

Does Maintaining Apical Patency during Instrumentation Increase Postoperative Pain or Flare-up Rate after Nonsurgical Root Canal Treatment? A Systematic Review of Randomized Controlled Trials

Ibrahim Ethem Yaylali, PhD,* Gözde Kandemir Demirci, PhD,[†] Safa Kurnaz, DDS,[‡] Gul Celik, PhD,[§] Buglem Ureyen Kaya, PhD,[§] and Yasar Meric Tunca, PhD^{||}

Abstract

Introduction: The concept of maintaining apical patency (AP) is a controversial issue in endodontics. The primary objectives of this systematic review of randomized controlled trials (RCTs) were to determine the influence of maintaining AP during instrumentation on postoperative pain severity and the prevalence of flare-ups. A second objective was to assess the effect of maintaining AP on the use of analgesics. **Methods:** RCTs and controlled clinical trials were searched for in MEDLINE (Ovid), Embase (Ovid), and the Cochrane Library. Four reviewers independently screened all identified articles for eligibility. The included studies were assessed for bias using the Cochrane Risk of Bias Tool. The Grading of Recommendations Assessment, Development and Evaluation approach was used to rate the quality of the body of evidence. Because of the considerable heterogeneity of the studies, a meta-analysis was not possible. Therefore, the results were analyzed narratively. **Results:** Five RCTs that included a total of 848 patients were found eligible and included in the review. An assessment of the risk of bias in the included studies provided results that classified the studies as showing a low risk ($n = 1$), high risk ($n = 1$), or unclear risk ($n = 3$) of bias. The available evidence indicated that maintaining AP (1) did not increase postoperative pain in teeth with nonvital pulp, (2) did not increase postoperative pain in teeth with vital pulp, and (3) did not cause (0%) flare-ups. The available evidence also indicated that maintaining AP did not increase analgesic use. The available evidence indicated that maintaining AP did not increase postoperative pain when a single-visit or 2-visit root canal treatment approach was used. **Conclusions:** In light

of the current evidence, maintaining AP does not increase postoperative pain in teeth with vital/nonvital pulp when compared with nonapical patency (low to moderate quality evidence). Furthermore, maintaining AP did not cause flare-ups (low evidence) and did not increase analgesic use (moderate evidence). (*J Endod* 2018; ■:1–9)

Key Words

Apical patency, endodontics, flare-up, postoperative pain, systematic review

Adequate debridement of the root canals, especially in the apical portion, is essential for long-term success in endodontics. However, the removal of organic tissue and microbial load reduction are difficult tasks, especially in the apical portion, because of the ever-increasing complexity of the root canal system, which compromises the action of irrigating solutions and endodontic files (1). Bacteria located in these complex areas may cause apical periodontitis if they obtain nutrients from organic tissue that was not adequately removed (2). Hence, irrigants should penetrate to the apical end of the root canal, which should be kept free of packed debris, to clean the apical portion.

Instrumentation of the apical portion has been considered to be an important step in the cleaning and shaping procedure in endodontic therapy. Simon (3) described the apical area as a critical zone for instrumentation. Spangberg (4) concluded that the last few millimeters that approach the apical foramen are crucial in the instrumentation process. However, during instrumentation, pulpal and dentinal debris can block access to the apical portion of the root canal and cause procedural errors, such as a loss of working length (WL), perforations, apical transportations, and ledge formations (5, 6). One accepted method for avoiding the accumulation of debris and organic tissue is to use a patency file (6, 7). Moreover, molecular analyses have indicated the presence of microbial biofilms not only within the apical portion of the root

Significance

The findings of the review indicated that maintaining apical patency does not increase the incidence of postoperative pain or flare-up rate after nonsurgical endodontic treatment. Furthermore, maintaining apical patency does not increase analgesic consumption.

From the *Department of Dentistry, Military Hospital, Isparta, Turkey; [†]Department of Endodontics, Ege University, Izmir, Turkey; [‡]Department of Endodontics, Dumlupinar University, Kutahya, Turkey; [§]Department of Endodontics, Suleyman Demirel University, Isparta, Turkey; and ^{||}Department of Endodontics, Yakin Dogu University, Mersin, Turkey.

Address requests for reprints to Dr Ibrahim Ethem Yaylali, Department of Dentistry, Military Hospital, 32010 Isparta, Turkey. E-mail address: ibotenring@yahoo.com 0099-2399/\$ - see front matter

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<https://doi.org/10.1016/j.joen.2018.05.002>

Review Article

canal system but also within the apical lesion itself (8, 9). Thus, maintaining patency at the apical end point may help remove the microbial biofilms that are present around the apical foramen in teeth with necrotic pulps (10).

Apical patency (AP), the opposite situation to apical blockage, implies an open communication between the apical canal orifice and the periodontal ligament where a small and flexible file can passively continue through the apical foramen. According to the *Glossary of Endodontic Terms* published by the American Association of Endodontists, AP is defined as a preparation technique in which the apical region of the root canal is maintained as free of debris by recapitulating through the apical constriction with a fine file (11). Recapitulation here refers to the reinsertion of a fine file during canal preparation to keep the apical end clean and patent (11). To maintain AP, a small file is set 1 mm longer than the WL and recapitulated after each instrument to prevent the packing of dentin chips and tissue remnants at the apical end of the root canal system. A flexible K-file (never a Hedstrom file) is inserted passively and intentionally through the apical foramen without binding and widening it (6, 12). The patency file should always be used before irrigation to loosen tissue remnants (12). It has been reported that the use of patency files after irrigation is less effective because dentin chips remain in the apical portion of the canal (6). The size 10 K-file has been reported to be the most popular patency file (13).

The concept of AP is a controversial issue in endodontics (14). Some North American and European dental schools hold that instrumentation should be contained within the root canal (13). Some authors suggest maintaining AP, whereas others have advocated the principle of terminating instrumentation short of the radiographic apex at the apical constriction (3, 15, 16). For example, Buchanan (6) indicated that maintaining AP minimizes the risk of a loss of WL. In their *in vivo* study, Vera et al (17) reported that maintaining AP improves the penetration of irrigants into the apical portion by 2 mm. Siqueira (18) put forward that maintaining AP may help remove bacteria present around the apical foramen in teeth with necrotic pulp. It has also been reported that maintaining AP improves the tactile sensation of the operator (6). On the other hand, Seltzer and Naidorf (19) reported that mechanical factors, such as preparation beyond the apical terminus, may contribute to the appearance of a flare-up. It has been claimed that the repeated passing of small patency files through the apex can lead to an acute apical inflammatory response (13). Siqueira (20) indicated that apical extrusion of infected debris that results from mechanical instrumentation is a reason for postoperative pain.

Postoperative pain can be described as any intensity of pain that begins after the initiation of an endodontic treatment, whereas a flare-up is considered to be the initiation or continuation of pain and/or swelling after an endodontic treatment that disturbs the patient's quality of life such that the patient needs additional and unscheduled visits (21, 22).

The efficacy of maintaining AP on postoperative pain and the flare-up rate in teeth with vital/nonvital pulps has been investigated by several randomized controlled trials (RCTs) (23–25); however, the role of maintaining AP on the severity of postoperative pain and the prevalence of flare-ups has not yet been systematically reviewed. Therefore, the primary objectives of this systematic review of RCTs were as follows:

1. In patients with vital/nonvital pulp, does maintaining AP result in a higher severity of postoperative pain compared with nonapical patency (NAP)?
2. In patients with vital/nonvital pulp, does maintaining AP result in a higher prevalence of flare-ups compared with NAP?

The secondary objective of this study was as follows: In patients with vital/nonvital pulp, does maintaining AP lead to the more frequent use of analgesics compared with NAP?

Materials and Methods

The methodology used in this systematic review was in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (26) and the Cochrane Handbook for Systematic Reviews of Intervention (27) guidelines. The review protocol was registered with the International Prospective Register of Systematic Reviews (registration no. CRD42018081673).

Eligibility Criteria

Studies were selected based on the PICO (patient, intervention, comparison, and outcome) framework (28) as follows:

1. Types of studies and participants: RCTs that compared postoperative pain after AP with postoperative pain after NAP were considered eligible for inclusion. There was no restriction on sex. Observational studies, narrative reviews, animal studies, case reports, and studies not evaluating NAP as a control group were excluded.
2. Interventions and comparisons: in the intervention (test) group, AP should have been maintained using a hand file during instrumentation. In the comparison (control) group, AP should not have been maintained.
3. Outcomes: primary outcomes were changes in postoperative pain level from baseline and the prevalence of flare-ups. The secondary outcome was the use of analgesics.

Search Methods for the Identification of Studies

Detailed search strategies were developed as suggested by Yaylali and Alacam (29) for each database that was searched for the identification of studies to be considered for this review. A search strategy was developed for Ovid MEDLINE but revised for each electronic database according to syntax rules and controlled vocabulary. There was no language restriction. We did not identify any non-English articles; therefore, no translation was needed. The MEDLINE search strategy, which included Medical Subject Headings terms and key words, is presented in Table 1.

Electronic Searches. Electronic searches were performed as follows:

1. Ovid MEDLINE and MEDLINE In-Process (1946–present, searched February 28, 2018)
2. Ovid EMBASE (1974–2018 week 09, searched February 28, 2018)
3. Cochrane Central Register of Controlled Trials (2003–2018, Issue 2) in the Cochrane Library (searched February 28, 2018)

Search for Unpublished Studies and Ongoing Studies. A search for unpublished studies was performed to minimize publication bias (29) as follows:

1. US National Institutes of Health Ongoing Trials Register (www.clinicaltrials.org), searched February 28, 2018)
2. EU Clinical Trials Register (EudraCT, 2000–February 28, 2018)
3. OpenGrey (1980–February 28, 2018)

Hand Searching. Hand searching was performed as follows:

1. *Journal of Endodontics* (1975–February 2018)
2. *International Endodontic Journal* (1967–February 2018)
3. *Australian Endodontic Journal* (1967–February 2018)

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