

META ANALYSIS



Outcome of Single- vs Multiple-visit Endodontic Therapy of Nonvital Teeth: A Meta-analysis

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ABSTRACT

Introduction: Endodontic therapy is a specialized procedure more demanded by patients within public oral health care in the country. Then, single-visit endodontic therapy may offer advantages to the health care services, to the professionals, and to the patients by reducing access barriers.

Materials and methods: A meta-analysis was done and the variables evaluated were periapical repair, microbiological control, and postobturation pain in randomized clinical trials (RCTs) involving endodontic treatment of nonvital teeth at single- or multiple visits.

Results: About 17 RCTs were included. There were no differences found in periapical repair or microbiological control in single- and multiple-visit therapy. Single-visit endodontic therapy resulted in 21% less postobturation pain (relative risks = 0.79; 95%, confidence interval: 0.66-0.94).

Conclusion: There was less postobturation pain in the single-visit endodontic therapy group. In the public dental care, this analysis favors the adoption of this one therapy because it will be possible to increase the patient access and the supply of this therapy.

Clinical significance: It is possible to get a better cost-effectiveness for the patients and the health care service. This is very important because the reduction of the cost to the patient allows it to become a complete treatment. The health service, in turn, is able to be better used, with a greater supply of this service.

Keywords: Endodontics, Meta-analysis, Nonvital tooth, Public health, Root canal obturation.

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INTRODUCTION

Clinical research in public oral health care in Brazil has grown due to increased funding and the implementation of specialist dental clinics.¹ Recent studies have shown that endodontic therapy is the specialized procedure more demanded by patients within public oral health care in the country.² Compared with the other specialties, endodontic therapy involves a heavier outpatient workload, with waiting time for treatment around 30 days in approximately 60% of the specialist dental centers. In some cases, waiting time may exceed 1 year.

Inability to comply with goals, low rates of use of specialist dental services, absences in consultations, and the different techniques used by each professional – some endodontists preferring to complete treatment at a single visit, while others prefer fractioned visits³ – may reflect management problems within the service.⁴

It is more common performing endodontic treatment in two or more consultations.⁵ The treatment at a single visit has generated considerable controversy in the scientific field.⁵⁻⁷ In public oral health care, single-visit endodontic therapy may offer certain advantages to the health care services, to the professionals, and to the patients. The access barriers to public health care may be reduced by decreasing the cost of treatment to the patient by minimizing transportation costs and absenteeism at work. The costs to the health care service are reduced because the treatment can be offered to a greater number of patients.^{2,3} In addition, single-visit therapy

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may prevent the contamination of vital teeth and the recontamination of nonvital teeth that can occur between treatment visits.⁸

The main difference between therapy in single- or multiple-visit session is the use of intracanal medication between consultations.⁸ Some investigators argue that the use of an antimicrobiological intracanal medication is essential for controlling infection of the root canal system, particularly in cases of nonvital teeth.^{9,10} Other studies have found no difference in success rates between single- and multiple-visit therapy in nonvital teeth with apical periodontitis.^{6,7,11} Therefore, there is no consensus on the adoption of single-visit endodontic therapy for the care of these patients.

In addition to this controversy, there is a lack of meta-analyses involving studies with adequate sample sizes to compare these techniques for the treatment of teeth with nonvital pulp. The results of this study may contribute toward implementing clinical endodontic protocols, specifically focused on public oral health care services (specialist or otherwise).

The present meta-analysis evaluated the outcomes of endodontic treatment of nonvital teeth at a single visit compared with multiple visits with respect to periapical repair, microbiological control, and postoperative pain.

MATERIALS AND METHODS

It was made a meta-analysis and systematic review¹² that searched, in the web of science and medline databases, randomized clinical trials (RCTs) involving endodontic treatment of nonvital teeth at single or multiple visits. Search strategies and keywords included were (1) Endodontic (treatment OR therapy), (2) root canal (treatment OR therapy OR preparation), (3) dental pulp (capping OR devitalization), (4) pulpectomy OR pulpotomy, (5) (single OR one) AND (visit OR session OR appointment), and (6) (multiple OR two OR three) AND (visit OR session OR appointment). In addition, combinations of these keywords were used.

The eligibility criteria consisted of studies conducted with human subjects published up to December 2012 in English, Spanish, or Portuguese.

Inclusion Criteria

- Randomized clinical trials
- Completely formed set of permanent teeth and a diagnosis of dental pulp necrosis
- Type of intervention: Endodontic therapy performed at a single visit compared with multiple visits
- Type of outcome: Periapical repair, postobturation pain, and microbiological control.

Exclusion Criteria

- Nonprospective and noncomparative studies of the two techniques
- Nonrandomized studies
- Endodontic treatment of teeth with vital pulp
- Data missing on the numbers of patients in the vital and nonvital groups in studies involving both conditions
- Undefined pulp condition
- Need for retreatment and/or surgical endodontic treatment
- Follow-up period <1 year for the assessment of periapical repair.

A total of 420 studies were identified in the Medline database and 273 in the web of science database. After excluding those repeated, 526 studies remained. Of these, 133 were selected for reading the abstracts. After checking for eligibility, 30 were read fully. The inclusion and exclusion criteria eliminated 13 studies. The remaining 17 studies were evaluated by two reviewers in accordance with 20 validity criteria, established in a study conducted by Kay and Locker¹³ that permitted evaluation of the strength of the methodology. Each study had to fulfill at least 12 of the 20 criteria to be included.

Statistical analysis of the results was performed using binary data: Cured/not cured, presence/absence of pain, and negative/positive cultures. The cure was defined as complete periapical repair determined by clinical evidence or radiography. The cases in which the patient reported no postobturation pain were classified as "absence of pain," while the mild, moderate, or severe pain was classified as "presence of pain." In studies with multiple results (at different evaluation moments), 48 hours were taken as reference. Postoperative pain between visits was not considered in the analysis since no cases of this complaint were recorded in either of the groups. With respect to microbiological control, teeth in which no microorganisms were considered "negative," whereas those in which some type of microorganism was found were considered "positive."

In the studies in which the intervention was compared between three different groups (a single-visit experimental group and two multiple-visit control groups, with and without the use of intracanal medicaments), only were considered the experimental group and the multiple-visit group in which it was used intracanal medicaments.

Relative risks (RR) and their respective 95% confidence intervals (CI) were calculated for the studies in which this measure of epidemiological association was not provided directly. In addition, the RR of the fixed and random effects were calculated together with their respective 95% CI as summary measures of the meta-analysis.

Heterogeneity between the studies was evaluated using I^2 statistics. The results were confirmed by

Cochran's Q-test at 95% CI and by graphical inspection. A random effects model was selected to the high degree of heterogeneity (over 50%) and statistically significant ($p < 0.05$). Publication and sensitivity biases were analyzed by funnel plot. The R statistical software package (Free Software Foundation Inc., Boston, USA), version 2012, was used.

RESULTS

This meta-analysis included 17 RCTs. Of these, six analyzed periapical repair,¹⁴⁻¹⁹ four microbiological control,^{17,20-22} and eight postobturation pain.²³⁻³⁰ Table 1 describes the characteristics of the studies related to periapical repair and microbiological control. Table 2 is a description of the studies on postobturation pain.

Table 1: Characteristics of the selected studies evaluating the endpoints periapical repair (n = 6) and microbiological control (n = 4) between visits in the single-visit and multiple-visit groups

Author (year)	n	Time (months)	Type of Prep.	Sodium hypochlorite (%)	Medicament (weeks)	Medicament experimental group	Frequency of the outcome (%)
<i>Studies on periapical repair</i>							
Molander et al (2007) ¹⁴	89	24	Manual and rotary	0.5	01	Yes	T = 65.3 C = 75.0
Paredes-Vieira and Enriquez (2012) ¹⁵	282	24	Manual and rotary	5.25	01	No	T = 96.5 C = 88.9
Penesis et al (2008) ¹⁶	63	12	Manual and rotary	5.25	02-04*	No	T = 66.6 C = 70.0
Peters and Wesselink (2002) ¹⁷	38	54	Manual	2.00	04	No	T = 80.9 C = 70.5
Weiger et al (2000) ¹⁹	67	60	Manual	1.00	6.7	No	T = 83.3 C = 70.9
Trope et al (1999) ¹⁸	76	13	Manual	2.50	01	No	T = 63.6 C = 73.6
<i>Studies on microbiological control</i>							
Kvist et al (2004) ²⁰	96	*	Rotary and manual	0.5	1	Yes	T = 28.8 C = 36.3
Peters and Wesselink (2002) ¹⁷	38	*	Manual	2	4	No	T = 33.3 C = 5.8
Peters et al (2002) ²¹	42	*	Manual	2	4	No	T = 33.3 C = 9.5
Waltimo et al (2005) ²²	38	*	Manual	2.5	**	No	T = 20 C = 0

T: Test group; C: Control group; *Time in weeks of medicament use; **together with 2% chlorhexidine solution. Sample size, study duration, type of preparation, sodium hypochlorite concentration and period of intracanal medicament between visits in the experimental and control groups

Table 2: Characteristics of the studies (n = 8) evaluating the endpoint postobturation pain in the single-visit and multiple-visits groups

Author (year)	n	Preoperative condition	Time (days)	Type of preparation	Medicament control group	Analgesic	Frequency of the outcome (%)
Al-Negrish and Hababbeh (2006) ²⁵	112	Asymptomatic	2	Manual	Calcium hydroxide (07 days)	Paracetamol 500 mg	T: 14.9 C: 24.1
Albashaireh and Alnegrish (1998) ²³	215	Asymptomatic	30	Manual	None	Acetaminophen 500 mg	T: 32.3 C: 48.6
Ghoddusi et al (2006) ²⁴	40	*	3	Manual	Calcium hydroxide (07 days)	*	T: 40 C: 5
Ince et al (2009) ²⁶	153	Asymptomatic and symptomatic	3	Manual	None	Ibuprofen 400 mg	T: 71.2 C: 71.2
Mulhern et al (1982) ²⁷	60	Asymptomatic	2	Manual	None	Aspirin and paracetamol**	T: 23.3 C: 20
Risso et al (2008) ²⁹	118	Asymptomatic and symptomatic	10	Manual	Calcium hydroxide (10/12 days)	Paracetamol 500mg	T: 10.5 C: 22.9
Prashanth et al (2011) ²⁸	16	Asymptomatic	2	Manual/rotary	*	**	T: 12.5 C: 12.5
Singh and Garg (2012) ³⁰	110	Asymptomatic and symptomatic	2	Manual/rotary	None	Ibuprofen 600 mg	T: 3.9 C: 5.5

T: Test group; C: Control group; *Not specified; **and others: Aspirin/caffeine/dihydrocodeine and paracetamol/propoxyphene. Sample size, preoperative condition, time evaluated, type of preparation, intracanal medicament between visits in the control group, analgesic drug used and frequency of the outcome



With respect to the apical repair, there was no difference between the therapy groups (RR = 1.04; 95% CI: 0.97–1.12), as shown in the fixed effects model (Fig. 1).

The study with the largest sample size¹⁵ produced results that favored the single-visit group. The type of instrumentation used (manual, rotary, or both) appeared to have no effect on the outcome. The concentration of sodium hypochlorite varied between the studies and there was no association between higher concentrations and more favorable results in the experimental group. There was a positive association between a longer follow-up time and an increase in the percentage of successful repair with single-visit therapy in the studies wherein the observation time exceeded 24 months.

Microbiological control was similar in both groups (RR = 2.48; 95% CI: 0.67–1.97) (Fig. 2). Heterogeneity between the studies was high ($p = 0.0296$, $I^2 = 66.6\%$). Sensitivity analysis showed that in the study conducted by Kvist et al,²⁰ the direction was different from that of the

other studies; nonetheless, it was decided to maintain this study in the analysis, since it was the only one to apply a different technique. This consisted of using intracanal medicament for 10 minutes following instrumentation in the single-visit group and may have been responsible for the positive effect encountered. Because of this heterogeneity, the data from the meta-analysis were used in a random effects model in which the RR encountered was 2.48.

The incidence of postobturation pain was on average 21% less (RR = 0.79; 95% CI: 0.66–0.94) when endodontic therapy was performed at a single visit compared with multiple visits (Fig. 3).

The studies conducted by Prashanth et al²⁸ and Ghoddusi et al²⁴ were excluded due to the large standard error and the divergence in relation to the funnel margin respectively. The sensitivity test in the six remaining studies showed moderate heterogeneity ($p = 0.114$, $I^2 = 43.7\%$). The fixed effects model was taken as a reference. Nevertheless, although the study conducted by Ince

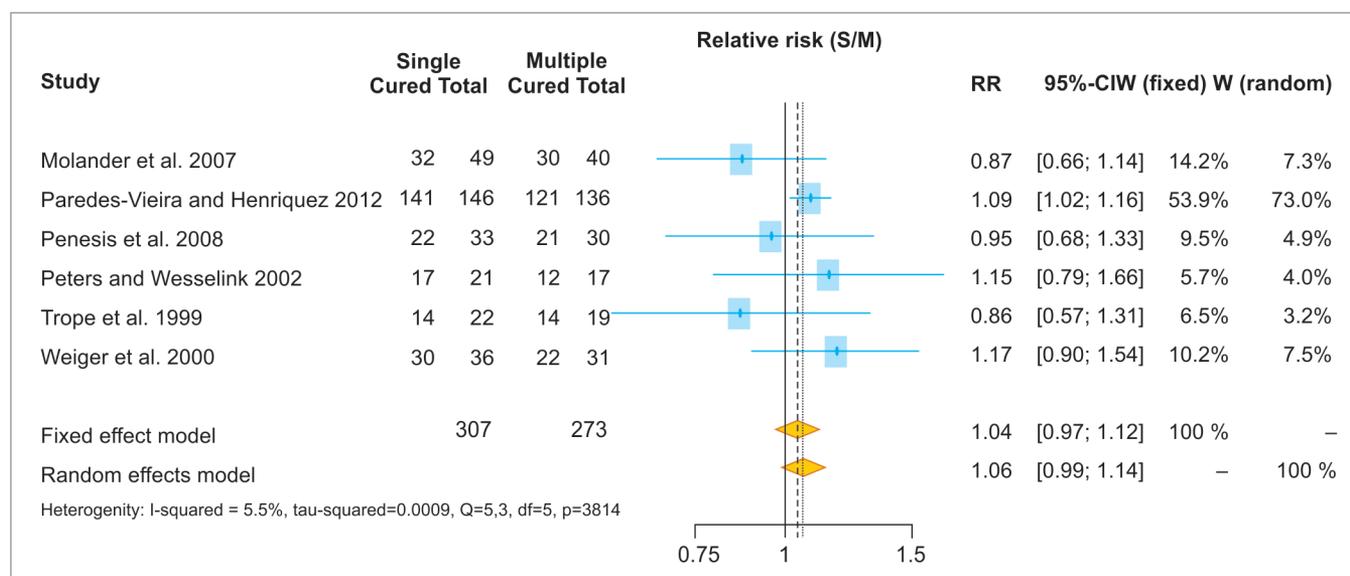


Fig. 1: Forest plot of the endpoint periapical repair for the six studies included in this meta-analysis

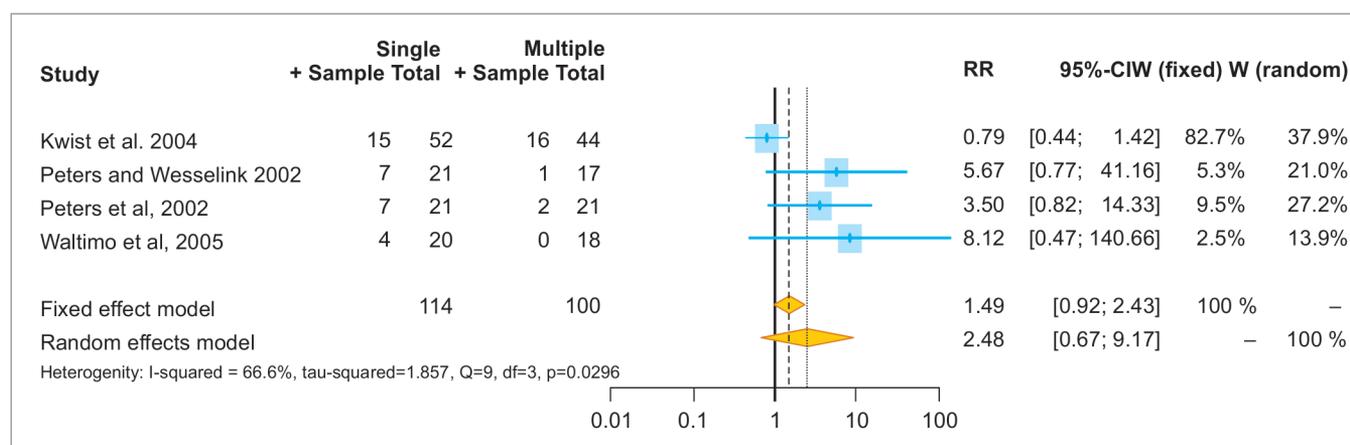


Fig. 2: Forest plot for the endpoint microbiological control for the four studies included in this meta-analysis

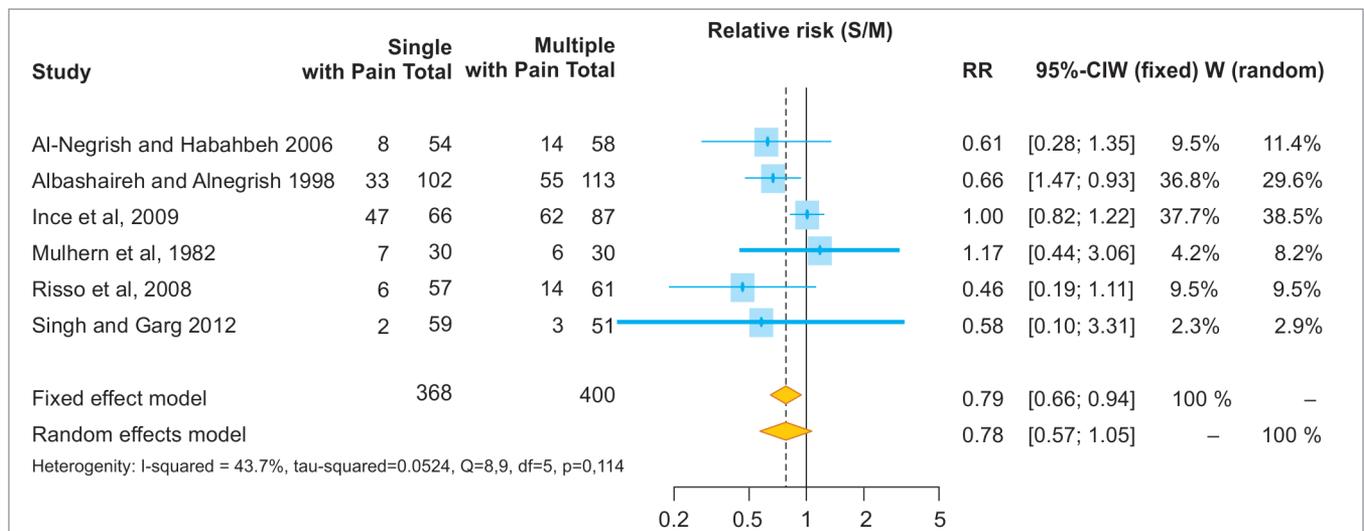


Fig. 3: Forest plot for the endpoint postobturation pain for the six studies included in this meta-analysis

et al.²⁶ diverged from the funnel margin, it was decided to keep it in the analysis because the summary measure for the fixed effects model was statistically significant.

Half the studies included in this meta-analysis involved symptomatic and nonsymptomatic participants; nevertheless, this did not contribute toward any increase in the frequency of postobturation pain. In addition, the study with the lowest rate of postobturation pain in both groups was the one in which rotary instrumentation was used in association with manual instrumentation.³⁰ Finally, in the studies in which intracanal medicaments were used in the multiple-visit therapy group,^{24,25,29} these procedures were not associated with any reduction in the frequency of postobturation pain compared with the single-visit group. For those in which no medication was used,^{23,26,27,30} it was impossible to establish a relationship with the frequency of postobturation pain in either of the groups. For all the endpoints, analysis of the funnel plot showed movement from the center of the plot toward the single-visit group, suggesting a publication bias in this direction.

DISCUSSION

This meta-analysis found that the single-visit endodontic therapy was better than multiple visits only with regard to the postobturation pain. To the others factors compared – periapical repair and microbiological control – there were no differences between the therapies. These results are in agreement with the findings of another meta-analysis.^{6,7,31}

The differentiating factor in this study was the analysis conducted on the effects of microbiological control. In this respect, the frequency of positive samples before obturation was greater in the single-visit therapy group compared with the multiple-visit group.^{8,9}

Although these results appear favorable to single-visit endodontic treatment, constructing a body of clinical

evidence sufficient to enable any given practice to be changed demands extensive scientific research with the meticulously strong methodology. Critical analysis of the clinical studies included in this paper constitutes an important step forward, since there are many possible biases to the internal validity of a study design, compromising its external validity. Furthermore, the variety of clinical protocols and the range of professional experience may affect the results of endodontic therapy.^{32,33}

The presence of a publication bias is probably associated with the small sample size of some of the studies, which contributed negatively to the meta-analysis with wide standard deviations. In addition, there is the investigators need to seek recognition for new technologies in a consolidation process. Therefore, RCTs with larger sample sizes¹⁵ are necessary.

From a methodological point of view, forming groups with the objective of minimizing the difference between them and calculating the minimum sample size necessary are important steps that allow different results to be identified at a certain level of statistical significance. In the studies that analyzed the effect of periapical repair, use of the minimization method was evident as well as the reference of 0.5 units as the baseline periapical index, with a clinically significant minimal mean difference between the groups.

The discontinuation rate is another aspect that may affect the balance between the groups and therefore requires analysis. Except for three studies,^{14,16,24} all other had discontinuation rates <10%, an index acceptable. The examiners were blinded in nine studies^{14-18,26,28,29} and were calibrated before initiation of the study in four.^{15,16,18,33}

The clinical protocols differed with respect to the types of professional involved (undergraduate students to experienced endodontists), instrumentation and obturation

techniques, concentrations of sodium hypochlorite, use of intracanal medication in the control group, etc. There was an important variation in the protocol of two of the studies^{13,14} in which the intracanal medicament iodine-potassium iodide (IKI) was used in association with a smear layer removed in the test group.

The study conducted by Kvist et al²⁰ evaluated microbiological control and reported fewer positive samples before obturation in the experimental group (28.8%) compared with the control group (36.3%). The previous studies have reported a poorer antimicrobiological effect of IKI compared with the use of calcium hydroxide as an intracanal medicament between visits.^{15,34} However, in the study conducted by Kvist et al,²⁰ its use as an intracanal medicament for a short period had a positive effect, probably due to the association with a substance, which removes the smear layer.

Other features of the microbiological procedures may affect the sensitivity of the studies and need to be identified: (1) Description of the technique used for asepsis. All the studies in this meta-analysis fulfilled this requirement. (2) The time taken to process the specimens must be specified. The studies reported times of 15 minutes,^{17,21} 2 hours,²² and 24 hours.²⁰ (3) The type of culture medium must be mentioned –anaerobic and aerobic^{17,20,21} or only anaerobic.²²

Postobturation pain is a very important issue and a short-term indicator; however, it is a highly subjective aspect, affected by psychological and physical factors. Its evaluation is also subject to great variation, particularly when the sample is composed of symptomatic participants and when different pain evaluation scales are used. Some studies classified pain in presence or absence, others ranked second intensity levels (no pain, slight, moderate, and intense), which is more interesting from a clinical viewpoint.

Decision-making in clinical dentistry should be based on biological criteria, in the skill of the professional performing the work, on the patient's comfort and on optimizing time and resources, particularly in public health care services.

Since there was no significant difference between single and multiple visits in the success rate of periapical repair, the most important parameter in endodontic therapy, and the frequency of postobturation pain was lower in the single-visit group, it may be reasonable to suggest that single visit endodontic therapy is adopted in public oral health care services.

Considering the methodological limitations of the studies and the advantages of adopting this technology to increase access to treatment in public health care services, it is recommended clinical trials with rigorous

methodological criteria and investigated the access and cost-effectiveness of these two techniques.

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