Healing Rate and Post-obturation Pain of Single- versus Multiple-visit Endodontic Treatment for Infected Root Canals: A Systematic Review

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Abstract

Introduction: The choice of single- versus multiple-visit root canal treatment for infected teeth is in dispute. The purpose of this systematic review was to compare the healing rate and post-obturation pain of single- versus multiple-visit root canal treatment for teeth with infected root canals. **Methods:** An exhaustive literature search combined with specified inclusion criteria was performed to identify randomized or quasi-randomized controlled trials (RCTs or quasi-RCTs), comparing root canal treatment in single and multiple appointments (2 or more visits) in patients with infected root canals. **Results:** Ten RCTs were identified and included in this review. Of these, 6 compared the healing rate and 5 compared the prevalence of post-obturation pain in single- and multiple-visit root canal treatment on teeth with infected root canals. No significant difference was observed in the healing rate between single- versus multiple-visit root canal treatment, as well as the incidence of medium-term post-obturation pain. As to the short-term follow up, the prevalence of post-obturation pain was significantly lower in single-visit than in multiple-visit group. **Conclusions:** On the basis of current studies, the healing rate of single- and multiple-visit root canal treatment is similar for infected teeth. Patients experience less frequency of short-term post-obturation pain after single-visit than those having multiple-visit root canal treatment. *(J Endod 2011;37:125–132)*

Key Words

Infection, multiple-visit, post-obturation pain, root canal treatment, single-visit, systematic review

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Traditionally, root canal treatment or endodontic treatment was performed in multiple visits, with medication between root canal preparation and obturation, which mainly aims to reduce or eliminate microorganisms and their by-products from the root canal system before obturation. Multiple-visit root canal treatment is well-accepted as a safe and common therapy (1); however, in recent years, there is a growing concern about the necessity of multiple appointments in endodontic treatment because no significant differences in antimicrobial efficacies have been reported between the single- and multiple-visit treatments (2). Furthermore, the recent invention of rotary nickel-titanium systems and improvements in the understanding of irrigation dynamics and delivery systems have facilitated the mechanical instrumentation and disinfection of the root canal, which makes the single-appointment treatment more convenient than before. Along with other advantages including timesaving, cost-effectiveness, better patient acceptance, and reduction of the interappointment infection risks, single-visit root canal treatment has become an acceptable treatment regimen (3).

Outcome and complications are the most important factors to be considered when making treatment plans (4). Numerous studies evaluating the effectiveness and post-treatment pain of single- versus multiple-appointment root canal treatment have been published, which reported no significant differences in effectiveness (healing rates) and postoperative pain between these 2 treatment regimens (5–7). However, most of the previous systematic reviews focused primarily on comparing procedures without considering the pretreatment pulpal status (5,7). Many studies have demonstrated the association of pulpal and periapical status with the outcome of endodontic treatment (8–12). In their meta-analysis, Sathorn et al (6) evaluated the differences in healing rates between single- and multiple-visit root canal treatment for teeth with apical periodontitis; it seems premature to make conclusions because of their small sample size (only 146 teeth included). In case of nonvital pulp, the root canals are usually infected, especially in the presence of apical periodontitis. Effective control of intracanal microbial load before obturation is a key element that leads to a high success rate of root canal treatment (11–13). In vital pulps, aseptic conditions are maintained after instrumentation, and the primary focus of the endodontic procedure is to prevent iatrogenic infection of the root canal. Consequently, disinfection of root canals in these cases might not be needed for root canal in comparison to cases with infected pulps (14).

The purpose of this review was to investigate whether there was any detectable difference in therapeutic efficacies and post-obturation pain between single- and multiple-visit root canal treatments in teeth with infected root canals.

Materials and Methods

Literature Search

A computerized literature search was performed in MEDLINE (1966–2010), the Cochrane Library (issue 2, 2010), EMBASE (1984–2010), SCI (1995–2010), and CNKI (1982–2010). Randomized or quasi-randomized controlled trials (RCTs or quasi-RCTs) comparing root canal treatment in single and multiple appointments (2 or more visits) in patients with infected root canals were identified. The following MeSH terms were used in various combinations: endodontics, root canal therapy,

TABLE 1. Characteristics of Included Studies

Study	Sample size	Preoperative status of teeth	Intervention	Follow-up period	Raw data heal/total (single vs multiple)	Risk of bias
Studies concerning the healing results of single- versus multiple-visit treatment						
Molander 2007 (19)	94 patients with 101 teeth, 89 teeth were finally included in the analysis	Asymptomatic necrotic teeth with apical periodontitis	Single visit or 2 visits. Four operators. For the 2-visit group, root canals were placed with $Ca(OH)_2$ and access cavity was sealed with Coltosol for a week.	2 y	32/49 vs 30/40	Low
Penesis 2008 (18)	97 patients (1 tooth each), 63 teeth included in the final analysis	Necrotic teeth with apical periodontitis	Single visit or 2 visits. Second-year endodontic residents performed the treatment. In the 2-visit group, root canals were filled with paste made by mixing $Ca(OH)_2$ powder and 2% chlorhexidine liquid for 2–4 weeks.	1 y	22/33 vs 21/30	Low
Peters 2002 (20)	38 patients (1 tooth each), all were included in the final analysis	Asymptomatic teeth with periapical lesion	Single visit or 2 visits. Single operator. For the 2-visit group, root canals were dressed with $Ca(OH)_2$ and access cavity was filled with 2 layers of Cavit and glass ionomer restoration for 4 weeks.	4.5 y	17/21 vs 12/17	Moderate
Trope 1999 (22)	81 patients with 102 teeth (20 patients contributed more than 1 tooth.)	Teeth with periapical lesion	Single visit or 2 visits. One operator. In the 2-visit group, a dressing of $Ca(OH)_2$ was placed to remain for at least 1 week.	52 wk	14/22 vs 14/19	Moderate
Weiger 2000 (21)	73 patients (1 tooth each), 67 included in the final analysis	Teeth with pulpal necrosis and periapical lesion	Single visit or 2 visits. Two operators. In the 2-visit group, root canals were medicated with $Ca(OH)_2$ for 7–47 days and access cavity was sealed with a temporary material.	0.5–5 y	30/36 vs 22/31	Moderate
Xiao 2010 (17)	86 patients with 138 teeth, all teeth were finally included in the analysis	Necrotic pulp, periapical periodontitis	Single visit or 2 visits. Single operator. In the 2-visit group, root canals were medicated with $Ca(OH)_2$ paste for 7 days.	6 mo,1 y,2 y	52/76 vs 40/62 (6 mo); 70/76 vs 57/62 (1 y); 75/76 vs 60/62 (2 y)	Low
Study	**Sample size**	**Preoperative status of teeth**	**Intervention**	**Timing of recording pain after obturation**	**Raw data pain/total (single vs multiple)**	**Risk of bias**
Studies concerning post-obturation pain of single- versus multiple-visit treatment						
Al-Negrish 2006 (24)	120 patients (1 tooth each), 112 were included in the final analysis	Asymptomatic necrotic pulp	One visit or 2 visits. In the 2-visit group, root canals were medicated for 7 days with $Ca(OH)_2$ paste and a dry sterile cotton pledget.	2 and 7 days	8/54 vs 14/58 (2 days); 2/54 vs 6/58 (7 days)	High

Albashaireh 1998 (9)	Among 291 patients (1 tooth each), 215 had nonvital pulp	Nonvital pulp	Single visit or multiple visits. One operator. In the multiple-visit group, no medicaments were placed in the root canals, and only a dry sterile cotton pledget was sealed in the pulp chamber with a temporary filling restoration.	1, 2, 3, 7, and 30 days	33/102 vs 55/113 (1 day)	High
Mulhern 1982 (25)	38 patients (1 tooth each), all were finally included in the analysis	Asymptomatic necrotic pulp	Single visit or 3 visits. Two postgraduate students performed the treatment. In the 3-visit group, the medication used in the interappointment was not stated. The coronal access cavity was covered by a dry pledget of cotton sealed with a double cement system of Cavit G and zinc oxyphosphate cement.	2 and 7 days	7/30 vs 6/30 (2 days); 3/30 vs 2/30 (7 days)	High
Risso 2008 (23)	121 patients (1 tooth each), 118 were included in the final analysis	Necrotic pulp	Single visit or 2 visits. Single operator. In the 2-visit group, root canals were medicated with $Ca(OH)_2$ paste for 10–12 days. A dry sterile cotton pledget was sealed in the pulp chamber with a minimum 3-mm thickness temporary filling restoration.	10 days	6/57 vs 14/61	Low
Xiao 2010 (17)	86 patients with 138 teeth, all teeth were finally included in the analysis	Necrotic pulp, periapical periodontitis	Single visit or 2 visits. Single operator. In the 2-visit group, root canals were medicated with $Ca(OH)_2$ paste for 7 days.	Immediate to 7 days	36/76 vs 22/62	Low

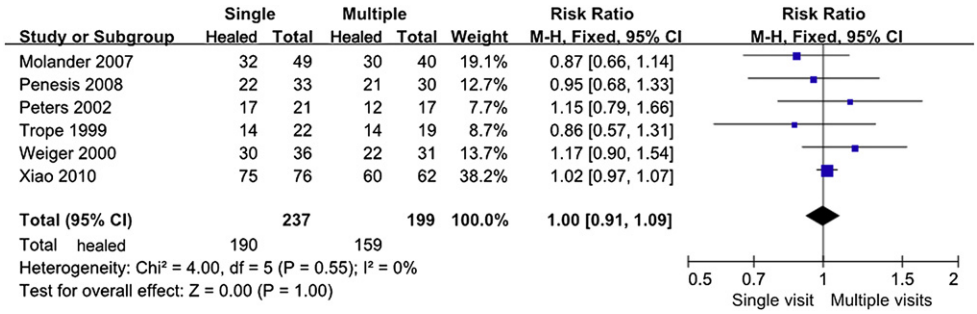

Figure 1. Healing results of single- versus multiple-visit treatment. Each study is represented by a block at the point estimate of intervention effect, with a horizontal line extending either side of the block. The area of the block indicates the weight assigned to that study in the meta-analysis, with the horizontal line depicting the 95% CI. The vertical line represents no effect. The black diamond shows the combined results, and the horizontal tips indicate CI. The diamond intersects with the vertical line, indicating no difference in healing rate between single- and multiple-visit groups.

pulpotomy, pulpectomy, dental, pulp, diseases, devitalization, obturation, visit$ (use "$" for truncation), appointment$. A useful search strategy was received from the *Cochrane Handbook for Systematic Reviews of Interventions* (15). The references cited in relevant review articles were also checked. In addition, all relevant articles and review articles of 3 journals (*Journal of Endodontics*, *International Endodontic Journal*, *Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontics*) were hand-searched. All available titles and abstracts were identified, and the relevance to single- or multiple-visit root canal treatment for infected canals was determined. When information from the title and abstract were ambiguous, full articles were scrutinized.

Inclusion and Exclusion

The full texts of the studies were obtained and independently reviewed by 2 reviewers (Y.Y.S., C.L.W.) to establish whether the studies met the inclusion criteria. The inclusion criteria were as follows: (1) permanent teeth with fully formed apex undergoing endodontic treatment presented with infected root canals or radiographic evidence of apical periodontitis; (2) all the selected teeth had no previous endodontic therapy; (3) the outcome measures were in terms of the number of teeth showing radiographic evidence of healing and in terms of incidence of pain; (4) the observation period in studies concerning the healing results was at least 1 year. The exclusion criteria included the following: (1) studies that were not RCTs or quasi-RCTs (a quasi-RCT uses quasi-random method of allocating participants to different interventions; the allocation is not adequately concealed as compared with RCTs with adequate allocation concealment.); (2) no comparison between single- and multiple-visit root canal treatment for infected root canal within the same study; (3) no data concerning healing rate or prevalence of pain; (4) the pulp status was not specified; (5) the endodontic procedure was not stated explicitly.

Reference lists from identified articles were scanned to determine other potentially relevant articles by 2 observers. Any disagreement between the authors was resolved via discussion.

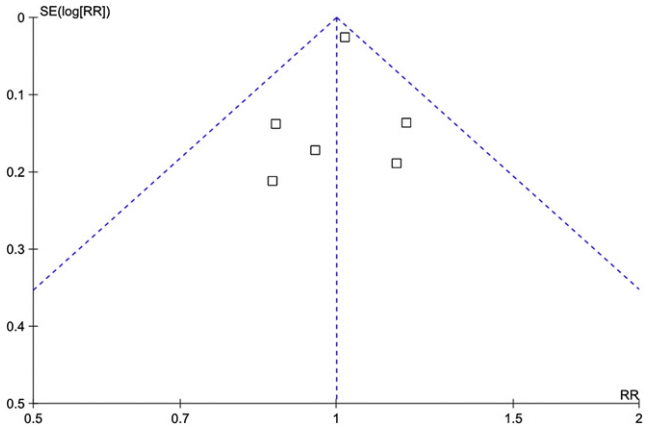

Figure 2. Publication bias among studies regarding the healing rate of single- versus multiple-visit treatment. The funnel plots are simple scatter plots of the RRs of individual studies (on the x-axis) against the standard error (SE) of the RRs on a logarithmic scale (y-axis). The plot showing a symmetrical inverted funnel indicates the absence of publication bias.

Outcome

The main outcome measures of root canal treatment are the long-term success and presence/absence of complications. Therefore, the outcome assessed in this review was the healing rate after 1 year, as determined mainly by radiographic assessment of size of periapical radiolucency, combined with clinical examination of signs and symptoms (scored as a binary [yes/no] outcome). How the most common scales of endodontic treatment outcome converted to a dichotomous outcome was summarized in a previous review (5). The outcome measure for complication was post-obturation pain. Flare-up was defined as postoperative pain (that could not be controlled) or increasing swelling, reported by the patient (16). We investigated pain incidence during short-term (up to 72 hours) and medium-term (7–10 days) during the post-obturation period.

Data Extraction and Quality Assessment

Studies that fulfilled the inclusion criteria were processed for data extraction. The focus of this review was the healing rate and prevalence of post-obturation pain after single- versus multiple-visit root canal treatment. In addition, the name of the first author, year of publication, number of cases and dropouts, pretreatment status of controlled teeth, the procedure of treatment, follow-up period, and timing of recording pain after obturation were also extracted from each study. Included studies were submitted to quality assessment according to the criteria described in the *Cochrane Handbook for Systematic Reviews of Interventions* 5.0.0 (updated February 2008) (15).

Statistical Analysis

To standardize statistical calculations, the outcome measures were based on binary data, ie, healed/not healed, pain/no pain. The cases classified as complete healing that was determined by clinical and

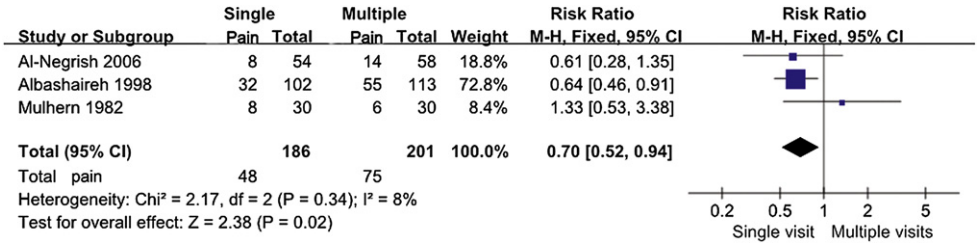

Figure 3. Incidence of short-term post-obturation pain in single- versus multiple-visit treatment. The diamond lies on the left of the vertical line, indicating the incidence of short-term post-obturation pain in single-visit treatment is significantly lower than that in multiple-visit group.

radiographic evidence were considered as "healed," whereas those cases defined as failures or uncertain healing were considered as "not healed." Likewise, the cases reporting no pain after obturation were defined as "no pain," those of slight, moderate, strong, or severe pain were all classified as "pain." Pain during the interappointment period in multiple-visit group was not recorded because there were no interappointments in the single-visit RCT group. As a result, pain reported after obturation appointment was reviewed for analysis.

For each study, risk ratios (RRs) along with 95% confidence intervals (CIs) were calculated to estimate the effect of interventions. Meta-analysis was conducted for studies with similar designs, intervention, and outcome measures. The significance of discrepancies in the estimates of the treatment outcomes from different studies was assessed by Cochran Q test and the I^2 statistics. A fix effect model was applied to combine the data in cases in which no variation existed among studies ($P \geq 0.1$, $I^2 \leq 50\%$). When significant heterogeneity ($P < 0.1$, $I^2 > 50\%$) was detected, a random effect model was used to reassess the data. If heterogeneity still existed, descriptive statistics were used.

Subgroup analysis was performed to investigate the relevance of follow-up time to post-obturation pain incidence.

Sensitivity analysis was undertaken to exclude studies of the lowest quality.

All analyses were performed by using Revman version 5 Software provided by the Cochrane Collaboration.

Results

Characteristics of Studies Included in the Review

Ten randomized control trials (9,17–25) were included. The main characteristics of the studies included are shown in Table 1. Of these, 6 studies (17–22) (436 teeth included) compared the healing rate and 5 studies (9,17,23–25) (569 patients included) compared the prevalence of post-obturation pain in single- and multiple-visit root canal treatment on teeth with infected canals.

All studies (9,17–25) were described as randomized. Randomization was undertaken by using random numbers listed in a table in the study of Risso et al (23) and a block of random numbers in the study by Penesis et al (18). Xiao and Zhang (17) and Trope et al (22) adopted the method of coin toss and die toss to generate randomization, respectively. Minimization method was used in the studies of Molander et al (19) and Weiger et al (21), considering the randomization factors of tooth type and size of periapical lesion. An alternate allocation was used by Albashaireh et al (9) and Al-Negrish and Habahbeh (24). The details of randomization were not specified by Peters and Wesselink (20) and Mulhern et al (25).

Blinding was stated in 7 (17–23) of the 10 studies (9,17–25), although without specific details in some trials. Reasons for dropout from the study or no withdrawal were also explicitly described in all studies (9,17–25).

Healing Rate

Six studies (17–22) involving 436 teeth described the therapeutic outcome by the number of teeth showing radiographic or clinical success per total teeth. Because no heterogeneity existed between studies, we used fix effect models to aggregate the data, as shown in Fig. 1. When data were combined in meta-analysis, the summary RR was 1.00 (95% CI, 0.91–1.09). On the basis of the current available evidence, there was no significant difference in healing rate between single- and multiple-visit root canal treatment in teeth with infected root canals (80.1% vs 80.0% for single-visit group and multiple-visit group, respectively; $P = 1.00$).

The funnel plot showed no detectable publication bias (Fig. 2).

Post-obturation pain

Short-term Pain (Immediate to 72 Hours). Three studies (9,24,25) involving 387 patients were available for analyzing short-term post-obturation pain (Fig. 3). Patients with single-visit root canal treatment experienced short-term postoperative pain less frequently (26%) than those with multiple-visit root canal treatment (37%) ($P < .05$).

Medium-term Pain (7 to 10 Days). Four studies (17,23–25) reported medium-term post-obturation pain. Heterogeneity existed in

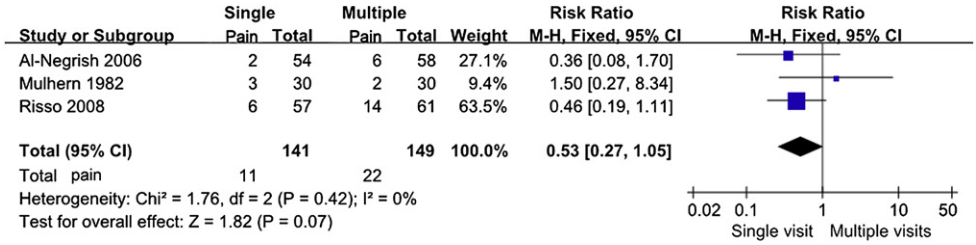

Figure 4. Incidence of medium-term post-obturation pain in single- versus multiple-visit treatment. The diamond intersects with the vertical line in the forest plot, indicating no difference in the incidence of medium-term post-obturation pain between single- and multiple-visit groups.

the included studies. Sensitivity analysis was performed, and the study by Xiao and Zhang (17) was excluded because pain was evaluated by dentists. In the remaining 3 studies, severity of pain was perceived by the patients. Heterogeneity test was re-performed, and the remaining 3 studies (290 patients included) were homogeneous (P = .42, I^2 = 0%). The meta-analysis data are summarized in Fig. 4. Although single-visit root canal treatment appeared to be slightly more favorable with a 7% lower medium-term post-obturation pain incidence than multiple-visit treatment, the difference was not statistically significant (RR, 0.53; CI, 0.27–1.05).

Pain at 1 Month. One article (9) including 215 patients investigated post-obturation pain during a longer term (1 month), and no patient reported continuous pain at 30 days.

Discussion

The adoption of clinical procedures in endodontic therapy depends not merely on their efficacy or biological consequences but also on minimization of patients' discomfort. Research focusing on issues relevant to the treatments or techniques aimed to provide evidence to support clinical decisions. In recent decades, the discussion on single- or multiple-visit root canal treatment has gained attention; however, no consensus has been reached (8,10,16). This might be explained by the inconsistencies in the design, participants, intervention, and outcome measures and small sample sizes among studies. A systematic review has several purposes when the related studies had conflicting results or small sample sizes, such as to increase power and precision, to answer questions not posed by the individual studies (15,26). This review aimed to compare the outcomes and complications of single- versus multiple-visit root canal treatment for teeth with infected root canals.

The outcomes of endodontic treatment might be influenced by several factors such as clinical approaches, experience of operators and evaluators, location and size of periapical lesion, and follow-up periods (27). Moreover, the pretreatment status of pulp has been suggested to have a considerable influence on the outcome of endodontic treatment (11,12). The prognosis for endodontic treatment in teeth with necrotic pulp and periapical radiolucencies is significantly worse as compared with teeth with a vital pulp. Consequently, only studies concerning teeth with necrotic pulp or apical periodontitis were identified in this review so as to exclude the effects of pulpal status on treatment outcomes.

The treatments in all 6 studies (17–22) were undertaken by experienced endodontists following a standardized protocol, with exception of one (18), in which the treatments were performed by endodontic residents under faculty supervision. The healing results were primarily evaluated by different examiners by means of radiographs. The level of agreement reached between examiners significantly affected the validity and reliability of the study because the radiologic assessment could be subjective. In the study by Peters and Wesselink (20), three endodontists who had not been involved in the treatment or follow-up appointments were asked to judge the radiographs. The radiographic images were evaluated blindly and independently by different observers in the remaining 5 studies (17–19,21,22). Observation consistency or agreement between and within evaluators was determined by using the intraclass correlation coefficient or kappa scores in 3 studies (18,20,22). The agreement test was also undertaken by Xiao and Zhang (17), although the detail was not described. To balance the difference in tooth group and size of periapical lesions, minimization method was used by Molander et al (19), Weiger et al (21), Penesis et al (18), and Trope et al (22) by using baseline adjustment in their studies (including cases with a periapical index $\geq$3).

When an investigator is designing an RCT to compare the outcomes of an intervention, an essential step is the calculation of sample sizes that will allow a reasonable power of detecting a predetermined difference in the outcome variable at a given level of statistical significance. Sample size is critically dependent on the purpose of the study, the outcome measure and how it is summarized, the proposed effect size, and the method of calculating the test statistic (28). The difference in healing rate considered to be clinically significant was the primary outcome measure, and the highest possible healing rate difference at present is 26% (94% vs 68% in teeth yielding a negative culture and positive culture, respectively), which is stated in the study by Sjögren et al (29). Hence, the minimum sample size required for this difference is 32 per group, which was determined with the method described by Chan (30), on the basis of P = .05 and 80% power. Accordingly, studies by Xiao and Zhang (17) and Molander et al (19) reported a proper sample size (138 and 89, respectively). In addition, lack of follow-up should be taken into consideration with respect to the success and failure of endodontic therapy. It should be pointed out that the overall sample size of the 6 studies comprised 237 teeth for single-visit and 199 teeth for multiple-visit root canal treatment. Because all 6 studies (17–22) were reported as randomized, the discrepancy in sample size might result from the uneven loss of follow-up between groups.

After root canal treatment, the results can only be observed after a certain time period. The probability of periapical healing increases over time, and some researchers suggested no less than 4 or 5 years after treatment would be necessary to evaluate adequate healing (20,21). However, studies have reported that the peak healing incidence and established lesion of apical periodontitis appeared at 1 year after obturation (31,32). Although longer observation periods might provide a better understanding of the outcome of endodontic therapy; from the practical point of view, 1-year follow-up time is considered acceptable (33,34). In all studies (17–22), the observation period ranged from 1–5 years. Although followed by several intervals (from 6 months–5 years), the subjects were observed radiographically until complete healing occurred in 2 studies (17,21). On the basis of the available evidence, similar healing results were found between single- and multiple-visit treatment for infected teeth. No detectable publication bias was observed among the included studies according to the funnel plot.

When multiple-visit root canal treatment was performed, calcium hydroxide ($Ca(OH)_2$) was commonly used as an intracanal medication to eradicate the microbial invaders (35,36). In all 6 studies identified in this review, $Ca(OH)_2$ was applied as an interappointment antibacterial dressing in multiple-visit group, and root canal shaping and obturation were performed following a standardized treatment protocol. However, there is a growing amount of evidence that questions the effectiveness of $Ca(OH)_2$ to eliminate microorganisms completely from the root canals (33,37,38). $Ca(OH)_2$ medication has been reported to be ineffective in short time (10 minutes) (35), and there was a clinical study that reported the number of bacterial positive canals increased after $Ca(OH)_2$ medication during the interappointment period (11). In a systematic review conducted by Sathorn el al (39), $Ca(OH)_2$ was indicated to have limited effectiveness in eliminating bacteria from human root canal by means of culture techniques; the quest for better antibacterial agents was suggested. On the other hand, studies have shown that rotary instrumentation and antimicrobial irrigation of the root canal system can substantially reduce the number of cultivable microorganisms (36,40). The sealer and gutta-percha are also confirmed to possess the antibacterial ability and thus be capable of eliminating the residual bacteria after instrumentation (41,42). Complete and

3-dimensional obturation can eliminate the bacteria remnants by depriving the microorganisms of nutrition and the space required to survive and multiply (21,43). Given the combination of effective mechanical instrumentation, the use of antimicrobial irrigating solution, and complete obturation, single-visit endodontic treatment can effectively eradicate the intracanal microbiota and lead to a favorable treatment outcome.

Discomfort after endodontic treatment can be categorized to short-term, medium-term, and long-term. Compared with multiple-visit approach, the prevalence of short-term post-obturation pain was significantly lower in single-visit treatment. Post-obturation pain is considered to be related with several factors including infection, retreatment, preoperative pain, intracanal medications, and physical and chemical damage to periapical tissues (44–48). The lower incidence of post-obturation pain in single-visit root canal treatment might be attributed to immediate obturation, thereby to avoid passage of medications, repeated instrumentation, and irrigation. Moreover, a single-visit approach might also prevent the occurrence of pain resulting from reinfection of the canals as a consequence of bacterial ingress from a leaky temporary restoration or lateral canal (16,49). On the contrary, the multiple-visit technique involves the placement of a temporary seal and the repeated physical and chemical stimulation to periapical tissues. In addition, as noted in 2 studies (9,25), no specific intracanal medication was placed during interappointment period in multiple-visit group. Recontamination of the root canals or secondary microbial invasion might be another reason leading to the higher post-obturation pain in multiple-visit group. Studies have demonstrated that the incidence of post-obturation pain decreased over time; it was greatest during the first 24–48 hours, with a steady reduction in the following 7 days (24,45,50). In terms of medium-term post-obturation period, the incidence of post-obturation pain in both single-visit and multiple-visit groups was reduced, and the difference between the 2 procedures was not significant. Only 1 study (9) investigating post-obturation complication at 1 month was identified in this review. This study reported that the incidence of post-obturation pain was greatest during the first 24 hours, which reduced rapidly and disappeared on the 30th day of observation.

However, another systematic review conducted by Figini et al (5) reported no difference in short-term postoperative pain incidence between the 2 treatment regimens. This might be explained by the differences in participants and clinical interventions. In the review by Figini et al, teeth with vital and nonvital pulps were assessed, whereas RCTs investigating necrotic pulps were included in the present review. Two studies (51,52) included in the review by Figini et al reported no explicit details of endodontic clinical procedure. The medication placed in root canal system and the temporary filling materials in multiple-visit group were also not specified. There was no clear description of either the instruments or the techniques used for canal shaping. These factors are important in clinical trials and might influence the statistical power of meta-analysis. Another factor is the variability in trial design and quality. The acceptable dropout rate of an RCT is considered to be less than 10%. A high dropout rate affects the reliability and validity of a study greatly because the loss of participants might result in the decrease of sample size and imbalance between groups. Three studies (51–53) included in the review by Figini et al presented a relatively high dropout rate ranging from 13%–15%. Last, in both reviews, the number of included studies was too small (6 in the review by Figini et al and only 3 in our review) to come to a definite conclusion. Furthermore, in the present review, a narrower CI of the study by Albashaireh and Alnerish (9) indicated the larger weight of the study in the meta-analysis; in other words, the result of the study by Albashaireh and Alnerish dominated the calculation of the pooled result. This might lead to bias of the systematic review. Hence, more well-designed RCTs are needed to further investigate the differences in prevalence of post-obturation pain between the 2 endodontic treatment regimens.

According to the results from the present review, the healing rate of single- versus multiple-visit root canal treatment was similar for infected teeth. The prevalence of post-obturation pain was significantly lower in single-visit approach at short-term follow-up time. However, because the number of studies included in this review was limited, it might be preliminary to conclude that there is no difference between single- and multiple-visit root canal treatments in terms of postoperative complications for teeth with infected root canals. More RCTs are still needed to elucidate this problem.

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The authors deny any conflicts of interest related to this study.

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