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| ORIGINAL

Comparison between the use of alcohol and chlorhexidine in the intracanal disinfection protocol before the installation of fiberglass pin related to the increase in adhesiveness: a systematic literature review

Comparativo entre o uso de álcool e clorexidina no protocolo de desinfecção intracanal anterior à instalação de pino de fibra de vidro relacionado ao aumento da adesividade: uma revisão sistemática da literatura

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ABSTRACT

Introduction: Many clinical failures involving the fiberglass post result from the detachment between the retainer, the root canal and the cement. Thus, the connections that cause a probability of these failures are essential for dentistry. **Objective**: To compare the efficiency of intracanal disinfection between alcohol and chlorhexidine in the context of minimizing fractures. **Methods**: The present systematic review registered in PROSPERO under the protocol CRD42021233516 based on a Medical Subject Headings strategy: "((Endodontics OR Root Canal Filling Materials OR Dental Materials) AND Chlorhexidine AND Ethanol AND Dental Bonding)" in the search engines PubMed, Scopus, Web of Science, Cochrane Library, Embase and Lilacs. Studies in Portuguese, English or Spanish were included, without restrictions regarding their methodology and year of publication. Articles that did not report an intracanal hygiene protocol before the procedure, without full publication and orthodontic research were excluded. **Results**: Six studies were selected according to the inclusion and exclusion criteria. In all, chlorhexidine was used for intracanal cleaning, comparing it with the other groups, and in 4 it was compared with alcohol and other groups. Discussion: The articles used different media and storage times and most used bovine teeth. There was no significant difference between any other characteristics regarding the increase in adhesiveness of the set. **Conclusion**: There is no difference between the use of alcohol or chlorhexidine as a disinfection method. However, a previous protocol must be established for longer treatment longevity.

Indexing terms: Chlorhexidine. Endodontics. Ethanol. Root canal filling materials.

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RESUMO

Introdução: *Muitas falhas clínicas que envolvem o pino de fibra de vidro decorrem do descolamento entre o retentor, o canal radicular e o cimento. Assim, protocolos que reduzem a probabilidade dessas falhas são essenciais para a odontologia.* ***Objetivo****: Comparar a eficiência da desinfecção intracanal entre o álcool e clorexidina no contexto de minimização de fraturas.* ***Métodos****: A presente revisão sistemática registrada no PROSPERO sob o protocolo CRD42021233516 usou a estratégia baseada nos Medical Subject Headings: "((Endodontics OR Root Canal Filling Materials OR Dental Materials) AND Chlorhexidine AND Ethanol AND Dental Bonding)" nos buscadores PubMed, Scopus, Web of Science, Cochrane Library, Embase e Lilacs. Foram incluídos estudos em português, inglês ou espanhol, sem restrições quanto a sua metodologia e ano de publicação. Excluiu-se artigos que não relataram um protocolo de higiene intracanal antes do procedimento, sem publicação na íntegra e pesquisas ortodônticas.* ***Resultados****: Foram selecionados 6 estudos de acordo com os critérios de inclusão e exclusão. Em todos utilizou-se a clorexidina para limpeza intracanal, comparando com os demais grupos, e em 4 houve a comparação dela com álcool e outros agrupamentos. Discussão: Os artigos utilizaram diferentes meios e tempos de armazenamento e a maioria fez o uso de dentes bovinos. Não verificou-se uma diferença significativa entre quaisquer substâncias quanto ao aumento da adesividade do conjunto.* ***Conclusão****: Não existe diferença entre o uso do álcool ou clorexidina como método de desinfecção, entretanto, um protocolo prévio deve ser estabelecido para uma maior longevidade de tratamento.*

Termos de indexação: *Endodontia. Clorexidina. Etanol. Materiais restauradores do canal radicular.*

INTRODUCTION

It is the duty of restorative dentistry to keep up with the technological progress of dentistry, at all stages of oral rehabilitation. As an example, it is possible to notice the emergence of new possibilities to help with the retention of the restorative material, such as fiberglass posts. It is known that, depending on the degree of coronary destruction, the use of intraradicular retainers is essentia. Therefore, the fiberglass post has been used as an alternative to cast cores, as their modulus of elasticity is the main advantage of close to dentin and it is able to distribute occlusal forces more evenly, Improving esthetics, not requiring laboratory steps, not suffering from corrosion, enabling greater preservation of the tooth structure and biocompatibility [1-4].

The preparation and cementation of the intraradicular retainers can make microorganisms resistant to the root canals to aggregate on the surface of the posts. Therefore, correct cleaning is essential to avoid reinfection in the root canal(s) of the endodontically treated dental element. In dental practice, 70% alcohol and chlorhexidine are the most used disinfection agents for this purpose [3,5].

In addition to the above, it is important to pay attention to the issue of bond strength among the root canal, the cement, and the fiberglass post. Most of the clinical failures which involve the root retainer in question, happen due to the detachment of this set. Aiming to avoid this problem, the control of dentin moisture and the promotion of effective adhesion have been analyzed since there is still no pre-established effective cleaning protocol for this purpose. Thus, it is worth noting that chlorhexidine has the advantages of its antimicrobial activity, acting as a topical antiseptic, being a disinfectant, and being a potent inhibitor of metalloproteinases, which are enzymes related to hydrolytic degradation. Alcohol 70% is a fast-acting, non-toxic, low-cost, colorless bactericide and its use has been proposed to help control dentin moisture [2,3,6].

Based on what has been established, this study aims to carry out a literature review that tries to establish an effective clinical protocol for correct intra-radicular cleaning, aiming to improve the adhesiveness of the joint (root canal, cement and fiberglass post) and its short, medium and long term answer. Thus, analyzing a possible advance in the stability of the bond strength.

METHODS

The study in question was filed following the parameters of the PROSPERO protocol (International Prospective Registry of Systematic Reviews), under the registration number CRD42021233516. To accomplish it, the PICO model was used with the population: teeth with the use of intraradicular retainers; the intervention: intracanal disinfection

with chlorhexidine; the control: comparison with ethanol; and the outcome: the circumstance of oral rehabilitation with emphasis on the prognosis associated with the analyzed intracanal materials. Eligible studies had no restrictions regarding their methodology and year of publication. Works published in Portuguese, English or Spanish were analyzed, due to the command of the languages by the reviewers and because of what they represent in an almost absolute way in the selected sample. Articles that did not report an intracanal hygiene protocol before the procedure and studies without full publication and orthodontic studies were excluded. Such eligibility and exclusion criteria was established due to the proposed objective of the review in question, as it aims at a detailed analysis of previously published works comparing intracanal cleaning methods before installing a fiberglass post, regardless of the study design and when they were done.

For the development of this systematic review, a literature search was carried out, using the basic strategy: "((Endodontics OR Root Canal Filling Materials OR Dental Materials) AND Chlorhexidine AND Ethanol AND Dental Bonding)" and all entry terms suggested as synonyms of MeSH (Medical Subject Headings), in the following electronic databases: PubMed, Scopus, Web of Science, Cochrane Library, Embase and Lilacs. For the Embase search, the MeSH terms were replaced by their entree counterparts, keeping all additional terms. The analysis was carried out including studies published until December 29, 2020. All selected works presented in the text were available on the virtual network and it was not necessary to contact the authors. Two references constantly cited in the included studies were also added [7,8].

The study selection process followed the criteria recommended by the PRISMA flowchart, being carried out by two duly calibrated reviewers with a final Kappa agreement index of 0.87. The reviewers' calibration process took place through a virtual meeting in which a preliminary reading ofthe 5 studies was carried out in full and their inclusions and exclusions were discussed. After consensus on the criteria, the reviewers independently and blindly selected them, using an excel® table to enable the Kappa test which minimum agreement was set at 0.85.

The risk of bias assessment was performed based on the Cochrane Collaboration Tool for Assessing the Risk of Bias of Randomized Clinical Trials. However, most of the selected studies are not compatible with the design provided by the tool, so minor adaptations were made for the suitability in the vitro studies. Studies with high levels of bias will be emphasized in the qualitative synthesis of the results.

RESULTS

With the search made in electronic databases, 235 eligible articles were found. After removing the duplicates, 181 studies remained. Through the reading of titles and abstracts, 21 works were chosen for a full reading. In the end, four articles were included, according to the eligibility and exclusion criteria mentioned above in the methodology. Two references constantly cited in the included studies were also added, totaling 6 studies for the systematic review. The steps can be analyzed according to the complete PRISMA flowchart seen in figure 1.

The year of publication of the articles ranged from 2010 to 2019, with one of them having been carried out in Finland [8], one in Italy [7] and the other 4 in Brazil [2,3,9,10]. There was a variation in the sample size from 40 to 72 dental elements, and in two studies, by Angeloni et al. [7] and Lecardelli et al. [2], human teeth were used, while in the others, bovine teeth were analyzed. Regarding the follow-up time, two of the selected articles evaluated the dental elements in the same period, this being an immediate evaluation and in another after 12 months [9,10]. Two other analysis were also performed using the same evaluation period: one initial and the other after 6 months [2,3]. The other studies were heterogeneous in this regard, with one of them being evaluated only immediately [8] and the other that analyzed it initially and after 6 and 12 months [7].

After the selection and the preparation of teeth in all studies, specimens were divided into groups. Except for one of the analyses, in which the roots were divided into 3 groups [3], the dental elements were evaluated in 4 different groups. In all articles, intracanal preparation with chlorhexidine was performed for comparison. In the works selected by reference to the articles included [7,8], chlorhexidine was compared only with the control group, while in the others it was compared with alcohol and with the other groups.

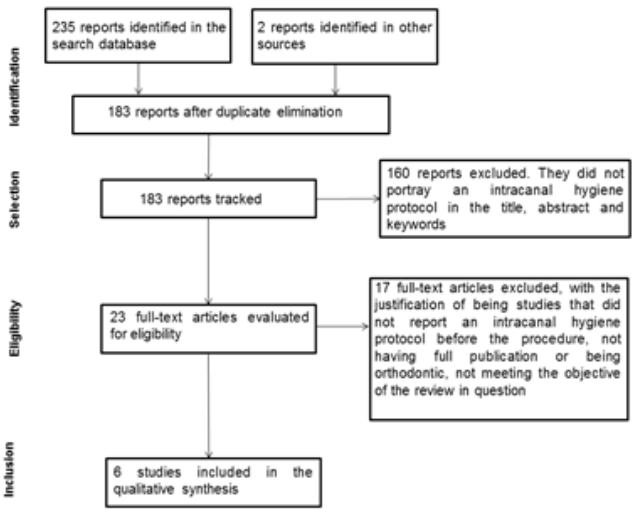

Figure 1. PRISMA flowchart for study selection.

After cleaning, drying the canals and distributing the teeth in clusters, in all studies, the fiberglass post was cemented with subsequent storage of the dental element, except the work by Cecchin et al. [9], in which the type of storage was used for the separation of groups of teeth. There was heterogeneity regarding this step, which can be seen in the data summarized in table 1.

Table 1. Storage methods used in the evaluated works.

Author	Storage medium	Time	Temperature
Lindblad et al. [8]	Artificial saliva	3-7 days	37°C
Cecchin et al. [9]	Mineral water and oil	24h (in water) and 12 months (in water and mineral oil)	–
Cecchin et al. [10]	Water	24h and 12 months	–
França et al. [3]	Distilled water	48h and 180 days	37°C
Angeloni et al. [7]	Artificial saliva	24h, 6 months and 1 year	37°C
Lecardelli et al. [2][2]	Distilled water	24h and 6 months	37°C

In all articles analyzed, the push-out test was carried out using a universal testing machine, obtaining the bond strength data in megapascals and there was a difference only in the speed of the crosshead used, being 1mm/min in 3 of them [2,7,8] and 0,5mm/min on the others [3,9,10]. Subsequently, in all works, the failure mode of the dental elements was verified using a stereomicroscope.

Regarding the failure modes observed in the analyzed works, the behaviors verified are described in Table 2. In the studies by Lindblad et al. [8] and Angeloni et al. [7], the control group and chlorhexidine with two different types of cement were compared. Therefore the table for comparing the types of fracture considered the DTLight-Post and RelyX Unicem cements, respectively, chosen by drawing lots in Excel software (Microsoft Corporation) with numbers, differing only about the amount of types of cement evaluated in each article.

After analyzing bond strength, the article by Lecardelli et al. [2] found similar values for all dentine initially. This evaluation was the only one that presented alcohol as the best treatment alternative, after 6 months of storage. However, even if the group that received the pre-treatment with alcohol showed a smaller reduction, all groups showed a significant decrease in the evaluated characteristics over time.

Table 2. Distribution of fracture types.

Article	Intrachannel irrigant	Time	Type of fracture (% frequency)
Lindblad et al. [8]	Control	3-7 days	Between adhesive and dentin (75%)
			Mixed (25%)
	Chlorhexidine	3-7 days	Mixed (58.6%)
			Between adhesive and dentin (41.4%)
Cecchin et al. [9]	Control	24h	Mixed (66.66%)
			Cohesive (23.33%)
			Between dentin and cement (10%)
			Between pin and cement (0%)
		1 year (water)	Between dentin and cement (53.33%)
			Mixed (33.33%)
			Between pin and cement (6.66%)
			Cohesive (6.66%)
		1 year (oil)	Mixed (50%)
			Between dentin and cement (50%)
			Between pin and cement (0%)
			Cohesive (0%)
	Chlorhexidine	24h	Mixed (66.66%)
			Cohesive (20%)
			Between dentin and cement (13.33%)
			Between pin and cement (0%)
		1 year (water)	Mixed (54.83%)
			Cohesive (22.58%)
			Between dentin and cement (19.35%)
			Between pin and cement (3.22%)
		1 year (oil)	Mixed (70%)
			Cohesive (16.66%)
			Between dentin and cement (13.33%)
			Between pin and cement (0%)
	Ethanol	24h	Mixed (66.66%)
			Cohesive (23.33%)
			Between dentin and cement (10%)
			Between pin and cement (0%)
		1 year (water)	Mixed (63.33%)
			Cohesive (20%)
			Between dentin and cement (13.33%)
			Between pin and cement (3.33%)
		1 year (oil)	Mixed (56.66%)
			Cohesive (30%)
			Between dentin and cement (13.33%)
			Between pin and cement (0%)
	Chlorhexidine + Ethanol	24h	Mixed (60%)
			Cohesive (26.66%)
			Between dentin and cement (10%)
			Between pin and cement (3.33%)
		1 year (water)	Mixed (73.33%)
			Cohesive (23.33%)

Table 2. Distribution of fracture types.

Article	Intrachannel irrigant	Time	Type of fracture (% frequency)
			Between dentin and cement (3.33%)
			Between pin and cement (0%)
		1 year (oil)	Mixed (70%)
			Cohesive (23.33%)
			Between dentin and cement (6.66%)
			Between pin and cement (0%)
Cecchin et al. [10]	Control	24h	Mixed (70%)
			Cohesive (16.66%)
			Between dentin and cement (10%)
			Between pin and cement (3.33%)
		1 year	Mixed (48.57%)
			Between dentin and cement (45.71%)
			Between pin and cement (2.85%)
			Cohesive (2.85%)
	Chlorhexidine	24h	Mixed (63.33%)
			Cohesive (23.33%)
			Between dentin and cement (13.33%)
			Between pin and cement (0%)
		1 year	Mixed (70%)
			Cohesive (23.33%)
			Between dentin and cement (6.66%)
			Between pin and cement (0%)
	Ethanol	24h	Mixed (63.33%)
			Between dentin and cement (30%)
			Cohesive (6.66%)
			Between pin and cement (0%)
		1 year	Mixed (83.33%)
			Between dentin and cement (13.33%)
			Cohesive (3.33%)
			Between pin and cement (0%)
	Chlorhexidine + Ethanol	24h	Mixed (56.66%)
			Between dentin and cement (26.66%)
			Cohesive (16.66%)
			Between pin and cement (0%)
		1 year	Mixed (76.66%)
			Between dentin and cement (13.33%)
			Cohesive (10%)
			Between pin and cement (0%)
França et al. [3]	Control	48h	Between dentin and cement (44.4%)
			Between pin and cement (22.2%)
			Mixed (37%)
			Cohesive (19%)
		180 days	Between dentin and cement (51.9%)
			Between pin and cement (37%)
			Mixed (16.7%)
	Chlorhexidine	48h	Between pin and cement (46.3%)

Table 2. Distribution of fracture types.

Article	Intrachannel irrigant	Time	Type of fracture (% frequency)
			Between dentin and cement (25.9%)
			Mixed (14.8%)
			Cohesive (13%)
		180 days	Between pin and cement(68.5%)
			Between dentin and cement (14.8%)
			Mixed (13%)
			Cohesive (3.7%)
	Ethanol	48h	Between pin and cement (37%)
			Between dentin and cement (31.5%)
			Mixed (29.6%)
			Cohesive (7.4%)
		180 days	Between pin and cement (46.3%)
			Mixed (39.9%)
			Between dentin and cement (20.4%)
Angeloni et al. [7]	Control	24h	Between dentin and cement (58.8%)
			Mixed (29.5%)
			Between pin and cement (5.8%)
			Cohesive (5.8%)
		6 months	Between dentin and cement (55.5%)
			Cohesive (33.3%)
			Between pin and cement (5.5%)
			Mixed (5.5%)
		1 year	Between dentin and cement (55.5%)
			Mixed (22.2%)
			Cohesive (14.8%)
			Between pin and cement (7.4%)
	Chlorhexidine	24h	Between dentin and cement (62.5%)
			Mixed (16.6%)
			Cohesive (12.5%)
			Between pin and cement (8.3%)
		6 months	Between dentin and cement (50%)
			Cohesive (25%)
			Between pin and cement (15%)
			Mixed (10%)
		1 year	Between dentin and cement (47.3%)
			Mixed (31.5%)
			Between pin and cement (15.7%)
			Cohesive (5.2%)
Lecardelli et al. [2]	Control	1 month	Between dentin and cement (90%)
			Mixed (5%)
			Between pin and cement (5%)
		6 months	Between dentin and cement (100%)
			Mixed (0%)
			Between pin and cement (0%)
	Chlorhexidine	1 month	Between dentin and cement (97%)

Table 2. Distribution of fracture types.

Article	Intrachannel irrigant	Time	Type of fracture (% frequency)
			Mixed (3%)
			Between pin and cement (0%)
		6 months	Between dentin and cement (97%)
			Mixed (3%)
			Between pin and cement (0%)
	Ethanol	1 mês	Between dentin and cement (95%)
			Mixed (5%)
			Between pin and cement (0%)
		6 months	Between dentin and cement (95%)
			Mixed (5%)
			Between pin and cement (0%)
	Chlorhexidine + Ethanol	1 month	Between dentin and cement (97%)
			Mixed (3%)
			Between pin and cement (0%)
		6 months	Between dentin and cement (100%)
			Mixed (0%)
			Between pin and cement (0%)

In the studies by Angeloni et al. [7] and Lindblad et al. [8], which compared chlorhexidine with a control group, there was no significant statistical difference and with aging, the bond strength was reduced by both groups.

Cecchin et al. [9] demonstrated that the groups that were pre-treated with alcohol and/or chlorhexidine preserved the bond strength after 12 months, with no statistically relevant difference in the initial assessment.

In the articles by Cecchin et al. [10] and França et al. [3], chlorhexidine showed better bond strength than the control and alcohol groups over time. However, regarding the immediate evaluation, Cecchin et al. [10] found that there was no statistical significant difference, while the other study showed that the use of alcohol or chlorhexidine improved the initial bond strength.

Due to the current methodology of studies being in vitro, an adaptation of the risk of bias assessment tool present in the Cochrane Handbook was used. The evaluative element "allocation concealment" was excluded because in in vitro studies, there was no need for it. The general assessment can be seen in figure 2. All studies had an uncertain risk regarding the blinding of the outcome evaluators and none had a registered protocol to allow the assessment of the selective outcome. All had adequate outcomes about the objectives. Therefore, only two studies, Lindblad et al. [8] and Angeloni et al. [7], stored their samples in artificial saliva, corresponding to an important methodological bias to better replicate the oral environment . For having very similar performances, it was decided not to take into account this criterion for the qualitative analysis. However, the methodological flaws were better explained in the discussions.

DISCUSSION

According to the data obtained in this review, a lack of inclusion and exclusion criteria for the sample was noted, which was mentioned in only two of the studies that were performed with human teeth [7,8]. In the article by Angeloni et al. [7], the inclusion criteria was the absence of fracture, root caries, previous root treatment, pin or crown, and minimum

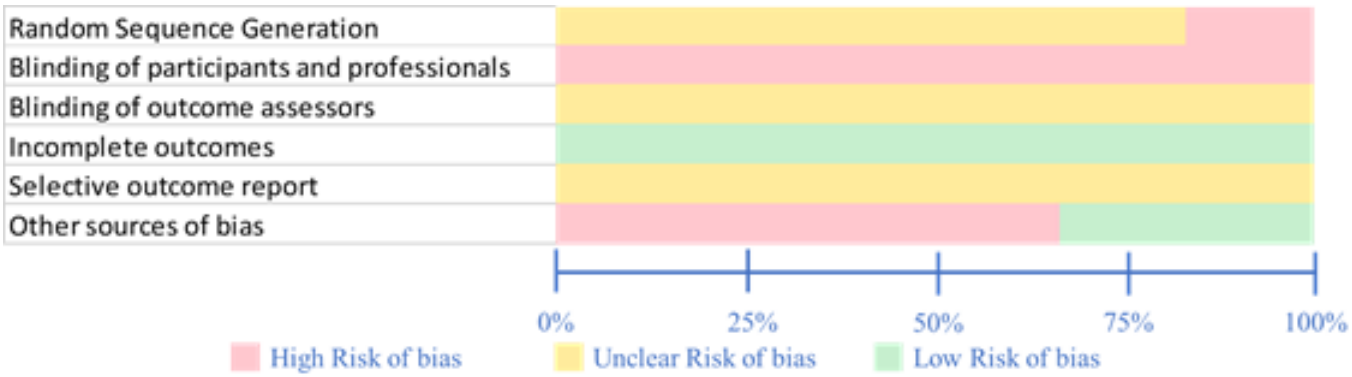

Figure 2. Overall risk of bias among selected studies according to adaptation of the Cochrane risk of bias analysis tool.

root length of 13 ± 3 mm. While in the evaluation by Lindblad et al. [8], only the minimum length of 9 mm was required.

Many clinical failures that are related to fiberglass posts are caused by detachment of the cement, post and root canal walls. Therefore, some substances have been studied to promote greater adherence to the group mentioned above, among them alcohol and chlorhexidine [2,6]. When performing a comparison of intracanal treatment with chlorhexidine and isopropyl alcohol, in association or isolation, Lecardelli et al. [2], observed a similar bond strength for all dentins in the initial evaluation and after the follow-up period, the alcohol proved to be more efficient, with a better bond strength of the set with its previous use than in the other evaluated groups. As in other studies, initially, there was no statistical significant difference, but only in this article did alcohol prove to be superior over time.

In another of the evaluated studies, that of Cecchin et al. [9], as mentioned above, there was no significant difference in the initial assessment. However, after 12 months, both alcohol and chlorhexidine were superior to the control group, preserving the bond strength of the fiberglass post with the dentien, with no one that surpasses the other in a statistically relevant way. As demonstrated in previous studies, chlorhexidine proved to be efficient due to its capacity to inhibit metalloproteinases [11-16]. However, because that collagen fibrils present in the dentin are intrinsically wet due to their affinity for water, some discoveries have shown the increase in the stability of the bonds when adhesive mixtures are hydrophobic, which is why ethanol can be a substitute dentin water and it can form a less unstable hybrid layer [17-19]. Therefore, it was explained that the use of such agents can prevent the reduction of the bond strength for the evaluated period.

Another article [10], written by the same group of authors mentioned above, assessed aging after the period equivalent to the previous one. However, they observed that the intracanal pretreatment with chlorhexidine preserved the bond strength after aging. Ethanol has a higher vapor pressure than water at 23.8°C, evaporating more quickly, so this may be linked to its inability to maintain bond strength when using a hydrophobic adhesive [20]. Thus, this explanation is in agreement with the results verified by the authors of the explained analysis.

The application of alcohol and chlorhexidine related to conditioning and rinsing adhesives has been investigated to improve the longevity of bonding adhesive systems to dentine [12,21,22]. França et al. [3] analyzed the dental groupings initially and after 180 days (6 months), demonstrating that both ethanol and chlorhexidine increased bond strength in the initial assessment when compared to the control group. However, with aging, chlorhexidine proved to be superior to the other groups, presenting the highest bond strength averages and the best results regardless of the storage period.

The two remaining evaluations, by Angeloni et al. [7] and by Lindblad et al. [8], showed that there was no statistically significant difference in any group. Both studies compared chlorhexidine with a control group. Lindblad et al. [8] evaluated it only initially (3-7 days) while Angeloni et al. [7] also analyzed the bond strength after aging (afterward 6 and 12 months). Therefore, it could be observed that the use of chlorhexidine for dentinal pretreatment did not improve the durability of adhesion over time, but this feature was not shown to negatively affect the evaluated characteristic.

All studies evaluated fracture patterns to analyze failure modes and classify them. When observing the assessments made by the authors, there is heterogeneity regarding the findings related to the predominant types of failures. However, except Angeloni et al. [7] and Lecardelli et al. [2], in all otherwise, intracanal pretreatment with some of the materials (alcohol and chlorhexidine) resulted in marked changes in fracture patterns. According to Angeloni et al. [7] chlorhexidine did not show results on resistance

CONCLUSION

Despite the limitations of the studies evaluated, it is inferred that it is not possible to establish a material used in the intracanal disinfection protocol before the installation of a fiberglass post that significantly improves the adhesiveness between the root canal, cement and post.

Regardless of the applied material, there was no difference in the initial bond strength values. However, over time, the use of alcohol or chlorhexidine contributed so that the evaluated characteristic was preserved.

Therefore, it is up to the dentist to choose a disinfectant agent for intracanal cleaning, regardless of what it is, taking into account their clinical reality to select it.

Collbaorators

These authors were assisted and participated in all stages of design, writing and review of this entire document. The writers participated in all stages of evaluation of the works described here, as well as reviewed the writing of the entire text. Everyone agrees with the information presented here and declares the authorship of its content. ALCM Rodrigues, Contributor in the selection of studies, analysis and interpretation of data and in the writing of the work. DFF Paiva Contributor in the selection of studies, analysis and interpretation of data and in the writing of the work.

REFERENCES

1. Da Costa Fartes O, De Resende L, Cilli R, Do Carmo A, Baroudi K, Cortelli J. Retention of provisional intraradicular retainers using fiberglass pins. J Int Soc Prev Community Dent. 2020;10(5):666-73. https://doi.org/10.4103/jispcd.JISPCD_298_20
2. Lecardelli EA, Poletto-Neto V, Pappen FG, Pereira-Cenci T, Morgental RD. Effect of chlorhexidine and isopropyl alcohol on immediate and delayed bond strength of glass fiber posts. G Ital Endod. 2019;33(2):55-61. https://doi.org/10.32067/gie.2019.33.02.06
3. Gomes França FM, Vaneli RC, Conti CM, Basting RT, do Amaral FL, Turssi CP. Effect of Chlorhexidine and Ethanol Application on Long-term Push-out Bond Strength of Fiber Posts to Dentin. J Contemp Dent Pract. 2015;16(7):547-53. https://doi.org/10.5005/jp-journals-10024-1720
4. Cannella V, Altomare R, Chiaramonte G, Di Bella S, Mira F, Russotto L, et al. Cytotoxicity Evaluation of Endodontic Pins on L929 Cell Line. Biomed Res Int. 2019;2019. https://doi.org/10.1155/2019/3469525
5. Gomes BP, Ferraz CC, Vianna ME, Berber VB, Teixeira FB, Souza-Filho FJ. In vitro antimicrobial activity of several concentrations of sodium hypochlorite and chlorhexidine gluconate in the elimination of Enterococcus faecalis. Int Endod J. 2001;34(6):424-8. https://doi.org/10.1046/j.1365-2591.2001.00410.x
6. Venturelli AC, Torres FC, Almeida-Pedrin RR de, Almeida RR de, Almeida MR de, et al. Avaliação microbiológica da contaminação residual em diferentes tipos de alicates ortodônticos após desinfecção com álcool 70%. Rev Dent Press Ortod Ortop Facial. 2009;14(4):43-52. https://doi.org/10.1590/S1415-54192009000400005
7. Angeloni V, Mazzoni A, Marchesi G, Cadenaro M, Comba A, Maravić T, et al. Role of chlorhexidine on long-term bond strength of self-adhesive composite cements to intraradicular dentin. J Adhes Dent. 2017;19(4):341-8. https://doi.org/10.3290/j.jad.a38896
8. Lindblad RM, Lassila LVJ, Salo V, Vallittu PK, Tjäderhane L. Effect of chlorhexidine on initial adhesion of fiber-reinforced post to root canal. J Dent. 2010;38(10):796-801. https://doi.org/10.1016/j.jdent.2010.06.011
9. Cecchin D, De Almeida JFAJFA, Gomes BPFABPFA, Zaia AAAA, Ferraz CCRCCR. Effect of chlorhexidine and ethanol on the durability of the adhesion of the fiber post relined with resin composite to the root canal. J Endod. 2011;37(5):678-83. https://doi.org/10.1016/j.joen.2011.01.007
10. Cecchin D, De Almeida JFAJFA, Gomes BPFABPFA, Zaia AAAA, Ferraz CCRCCR. Influence of chlorhexidine and

ethanol on the bond strength and durability of the adhesion of the fiber posts to root dentin using a total etching adhesive system. J Endod. 2011;37(9):1310-5. https://doi.org/10.1016/j.joen.2011.05.004

11. Carrilho MRO, Carvalho RM, de Goes MF, di Hipólito V, Geraldeli S, Tay FR, et al. Chlorhexidine preserves dentin bond in vitro. J Dent Res. 2007;86(1):90-4. https://doi.org/10.1177/154405910708600115
12. Carrilho MRO, Geraldeli S, Tay F, de Goes MF, Carvalho RM, Tjäderhane L, et al. In vivo preservation of the hybrid layer by chlorhexidine. J Dent Res. 2007;86(6):529-33. https://doi.org/10.1177/154405910708600608
13. Breschi L, Mazzoni A, Nato F, Carrilho M, Visintini E, Tjäderhane L, et al. Chlorhexidine stabilizes the adhesive interface: a 2-year in vitro study. Dent Mater. 2010;26(4):320-5. https://doi.org/10.1016/j.dental.2009.11.153
14. Ricci HA, Sanabe ME, de Souza Costa CA, Pashley DH, Hebling J. Chlorhexidine increases the longevity of in vivo resin-dentin bonds. Eur J Oral Sci. 2010;118(4):411-6. https://doi.org/10.1111/j.1600-0722.2010.00754.x
15. Chang Y-E, Shin D-H. Effect of chlorhexidine application methods on microtensile bond strength to dentin in Class I cavities. Oper Dent. 2010;35(6):618-23. https://doi.org/10.2341/09-360-L
16. Stanislawczuk R, Reis A, Loguercio AD. A 2-year in vitro evaluation of a chlorhexidine-containing acid on the durability of resin-dentin interfaces. J Dent. 2011;39(1):40-7. https://doi.org/10.1016/j.jdent.2010.10.001
17. Malacarne J, Carvalho RM, de Goes MF, Svizero N, Pashley DH, Tay FR, et al. Water sorption/solubility of dental adhesive resins. Dent Mater. 2006;22(10):973-80. https://doi.org/10.1016/j.dental.2005.11.020
18. Breschi L, Mazzoni A, Ruggeri A, Cadenaro M, Di Lenarda R, De Stefano Dorigo E. Dental adhesion review: aging and stability of the bonded interface. Dent Mater. 2008;24(1):90-101. https://doi.org/10.1016/j.dental.2007.02.009
19. Pashley DH, Tay FR, Carvalho RM, Rueggeberg FA, Agee KA, Carrilho M, et al. From dry bonding to water-wet bonding to ethanol-wet bonding. A review of the interactions between dentin matrix and solvated resins using a macromodel of the hybrid layer. Am J Dent. 2007;20(1):7-20.
20. Sadek FT, Mazzoni A, Breschi L, Tay FR, Braga RR. Six-month evaluation of adhesives interface created by a hydrophobic adhesive to acid-etched ethanol-wet bonded dentine with simplified dehydration protocols. J Dent. 2010;38(4):276-83. https://doi.org/10.1016/j.jdent.2009.11.007
21. Stanislawczuk R, Amaral RC, Zander-Grande C, Gagler D, Reis A, Loguercio AD. Chlorhexidine-containing acid conditioner preserves the longevity of resin-dentin bonds. Oper Dent. 2009;34(4):481-90. https://doi.org/10.2341/08-016-L
22. Breschi L, Cammelli F, Visintini E, Mazzoni A, Vita F, Carrilho M, et al. Influence of chlorhexidine concentration on the durability of etch-and-rinse dentin bonds: a 12-month in vitro study. J Adhes Dent. 2009;11(3):191-8.

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