
C + DH: Conventional adhesive strategy with wet dentin.  
 C + DS: conventional adhesive strategy with dry dentin

**Figure 5.** Forest plot of the event “Clinical parameters evaluated in the comparison of the self-etching adhesive strategy of UA with and without selective etching of enamel”.



**A:** Self-etching adhesive strategy without selective enamel etching.  
**A + GE:** Self-etching adhesive strategy with selective enamel etching

**Figure 6.** Forest plot of the event "Clinical parameters evaluated in the comparison of the conventional adhesive strategy of UA and dry dentine with self-etching and selective etching enamel"



**CC+DS:** Conventional adhesive strategy with dry dentin.  
**A + GE:** Self-etching adhesive strategy with selective enamel etching

## DISCUSSION.

The objective of the present systematic review and meta-analysis was to compare the adhesive strategies of universal adhesives (conventional or self-etched) in the treatment of NCCLs based on randomized clinical trials (RCTs). The results showed that the use of both the conventional adhesive strategy and the self-etching adhesive strategy of universal adhesives resulted in good marginal adaptation, absence of discoloration or marginal staining, absence of secondary caries and absence of postoperative sensitivity; however, the use of a conventional adhesive strategy resulted in better retention and therefore a greater absence of fractures.

These results may be due to the fact that self-etched materials do not produce the same pattern as the use of phosphoric acid retentive etching used in the conventional system when applied to the enamel, and thus possibly representing the factor responsible for the union of the restoration with the dental structure.<sup>1,23</sup> In contrast, conventional adhesive systems require the etching of dentin and enamel, and keeping the surface of the dentin moist before the application of the adhesive. If this protocol is not carried out, and the dentin is left excessively dry or excessively moist, hindering the penetration of the adhesive into the intertubular collagen, thus making this interface more prone to degradation over time.<sup>1,9</sup> On the other hand, self-etching adhesive systems that employ conditioning agents without the need for rinsing and reduce the number of steps needed, are less sensitive to technical nuances and are more user-friendly.<sup>1,9,24</sup> Due to the inadequate etching of self-etching adhesives, selective etching of the enamel margins with phosphoric acid has been recommended before their application. Although some positive effects were observed in some studies, no significant differences were observed in others.<sup>1,25</sup> However, despite this, the results obtained in this research show that the use of the etch-and-rinse adhesive strategy significantly

improves the retention and absence of fractures in NCCL restorations in patients during a time period ranging from 6 months to 3 years. Furthermore, it shows that the use of a conventional adhesive strategy with dry dentin presents a better retention and absence of fractures compared to the conventional adhesive strategy with wet dentine and the self-etching adhesive strategies (with or without selective etching of the enamel). In this study, we used a random effects model for the meta-analysis where it was shown, in addition, that there was no difference if the RCT was of parallel<sup>19</sup> or crossed design<sup>15-18,20-22</sup> as the studies showed positive clinical effects for the use of adhesive strategies of universal adhesives in the treatment of NCCLs.

The strength of this systematic review was the selection of the studies as an exhaustive search of the most important databases was conducted and strict inclusion criteria were used; and, in addition, that all the considered RCTs<sup>15-22</sup> presented a low risk of bias which supports the solidity of our findings.

Based on all the aforementioned, we believe that these results cannot be yet generalized, because the included RCTs are heterogeneous, and were conducted in countries within the American continent only; As such the included RCTs are not globally representative, which it can cause a dilemma since each region and country has its own culture and foods, which we believe can influence the results. This is why we recommend performing well-designed RCTs, such as those present in the review, that deal with this same issue in countries of the rest of the world in order to be able to compare the results and reach a more clear and general conclusion.

## CONCLUSION.

In general, the conventional adhesive strategy of universal adhesives presents better retention and results in a greater absence of fractures compared with the self-etching adhesive strategy in the treatment of NCCLs.

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