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SYSTEMATIC REVIEW

Evaluation of the Effect of the Intensity and Occurrence of Postoperative Pain of Resin-Based and Bioceramic Root Canal Sealers: A Systematic Review and Meta-Analysis of Randomized Controlled Trial Studies

Samira Jamali[1], Maryam Darvish[2], Navid Nasrabadi[3], Sara Jafarizadeh[4]

[1]Department of Endodontics, Stomatological Hospital, College of Stomatology, Xi'an Jiaotong University, Shaanxi 710004, PR China.
[2]Department of Endodontics, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran.
[3]Department of Endodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[4]School of Dentistry, Islamic Azad University, Tabriz Branch, Tabriz, Iran.

Correspondence: Samira Jamali, Department of Endodontics, Stomatological Hospital, College of Stomatology, Xi'an Jiaotong University, Shaanxi 710004, PR China. **E-mail:** samira.jamali90@yahoo.com

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ABSTRACT

Objective: To evaluate resin- and bioceramic root canal sealers affect postoperative intensity and pain occurrence. **Material and Methods:** From the electronic databases, PubMed, Cochrane Library, Embase, ISI have been used to perform systematic literature until September 2020. Electronic titles were managed using the Endnote X8 software. They performed searches with mesh terms. Two reviewers blindly and independently extracted data from studies that included data for data extraction. **Results:** A total of 186 potentially relevant titles and abstracts were found. Finally, four studies were included. Pain score was (RR = -0.20; 95% CI -1.09–0.68; p= 0.65). This result showed no statistically significant difference for the resin-based and bioceramic root canal sealers after 24 hours between the VAS scores. **Conclusion:** Postoperative pain was low in Patients requiring root canal retreatment and obturated with resin-based or bioceramic-based sealers without extrusion beyond the apex. No differences were observed between postoperative pain in resin-based and bioceramic root canal sealers 24 and 48 hours postoperatively.

Keywords: Endodontics; Root Canal Filling Materials; Pain, Postoperative.

Introduction

Studies have shown that endodontic postoperative pain between 3 to 58 % [1-3]. Pain may occur in periodontal tissues after mechanical, chemical, and microbiological injuries [4]. There are various parameters in treatment that can cause postoperative pain. One of these parameters is including working length (WL). Also, the number of visits, selection of instruments, and the selection of root canal sealers are other related parameters [5-7].

Sealers placed in the root canals and interact with the periodontal tissues through the apical perforation, lateral canals, or leaching can affect the periodontium's healing process. As a result, postoperative pain is caused by local inflammation of the root canal [8].

Bioceramic materials can help endodontic treatment by releasing biologically active substances and promoting odontoblasts' differentiation [9-12]. In vitro studies have shown that bioceramic materials were less cytotoxic than resin-based materials [13-16]. Other studies have also shown that resin-based have stronger bonding capacity and higher radiopacity than bioceramic materials [17,18]. Graunaite et al. [19], in a split-mouth randomized controlled trial, showed resin-based sealer (AH Plus) and Total Fill had a similar occurrence and intensity of postoperative pain.

Given that the exact results are not noticeable, and a systematic review and meta-analysis studies have not been performed in this field, the researcher decided to review the results of RCT studies; the aim of this study is to evaluate the effect of resin-based and bioceramic root canal sealers on postoperative pain intensity and occurrence.

Material and Methods

Search Strategy

From the electronic databases, PubMed, Cochrane Library, Embase, ISI have been used to perform systematic literature over the last five years between 2015 to September 2020. Endnote X8 software was used to manage electronic titles. Searches were performed using mesh terms: ("Dental Pulp Cavity"[Mesh] OR "Root Canal Therapy"[Mesh] OR "Root Canal Filling Materials"[Mesh]) OR "Endodontics"[Mesh]) AND "iRoot BP Plus" [Supplementary Concept]) AND "epoxy resin-based root canal sealer" [Supplementary Concept]) AND "Pain, Postoperative"[Mesh].

This study is based on the Systematic Review and Meta-Analysis (PRISMA) Statement-Preferred Reporting Items [20] and the PICO or PECO Strategy (Table1).

Table 1. PICO OR PECO strategy.

PICO OR PECO Strategy	Description
P	Population/ Patient: Patients requiring root canal retreatment
E	Exposure/ Intervention: Resin-based sealer (AH Plus) / Total Fill BC
C	Comparison: AH Plus vs. Bioceramic-based sealers
O	Outcome: Postoperative Pain Scores

Selection Criteria

The following inclusion criteria were adopted: 1) Randomized controlled trial studies, controlled clinical trials, and prospective and retrospective cohort studies; 2) Used AH Plus; 3) Used bioceramic root canal sealers; 4) Patients requiring root canal retreatment; 5) VAS scale; and 6) In English.

Regarding the exclusion criteria, the following were established: 1) Periapical lesions; 2) Studies carried out in vitro, case reports, case studies, and reviews; and 3) Animal studies.

Data Extraction and Method of Analysis

The data were extracted from the research that included information about the study, years, study design, sample size, mean/ range of age, number of teeth, scale, root canal sealers, and follow-up period. The quality of the included studies has been evaluated using the tool of Cochrane Collaboration [21]. The scale scores for low risk were 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality. Two reviewers blinded and extracted data independently for data extraction of studies that included.

Moreover, the risk ratio between two groups (resin-based and bioceramic root canal sealers), the model for random effect and the method for restricted maximum likelihood (REML) were calculated with a 95% confidence interval (CI). Random effects were used to resolve the potential heterogeneity, and I^2 showed heterogeneity. Stata Statistical Software, V.16 (StataCorp LLC., TX, USA) was used in meta-analysis.

Results

According to the research design, 186 potentially important research abstracts and titles have been discovered in our electronic searches. In the first phase of the study selection, 156 research has been about the topics and abstracts. Therefore, we thoroughly assessed the complete full-text papers of the rest 28 studies in the second stage to exclude 24 publications due to the lack of the defined inclusion criteria. Then, four papers remained in agreement with our inclusion criteria required (Figure 1).

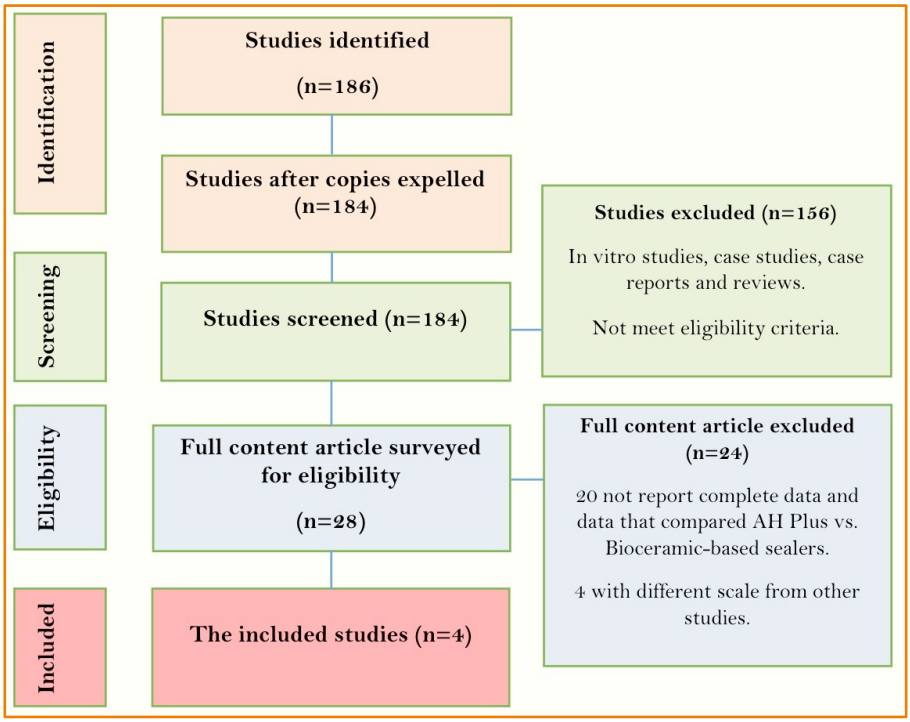

Figure 1. Study Attrition.

Sample Size

Therefore, four studies (randomized controlled trials) have been included. The number of patients a total was 121. The mean age was 42.6 years. The number of teeth a total was 276. Per patient received a visual analog scale (VAS) in all studies to record pain intensity 24 hours, 48 hours, 72 hours, and seven days after treatment (Table 2).

Table 2. Studies selected for systematic review and meta-analysis.

Study	Design	No. of Patients		Age* (Mean)	No. of Teeth	Scale	Root Canal Sealers	Follow-up
		Male	Female					
Ferreira et al. [22]	RCT	17	40	41	60	VAS	AH Plus, MTA Fillapex, and EndoFill	24 h, 48 h, and 7 days
Fonseca et al. [23]	RCT	26	38	38	64	VAS	AH Plus and Premixed Sealer + BC	24 h, 48 h, and 7 days
Graunaite et al. [7]	RCT	25	36	49.5	122	VAS	AH Plus Gutta-Percha Point, Total Fill Sealer and a Total Fill BC Point	24 h, 48 h, and 7 days
Paz et al. [24]	RCT	NA	30	NA	30	VAS	AH Plus and BioRoot	24 h, 48 h, and 7 days

*In Years; RCT: Randomized Controlled Trial; VAS: Visual Analog Scale; NA: No information provided by the authors.

Bias Assessment

According to Cochrane Collaboration's tool, two studies had a total score of 4/6, one study had a total score of 5/6, and one study had a total score of 6/6. This result showed a low bias risk in all studies and high quality (Table 3).

Table 3. Risk of bias assessment.

Study	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Total Score
Ferreira et al. [22]	+	+	+	+	+	?	5
Fonseca et al. [23]	+	+	?	+	+	?	4
Graunaite et al. [7]	+	+	+	+	+	+	6
Paz et al. [24]	+	+	+	-	+	?	4

Low (+); Unclear (?); High (-).

Pain Scores after 24 Hours

Pain score was (RR = -0.20; 95% CI -1.09–0.68; p= 0.65) among four studies and heterogeneity found (I^2 = 30.61%; p=0.19). This result showed that, after 24 hours, no statistically significant difference existed between the VAS scores for resin and bioceramic root canal sealers (p=0.65), and no statistically significant difference was observed between the studies (p=0.19) (Figure 2).

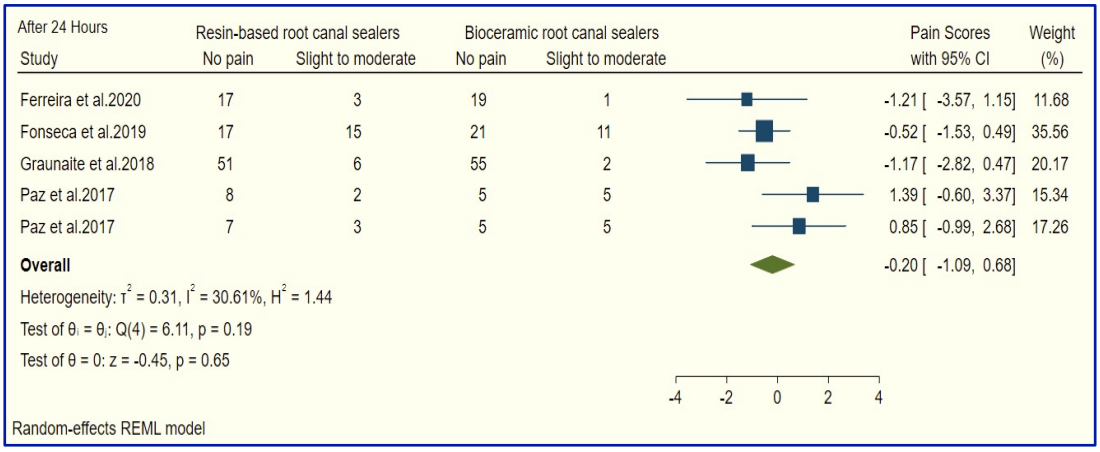

Figure 2. The forest plot showed postoperative pain after 24 hours.

Pain Scores after 48 Hours

Pain score was (RR = -0.10; 95% CI -1.44–1.23; p=0.88) among 4 studies and heterogeneity found (I^2 = 46.61%; p=0.12). This result showed that after 48 hours, no statistically significant difference was observed between the VAS scores for the resin and bioceramic root canal sealers (p=0.88) and no statistically significant difference was observed between the studies (p=0.19) (Figure 3).

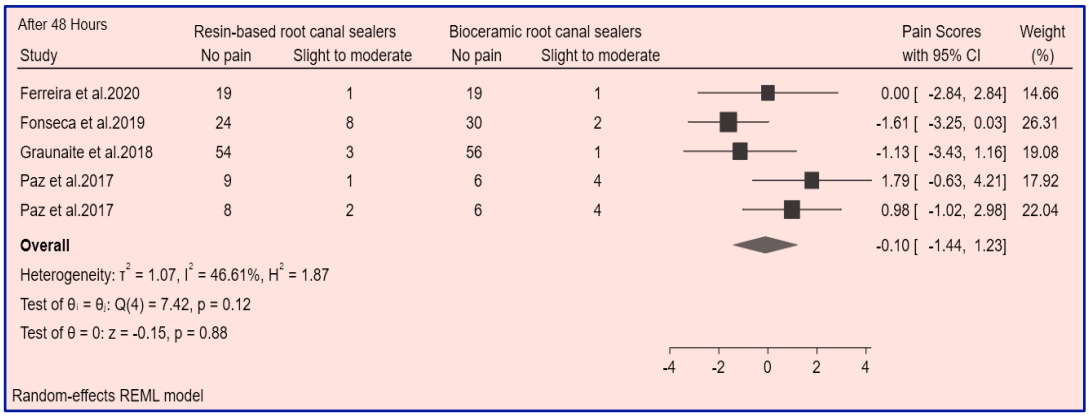

Figure 3. The forest plot showed postoperative pain after 48 hours.

Pain Scores after Seven Days

No pain or mild pain was reported in the studies after seven days.

Compared to Pain Scores after 24 and 48 Hours

Postoperative pain was felt more in the first 24 hours than after 48 hours, and the VAS score was higher after 24 hours *vs.* 48 hours.

Discussion

The local inflammatory response in periapical tissues causes postoperative pain in endodontics treatment [25,26]. In vivo studies have reported that reactive oxygen species can be directly associated with inflammatory pain [27]. If human pulp cells were treated in vitro with the root canal sealers, reactive oxygen species would increase from 4 to 7 times [28,29].

Resin-based AH Plus can also release toxic monomers such as diglicidyl ether bisphenol A, and the bioceramic sealer can have cytotoxic effects. But it should be noted that iRoot SP is less toxic than AH Plus [30,31]. Postoperative pain is triggered when the sealers' cytotoxicity implied contact with the periapical tissue. In gross overfilling cases, it can also be caused by the sealer [32,33].

No statistically significant difference in the present systematic review results and meta-analysis is shown in the postoperative pain observed at any of the points in time between the root canals obturated with resin-based and bioceramic sealers. It took 24 hours, 48 hours, 72 hours, and seven days to measure pain by 4 points. These time points have been used in studies to assess postoperative pain, as well as in vitro cytotoxicity tests [33]. Although differences between AH Plus and Total Fill have already been reported in vitro studies, no clinical differences have been observed. According to the present study results, the highest VAS score was reported 24 hours after surgery, which decreased after 48 hours. No pain was reported after seven days or was very mild. These results can be explained by the fact that to induce ROS formation, cytotoxic unpolymerized

root canal sealers can play a role in the first 24 hours. The amount of pain varies from 24 hours to 48 hours in studies, but almost all results are the same. The quality of the selected studies was high in the present study, so this study's results can be cited. However, low postoperative pain scores can also be explained by not being overfilled. In this case, more studies are needed to achieve better results. Resin-based and bioceramic root canal sealers on the intensity and occurrence of postoperative pain could help the results of the present study.

Conclusion

Postoperative pain was low in patients requiring root canal retreatment and obturated with resin-based or bioceramic-based sealers without extrusion beyond the apex. No differences were observed 24 and 48 hours postoperatively between postoperative pain in resin-based and bioceramic root canal sealers. This means that resin-based and bioceramic root canal sealers act the same in incidence and postoperative pain severity. It will also require randomized controlled trial studies comparing resin-based and bioceramic root canal sealers with high sample sizes and seven days.

Authors' Contributions

SJ	https://orcid.org/0000-0003-3803-1235	Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing, Visualization and Supervision.
MD	https://orcid.org/0000-0002-0622-4895	Writing - Original Draft and Writing - Review and Editing.
NN	https://orcid.org/0000-0002-6365-6619	Writing - Original Draft and Writing - Review and Editing.
SJ	https://orcid.org/0000-0001-5196-0296	Writing - Original Draft and Writing - Review and Editing.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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