Review Article

Effect of Apical Patency on Postoperative Pain: A Meta-analysis

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Abstract

Introduction: This systematic review and meta-analysis assessed the available evidence regarding the effect of apical patency versus nonpatency on postendodontic pain in adult patients. **Methods:** The study adhered strictly to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. PubMed, Scopus, MEDLINE via Ovid, Google Scholar, and the Web of Science databases were searched up to April 2018 to retrieve the most relevant studies. Two authors evaluated the studies for eligibility criteria and assessed the risk of bias using the Cochrane tool. The weighted means were calculated using a fixed effects model. When statistically significant ($P < .1$) heterogeneity was detected, a random effects model was used to assess the significance of treatment effects. **Results:** Five studies were identified for this systematic review; 4 were included in the meta-analyses. Two studies revealed a low risk of bias, whereas 3 studies revealed a high risk of bias. Because of the significant heterogeneity between studies, a random effects model was used. The meta-analysis showed that the apical patency resulted in less postoperative pain compared with nonpatency, but the difference was not statistically significant. Moreover, no statistically significant difference was found with regard to analgesic consumption. **Conclusions:** Considering the limitations of this study, it was concluded that maintaining apical patency during routine endodontic treatment was not associated with an increased incidence of postoperative pain in adult patients. *(J Endod 2018;■:1–7)*

Key Words

Apical patency, postoperative pain, root canal treatment, systematic review

Significance

This systematic review and meta-analysis provides some evidence that apical patency is not associated with an increase in postoperative pain.

In the context of endodontic treatment, the accumulation of soft tissue remnants or dentinal debris in the apical region of the root canal is a common event that might cause blockage of its apical third. This can be avoided if the patency of the apical foramen is maintained during the shaping procedure (1). In order to avoid blockage of the apical third, Buchanan (2) introduced the concept of apical patency (AP) and recommended using a patency file during instrumentation. A patency file is a small flexible K-file (usually a size #10 or #15) that can be passively moved through the apical constriction without widening it. It passes through the canal 1 mm beyond the already set working length (3).

Primarily, a patency file is used to negotiate root canals. It minimizes the risk of losing the working length, reduces canal transportation and other accidents such as ledges and apical perforations, improves the tactile sensation of the clinician during apical shaping (2), eases irrigation in the apical third of the canal, and allows maintenance of the anatomy of the apical constriction (4). Although this technique facilitates intracanal irrigations and medicaments to gain access to the apical foramen and periapical tissues (5), there is a potential risk of apical extrusion of infected debris secondary to the mechanical instrumentation beyond the apical foramen that may cause postoperative pain (6). Therefore, the concept of using a patency file has been controversial and conflicting (7). Although many authors recommend maintaining AP, others suggest avoiding it, with each team having their own justifications.

The conclusions drawn from classic histologic studies (8, 9) advised against mechanical irritation of the foramen and beyond with patency instruments; repeated passing of small patency files through the apex can cause an acute apical inflammatory response (3). Vera et al (10) indicated that maintaining AP improves canal irrigation of the apical third. In line with that, Siqueira (11) reported that maintaining AP may help remove bacteria present around the apical foramen in teeth with necrotic pulp.

Typically, postoperative pain is a frequent complication associated with root canal treatment, with a reported incidence ranging from 3%–58% (12). Although some randomized controlled trials (RCTs) found no significant influence of maintaining AP on postoperative pain (13–15), others reported significantly less postoperative pain with AP (16, 17). Apart from postoperative pain, a prospective study indicated that the AP

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technique was identified as a factor possibly associated with higher clinical success rates (18).

Obviously, based on the findings from previous research, the debates about maintaining or avoiding AP seem equivocal and shrouded in controversies. Hence, the purpose of this systematic review and meta-analysis was to critically appraise and summarize the available evidence on the effect of maintaining AP during endodontic therapy considering postoperative pain as the main outcome.

Materials and Methods

The protocol for this systematic review was developed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (19) and was registered in the PROSPERO database (registration number: CRD42018090602). The focused research question was as follows: "Does AP decrease or increase postendodontic pain in adult patients?"

Search Strategy

PubMed, Scopus, MEDLINE via Ovid, Google Scholar, and Web of Science were the databases that were searched up to April 2018. The following key words and Medical Subject Heading terms were used: (Apical patency) AND (Patency file) AND (Post-operative pain) AND (Post endodontic pain) AND (Root canal treatment).

Inclusion and Exclusion Criteria

The present systematic review and meta-analysis were set to include randomized controlled trials and prospective clinical studies that were published in English. Observational, case control, case series, and *in vitro* studies were excluded. The studies were included provided that the following PICO components were applied: Population: patients undergoing root canal therapy; Intervention: AP technique; Comparison: nonapical patency technique (NAP); and Outcomes: the primary outcome was postoperative pain, whereas the analgesic consumption was considered as a secondary outcome.

Data Extraction

Studies that fulfilled the inclusion criteria were processed for data extraction. Two authors (S.A. and S.A.A.) independently extracted the necessary information. The following data were extracted from each study: author and year of the article, country, study design, numbers of patients, types of teeth, endodontic treatment (irrigation, instrumentation, and number of sessions), preoperative symptoms, assessment (method and intervals), and results.

Quality Assessment

The risk of bias was assessed according to Cochrane Collaboration tools (20). Each study was scored as high (−), low (+), or unclear (?) based on the following parameters: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias.

Statistical Analyses

Measures of Treatment Effect. The effect estimate of an intervention was expressed as mean differences (MDs); means and standard deviations were used to summarize the data for each group with 95% confidence intervals (Cis).

Data Synthesis and Assessment of Heterogeneity. All statistical tests were performed using the RevMan software (version 5.3; Cochrane, London, UK). The significance of any variations in the estimates of the treatment effects from the different trials was assessed by means of the Cochran test for heterogeneity, and heterogeneity was considered significant if the P value was <.1. Heterogeneity between the studies was assessed using the I^2 statistic, which describes the variation percentage caused by heterogeneity rather than chance (21). An I^2 value over 50% was considered as moderate to high heterogeneity.

Meta-analyses were conducted whenever studies of similar comparisons reported the same outcome measures. The MD for pain intensity was calculated and compared between the 2 studied interventions (AP and NAP). CIs were set at 95%.

Weighted means across the studies were calculated using a fixed effects model. When statistically significant (P < .1) heterogeneity was detected, a random effects model was used to assess the significance of the treatment effects.

Results

Search and Selection of Articles

Figure 1 shows the process of retrieving and screening the studies for inclusion in this systematic review and meta-analysis. The search strategy yielded 62 studies from all databases, and 36 studies were excluded for being duplicates. Meanwhile, 26 studies had their titles and abstracts screened for relevancy, 18 of which were irrelevant and hence excluded. The remaining studies (n = 8) were critically reviewed independently by 2 reviewers (S.A. and S.A.A.) for eligibility. At this stage, 3 studies were excluded because of the absence of a comparison (nonpatency) group or because they reported other outcomes. Finally, 5 studies (13–17) met the inclusion criteria and were processed into the qualitative analysis. Four studies on postoperative pain (using a numeric scale) (13–15, 17) were included in the quantitative meta-analyses; 1 study (16) was not included because postoperative pain was measured using an ordinal scale.

Quality Assessment of Risk of Bias

Figure 2 shows the quality assessment of the selected studies. The studies by Yaylali et al (17) and Arora et al (14) showed a low risk of bias, whereas the remaining studies (13, 15, 16) showed a high risk of bias. The highest fractions of being a high risk of bias were attributed to the selection, performance, and detection bias.

Characteristics of the Included Studies (Clinical Parameters)

The characteristics of the included studies are presented in Table 1. The study by Arias et al (16) was not included in the quantitative meta-analyses because pain outcome was measured using an ordinal scale. Arias et al's study also had insufficient data; they did not report data regarding postoperative pain for the patency and nonpatency groups. Regrettably, the authors also did not respond to our communications in which we requested more details regarding their results. All of the included studies recruited samples of AP/NAP ranging from 32/33 to 160/160. Three studies (13, 15, 16) treated anterior and posterior teeth, 1 study treated first lower molars (14), and another treated upper and lower molars (17). Two studies (14, 17) combined sodium hypochlorite (NaOCl) with EDTA for irrigation, 1 study (15) added normal saline, and another study (13) used NaOCl only.

Rotary instrumentation was performed in 3 studies (14, 15, 17), 1 study combined rotary and manual instrumentation (13), and another (16) used manual instrumentation only. Root canal treatment was finished either in a single visit (15–17) or 2 visits (13, 14). Three studies (13, 15, 16) included vital and nonvital (necrotic) teeth, whereas the others (14, 17) included nonvital (necrotic) teeth with