

Endodontic Treatment in Single and Multiple Visits: An Overview of Systematic Reviews

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Abstract

Introduction: The effectiveness of endodontic treatment regarding the number of sessions to complete the therapy is still controversial. The aim of this study was to conduct an overview of published systematic reviews (SRs) comparing endodontic treatment in single and multiple visits. **Methods:** A systematic search was performed in the electronic databases MEDLINE/PubMed and Cochrane Central Register of Controlled Trials until August 18, 2016, without language restriction. The eligibility criteria were as follows: (1) SRs and (2) a focus on endodontic techniques in single or multiple visits. The phases of eligibility and analysis of risk of bias were conducted by 2 or 3 independent and calibrated examiners, and a fourth examiner was consulted to resolve inconsistencies. Assessment of Multiple Systematic Reviews was used to evaluate the risk of bias of the included SRs, which were assessed according to the risk to develop knowledge and the existing knowledge gap. **Results:** The main characteristics including healing rates, success, and clinical complications during and after endodontic treatment were extracted from the SRs. From the 20 SRs initially identified, 8 were included in the analysis. Of these, 6 SRs showed low to moderate risk of bias and were suitable as strong clinical evidence on the topic. **Conclusions:** Overall analysis indicated that single and multiple visits showed similar repair or success rates regardless of the precondition of the pulp and periapex. The apical periodontitis subgroup showed a slight positive trend toward a decreased incidence of postoperative complications and a higher effectiveness and efficiency for a single session. Based on the risk of bias, the current level of evidence for this clinical approach is high. (*J Endod* 2017;43:864–870)

Key Words

Periapical disease, pulp disease, root canal therapy, systematic review

Endodontic treatment in multiple visits has been a traditionally accepted protocol. However, an alternative protocol comprising a single visit also has been proposed (1–12). Several factors such as automation, evolution of endodontic treatment techniques, and

advances in anatomic and biological knowledge of pulpal and periapical diseases have led to the treatment option entailing a single visit to the dental office (4, 7).

Both approaches have unique advantages and disadvantages. However, the approach of conventional therapy with the single-visit protocol is a paradigm shift from endodontic treatment in multiple visits (8, 11).

Endodontists determine the best approach by considering the immediate outcomes including complications after endodontic therapy (eg, flare-up, discomfort or pain, and swelling); results of microbiological analyses; instrumentation and root canal filling quality; and intermediate or later outcomes such as healing rates, success, effectiveness and efficiency, occurrence of newly developed or persistent periapical lesions, dental fractures, and indications for tooth extraction (6).

Despite the availability of systematic reviews (SRs), existing gaps in knowledge have resulted in the failure of guidelines for effective clinical practice; moreover, a consensus among professionals is lacking (6, 8). Hence, there is a need for robust scientific evidence to support clinical decision making.

The overview of SRs is a new study design proposed by the Cochrane Collaboration. The findings of multiple SRs are compiled in a single document with ease of access and use to synthesize and integrate information, reduce uncertainty for decision making, and create a new hierarchy of evidence, thus serving as a friendly front-end for health decision making (13–15). A clinical decision must be free of professional opinions that could bias selection of a technique. Therefore, this study was based only on SRs because these are considered as studies with the highest level of scientific evidence. We aimed to develop an overview of available SRs (15) to summarize evidence and the level of risk of bias and compile results related to single- and multiple-visit approaches.

The purpose of this overview was to identify all SRs on endodontic treatment in single and multiple visits, to interrogate the methodological quality (risk of bias) of these studies, and to evaluate the available evidence regarding the best clinical practices

Significance

The aim of this study was to form a consensus that guides clinical decision making in endodontics related to the number of sessions required for effective and safe endodontic treatment. This article is an original methodology design proposed by the Cochrane Collaboration and reports on a study of published systematic reviews.

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in endodontic treatment. The null hypothesis was that the single-visit approach has similar performance to the traditional approach of multiple visits.

Materials and Methods

Search Strategy

We conducted advanced searches in the PubMed/MEDLINE and Cochrane Central Register of Controlled Trials databases until August 18, 2016, without language restriction for reviews that were within the scope of this overview. The search included SRs related to endodontic techniques in single or multiple visits as well as references included in the SRs. The overview was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines (16). In addition, Assessment of Multiple Systematic Reviews (17) was used to evaluate the risk of bias of the included SRs.

The final strategy included a filter of the PubMed/MEDLINE database (clinical queries) and key words appropriate to the study (root canal therapy OR root canal treatment). The search strategy in the Cochrane Central Register of Controlled Trials included the following key words: “root canal therapy” and “single visit” and “multiple visits.”

Inclusion and Exclusion Criteria in Screening of SRs

The studies were initially selected for the title and abstract according to the following inclusion criteria:

1. SRs
2. Related to the endodontic techniques of single or multiple visits

Articles without an abstract or those without an adequate description were included for full-text evaluation. Eligibility was confirmed after access of the full text by following the previously defined exclusion criteria (ie, single- or multiple-visit approach not addressed, duplicated, and comments and editorials).

Data Collection Process

Data were collected by 2 independent examiners who were previously trained and calibrated (S.M. and M.S.N.A.M.) ($\kappa = 1.0$). Healing or success rate, clinical complications, and the characteristics of the included studies were extracted. Doubts and discrepancies were discussed and resolved by consensus; when necessary, a third examiner (M.S.) was consulted.

Assessment of Risk of Bias

Assessment of Multiple Systematic Reviews was used for the assessment of risk of bias as described by Shea et al (17). Eleven items were used to assess the methodological quality of the SR (Table 1). Finally, each article was given a score of high, moderate, or low risk of bias. An SR was considered as low risk when 8 to 11 positive responses were obtained from 11 items, moderate risk between 4 and 7 parameters, and high risk of bias ≤ 3 items (15). The assessment was performed by 3 examiners who were previously trained and calibrated (S.M., T.K.T., and M.S.N.A.M.) ($\kappa = 0.9$). Doubts and discrepancies were discussed, and if not resolved by consensus, a fourth examiner (M.S.) was consulted.

Results

Screening of SRs

Initially, 20 articles were identified including 13 from PubMed/MEDLINE, 5 from The Cochrane Central Register of Controlled Trials, and 2 references from the manual search. Thirteen studies were selected by eligibility assessment of the title and abstract based on the

inclusion criteria. After the eligibility step, 8 SRs (1–3, 5, 6, 8, 9, 11) were selected (Fig. 1). The data from the SRs were compiled into 2 parts with the number of visits for endodontic treatment as a secondary outcome. Data from Ng et al (2, 3) were viable; therefore, these 2 articles were considered as a single SR for both subsequent qualitative and quantitative analyses. Thus, the calculations were based on a total of 7 SRs. All other studies (1, 6, 5, 8, 9, 11) addressed the issue as a primary outcome. A total of 62 primary studies were originally analyzed by SRs included in this overview.

Assessment of Risk of Bias

The Assessment of Multiple Systematic Reviews tool was used to assess the risk of bias for all SRs included. The results of classification into high, moderate, or low risk of bias according to the number of positive responses are shown in Table 1.

Three SRs were at low risk of bias (6, 8, 11), 3 at moderate risk of bias (1, 2, 5), and 1 at high risk of bias (9). SRs with low and moderate risk of bias were considered as strong clinical evidence on the topic. The 6 SRs that were classified as low or moderate risk accounted for 85.6% of the studies analyzed (Table 1).

Characteristics of Systematic Reviews

Table 2 described the overall sample according to characteristics of each SR regardless of the preconditions of dental pulp and periapices as follows: authors, year of publication, number and type of primary studies included, languages, outcomes and period of follow-up, presence of statistical analysis/meta-analysis, and main results.

Analysis of the Overall Sample

Analysis of the Immediate Postoperative Complications (Flare-up, Pain, Swelling, Presence of Fistula, and Other), Tissue Repair, and Success Rate.

The 8 included SRs focused on root canal treatments by single or multiple visits. With regard to immediate outcomes, 4 of the 7 SRs reported postoperative complications and discomfort including the incidence of postoperative pain, swelling, flare-up, and fistula. Regarding the incidence of discomfort up to 72 hours after root canal obturation, the SRs showed contradictory results (6, 8). Figini et al (6) reported that the frequency of pain at 72 hours and 1 week was not significantly different between single and multiple visits; moreover, there were no reports of discomfort at 1 month after treatment. However, the meta-analysis of the use of painkillers after post root canal obturation obtained from 3 primary studies (559 patients) indicated that the use of painkillers was significantly more frequent in single-visit cases. Conversely, Su et al (8) showed that patients submitted to a single visit had a lower frequency of pain in the first 72 hours after root canal obturation; however, there was no significant difference in pain after 1 week between single and multiple visits, and none of the patients reported discomfort after 1 month of treatment. Wong et al (9) reported no difference in postoperative complications between single and multiple visits in their meta-analysis of 21 clinical trials.

Complications related to the frequency of flare-up, which is characterized by the development of pain, swelling, or both, were another immediate outcome. This complication occurs days or hours after endodontic intervention and, depending on the severity, requires an emergency visit for treatment (18). The exact definition of flare-up was not consistently comparable between studies (5, 6), which results in different clinical settings (19, 20). Figini et al (6) included 3 studies that considered flare-up as swelling (192 patients), but despite the lower frequency of complications in multiple compared with single visits, the significance was not statistically verified. In cases of mixed

TABLE 1. The Assessment of Multiple Systematic Reviews (AMSTAR)

1) AMSTAR questions	De Deus & Canabarro, 2016 (11)	Wong et al, 2014 (9)	Su et al, 2011 (8)	Sathorn et al, 2008 (5)	Ng et al, 2007/2008 (2, 3)	Figini et al, 2007 (6)	Sathorn et al, 2005 (1)
1. Was an 'a priori' design provided?	Yes	No	Yes	Yes	Yes	Yes	Yes
2. Was there duplicate study selection and data extraction?	Yes	No	Yes	No	Yes	Yes	No
3. Was a comprehensive literature search performed?	Yes	No	Yes	Yes	Yes	Yes	Yes
4. Was the status of publication (ie, gray literature) used as an inclusion criterion?	Yes	No	Yes	Yes	Yes	Yes	Yes
5. Was a list of studies (included and excluded) provided?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Were the characteristics of the included studies provided?	Yes	No	Yes	Yes	Yes	Yes	Yes
7. Was the scientific quality of the included studies assessed and documented?	Yes	No	Yes	No	No	Yes	No
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	Yes	No	Yes	No	No	Yes	No
9. Were the methods used to combine the findings of studies appropriate?	NA	No	Yes	Yes	No	Yes	Yes
10. Was the likelihood of publication bias assessed?	NA	No	Yes	Yes	Yes	NA	NA
11. Was the conflict of interest stated?	Yes	Yes	Yes	No	No	Yes	No
Results according to number of yeses	Low risk (9)	High risk (2)	Low risk (11)	Moderate risk (7)	Moderate risk (7)	Low risk (10)	Moderate risk (6)
Criteria for AMSTAR analysis according to positives answers	Low risk (8–11)	Moderate risk (4–7)	High risk (≤ 3)				
% (n/N questions)	42.8 (3/7)	42.8 (3/7)	14.28 (1/7)				

NA, not applicable.

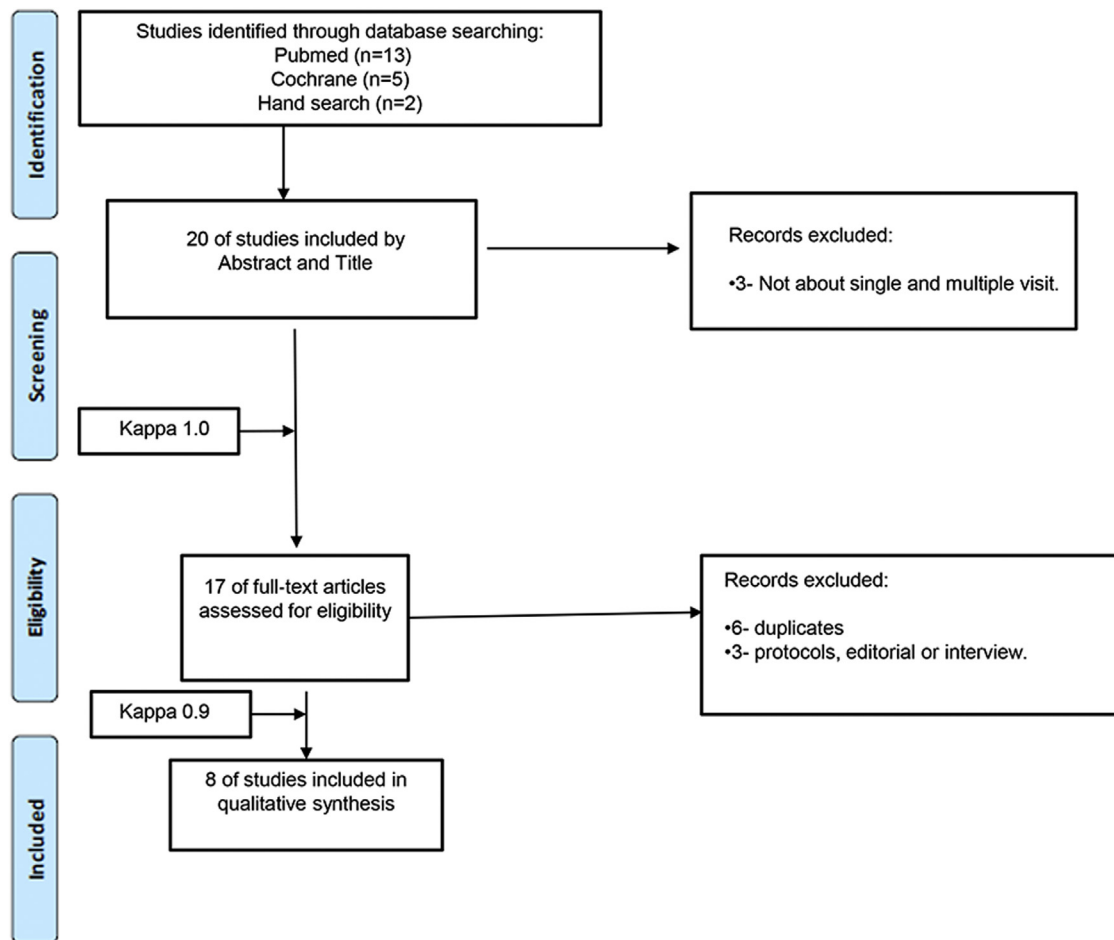


Figure 1. A flowchart of the screening of studies according to the PRISMA recommendation (16).

or undeclared initial clinical diagnosis, Sathorn et al (5) reported no difference related to the immediate complications (pain or flare-up) in a single visit compared with multiple visits.

Late outcomes or the effectiveness or efficiency of the treatment related to the healing rate (1, 8, 9, 11) and the success rate (2, 3, 6, 9) showed no significant differences in a single visit compared with multiple visits.

Subgroup Analysis of the Apical Periodontitis

Table 3 describes the apical periodontitis subgroups' immediate postoperative complications as well as the effectiveness of endodontic treatment through tissue repair and the radiographic success rate among other parameters. Regarding the flare-up rate in teeth with apical periodontitis, Sathorn et al (5) identified 2 studies with conflicting results on immediate outcomes (postoperative complications) and concluded that there was a gap in knowledge. Figini et al (6) showed that for cases with a clinical diagnosis of apical periodontitis, when the effectiveness was analyzed in terms of postoperative discomfort, there were no significant differences between the 2 approaches; however, a trend of less discomfort for treatment in a single visit was observed. Likewise, Su et al (8) confirmed that patients with infected root canals submitted to a single visit had a lower frequency of pain in the first 72 hours after root canal obturation. Furthermore, after 1 week, the authors did not observe significant difference between a single visit or multiple visits although there was a slight tendency in favor of a single

visit; in addition, none of the patients reported discomfort at 1 month after treatment.

For late outcomes (healing/success rate), Sathorn et al (1) reported slightly higher effectiveness in relation to the healing rate (6.3%) for the single-visit endodontic treatment of teeth with apical periodontitis. However, meta-analysis of the primary studies showed no significant differences between the 2 approaches. Su et al (8) analyzed patients with infected root canals (necrotic with or without periapical lesion) and showed a similar healing rate for both approaches. In the apical periodontitis subgroup, Figini et al (6) reported that radiographic success was 38% better for the single visit compared with multiple visits without significance.

Thus, for the evaluation of preoperative status and treatment approach by including cases of necrosis, apical periodontitis, and endodontic retreatment, a slight trend toward a lower incidence of complications and greater effectiveness was observed for the single-visit approach (1, 6, 8).

Discussion

Contraindications for endodontic treatment in a single visit are still a matter of debate because this modality has been an alternative to the conventional approach in multiple visits (1, 4, 6, 7, 8, 9). Problems related to leakage in the interappointment coronal sealing, reinfection of the root canal system, and difficulties in eliminating bacteria from the dentinal tubules are cited by proponents to justify

TABLE 2. Characteristics of Systematic Reviews Assessing the Overall Sample Regardless of the Precondition of the Pulp and Periapex

Authors	N included studies	Language accessed	Design of included studies	Outcomes accessed	Period of follow-up	Statistic/meta-analysis	Main results
De Deus & Canabarro, 2016 (11)	39	English	All types of study	Healing rate, microbiological tests, absence of signs and symptoms, the use of painkiller, extractions, postobturation pain	1–5 y	No	Single visit = multiple visits, healing rate
Wong et al, 2014 (9)	47	English	CT, PS, RS, and cohort	Healing rate, postobturation pain, success rate, flare-up	1 d–4 or 5 y	Yes	Single visit = multiple visits; healing rate, success rate, and postobturation pain
Su et al, 2011 (8)	10	Not specified	RCT or quasi-RCT	Healing rate, postobturation pain in infected root canals	1 d–5 y	Yes	Single visit = multiple visits, healing rate Single visit showed greater prevalence of postobturation pain
Sathorn et al, 2008 (5)	16	Without restriction	RCT, PS, RS and cohort	Post obturation pain, flare up	NS	No	Single visit = multiple visits, prevalence of postobturation pain
Figini et al, 2007 (6)	12	Without restriction	RCT or quasi-RCT	Success rate, extractions, radiographic assessment, complications, swelling, sinus problems, the use of painkiller	Immediate–5 y	Yes	Single visit = multiple visits, radiographic success Single visit showed greater frequency of the use of painkiller
Sathorn et al, 2005 (1)	3	Without restriction	RCT	Healing rate	6 m–5 y	Yes	Single visit = multiple visits, healing rate
Ng et al, 2007/2008 (2, 3)	63	4 languages	RCT, cohort and RS	Success rate	Not specified	Yes	Single visit = multiple visits, success rate

CT, clinical trial; PS, prospective study; RCT, randomized clinical trial; RS, retrospective study.

TABLE 3. Subgroup Analysis of Apical Periodontitis

Authors	Complications		Effectiveness	
	Single visit	Multiple visits	Single visit	Multiple visits
Su et al, 2011 (8)		>Pain (72 h)	Without difference	Without difference
Sathorn et al, 2008 (5)	Contradictory results	Contradictory results	Not assessed	Not assessed
Figini et al, 2007 (6)	Without difference	Without difference, but trend for greater discomfort	Without difference, but greater radiographic success (38%)	Without difference
Sathorn et al, 2005 (1)	Not assessed	Not assessed	Without difference, but greater healing rate (6.3%)	Without difference

selection of this new therapy. Nevertheless, other professionals prefer the multiple-visit approach to ensure no pain or postoperative complications before obturation of the root canal system as well as for greater likelihood of achieving microbiological reduction levels compatible with tissue repair through the use of intracanal medication, chemical and mechanical preparation, and additional therapies.

Adjunct therapies and antimicrobial strategies aimed at maximum reduction of intracanal biofilm because the persistence of bacteria in the root canal is related to a poor prognosis have been used in multiple visits according to the preference of dentists (21). However, all efforts should be directed to strategies that avoid complications (pain, swelling, and discomfort), especially in patients with a systemic imbalance that may alter the tissue repair process after endodontic treatment or worsening of their medical condition. Furthermore, patients conceive of professional skills primarily by the ability to prevent and control pain (22).

The rationale for the current study was to form a consensus that guides clinical decision making in dentistry related to the number of sessions required for effectiveness, efficiency, and safe endodontic treatment. SRs currently do not provide strong evidence for a consistent conclusion. Thus, an overview of the available SRs is relevant.

The advantages, disadvantages, safety, and effectiveness of endodontic treatment in a single visit compared with the multiple-visit approach were investigated in SRs (4, 7, 8). SRs include scientific evidence from different primary studies including randomized clinical trials and prospective and retrospective designs. Consequently, this overview, based on 62 studies in the 7 SRs, resulted in consolidation of the compiled data from a significant number of primary studies. In the overall analysis, 6 SRs showed that in teeth with vital or nonvital pulp, similar success and healing rates of endodontic treatment performed in single or multiple visits were obtained.

However, the main questions of this issue were the cases with apical periodontitis in which the root canal system as well as the periapex showed infection. In the subgroups analysis of teeth with necrosis and apical periodontitis, the results of the overview indicated a slight trend toward a lower incidence of postoperative complications and a higher effectiveness of treatment using the single-visit approach. The higher frequency of postoperative complications in multiple visits is likely because of associated factors, including mechanical, chemical, or microbiological injuries of the periapical tissues (18, 23). These can depend on the following: extrusion of contaminated debris (24), changes in the microbiota of the root canal, incomplete root canal preparation, type of treatment, establishment of patency (18, 23), intracanal medication (25), use of a high concentration of chemical substances, or the constant frequency of root canal manipulation and periapical tissues because of the number of sessions required to complete the treatment (10, 26).

Sathorn et al (1) suggested that a low prevalence of flare-up should not be a determinant factor in selecting the number of sessions for endodontic treatment. However, despite the low prevalence, studies

showed that this complication can occur with high frequency in individuals with a medical history that could compromise the healing process (eg, diabetic patients). Moreover, the prevalence of flare-up is higher in individuals >50 years old (25) and, therefore, more susceptible to systemic diseases. Individuals with systemic diseases, such as diabetes (type 1 or 2), cancer or chemotherapy, autoimmune disease, or those resulting from the use of bisphosphonates (27–29) submitted to endodontic treatment, >50 years old normally are not included in a primary clinical trial.

Although the results for the effectiveness of outcome are generally similar, in dentistry procedures, especially endodontics, the dentist should also consider patient-centered outcomes (interests and comfort of the patients, such as pain relief, improvement of oral health-related quality of life and cost efficacy) in clinical decision making (8, 11). Consequently, the causes of complications and the impact on the patient should be considered. Therefore, studies are needed to determine the effect of systemic conditions in the immune responses and the occurrence of flare-up in order to verify if the complications are determining factors for the type of approach to endodontic treatment, ensuring safety by the number of sessions in the treatment.

Sathorn et al (5) reported a gap in determining the prevalence of postoperative pain or flare-up after endodontic treatment in a single visit or multiple visits. This could be related to a lack of randomized clinical trials or the high heterogeneity of the included studies, which could be explained by differences between participants and clinical interventions, variability in the design, and quality of the studies. Therefore, the authors (4, 7, 8, 11) suggested that randomized clinical trials, particularly multicenter studies of large-scale, adhering to the intervention protocols and diagnostic methods are still needed to improve the evidence. Studies are required to determine factors associated with endodontic techniques in different subgroups according to the preoperative status (apical periodontitis, vital pulp, necrotic pulp, or retreatment), patient-related factors (age, sex, type and location of the tooth, and systemic conditions), and the type of medications and chemical irrigators. Moreover, well-established and standardized clinical and radiographic criteria are required for the assessment of healing/success/effectiveness or efficiency rate and discomfort after endodontic treatment based on validated scales and indexes.

Since completion of this study, 2 clinical trials (10, 12) comparing complications or the healing rate between a single visit and multiple visits have been published. The findings were consistent with those presented in this overview.

The recognition of level of evidence from the evaluation and qualification of SRs is necessary for better interpretation of the findings using quality analysis tools. AMSTAR is an analysis tool designed to meet several essential criteria in performing SRs using a checklist, allowing the evaluation of methodological quality or risk of bias. During the assessment, parameter 11 from the Assessment of Multiple Systematic Reviews, which is related to a possible conflict of interest of authors with the study, was not always explicit in the text. Nevertheless, in

general, journals request disclosure from authors during the submission process. We recommend that the journals and authors emphasize this in the article because these data may have been a disadvantage for some authors regarding total computation of the evaluation. In our study, 6 SRs (85.6%) were classified as low/moderate risk of bias and considered suitable for the generation of strong clinical evidence regarding the subject.

Conclusion

In the overall analysis, the single- and multiple-visit approaches showed similar healing or success rates regardless of the precondition of the pulp and periapex. The apical periodontitis subgroup showed a slight trend toward a decreased incidence of postoperative complications and a higher effectiveness for the single-visit approach. Based on the risk of bias, the current level of evidence for this clinical approach is high.

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

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