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Post-operative pain after single-visit root canal treatment using resin-based and bioceramic sealers in teeth with apical periodontitis: A randomised controlled-trial

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Abstract

The present study aimed to compare postoperative pain in teeth with symptomatic and asymptomatic apical periodontitis (AP) following a single-visit endodontic treatment using BioRoot™ RCS or AH Plus at 8 h, 24 h and 48 h postoperatively. Postgraduate students performed endodontic treatment on 101 teeth with AP, randomised into two obturation groups. A 100-mm Visual Analog Scale was used to document the intensity of pain at preoperative, 8-h, 24-h and 48-h intervals. The Kolmogorov–Smirnov test was used for normality, and the median and interquartile ranges were compared using the Mann–Whitney U test. Preoperative pain (1.90 ± 3.50) was more frequent in teeth with symptomatic AP ($p < 0.05$). However, no significant differences were observed in postoperative pain at the 8-h, 24-h and 48-h intervals. Pre and postoperative pain were directly associated ($p < 0.05$). Single-visit root canal treatment in teeth with AP using both sealers resulted in similar levels of postoperative pain.

KEYWORDS

pain measurement, pain postoperative, periapical periodontitis, randomised controlled trial, root canal filling materials, tricalcium silicate

INTRODUCTION

The endodontic treatment aims to clean and shape the root canal space and remove all organic tissues, following a comprehensive filling with adequate obturating materials to ensure a proper sealing. Adequate obturation of the root canal space avoids the exchange of microorganisms that could hamper treatment success [1]. An inadequate apical seal has been found to cause 58% of root canal treatment failures [2]. However, a complete cleaning, shaping and satisfactory obturation are not always achievable, even when meeting all treatment success criteria, which, due to the multifactorial nature of this treatment, can still result in the persistence of a periapical lesion/periodontitis or an occurrence of a new lesion/pathosis [3].

Gutta-percha cones have long been used as the main root canal filling material; however, this material does not adhere to dentinal walls [4]. Thus, gutta-percha is only used as a core material, leaving root canal sealers responsible for sealing through adhesion to dentin, which remains the weakest link in obturation [5]. Epoxy resin-based cement appears to adhere satisfactorily to dentin. However, it has been reported that resin-based cement AH Plus expands during its setting phase, which may compensate for the shrinkage suffered after resin polymerisation [6]. An ideal root canal sealer should be biocompatible and tolerated well by the periapical tissues. Nevertheless, endodontic sealers have been shown to exert some cytotoxicity when freshly mixed, although this decreases considerably at the final setting [7]. AH Plus sealer (Dentsply

Maillefer, Ballaigues, Switzerland), an epoxy resin sealer widely used in dental research and daily clinical practice, has been found to release monomers such as Bis-GMA or bisphenol A diglycidylether, which, if exposed to the periapical tissues, can lead to a delay of the healing process [8].

Calcium silicate-based sealers have demonstrated exceptional chemical and biological properties in in-vitro conditions [9]. Compared to resin-based AH Plus sealer, bioceramic sealers have exhibited better cytocompatibility and odontoblastic differentiation [10]. Unlike epoxy resin sealers, which tend to shrink during setting, bioceramic sealers can expand up to 0.2% within the root canal space [11]. Sealer expansion can help generate a fluid-tight seal between the gutta-percha and the dentin walls all over the root canal space and at the apical end, sealing the root canal from the periapical tissues. Moreover, bioceramic sealers have antimicrobial properties, elevated alkalinity and the ability to set in moist conditions [11].

BioRoot™ RCS (Septodont, Saint Maur Des Fosses, France) is a calcium silicate-based sealer that is recommended for use with a single-cone obturation technique to avoid changes in its properties, as when it is heated, it loses weight, decreases in flowability and increases in viscosity [12]. Moreover, when a single-cone technique is used, the proprieties of bioceramic sealers can be advantageous in overcoming the inadequate seal achieved using a resin-based sealer with this obturation technique [13]. This could explain the increased popularity of bioceramic sealers among clinicians in recent years. Notwithstanding, some concerns still need to be addressed over the low radiopacity of some of these sealers and the limited data on their clinical outcomes [14].

Root canal preparation and obturation may induce unwanted periapical injury, which can initiate an inflammatory response, releasing bio-mediators associated with postoperative pain [15]. Despite the highest standards of care, postoperative pain of tolerable intensity is still common, with a maximum level of intensity between 24 and 48 h post-treatment [16].

Recent studies have found no differences in postoperative pain when comparing resin-based sealers to calcium silicate-based sealers [17, 18]. Ferreira et al. [18] found no significant differences between MTA Fillapex (Angelus, Londrina, Brazil) and AH Plus sealers in the occurrence and intensity of postoperative pain in cases diagnosed as pulp necrosis with asymptomatic apical periodontitis (AP). However, the authors included only symptom-free patients, and the treatments were performed in two visits. Similarly, Shim et al. [19] found no differences in postoperative pain after root canal treatment using either Endoseal MTA (Maruchi, Wonju, South Korea) or AH Plus sealers. However, they included teeth with vital or non-vital pulps and with or without AP, which may have influenced the study's findings.

To our knowledge, no study has evaluated postoperative pain following a single-visit endodontic treatment in teeth with AP using BioRoot™ RCS sealer. Therefore, the present study aimed to compare the single-visit endodontic treatment postoperative pain levels using a calcium silicate-based sealer (BioRoot™ RCS) or a resin-based sealer (AH Plus) at 8 h, 24 h and 48 h postoperatively. The null hypothesis was that there would not be differences in postoperative pain after root canal treatment using the two different sealers tested.

MATERIALS AND METHODS

Study design and setting

The present study was a parallel randomized controlled trial conducted at the Dental Clinic of Universitat Internacional de Catalunya (UIC) following PRIRATE (Preferred Reporting Items for Randomized Trials in Endodontic) guidelines. The study protocol was approved by the University Ethics Committee (ENDECL201703) and was registered at ClinicalTrials.gov (NCT04528979).

Case selection/participants

Patients over 18 years old who were referred to the Endodontic Master's students at the University Clinic with the following inclusion/exclusion criteria were selected:

Inclusion criteria

- Patients willing to participate voluntarily signed the informed consent.
- Only one tooth per patient was included.
- Patients requiring non-surgical root canal treatment of a mono- or bi-radicular tooth diagnosed with pulp necrosis and AP.
- Patients with no relevant oral abnormalities.
- Patients with no systemic diseases such as uncontrolled diabetes or are immunocompromised.

Exclusion criteria

- Teeth needing additional treatment, such as crown lengthening to ensure restorability.
- Teeth with a periodontal probing depth of more than 5 mm.

- Teeth with cracks, root fractures or root resorptions.
- Teeth not completely treated in a single visit or had complications such as perforation or instrument separation during treatment.
- Pregnant women.

Variables and data measurements

- Demographic data (age and sex).
- Tooth type (incisor, canine and premolar).
- Postoperative pain (measured with a Visual Analog Scale 100 mm line).

Sample size

The sample size was calculated based on postoperative pain data reported by Graunaite et al. [20] in the AH Plus group after 48 h. Assuming their standard deviation of 6.89 and an alpha risk and beta risk of 0.05 and 0.10, respectively, the calculated sample obtained was 40 patients in each group. Given an estimated 20% loss due to erroneous or loss of data, the final total sample size was 100 patients (50 per group).

Procedure

Endodontic postgraduate students performed root canal treatments in a single visit. Demographic data and those related to each tooth, such as the number of roots, pulp and periapical diagnosis and probing depths, were recorded on a data collection form. In addition, preoperative pain was recorded as a subjective experience of pain intensity on a Visual Analog Scale (VAS) [21]. The patients were divided into two groups at random according to the sealer used following a randomised computer-generated sequence Study Randomizer (Phase Locked Software, Wageningen, The Netherlands). All participants were blinded to the treatment throughout.

A preoperative periapical radiograph was shot with a digital radiovisiograph (RVG) (Kodak 5200/6200; Kodak, Carestream Health, Rochester, NY, USA) using the paralleling technique and an x-ray positioner (Dentsply Rinn, Elgin, IL) with an X-ray beam (Heliodent DS, Sirona Dental Systems, LLC, Charlotte, NC) operating at 60 kV and 7 mA with an exposure time of 0.12 s. Local anaesthesia of 4% articaine hydrochloride and 1:100000 epinephrine was used. Each procedure was performed under rubber dam isolation and magnification (loupes or dental operating microscope).

A high-speed handpiece with a round bur was used to remove carious tissue and defective restorations. Before the access cavity, if needed, a pre-endo composite build-up was made using Automatrix (Dentsply Maillefer, TUL) or matrix bands. The working length was determined using the 0.5 reference of an electronic apex locator (Root ZX II; J Morita, Irvine, CA) and confirmed with a periapical radiograph. Reciprocating instruments (Reciproc; VDW, Munich, Germany) were used to shape the root canals that were abundantly irrigated with 4.25% sodium hypochlorite and a 27-gauge or 30-gauge side-vented needle. Profile rotary instruments (Dentsply Maillefer, TUL) were used for final apical enlargement until a preparation size according to the largest file that reached the working length during the apical gauging procedure with K-Files. Final irrigation consisted of activating 4.25% sodium hypochlorite, 10% citric acid and ethanol in each canal for 2 min with an EndoActivator (Dentsply Sirona, York, PA). The root canals were then dried using paper points (Coltene, Langenau, Germany). A periapical radiograph was used to confirm cone fit. The root canals were obturated with a calibrated master gutta-percha cone (Autofit, Analitic, SybronEndo, Orange, CA) according to the type of obturation group. A single master cone technique was used for the BioRoot™ RCS sealer group, and a warm gutta-percha technique for the AH Plus resin cement group. Excess gutta-percha was removed using an Endo Z bur (Dentsply Maillefer, TUL). Coronal sealing was performed with an adhesive and flowable composite (Tetric; IvoclarVivadent AG, Schaan, Liechtenstein). The direct final restoration with composite (Tetric; IvoclarVivadent AG, Schaan, Liechtenstein) was carried out either in the same or a subsequent visit.

Each patient was given a VAS form and asked to rate their level of pain before the treatment, and at 8 h, 24 h and 48 h post-treatment. Ibuprofen 600 mg was prescribed every 8 h if necessary, and the patients recorded the dose and frequency on the VAS form.

Data collection and evaluation

All patients were scheduled for a control visit and asked to deliver the completed form after 2 weeks. Data were registered on a spreadsheet, and the numerical values were then converted into a 0–10 scale corresponding to qualitative values as follows: no pain (0), slight pain (0.1–3.9), moderate pain (4–6.9), and severe pain (7–10).

Statistical and data analysis

Data were compiled and analysed using SPSS software (V23; IBM Corp., Armonk, NY). The Kolmogorov–Smirnov

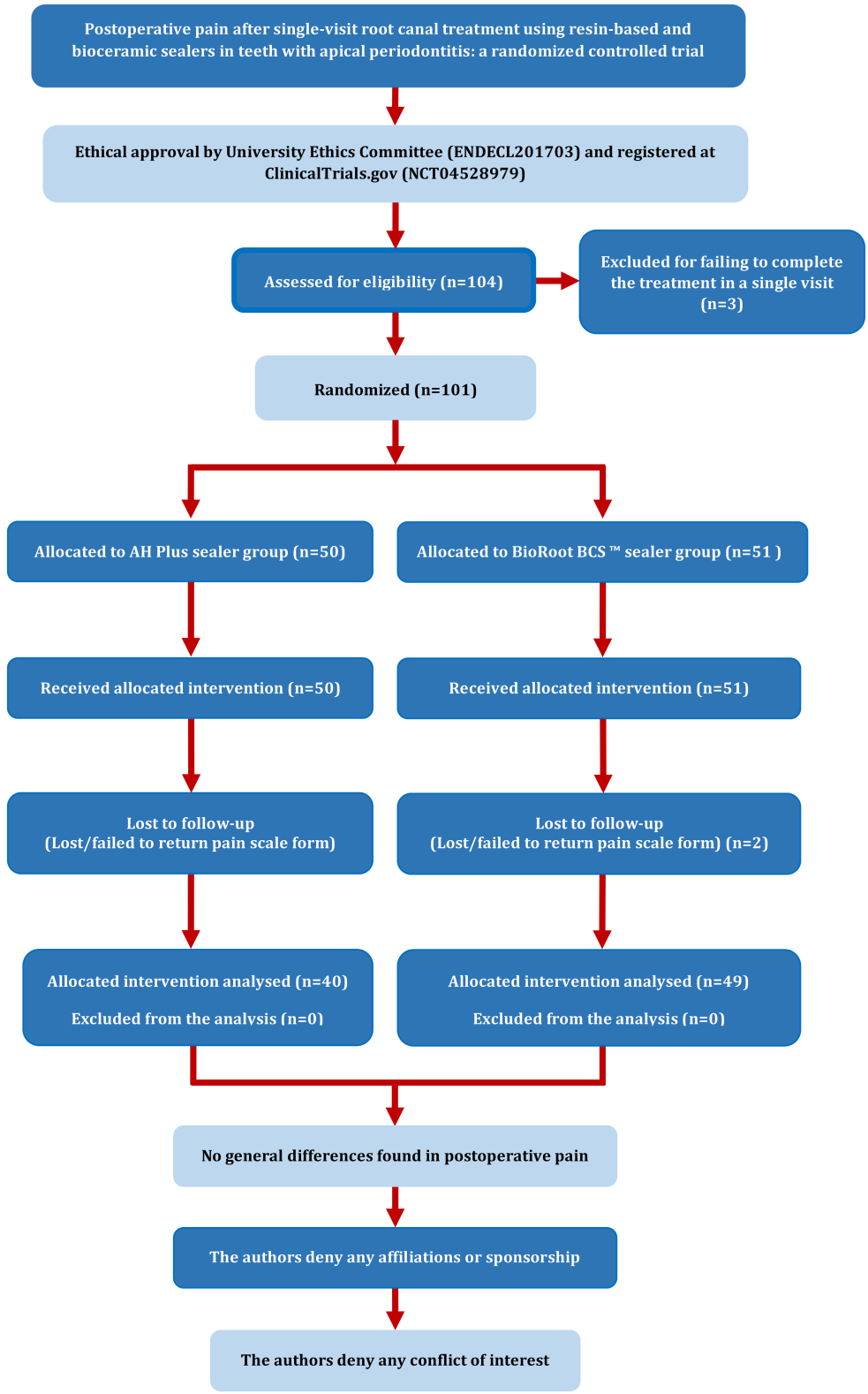

FIGURE 1 Flow diagram. *From[31] For further details, visit: http://pride-endodonticguidelines.org/prirate/

test was used to assess normality of the data. Population-based data and tooth features were represented using frequency and percentage. Pain scores were expressed using median and IQR, and the Mann–Whitney *U* test was used to compare VAS scores. The level of significance was set to 5%.

RESULTS

Of the 104 patients (101 root canal treatments) who met the inclusion criteria, 3 were excluded for failing to complete the treatment in a single visit. From the 101 patients included for randomisation and allocated to intervention, 12 were excluded for failing to return with the postoperative VAS form. Thus, 89 patients that completed the postoperative VAS form (49 in the BioRoot™ RCS group and 40 in the AH Plus group) were included for data analysis (Figure 1) [22].

No differences were found in the distribution of the groups based on the demographic and clinical variables (Table 1) except for preoperative pain levels; patients in the BioRoot™ RCS group reported higher preoperative pain levels than those in the AH Plus group ($p < 0.05$) (Table 2).

Forty-eight patients (53.93%) reported having preoperative pain. The patients with a treated bi-radicular tooth (2.00 ± 3.1) (Table 3) experienced preoperative pain more frequently than the patients with mono-radicular teeth ($p < 0.05$). No differences were found regarding sex, dental arch or type of sealer in preoperative pain levels ($p > 0.05$) (Table 3). However, a positive correlation was observed between the presence of preoperative pain and postoperative pain in all intervals ($p < 0.05$).

In general, levels of postoperative pain were very low (no pain—slight pain). Eight patients in the BCS group and eleven in the AH Plus group reported taking Ibuprofen 600 mg for pain control ($p > 0.05$). No differences were found regarding the other evaluated variables ($p > 0.05$). Two teeth in the BCS group and teeth in the AH Plus group resulted having unintentional sealer extrusion; however, no differences were found regarding their postoperative pain intensity ($p > 0.05$).

Thirty (33.70%) and fifteen patients (16.58%) reported some levels of postoperative pain up to 8 and 24 h, respectively (Table 2). Only eight patients (8.98%) experienced pain up to 48 h post-treatment. There were no differences in postoperative pain levels at 8, 24 and 48 h regarding all variables ($p > 0.05$). A comparison of post-treatment pain levels (reduction or increase) in both groups is displayed in Figure 2 ($p > 0.05$). No significant differences in postoperative pain were found concerning the type of sealer used (Table 4).

DISCUSSION

The present study aimed to compare the pain levels after a single-visit root canal procedure using a calcium silicate-based (BioRoot™ RCS) with a resin-based (AH plus) sealer. There were no differences in postoperative pain levels after root canal treatment using the two different sealers tested, indicating that the null hypothesis was not rejected ($p > 0.05$).

Huskinsson's VAS [21], represented by a 10-cm-long line, was used in the present study. It is the most commonly used method to evaluate pre- and postoperative pain, with many studies confirming its reliability and simplicity [19–21, 23]. Although more technology-based scales, such as eVAS (Interactive Clinics app, Bit Genoma Digital Solutions SL), have also been used, which presented reproducible and consistent to the VAS scale [24].

TABLE 1 Comparison of treatment mode according to different demographic and clinical variables.

Variable	Category	Total ($n = 89$)	AH plus ($n = 40$)	BCS ($n = 49$)	p Value
Age	18–30	11 (12.4)	5 (12.5)	6 (12.2)	0.974
	31–50	39 (43.8)	18 (45)	21 (42.9)	
	>50	39 (43.8)	17 (42.5)	22 (44.9)	
Sex	Male	50 (56.2)	20 (50)	30 (61.2)	0.391
	Female	39 (43.8)	20 (50)	19 (38.8)	
Tooth type	Max. anterior	37 (41.6)	17 (42.5)	20 (40.8)	0.865
	Max. Biradicular	19 (21.3)	7 (17.5)	12 (24.5)	
	Mnd. anterior	13 (14.6)	6 (15)	7 (14.3)	
	Mnd. biradicular	20 (22.5)	25 (10)	10 (20.4)	
Arch	Maxillary	56 (62.9)	24 (60)	32 (65.3)	0.663
	Mandibular	33 (37.1)	16 (40)	17 (34.7)	
Periapical diagnosis	Symptomatic AP	49 (55.1)	21 (52.5)	28 (57.1)	0.463
	Asymptomatic AP	40 (44.9)	19 (47.5)	21 (42.9)	

Abbreviation: BCS, Bioceramic sealer.

TABLE 2 Frequency and percentage of pain levels according to the different treatment groups.

Pre-op pain *n* (%)	Post-op pain *n* (%)		8 h	24 h	48 h
No pain 41 (46.1) AH Plus 21 (51.2) BCS 20 (48.8)	No pain	AH plus	17 (81)	17 (89)	19 (90.5)
		BCS	17 (85)	18 (90)	18 (90)
	Slight pain	AH plus	4 (19)	2 (9.5)	2 (9.5)
		BCS	1 (5)	1 (5)	1 (5)
	Moderate pain	AH plus	0	2 (9.5)	0
		BCS	1 (5)	0	0
	Severe pain	AH plus	0	0	1 (4.8)
		BCS	1 (5)	1 (5)	0
Slight 31 (34.8) AH Plus 16 (51.6) BCS 15 (48.4)	No pain	AH plus	8 (50)	13 (81.3)	16 (100)
		BCS	12 (80)	14 (93.3)	15 (100)
	Slight pain	AH plus	8 (50)	3 (18.8)	0
		BCS	3 (20)	1 (6.7)	0
	Moderate pain	AH plus	0	0	0
		BCS	0	0	0
	Severe pain	AH plus	0	0	0
		BCS	0	0	0
Moderate 15 (16.9) AH Plus 3 (20) BCS 12 (80)	No pain	AH plus	2 (66.7)	3 (100)	3 (100)
		BCS	3 (25)	8 (66.7)	9 (75)
	Slight pain	AH plus	0	0	0
		BCS	5 (41.7)	1 (8.3)	1 (8.3)
	Moderate pain	AH plus	1 (33.3)	0	0
		BCS	4 (33.3)	3 (25)	2 (16.7)
	Severe pain	AH plus	0	0	0
		BCS	0	0	0
Severe 2 (2.2) AH Plus 0 (0) BCS 2 (100)	No pain	AH plus	0	0	0
		BCS	0	1 (50)	1 (50)
	Slight pain	AH plus	0	0	0
		BCS	1 (50)	0	1 (50)
	Moderate pain	AH plus	0	0	0
		BCS	0	1 (50)	0
	Severe pain	AH plus	0	0	0
		BCS	1 (50)	0	0

Abbreviation: BCS, Bioceramic sealer.

However, the current study preferred the VAS scale for the ease of comparison and standardisation with previous research [21].

Experiencing postoperative pain following root canal treatment is not a rare occurrence and has been reported to range from 3% to 58% [25]. The substantial variability of the results could be attributed to inclusion criteria, the different methodologies used by authors to determine the pain intensity, or the different materials and techniques used [25]. Several factors have been associated with post-treatment pain, such as irrigation activation protocols, root canal instrumentation, working length determination control, or root canal obturation methods [25]. The presence of preoperative pain has also been identified as a strongly associated factor with postoperative pain [16, 23, 26]. Sadaf et al. [27] found that 83.3% of patients experiencing preoperative pain also felt some postoperative pain. Similarly, in a systematic review, Shibu et al. [28] also found a positive correlation between pre- and postoperative pain. This correlation could be justified by the fact that patients with preoperative pain typically have an inflamed periapical area, which may become secondarily irritated during treatment, resulting in postoperative pain [29]. In the present study, despite the unequal

TABLE 3 Comparison of median pain scores (Median ± IQR) according to different demographic and clinical variables.

Interval	Gender		Tooth type		Arch		Pulp diagnosis		Periapical diagnosis		Sealer	
	Male $n=50$	Female $n=39$	Front $n=50$	Birad $n=39$	Upper $n=56$	Lower $n=33$	Irreversible pulpitis	Necrotic pulp	Symptomatic $n=48$	Asymptomatic $n=40$	AH plus $n=40$	BCS $n=49$
Pre-operative	0.0 ± 2.8	1.0 ± 2.2	0.0 ± 1.93	2.00 ± 3.1	0.0 ± 2.2	1.9 ± 3.3	2.15 ± 2.53	0.00 ± 2.65	1.90 ± 3.50	0.0 ± 1.68	0.00 ± 2.15	1.00 ± 3.15
p Value	0.843		0.037[a]		0.106		0.065		0.001[a]		0.169	
After 8 hrs	0.0 ± 1.75	0.0 ± 2.0	0.0 ± 2.00	0.0 ± 1.5	0.0 ± 2.15	0.0 ± 1.10	0.00 ± 2.15	0.00 ± 1.60	0.0 ± 2.20	0.0 ± 1.20	0.00 ± 1.80	0.00 ± 2.00
p Value	0.461		0.655		0.258		0.524		0.084		0.540	
After 24 hrs	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.00 ± 0.0	0.00 ± 0.0
p Value	0.454		0.657		0.386		0.910		0.106		0.995	
After 48 h	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.00 ± 0.0	0.00 ± 0.00
p Value	0.701		0.739	0.493		0.319			0.214		0.219	

Abbreviation: BCS, Bioceramic sealer.

[a]Indicates significant difference at $p \leq 0.05$.

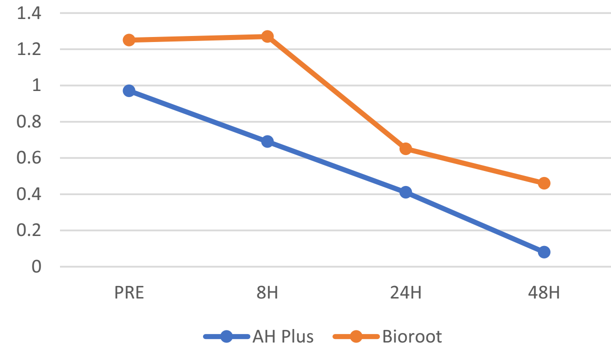

FIGURE 2 Pain reduction/increase comparison between groups.

distribution of patients with preoperative pain, patients in the BioRoot™ RCS group had more preoperative pain. However, the differences were not significant between the two groups. 53.93% of patients presenting with preoperative pain experienced some level of postoperative pain, although high levels of preoperative pain were not related to higher levels of postoperative pain, however some levels of discomfort were observed in such patients when compared to patients with no preoperative pain ($p > 0.05$).

Experiencing postoperative pain following root canal treatment is not a rare occurrence and has been reported to range from 3% to 58% [25]. The substantial variability of the results could be attributed to inclusion criteria, the different methodologies used by authors to determine the pain intensity, or the different materials and techniques used [25]. Several factors have been associated with post-treatment pain, such as irrigation activation protocols, root canal instrumentation, working length determination control, or root canal obturation methods [25]. The presence of preoperative pain has also been identified as a strongly associated factor with postoperative pain [16, 23, 27]. Sadaf et al. [27] found that 83.3% of patients experiencing preoperative pain also felt some postoperative pain. Similarly, in a systematic review, Shibu et al. [28] also found a positive correlation between pre- and post-operative pain. This correlation could be justified by the fact that patients with preoperative pain typically have an inflamed periapical area, which may become secondarily irritated during treatment, resulting in postoperative pain [29]. In the present study, despite the unequal distribution of patients with preoperative pain, patients in the BioRoot™ RCS group had more preoperative pain. However, the differences were not significant between the two groups. 53.93% of patients presenting with preoperative pain experienced some level of postoperative pain, although high levels of preoperative pain were not related to higher levels of postoperative pain, however some levels of discomfort were observed in such patients when compared to patients with no preoperative pain ($p > 0.05$).

TABLE 4 Median and Interquartile Range (IQR) values of pre- and postoperative pain according to periapical diagnosis in each group.

	Symptomatic AP			Asymptomatic AP		
Interval	**AH plus $n=20$**	**BCS $n=28$**	***p* Value**	**AH plus $n=19$**	**BCS $n=21$**	***p* Value**
Pre-operative	1.85 ± 3.20	3.55 ± 2.23	0.012[a]	0.00 ± 1.30	0.00 ± 0.75	0.768
Post-op 8 h	0.00 ± 1.68	0.00 ± 3.03	0.129	0.00 ± 2.00	0.00 ± 0.00	0.307
Post-op 24 h	0.00 ± 0.00	0.00 ± 0.68	0.551	0.00 ± 0.00	0.00 ± 0.00	0.573
Post-op 48 h	0.00 ± 0.00	0.00 ± 0.00	0.196	0.00 ± 0.00	0.00 ± 0.00	1.000

Abbreviation: BCS, Bioceramic sealer.

[a]Indicates significant difference at $p \leq 0.05$.

A single-visit endodontic treatment has been linked with superior patient compliance, shorter treatment time, lower cost, better scheduling and management, and comparable treatment outcomes [25]. To reduce possible confounding factors and to obtain more reliable results, all treatments were carried out in a single visit at the University clinic by endodontic postgraduate students under strict supervision, and only necrotic teeth with AP were included. Gotler et al. [30] found higher levels of postoperative pain in teeth diagnosed with irreversible pulpitis compared with necrotic teeth. In addition, only premolars and incisors were included, which also facilitated completing treatments in one visit [31]. Molar teeth have been associated with variable results regarding postoperative pain, especially when mandibular molars are compared with maxillary [28].

In the current study, a single master cone approach was used for teeth in the BCS group, while a warm gutta-percha technique was used for teeth in the AH Plus group. Our research found no significant differences in the occurrence of postoperative discomfort based on the obturation technique, which is consistent with the findings of the meta-analysis performed by Peng et al. [30]. Regarding the two sealers, similar results were found in a split-mouth randomised controlled trial comparing the resin-based with the calcium silicate-based sealers, that also showed no differences in postoperative pain levels [17].

In the present study, none of the teeth having unintentional sealer extrusion were related to significant postoperative pain ($p > 0.05$). Sadaf et al. [27] also found no significant differences in postoperative pain in cases with or without the extrusion of bioceramic sealers into the periapical tissues. This may be attributed to the findings of in vitro studies confirming that BioRoot™ RCS sealer is biocompatible, non-cytotoxic, bioactive, and preserves proliferation, migration and adhesion of dental pulp stem cells [10]. On the other hand, AH Plus sealer is cytotoxic when freshly mixed. However, it has also been found to be non-cytotoxic once set [10].

CONCLUSIONS

No difference was found in the levels of postoperative discomfort following a single-visit endodontic treatment of teeth with AP using a calcium silicate-based sealer (BioRoot™ RCS) when compared to a resin-based sealer (AH Plus) at 8 h, 24 h or 48 h post-treatment.

AUTHOR CONTRIBUTION

Tousif Iqbal Nathani: Investigation, Writing—original draft; Juan Gonzalo Olivieri: Conceptualisation, Methodology, Investigation, Writing—original draft—review & editing. Jordi Tomás: Writing—review & editing; Firas Elmsmari: Writing—review & editing; Francesc Abella: Writing—review & editing; Fernando Durán-Sindreu: Writing—review & editing.

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CONFLICT OF INTEREST STATEMENT

The authors deny any conflict of interest.

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REFERENCES

1. Kim S, Jung H, Kim S, Shin SJ, Kim E. The influence of an isthmus on the outcomes of surgically treated molars: a retrospective study. J Endod. 2016;42(7):1029–34.
2. Ingle J, Beveridge E, Glick D, Weichman J. Endodontic success & failure: the Washington study. Ingle JI Bakland LK Endodontics. 4th ed. Baltimore: Williams & Wilkins; 1994. p. 21–45.

3. Nair PNR, Sjögren U, Figdor D, Sundqvist G. Persistent periapical radiolucencies of root-filled human teeth, failed endodontic treatments, and periapical scars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999;87(5):617–27.
4. Skinner RL, Himel VT. The sealing ability of injection-molded thermoplasticized gutta-percha with and without the use of sealers. J Endod. 1987;13(7):315–7.
5. Kim YK, Grandini S, Ames JM, Gu LS, Kim SK, Pashley DH, et al. Critical review on methacrylate resin-based root canal sealers. J Endod. 2010;36(3):383–99.
6. Carvalho-Junior JR, Correr-Sobrinho L, Correr AB, Sinhoreti MA, Consani S, Sousa-Neto MD. Solubility and dimensional change after setting of root canal sealers: a proposal for smaller dimensions of test samples. J Endod. 2007;33(9):1110–6.
7. Langeland K. Root canal sealants and pastes. Dent Clin N Am. 1974;18(2):309–27.
8. Dahl JE. Toxicity of endodontic filling materials. Endod Top. 2005;12(1):39–43.
9. Camps J, Jeanneau C, El Ayachi I, Laurent P, About I. Bioactivity of a calcium silicate-based endodontic cement (BioRoot RCS): interactions with human periodontal ligament cells in vitro. J Endod. 2015;41(9):1469–73.
10. Jung S, Sielker S, Hanisch MR, Libricht V, Schäfer E, Dammaschke T. Cytotoxic effects of four different root canal sealers on human osteoblasts. PLoS One. 2018;13(3):e0194467.
11. Zhou HM, Shen Y, Zheng W, Li L, Zheng YF, Haapasalo M. Physical properties of 5 root canal sealers. J Endod. 2013;39(10):1281–6.
12. Aksel H, Makowka S, Bosaid F, Guardian MG, Sarkar D, Azim AA. Effect of heat application on the physical properties and chemical structure of calcium silicate-based sealers. Clin Oral Investig. 2021;25(5):2717–25.
13. De-Deus G, Coutinho-Filho T, Reis C, Murad C, Paciornik S. Polymicrobial leakage of four root canal sealers at two different thicknesses. J Endod. 2006;32(10):998–1001.
14. Reszka P, Grocholewicz K, Droździk A, Lipski M. Evaluation of the radiopacity of selected calcium-silicate root canal sealers. Pomeranian J Life Sci. 2019;64(4):17–24.
15. Hackel D, Pflücke D, Neumann A, Viebahn J, Mousa S, Wischmeyer E, et al. The connection of monocytes and reactive oxygen species in pain. PLoS One. 2013;8(5):e63564.
16. Ng YL, Glennon JP, Setchell DJ, Gulabivala K. Prevalence of and factors affecting post-obturation pain in patients undergoing root canal treatment. Int Endod J. 2004;37(6):381–91.
17. Graunaite I, Skucaite N, Lodiene G, Agentiene I, Machiulskiene V. Effect of resin-based and bioceramic root canal sealers on postoperative pain: a split-mouth randomized controlled trial. J Endod. 2018;44(5):689–93.
18. Ferreira N, de S, Gollo EKF, Boscato N, Arias A, da Silva EJNL. Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial. Braz Oral Res. 2020;34:e069.
19. Shim K, Jang YE, Kim Y. Comparison of the effects of a bioceramic and conventional resin-based sealers on postoperative pain after nonsurgical root canal treatment: a randomized controlled clinical study. Materials (Basel). 2021;14(10):2661.
20. Escalona-Marfil C, Coda A, Ruiz-Moreno J, Riu-Gispert LM, Gironès X. Validation of an electronic visual analog scale mHealth tool for acute pain assessment: prospective cross-sectional study. J Med Internet Res. 2020;22(2):e13468.
21. Huskisson EC. Measurement of Pain. Lancet. 1974;304(7889):1127–31.
22. Wong AWY, Zhang C, Chu CH. A systematic review of non-surgical single-visit versus multiple-visit endodontic treatment. Clin Cosmet Investig Dent. 2014;6:45–56.
23. Koçer A, Dönmez Özkan H, Turk T. Postoperative pain intensity and incidence following single visit root canal treatment with different obturation techniques: a randomized clinical trial. PeerJ. 2022;27(10):e13756.
24. Alí A, Olivieri JG, Duran-Sindreu F, Abella F, Roig M, García-Font M. Influence of preoperative pain intensity on postoperative pain after root canal treatment: a prospective clinical study. J Dent. 2016;45:39–42.
25. Sadaf D, Ahmad MZ. Factors associated with postoperative pain in endodontic therapy. Int J Biomed Sci. 2014;10(4):243–7.
26. Shibu TM. Post operative pain in endodontics: a systemic review. J Dent Oral Hyg. 2015;7(8):130–7.
27. Risso PA, Cunha AJLA, Araujo MCP, Luiz RR. Postobturation pain and associated factors in adolescent patients undergoing one- and two-visit root canal treatment. J Dent. 2008;36(11):928–34.
28. Gotler M, Bar-Gil B, Ashkenazi M. Postoperative pain after root canal treatment: a prospective cohort study. Int J Dent. 2012;2012:310467.
29. Kara Tuncer A, Gerek M. Effect of working length measurement by electronic apex locator or digital radiography on postoperative pain: a randomized clinical trial. J Endod. 2014;40(1):38–41.
30. Peng L, Ye L, Tan H, Zhou X. Outcome of root canal obturation by warm gutta-percha versus cold lateral condensation: a meta-analysis. J Endod. 2007;33(2):106–9.
31. Nagendrababu V, Duncan HF, Bjørndal L, Kvist T, Priya E, Jayaraman J, et al. PRIRATE 2020 guidelines for reporting randomized trials in Endodontics: a consensus-based development. Int Endod J. 2020;53(6):764–73.

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