EFFECT OF DIFFERENT ENDODONTIC IRRIGATION SOLUTIONS ON THE RETENTION OF A FIBER POST CEMENTED WITH A SELF-ADHESIVE RESIN CEMENT TO ROOT DENTIN

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Keywords: root canal irrigants, resin cement, fiber post, dental bonding.

Summary
The aim of this study was to systematically review the literature using in vitro studies to investigate if cleaning post-space preparation with different irrigants can increase the retention of fiberglass post evaluated by push-out test. The present systematic review reports the results according to guidelines of PRISMA statement. The research question was developed according to the PICO strategy. Two electronic databases including PubMed and Ovid (MEDLINE) were used to find relevant studies. Two reviewers independently screened titles and abstracts through the databases and performed evaluation of risk of bias of the included studies. After study selection, only 11 studies met the inclusion criteria and were included in the systematic review. There was significant heterogeneity in the methodological variables, and therefore, it was impossible to perform valid quantitative synthesis of the data (meta-analysis). Insufficient evidence was found to indicate any of the irrigation solutions used to their effect on bond strength of self-adhesive resin cement to root dentin. It is impossible to conclude recommendations to a specific irrigation protocol. Future studies should follow a standardized approach to implementation, same methodologies and reporting of data. Recommendations have been provided for standard methods of future studies so that clinical recommendations could be provided.

Introduction
Endodontic posts are often necessary in restoring endodontically treated teeth with excessive dental structural loss due to caries, fractures or endodontic access cavity preparations [1]. In recent years fiberglass posts have been often used and preferred over prefabricated metallic posts because of their similar physical properties to dentin. These physical properties include elastic modulus and flexural strength, which reduce the incidence of root fracture, and have advantages, such as aesthetics, biocompatibility and absence of corrosion risk [2,3].

The most commonly reported clinical failure in fiberglass post is debonding from the root canal at the dentin-resin cement interface [4,5,6]. The major factors influencing the bond strength of resin cement are the root canal shape, depth of the intraradicular area, orientation of dentinal tubules, irrigation solutions, negative C-factor, difficulty in access and moisture control, type of adhesive system, and endodontic sealer [7,8].

Conventional and self-adhesive resin cements are currently used to lute fiberglass posts to root dentin. Conventional resin cements associated with dentin pretreatment with etch and rinse adhesive systems have demonstrated good results, however, self-adhesive resin cements appeared as an alternative to avoid the pretreatment requirements for the root dentin and has no negative effects on the root canal resulting from either chemical or micromechanical retention to the tooth surface [9].

Canal preparation for post procedures creates a smear layer on the root canal dentin surface that directly affects the bond strength of the self-adhesive cement to the root dentin. Self-adhesive resin cement is unable to etch the root canal dentin through the smear layer or to form a hybrid layer and resin tags. Self-adhesive resin cements adhesion is based on the chemical interactions between acidic hydrophilic monomers and hydroxyapatite, which modifies the smear layer, and on micromechanical retention [10,11].

Post space irrigation may influence the strength of the
cement bond with the root canal dentin by removing remaining sealer, gutta percha and smear layer. Sodium hypochlorite, ethylenediaminetetraacetic acid, phosphoric acid, and chlorhexidine are the most routinely used agents [12,13].

**The aim of this study** was to systematically review the literature using in vitro studies and to summarize the outcomes of different irrigation solutions and their effect on bond strength of self-adhesive resin cement to root dentin. The null hypothesis states that cleaning the post-space with different irrigation solutions would not affect the bond strength of self-adhesive resin cement to root dentin. The research question was developed and investigated as follows: Do the irrigating solutions influence the retention of a fiberglass post evaluated by push-out test?

**Material and Methods**

The present systematic review reports the results according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [14].

A PICO question was developed as follows: “Population” included study groups with extracted human teeth, “Intervention” was the evaluation of different irrigation solutions to clean post space, “Comparison” was the evaluation of irrigation with saline or distilled water, and the “Outcome” evaluated was the bond strength of self-adhesive resin cement to root dentin assessed by the push-out test.

**Criteria for study selection.** The studies had to meet the following requirements: in vitro studies using human teeth; the push-out test must have been used to evaluate the bond strength of the self-adhesive resin cement to root dentin; a fiberglass post had to be used and cemented with self-adhesive resin cement; the post space was cleaned by irrigation solutions before cementing the fiberglass post; publications must be reported in the English peer-reviewed dental literature.

The exclusion criteria were as follows: studies that used non-human teeth; other than the push-out test was used to evaluate cement bond strength to root dentin; use of eugenol; endodontic sealer; use of any other canal cleaning method before irrigating the post space or during irrigation procedure.

**Studies Selection and Data Extraction.** Two reviewers (ES and RS) independently screened titles and abstracts through the databases. Any discrepancies were solved through consensus between the reviewers or by arbitration (GZ). Data from the selected studies were selected independently by three reviewers (ES, RS, and GZ).

The following data was extracted from selected studies: authors and year of publication; type of study; number of teeth used; storage after extraction; root canal preparation prior to preparing post space; post space preparation methods and materials used; period before post cementation-time and storage conditions; endodontic sealer used; type of cement used; irrigating solutions used to clean the post space prior to cementation.

**Literature Search.** Two electronic databases including PubMed and Ovid (MEDLINE) were used to find relevant studies using the search terms: (“Root Canal Irrigants”[Mesh]) OR “Root Canal Preparation”[Mesh]) AND “Post and Core Technique”[Mesh]) AND “Bond Force dental cement” [Supplementary Concept]) OR “Cementation”[Mesh]) OR “Dental Cements”[Mesh]) OR “Dental Bonding Agents”[Mesh]) OR “Dentin-Bonding Agents”[Mesh]). Articles restricted to the English language were considered with restriction of publication periods from December 2019 up to February 2020. The examiners evaluated titles and abstracts of all identified studies. When the abstract did not contain sufficient information to enable a decision on inclusion or exclusion, the full manuscript was evaluated before the final decision. Studies that appeared in more than one evaluated database were considered only once.

**Outcomes.** The outcome was cement bond strength to root dentin evaluated using push-out test and expressed in MPa.

**Risk of bias (quality assessment).** The risk of bias table was formulated by two reviewers based on the Joanna Briggs Institute Clinical Appraisal Checklist for Experimental Studies as described in previously published studies [15,16]. The risk of bias was marked “+” which equaled to “1” when the details of the parameters were mentioned with no ambiguity. When there was ambiguity or if no details were mentioned, it was marked as “-” which equaled to “0”. The scored points were added together. Methodologic quality was low if 1-4 points, moderate - if 5-7 points, and high - if 8-10 points were counted (Table 1).

**Results**

There was significant heterogeneity in the methodological variables, and therefore, it was impossible to perform valid quantitative synthesis of the data (meta-analysis). Therefore, a descriptive presentation of the data was performed.

**Study selection.** Article review and data extraction were performed according to the PRISMA flow diagram (Figure 1). The initial electronic search found a total of 52,381 articles, 37,490 of which were eliminated as duplicates or older than ten years publications. After titles and abstracts were reviewed, an additional 14,771 articles were filtered as not relevant studies, systematic reviews or not having enough information regarding selecting topic. 95 articles were iden-
tified as full-text articles, of which only 11 were included in this review [17-27].

**Study characteristics.** A total of 708 human teeth were used, the most frequent being premolars (46.3%), anterior teeth were used in three studies (24%), other studies did not mention the exact amount of teeth used (29.7%). The most popular endodontic sealers used in the studies was AH Plus (Dentsply), which was used in four studies [17,20,21,24], Sealer-26 (Dentsply) was used in four studies [18,22,25,26], AH-26 (Dentsply) was used in two [19,23], and Sealaplex sealer (Kerr) was used in one study [27]. The timing of post-space after obturation revealed was seven days in most studies [17,18,20,21,23-27], in one study teeth after obturation were stored for three days [22], another study did not even mention the timing after obturation [19]. The most used cement was Relyx U200 (3M ESPE), which was mentioned in six studies [17,18,21,24-27], Relyx U100 [18], Relyx Unicem (3M ESPE) [22], BisCem (Bisco inc.) [23], iCEM (Heraeus Kulzer) [20], Multilink Speed (Ivoclar Vivadent) [26], Maxcem Elite (MCE) (Kerr) [27] and Clearfil SA (Kuraray America inc.) [19] were used in separate single studies. In nine of the included studies, the push-out test was applied to different root thirds and differences were evaluated [1-4,6,8-10,11].

Table 1 summarizes the characteristics of the included articles.

**Sodium hypochlorite (NaClO).** Ten of included studies used sodium hypochlorite as irrigation solution alone [18-27]. There was variability in the duration and concentration of all irrigants. Three studies used 5% NaClO [18,21,22], three of which used NaClO followed by a rinse of distilled water [18,22,26], four studies used 5.25% [20,23,25,27] and 2.5% NaClO, 1% and 6.15% NaClO solutions were used in separate single studies [19,21,23,26]. Five studies used NaClO solution for one minute [22-25,27], one study for three minutes [18], four studies did not mention the exact amount of time irrigation was proceeded for [19-21,26]. There was used between 2 and 10 mL of NaClO. Five studies reported that NaClO significantly reduced bond strength [18,19,20,22,26]. Four included studies reported that bond strength after irrigating with NaClO solution was not significantly different from the control group [22-25]. One of these studies reported that it was not different from the control group when Relyx Unicem cement was used [22]. One of the studies did not even have control group [19]. One study found different results depending on the root part and different cement used [27]. Using Relyx U200 NaClO bond strength was reduced in apical, using MCE - cervical...
Five studies used 2% chlorhexidine gel [17,20,21,25,27]. There was used chlorhexidine gel [17,20,21,25,27]. There was not enough evidence to arrive at any conclusion regarding EDTA solution and its effect on bond strength of cervical and apical root thirds [25,26]. There was not enough evidence to arrive at any conclusion regarding EDTA solution and its effect on bond strength of cervical and apical root thirds [25,26].

**Table 1. Characteristics of included studies**

<table>
<thead>
<tr>
<th>Authors, year</th>
<th>Kal et al., 2016</th>
<th>Garcia et al., 2018</th>
<th>Alkhudhairy et al., 2018</th>
<th>Elnaghy et al., 2013</th>
<th>Seballos et al., 2018</th>
<th>Faria-e-Silveira et al., 2012</th>
<th>Khourzum et al., 2017</th>
<th>Fan et al., 2017</th>
<th>Crispim da Silveira et al., 2014</th>
<th>Jinimori et al., 2019</th>
<th>Suzuki et al., 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of samples</td>
<td>40 mandibular premolars</td>
<td>48 mandibular premolars</td>
<td>52 anterior teeth</td>
<td>90 single rooted</td>
<td>80 premolars</td>
<td>48 incisors</td>
<td>40 premolars</td>
<td>60 premolars</td>
<td>70 mandibular incisors</td>
<td>120 single rooted</td>
<td>60 premolars</td>
</tr>
<tr>
<td>Storage after extraction</td>
<td>Distilled water</td>
<td>Not mentioned</td>
<td>1% sodium azide</td>
<td>0.5% chlromine T at 4 °C</td>
<td>0.9% saline solution at 4 °C</td>
<td>Not mentioned</td>
<td>0.2% thymol solution</td>
<td>0.2% sodium azide</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Storage after canal obturaiton</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>None</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
<td>1. 100% humidity 2. 37 °C 3. 7 days</td>
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<tr>
<td>Post-space preparation</td>
<td>1. #1 Pesso taper 2. #1 drill (DT Light-Post System)</td>
<td>1. Low-speed drill (White Post - DC 2; FGM - Dentscare)</td>
<td>1. Hot plugger, sequential reamers (ParaPost Fiber Lux)</td>
<td>1. Preparing drill (Ruhla Post VOCO)</td>
<td>1. #2,3,4 Large drills (Dentbury Maillefer), the Exato Translucido AngelusN2 (Angelus) bar</td>
<td>1. Epoxy post system kit drills (White Post DC3; FGM)</td>
<td>1. Paxoo reamers 2. Post system drill (Series 91, Conical Type 2°, MicroMedic)</td>
<td>1. Preshaping post drill (3M ESPE)</td>
<td>1. #4 Gates Glidden drill 2. #5 Large drill (Angelus Ind.)</td>
<td>1. Post drill Whitepost DC 2 (FGM - Dentscare)</td>
<td>1. #2, 3, 4, 5 low-speed drill bit (Dentbury Maillefer) sequentially</td>
</tr>
<tr>
<td>Cement</td>
<td>RelyX U200 (3M ESPE)</td>
<td>RelyX U100 (3M ESPE)</td>
<td>Clearfil SA cement (Kuraray America)</td>
<td>iCem (Ivoclar)</td>
<td>RelyX U200 (3M ESPE)</td>
<td>RelyX Unicem clicker (3M ESPE) and BisCem (Bisco Inc.)</td>
<td>BioCem cement (Bisco Inc.)</td>
<td>RelyX U200 (3M ESPE)</td>
<td>RelyX U200 (3M ESPE) and Multilink Speed (Ivoclar Vivadent)</td>
<td>Rely X U200 (3M ESPE) and Maxcem Elite (MCE) (Kerr)</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>Not mentioned</td>
<td>White Post DC 2 (FGM - Dentscare)</td>
<td>A size #6, parallel-sided (ParaPost Fiber Lux)</td>
<td>Ruhida post (VOCO), size Ø 1.5</td>
<td>Exato Translucido N2 (Angelus)</td>
<td>Epoxy post system (White Post DC3; FGM)</td>
<td>Glass fiber post (MicroMedica s.r.l.)</td>
<td>3M ESPE post (FGM - Dentscare)</td>
<td>Relipost (Angelus Ind.)</td>
<td>WhipMix DC 2 (FGM - Dentscare)</td>
<td>#3 glass fiber post system (Relipost; Angelus)</td>
</tr>
<tr>
<td>Control group</td>
<td>Distilled water 15 mL</td>
<td>Distilled water 10 mL for 3 min</td>
<td>None</td>
<td>Sterile distilled water 5 mL</td>
<td>0.9% saline solution</td>
<td>No solution used</td>
<td>0.9% normal saline</td>
<td>0.9% normal saline solution 5 mL for 1 min</td>
<td>Saline solution for 1 min</td>
<td>Distilled water 5 mL</td>
<td>Distilled water</td>
</tr>
</tbody>
</table>

**Chlorhexidine (CHX):** Five studies used 2% chlorhexidine gel [17,20,21,25,27]. There was used chlorhexidine gel [17,20,21,25,27]. There was not enough evidence to arrive at any conclusion regarding EDTA solution and its effect on bond strength of cervical and apical root thirds [25,26]. There was not enough evidence to arrive at any conclusion regarding EDTA solution and its effect on bond strength of cervical and apical root thirds [25,26]. Two studies [18,22,26] showed that EDTA increased bond strength, one of which was when Multilink Speed (Ivoclar Vivadent) was used [22,26]. One study [22,26] did not have the control group [18].
| Experimental groups | 1. 5.25% NaClO  
+ 17% EDTA 5 mL each for 1 min + 5 mL of distilled water  
2. 15 mL of 1% CHX solution  
3. 35% Phosphoric acid for 15 sec + 15 mL of distilled water  
4. 0.9% saline solution  
5. Not mentioned  
6. 0.2% thymol  
7. Distilled water Not mentioned | 1. 6.13% NaClO  
2. 1.7% EDTA  
3. 6.15% NaClO + 17% EDTA  
4. 0.12% CHX + 6.15% NaClO  
5. OMK (Dentsply Tulsa Dental) | 1. 5.25% NaClO  
2. 2% CHX  
3. 1.7% EDTA  
4. 17% EDTA  
5. 2% CHX  
6. QMix (Dentsply Tulsa Dental)  
7. 5% CaCO3 | 1. 11.25% PA for 10 sec  
2. 17% EDTA for 60 sec  
3. 5% NaClO for 60 sec | 1. 2.5% NaClO, 2. 5.25% NaClO, 3. 2.5% CaCO3  
4. 5% NaClO, 5. 1% CaCO3, 6. 2.5% CaCO3  
7. 7.5% CaCO3 | 1. 5 mL of 2.5% NaClO for 1 min  
2. 17% EDTA + 2.5% NaClO each 5 mL for 1 min  
3. 3 mL of 7% MA for 45 sec + 5 mL of 2.5% NaClO for 1 min  
4. 2% CHX gel for 1 min  
5. 5.7% Ethanol for 1 min  
6. Polyacrylic acid for 30 sec | 1. 1.5 mL of 2.5% NaClO  
2. 5 mL of 17% EDTA  
3. 2 drops (ca. 0.25 mL of 26% PAA)  
4. 4. 5 mL of 17% EDTA + 5 mL of 2.5% NaClO. Final rinse 15 mL of distilled water for all groups |
|---|---|---|---|---|---|---|---|
| Time and storage after post cementation | 1. 100% humidity  
2. 37 °C  
3. 3 day | 1. 100% humidity  
2. 2.7 days | 1. 37 °C  
2. 2 days | 1. 100% humidity  
2. 37 °C  
3. 7 days | 1. 100% humidity  
2. 37 °C  
3. 24 hour | 1. 100% humidity  
2. 37 °C  
3. 7 days | 1. 100% humidity  
2. 37 °C  
3. 7 days |
| Analysis of teeth | Push-out test at 0.5 min ended root length  
Push-out test at 1 min applied root cement third  
Push-out test at 0.5 min applied to apical and cervical parts  
Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min applied to root thirds | Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min applied to root thirds | Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min ended root length  
Push-out test at 0.5 min ended root length | Push-out test at 0.5 min applied to root thirds | Push-out test at 0.5 min applied to root thirds | Push-out test at 0.5 min applied to root thirds | Push-out test at 0.5 min applied to root thirds |

One of these studies, both of which used 2.5% and 5% respectively, were found among root thirds [25]. OMK. One study showed that, 5 mL of OMK significantly increased bond strength compared to the control group [20].

Calcium hypochlorite (CaClO). CaClO was used in two of the included studies, both of which used 2.5% and 5% respectively. One study used 5 mL of CaClO for one minute, while another study did not mention the time used for CaClO.

Polyacrylic acid (PAA). Four studies included polyacrylic acid (PAA) in one of the experimental groups [22,25-27]. In one study, PAA was used to increase bond strength in six studies [26]. In one study, PAA + CHX was used to increase bond strength in six studies [27]. However, no significant differences were found between PAA + CHX and control groups [22,25-27]. It was not enough evidence to arrive at any conclusion regarding PAA solutions and their effect on bond strength of self-adhesive resin cement and its effect on bond strength of cement to root dentin [27]. PAA did not change bond strength compared to control groups [22,26,27]. In one study it decreased bond strength when MCE cement was used [27], but it was not signifi- cantly different from the control group in the other three studies.

In two studies there was a significant increase in bond strength when Relyx U200 cement was used [27], but it was not signifi- cantly different from the control group in the other three studies. There was not enough evidence to arrive at any conclusion regarding PAA solution and its effect on bond strength of cement to root dentin. CHX solution and its effect on bond strength of cement to root dentin was not enough evidence to arrive at any conclusion regarding PAA solution and its effect on bond strength of cement to root dentin [27].
Table 2. Risk of bias of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Were teeth assigned to groups truly randomly?</th>
<th>Were participants blinded to teeth treatment assignment?</th>
<th>Were the assignment of teeth to treatment groups blinded from the assignor?</th>
<th>Were the outcomes of people who withdrew described and included in the analysis?</th>
<th>Was the outcome assessors blind to treatment assignment?</th>
<th>Were all the groups comparable at baseline?</th>
<th>Were the groups treated the same other than the intervention of interest?</th>
<th>Were the outcomes evaluated the same way for all the groups?</th>
<th>Were the outcomes evaluated in right way?</th>
<th>Was an appropriate statistical analysis done?</th>
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<tbody>
<tr>
<td>Kul et al., 2016</td>
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<td>Garcia et al., 2018</td>
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<td>Alkhudhair y et al., 2018</td>
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<td>Elnaghy et al., 2013</td>
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<td>Faria-e-Silva et al., 2012</td>
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<td>Khouro ushi et al., 2019</td>
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<td>Fan et al., 2017</td>
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<tr>
<td>Crispim da Silveira. et al., 2014</td>
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<td>Jitumori. et al., 2019</td>
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<td>Suzuki et al., 2019</td>
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</table>

**Conclusion:**

- All of the studies included in the review were assessed for risk of bias. The results are summarized in Table 2.
- The studies were assessed for the following criteria:
  - Whether teeth were assigned to groups randomly.
  - Whether participants were blinded to teeth treatment assignment.
  - Whether the assignment of teeth to treatment groups was blinded from the assignor.
  - Whether the outcomes of people who withdrew were described and included in the analysis.
  - Whether the outcome assessors were blind to treatment assignment.
  - Whether all the groups were comparable at baseline.
  - Whether the groups were treated the same other than the intervention of interest.
  - Whether the outcomes were evaluated the same way for all the groups.
  - Whether the outcomes were evaluated in right way.
  - Whether an appropriate statistical analysis was done.
- The studies were evaluated against the criteria and each criterion was assigned a + or - based on whether the criterion was met or not.
- The overall risk of bias for each study was determined based on the criteria.

**Risk of bias within studies:**

- **CaClO used:** Not mentioned in duration and amount of CaClO used. Seballos study showed that CaClO reduced bond strength compared to the control group.
- **Phosphoric acid:** One study used 35% phosphoric acid for 15 seconds followed by a rinse of 15 mL of distilled water. Study showed that no statistically different result was found between Phosphoric acid and control groups.
- **Silver nanoparticles:** Thais Y. U. et al. used 23 ppm silver nanoparticles dispersion which increased bond strength and control group.
- **Bond strength in other root thirds:** For Maxcem Elite cement in middle root third, bond strength decreased for third, decreased for third, decreased for third, decreased for third, decreased for third, decreased for third, decreased for third, decreased for third.
- **Risk of bias summary:** The results of the studies are presented in the table above. The total risk of bias for each study is shown in the last column of the table.

**Table 2:** Risk of bias of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Risk of Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kul et al., 2016</td>
<td>-</td>
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<tr>
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**Total:** 5 6 5 6 5 5 6 6 6 6 6 6
sessed for the risk of bias (Table 2). The overall methodologic quality of studies was moderate. Four studies scored total five points [17,19,21,22], seven studies - six points [18,20,23-27]. In three of the studies, the assignment to groups either was not truly random, or not clear [17,21,2]. The nature of the studies did not allow for participants to be blinded to treatment allocation in any of the included studies. One study did not have a control group [19]. Those who were assessing the outcomes were not blinded to treatment allocation and allocation to treatment groups were not concealed from the allocator in any of the included studies.

Discussion

This aim of this systematic review was to evaluate the influence of irrigation solutions on the bond strength of self-adhesive resin cement to root dentin. It is important to understand the effect of irrigation solutions on the bond strength of self-adhesive resin cement to root dentin because irrigants described in this review are periodically used in everyday clinical practice. There was a heterogeneity in the study because of different methodologies of the articles evaluated which did not allow to do a meta-analysis, nevertheless some important conclusions could be made from the outcomes.

70% ethanol, Qmix, 5% CaClO, 35% Phosphoric acid, 23 ppm silver nanoparticles, 2,5% NaClO/7% Maleic acid and 17 % EDTA/2% CHX were evaluated in single studies and they all significantly increased the bond strength of self-adhesive resin cement to root dentin. However, moderate methodologic quality of all studies and not enough of studies that evaluate mentioned irrigants and their effect on the bond strength of self-adhesive resin cement to root dentin. Moreover, a single participant must perform all procedures in canal while the push-out test should be done by the other operator who is blinded to experimental groups.

In studies that evaluated NaClO, EDTA, CHX, PAA irrigants and their combinations methodologies varied. These studies used different type of teeth, concentrations, amount, volume of irrigants, cements, post, sealers, type of instruments for canal preparation and post preparation. Therefore, there was conflicting evidence in the results, and no evidence was found for the irrigation solutions effecting bond strength of self-adhesive resin cement to root dentin. For this reason, push-out test values are incomparable and have not been discussed. It is offered to that the methods of testing must be standardized to allow comparison of data and provide clinical recommendations.

Despite the restrictions of this review mentioned above this review has other restrictions too. One of them is this review includes in vitro studies, which gives less reliable results than randomized-control studies, nevertheless well-done and designed in vitro studies can also give favorable results. Another restriction is that in none of the studies operators who were assessing the outcomes were blinded to treatment allocation. Allocation to treatment groups were not concealed from the allocator in any of the studies and that increased risk of bias of the included studies.

Based on this review, that the papers evaluating irrigation solutions and their effect on bond strength of self-adhesive resin cement to root dentin should report following details: randomization of specimens, standardized protocol: root canal preparation methods and materials, duration of irrigation procedure, concentration and volume of irrigants, storage methods, posts and cements used, blinding of evaluator. Furthermore, a single participant must perform all procedures in canal while the push-out test should be done by the other operator who is blinded to experimental groups.

Conclusion

The results of this systematic review demonstrated the lack of standardization in both the method and the reporting of data on effect of irrigation solutions on bond strength of self-adhesive resin cement to root dentin. It is impossible to conclude recommendations to a specific irrigation protocol. Future studies should follow a standardization approach to implementation, same methodologies and reporting of data.

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buvo panaudotas duomenų, iš atrinktų publikacijų, surašymui. Dvi elektroninės duomenų bazės (PubMed, Ovid (MEDLINE)) buvo panaudotos straipsnių paiešką ir atrinkimui. Straipsnių atranką ir atrinktų publikacijų metodologinės kokybės vertinimą atliko du ne-priklausomi tyrėjai. Į mokslinės literatūros sisteminę analizę viso buvo įtraukta 11 įtraukimo kriterijus atitinkančių publikacijų. Dėl skirtingų tyrimo metodų, pateiktų publikacijose, metaanalizės atlikti buvo neįmanoma. Skirtingos tyrimų metodikos, rezultatai ir nevienodos pateiktos išvados atrinktose publikacijose neleido sudaryti tikslių išvadų apie skirtingų irigacinių tirpalų efektą stiklo pluoštų, cementuojamų savaiminio ėsdinimo derviniais cementais, retencijai. Dėl šios priežasties nėra galima pateikti klinikinių rek- homendacijų irigacijos protokolui. Tolimesnės studijos, turinčios standartizuotą tyrimo metodą, vienodą rezultatų pateikimą, reikalingos atlikti ateityje. Pateiktos rekomendacijos tokių studijų metodikų suvienodinimui ir klinikinių rekomendacijų pateikimui. Adresas susirašinėti: egle.sadz@gmail.com

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