

**One visit versus two visits endodontic treatment
- a review of literature**

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ABSTRACT

Background

Conventionally endodontic treatment has been performed during multiple visits with antimicrobial dressing between the cleansing and filling of the root. It is debated whether the antimicrobial dressing leads to a higher success rate of the treatment or if it is equal to cleansing and filling the canal during the same visit, which would be more convenient for the patient and the clinician.

Aim

The aim of this study was to compile the available articles comparing the success rates of single-visit and multiple-visit treatments.

Methods

Combinations of MeSH-terms were used in different databases to find relevant articles. They were sorted against inclusion- and exclusion criteria which resulted in ten final articles.

Results

Seven of the final articles concluded that there was no significant difference between one visit and multiple visit treatment. One article had significantly higher success rate for single visit and one article had significantly higher success rate for treatment during multiple visits.

Conclusions

Out of the ten final articles, only two showed a difference in success rate between one visit and two visits for endodontic treatment. The included systematic reviews have the highest scientific evidence and concluded no difference, based on our study. Our conclusion is that no difference in periapical healing can be demonstrated between the two methods. The clinician should decide based on available scientific knowledge and clinical experience what the best treatment is for each individual case.

INTRODUCTION

Endodontics is about treatment and prognosis regarding the disease status of the dental pulp. The goal of root treatment is to treat infection and inflammation in the pulpal and periapical tissues to achieve long lasting pain-relief, comfort, function and aesthetics (1). Examples of infectious injuries are caries, cracks, fissures and leaky materials. Aseptic damage is for example trauma. When the pulp becomes infected, a cascade of reactions in the immune system occurs to kill the bacteria (1).

Endodontic microbiology

The inflammation of the pulp gives a widening of the vessels and the pressure in the pulp increases. If the high pressure persists, it causes the tooth's pulp to go into necrosis. The high pressure is usually associated with toothache. The purpose of the root-canal treatment is to prevent and treat diseases in the pulp, so that the symptoms subside and preventing the root canal from being contaminated. In necrotic pulps preservative root treatment is always done, which involves removal of the necrotic pulp, chemo-mechanical cleaning and shaping of the canal, antimicrobial treatment and a final three-dimensional obturation of the root canal. Bacterial leakage and reinfection can be prevented by making a dense filling and sealing of the root canal (2).

The goal for a successful root-canal treatment is to eliminate bacteria by an aseptic approach, with cofferdam and sterile instruments, and prevent reinfection for a symptom-free functioning tooth without signs of root canal infection (2).

The root canal system is a complex network with so-called apex components with connections between the root channels. This complicates the technical work of achieving total elimination of bacteria (2).

Pathology in the pulp and periapical tissues

During a root canal infection, the area around the apex of the tooth can be affected by an inflammation, an apical periodontitis. The peri-radicular response may eventually lead to extensive bone-destruction due to the microbial factors, the host's immune response and the duration. Treatment of apical periodontitis is aimed at eliminating the total number of microbes if possible, to the extent that healing can occur, and to prevent reinfection through a tight closure of the root canal to prevent bacterial leakage (3).

The prognosis for total healing of teeth with periapical periodontitis after endodontic treatment is 10-15% lower than for teeth without periapical periodontitis (4).

Studies have shown that root canals that have negative bacterial values before root filling have a higher rate of success, and that root canals with positive bacterial samples have about 10-15% lower success rate (5). In bacterial samples it is essential that the bacteria are cultured properly, as most of the bacteria are anaerobic (5).

Cleaning and shaping

When treating root canals, the goal is to change the ecological environment to make it less beneficial for the microbes. In mechanical cleansing, the infected tissue is removed, and the canal is irrigated with antimicrobial solution, Sodiumhypochlorite (NaOCl), where most of the bacteria die. Sodiumhypochlorite has a broad spectrum and is also effective in low concentrations. In order to further reduce the number of bacteria an antimicrobial dressing, usually calcium hydroxide, is used after cleansing before obturation.

Intracanal dressing

With an alkaline pH of about 12.5 calcium hydroxide is an effective antimicrobial substance that acts by releasing hydroxyl-ions in an aqueous solution. Calcium hydroxide also has a tissue dissolving ability and can also stimulate the odontoblasts to form tertiary dentin. It has been shown that it can stimulate root formation of a non-closed apex, prevent root-resorption of traumatized teeth and a healing of roots with periapical periodontitis. Calcium hydroxide appears antimicrobial in most bacteria but there are studies showing that *Enterococcus faecalis* and *Candida albicans* are particularly resistant because of their high pH-tolerance and their ability to move through dental tubules so that they are not reached by the high concentration of calcium hydroxide. Therefore, a disadvantage of calcium hydroxide is the risk of increased growth of resistant microorganisms (6).

The outer wall of the gram-negative bacteria is made mostly out of Lipopolysaccharide (LPS) that is an endotoxin and a virulence factor. It causes the inflammatory response that is the fundamental cause of apical periodontitis and helps to maintain further bone destruction. Therefore, it is important to disinfect the root canal properly during root canal treatment for a successful healing of the periapical tissue. This is obtained by chemo-mechanical preparation and later a three-dimensional obturation of the root-canal, with or without an intermediate antimicrobial medication before obturation (7).

Conventional root treatment is performed during several visits with an antimicrobial dressing between cleansing and root filling in order to eliminate the bacteria and achieve higher success rates (5). Nevertheless, in recent years, a debate has been raised about the need to divide the treatment on several occasions instead of performing cleaning and root filling during one visit (8).

One visit and two visit endodontic treatment

The benefits of one visit treatment include fewer visits, lower expense for the clinic and the patient, less time-consuming and possibly even less post-operative pain. It is more convenient for the patient who does not need to come for a second appointment for placement of cofferdam and local anaesthetics (3, 8, 9).

In the scientific community there is a dispute about whether treatment should be performed in a single visit. It is alleged that one visit treatment can be beneficial for everyone involved, and for instance the recontamination of non-vital teeth through the temporary filling between treatments can be avoided. However, some believe that the use of an antibacterial dressing in the canal is of utmost importance for infection control in the canal, especially in the case of non-vital teeth (10).

Studies have shown that cleansing and irrigating with Natriumhypochlorite can result in 40-60% of the teeth becoming bacteria free. A dressing of calcium hydroxide in the canals can increase the percentage to 80-100% (11).

The results of these studies have been the fundamental reason for treatment during multiple visits. The treatment course for single-visit endodontic treatment is mechanical cleansing and irrigation with antibacterial solution followed by a root filling where the sealer and the Zinc ions in the gutta-percha have an antimicrobial effect. The bacteria get less access to nutrition and space and can no longer reproduce in the same way after obturation (11).

There are several types of medication that can be used as an antimicrobial insert but the most used is calcium hydroxide. The development of new technologies such as microscopes, apex locators, engine-driven Nickel-titanium files and the use of cofferdam have facilitated the endodontic treatment and made it more time efficient, but it is still unclear whether it affects the prognosis and the outcome positively (12).

Evaluation of Endodontic Outcomes

To assess whether a root treatment has succeeded, failed or given an unchanged result, radiological images are taken during follow-up and compared to baseline. The radiographic interpretation is subjective and differs between different individuals; the subjective perception also changes over time. This has led to the creation of criteria, created to facilitate the assessment of the treatment outcome and the assessment of the prognosis (2).

Success of the endodontic treatment can be measured in multiple different ways with varying criteria. In 1956, Larz Strindberg gave rise to the so-called Strindberg's criteria. It is a scale based on the patient's symptoms, clinical findings and radiographic information. When using Strindberg's criteria, the endodontic treatment is only evaluated as successful when an absence of apical periodontitis is seen and the structures are normal, or a widened periodontal is seen just around excess root filling. When these criteria are not fulfilled the treatment is considered unsuccessful (13).

Later in 1986, Ørstavik created a new index consisting of five radiological images sorted on a scale from a healthy tooth with healthy periapical tissues to a tooth with extensive periapical destruction (Figure 1). This periapical index (PAI) with a scale from 1 to 5 is a useful tool for therapists to calibrate more similarly regarding the perception of X-ray images (14).

OBJECTIVE

The aim of this study was to review and analyse the available articles comparing the success rates of single-visit and multiple-visit treatments.

METHODS

In order to find relevant articles regarding one-visit versus two-visit endodontic treatment we searched for literature in three different databases; Cochrane, PubMed and Web of Science (WoS). The strategy for our literature search was to use different combinations of keywords by searching for MeSH-terms; endodontic treatment, outcome, success, single visit, one visit, two visit, multiple visit, single versus multiple visit and one visit versus two visits (Table 1).

Randomized controlled trials in humans, with permanent necrotic teeth and an existent bone destruction due to apical periodontitis were included. The articles had to be written in English or Swedish comparing endodontic treatment in one versus two visits with a follow-up after minimum one year.

The search resulted in a total of 600 (PubMed + Cochrane + WoS) articles, 137 articles in Cochrane, 231 articles in PubMed and 232 articles in Web of Science. After the exclusion of duplicates there were 198 articles remaining (Figure 2). Preliminary two independent reviewers (E.S. and P.R.) scanned the titles and excluded articles for not matching the subject. Secondary the abstracts were scanned by the agreed inclusion and exclusion criteria (Table 2). In cases of uncertainty the articles were discussed in the pair (E.S. and P.R.) until consensus was reached. A third party (tutor M.E.) would be consulted if there were any further doubts. Both clinical trials, meta-analysis and systematic reviews were included, however the studies had to fulfil all the set criteria to be included. Altogether 591 articles were excluded, seven articles because of the full text was not available. A total of ten articles remained after screening and were thoroughly reviewed.

The final number of articles that were included in the review were inserted in an Excel-chart and categorized by author, publish-year, type of study, number of teeth, success criteria, success rate and conclusion regarding which treatment method had the best outcome regarding apical healing. The outcome variables were healed or not healed according the two established criteria, Peri Apical Index (PAI) and Strindberg`s criteria.

ETHICAL REFLECTION

To get a broad search of articles, we searched for articles in three different databases with a variety of keywords by searching for as many combinations as possible. The items that were included were selected based on our inclusion and exclusion criteria. We were two people who read and interpreted the articles independently of each other to get as objective an interpretation as possible.

Literary reviews are important for evaluating and updating outcome of published scientific articles to provide an overview at state of the art of the topic. Dental professionals have a responsibility to work from an evidence-based scientific perspective and therefore constantly update themselves on new scientific findings in order to give patients the best possible treatment. Therefore, literary overviews are of great importance in these contexts.

RESULTS

A total of 10 articles were fully read in full text and analysed. The publish year of the selected articles ranged from year 1999 to 2017. Out of the finally included articles 1 was a systematic review, 1 an overview of systematic reviews, 5 RCT studies and 3 meta-analyses.

Systematic review

The systematic review by Y. Su et.al. (15) included ten RCT-studies and concluded that there was no significant difference between one visit versus two visit endodontic treatment.

The included overview of systematic reviews by MS. Moreira et.al. (16) included eight systematic reviews and the analysis of the articles and concluded that single and multiple visits had similar success rates.

RCT-studies

The follow up visits ranged from 12 months to five years between the studies. One of the RCT studies had a 10% higher success rate for two visits compared to one visit.

The success rate for one visit varied from 64% to 76% whereas for two visits between 70% and 76%.

PAI was the method used to determine apical healing in six of the articles (Figure 1).

Modified Strindberg classification was used in one of the articles. In one of the articles the presence or absence of periapical repair was used to determine the success of the treatment.

The number of total teeth in each RCT-study are shown in the table (Table 3).

Meta-analysis

One meta-analysis concluded that single visit treatment had a significantly higher success rate by 6,3% compared to multiple visit treatment. The other two included meta-analyses showed no significant difference between one visit and two visit endodontic treatment.

In total eight of the articles concluded that there were no significant differences between one visit and multiple visit endodontic treatment in regards of success rate. The medicaments used as a dressing were left in the canal for one week in all the studies except for one study where it was left for two to four weeks.

Four of the articles did not specify the success rate of the necrotic teeth included. Table 3 is an overview of the final RCT-studies included in the study.

The number of teeth included in the RCT studies ranged from 38 to 89 teeth.

DISCUSSION

The main result was that most of the included articles reported no significant difference between one visit versus two visits endodontic treatment.

There are several factors other than the number of visits that could affect the outcome of success in these studies. Studies have shown that the prognosis for healing is reduced by 10 to 15% if apical periodontitis occurs compared to teeth without an apical destruction (17).

The success rate will generally be lower for teeth with more than one root canal; therefore, it would be of significance to include the number of multiple-rooted teeth in each group of one visit and two visits. The number of roots is believed to have significance where a study has shown that single-rooted teeth have an improved prognosis compared to multi-rooted teeth (18). This sounds reasonable because multi-rooted teeth have a more complex and extensive reticular network where the elimination of bacteria can be more difficult due to the tooth's anatomy and accessibility.

Another factor that can have a significance for the outcome of an endodontic treatment is the size of the periapical destruction. The size of the apical lesion has been found to be important for healing, where lesions with a diameter above 5 mm have been found to have a worse prognosis in comparison with lesions that have a diameter below 5 mm (19). However, this conclusion is not consistent throughout all studies (20, 21, 22).

Ideally it would be possible to make both groups be similar in terms of the type of teeth, quality of the root filling and the size of the periapical destruction before treatment to come to the conclusion that the number of treatments was the main factor to determine the success of the treatment.

In the results a trend can be seen that two visits generally have a higher success rate than one visit, however a conclusion cannot be drawn from this find since it is not significantly relevant.

The purpose of the study was to compare the two non-surgical endodontic treatment methods used after the diagnosis necrotic pulp and apical periodontitis. One method, a so called one visit, where the tooth is obturated directly after cleaning and shaping, versus the conventional two visits where the obturation is done later after the action of a bactericidal dressing between treatment sessions.

The causal link between the presence of bacteria and apical periodontitis was demonstrated already in 1965 by Kakehashi et. al. and has been confirmed in other studies since, for example by Sundqvist et al. in 1976 (23, 24). Therefore, the purpose of the treatment of apical periodontitis is to eliminate all bacteria for the bone to heal and the periodontal structure to be recreated (25).

The biological processes that give rise to the healing of the periapical tissues are dynamic and its slow progress requires enough time before the outcome of the treatment can be assessed (26, 27).

Conclusions that are drawn shortly after treatment can therefore be considered distorted and not truthful regarding the final prognosis (28).

Of the included RCT studies, four out of five have a follow-up period of one year and one has a follow-up that extends over two years. Reduced radiolucency can be seen already after a few weeks and more so after 3-6 months (29). Studies have concluded that one year is enough time to predict the outcome of the treatment (30). In addition, the risk of losing patients to follow-up due to, for example, migration, death, non-interest etc. increases with longer follow-up times. The treatment follow-up should be at least 4 years due to studies showing that the healing of periapical lesions can take from 6 months up to 4-5 years (5).

If the follow-up is extended to four years, an even more stable healing result is obtained and the healing rate can increase by up to 16% (26, 31). Long follow-up periods, however, require enough financial resources and as said increase the risk of loss during follow-up. Sample size varied between 42 and 89 teeth in the RCT studies, which is apparently low but compared to other equivalent well-quoted clinical studies, the number is at approximately the same level (32, 33). To increase the sample size, we decided to include systematic reviews and meta-analyses that matched our criteria.

Most of the studies included using the PAI index, one study used modified Strindberg criteria. All dentists who performed the treatments calibrated themselves for as similar a judgement as possible and were blinded to avoid bias. A small periapical clarification can mean either that a small number of bacteria remains in the canal and that a healing will not occur without further treatment, but it can also mean that it is bacteria-free and that the clearing will disappear within 5 years.

Strindberg's criteria, on the other hand, allow only a slightly widened periodontal gap around any filling surplus in order to be regarded as a successful treatment and is therefore considered stricter. A weakness of the PAI index is that it is a graded scale which means that there is more room for interpretation, this could in turn possibly significantly affect the result.

One visit requires fewer visits and is thus more comfortable for the patient, at the same time it is shorter treatment time and cost for the clinic. Despite this, the aim of the endodontic treatment should be a good treatment with high quality rather than the aim of as few visits as possible. Long-term profit is made for both the patient, the clinic and the care if a treatment does not need to be revised as a result of failed treatment results. A high clinical and technical standard is therefore sought in the first place.

CONCLUSION

Out of the 10 final articles, only 2 articles showed a difference in success rate between one visit and two visit endodontic treatment. Since the included systematic reviews have the highest scientific evidence, and in these papers no difference could be showed, our conclusion based on current study is that no difference in periapical healing can be demonstrated when comparing the two methods.

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Table 1 Mesh-terms (MeSH) and databases used when searching for article

Database	MeSH* terms
Pub Med	endodontic treatment, outcome, success, single visit, one visit, two visit, multiple visit, single versus multiple visit and one visit versus two visits
Cochrane	endodontic treatment, outcome, success, single visit, one visit, two visit, multiple visit, single versus multiple visit and one visit versus two visits
Web of Science	endodontic treatment, outcome, success, single visit, one visit, two visit, multiple visit, single versus multiple visit and one visit versus two visits

Table 2. Overview of the exclusion and inclusion criteria used.

Inclusion criteria	Exclusion criteria
Necrotic pulps with periapical destructions	Vital pulps
Studies only including humans	Animal studies
Clinical in vivo studies	In vitro studies
Articles written in English and Swedish	Articles not written in English or Swedish
Full text available	No full text available
At least one-year follow-up	Less than one-year follow-up
Permanent teeth	Primary teeth
Closed apices	Open apices
RCT-studies	
Primary treatments	Retreatments
Endodontic treatment 1 or 2 visits	
Prospective study, systematic review article or meta-analysis	
Comparing study	
	Duplicates
	Surgical treatments

Table 3. Overview over the reviewed articles.

Author, year	Article type	n (total teeth)	n (one visit)	n (multiple visit)	Time (Months)	Criteria	Medicament (Weeks)	success rate one visit	success rate multiple visit	Conclusion
Almeida, D.O., Chaves, S. C. Souza, R. A. Soares, F. F. 2017	Meta analysis									No significant difference
Moreira, M.S., Anuar, Asns Tedesco, T. K., dos Santos, M., Morimoto, S. 2017	Overview of systematic reviews									No significant difference
Schwendicke, F, Gostemeyer, G. 2017	Meta analysis									No significant difference
Gill, G.S., Bhuyan, A. C. Kalita, C., Das, L., Katak, R., Bhuyan, D. 2016	RCT	42	21	21	12	PAI - 2	1	76,2% (16 teeth)	76,2% (16 teeth)	No significant difference
Su, Y, Wang, C., Ye, L. 2011	Systematic review	436	237	199	6-24		1-7	80,2% (190 teeth)	79,9% (159 teeth)	No significant difference
Penesis, V.A., Fitzgerald, P. I., Fayad, M. I., Wenckus, C. S., BeGole, E. A., Johnson, B. R. 2008	RCT		33	30	12	PAI - 2	2-4	67% (22 teeth)	70% (21 teeth)	No significant difference
Molander, A, Warfvinge, J. Reit, C., Kvist, T. 2007	RCT	89	49	40	24	modified Strindbergs	1	65% (32 teeth)	75% (30 teeth)	No significant difference
Sathorn, C, Parashos, P., Messer, H. H. 2005	Meta analysis									One visit
Waltimo, T, Trope, M., Haapasalo, M., Orstavik, D. 2005	RCT	38	20	18	12	PAI - reduction	1			No significant difference
Trope, M, Delano, E. O., Orstavik, D. 1999	RCT	79	61	18	12	PAI - 2	1	64%	74%	Multiple visit

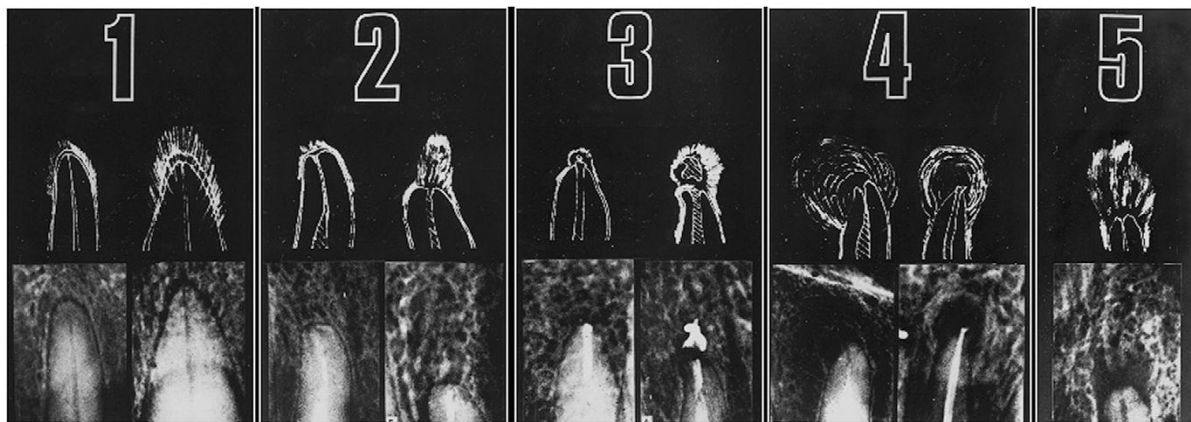


Figure 1.

Reference radiographs with correlative drawings and their associated PAI scores.

Ørstavik D, Kerekes K, Eriksen HM. The periapical index: A scoring system for radiographic assessment of apical periodontitis. *Endod Dent Traumatol* 1986; 2: 20-34.

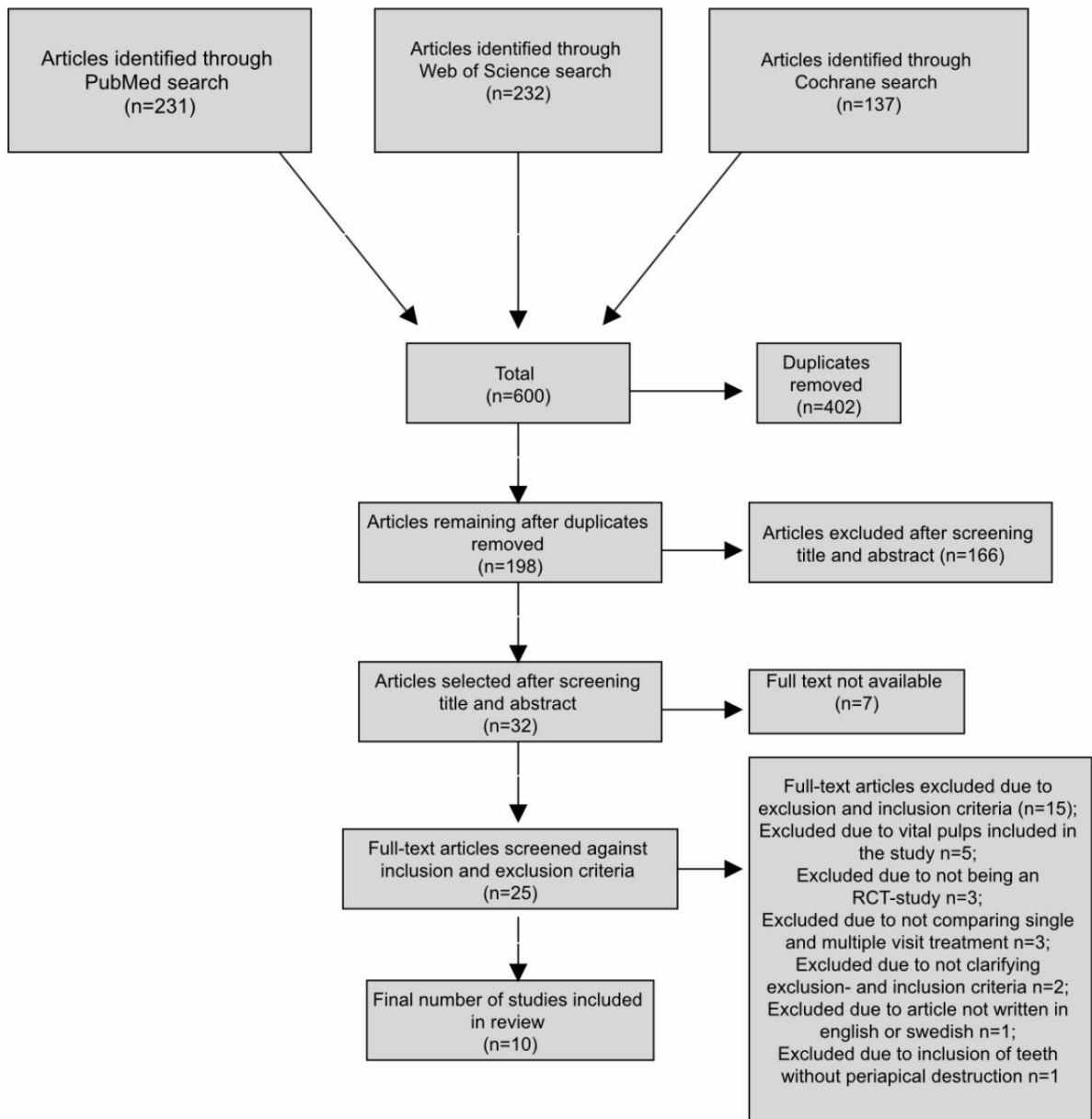


Figure 2. Flowchart of the literature search showing how the articles were included versus excluded