The Effect of Apical Positive and Negative Pressure Irrigation Methods on Postoperative Pain in Mandibular Molar Teeth with Symptomatic Irreversible Pulpitis: A Randomized Clinical Trial

Hüseyin Sinan Topçuoğlu, DDS, PhD, Gamze Topçuoğlu, DDS, PhD,† and Hakan Arslan, DDS, PhD‡*

Abstract

Introduction: This study compared the effect of conventional needle irrigation (positive pressure) and the EndoVac system (Discus Dental, Culver City, CA) (negative pressure) on postoperative pain in mandibular molar teeth with symptomatic irreversible pulpitis. **Methods:** One hundred sixteen patients with symptomatic irreversible pulpitis were selected. Teeth were randomly assigned to 2 groups according to the irrigation methods performed during root canal preparation. In group 1, root canal irrigation was performed using a syringe and a 31-G side-port needle (NaviTip; Ultradent, South Jordan, UT). In group 2, the EndoVac system was used for irrigation. Teeth were then obturated with gutta-percha and a resin-based sealer using the cold lateral compaction technique. The presence of postoperative pain was assessed after 6, 24, 48, and 72 hours and 1 week. **Results:** At 6-, 24-, and 48-hour time intervals, group 1 patients reported more intense postoperative pain than patients in group 2 ($P < .05$). There was no significant difference between the 2 groups at the other time intervals ($P > .05$), and in both groups the intensity of postoperative pain decreased over time. **Conclusions:** Apical positive pressure irrigation caused greater postoperative pain after endodontic therapy of mandibular molar teeth with symptomatic irreversible pulpitis compared with the apical negative pressure irrigation system. *(J Endod 2018;■:1–6)*

Key Words

EndoVac, irrigation, postoperative pain, root canal

Significance

This study showed that the positive pressure irrigation method caused greater postoperative pain than the negative pressure irrigation method after root canal treatment in teeth with symptomatic irreversible pulpitis.

Chemomechanical debridement is an important phase of root canal treatment (RCT). This phase aims to remove pulpal tissues, microorganisms and their by-products, and debris using endodontic instruments and irrigants (1). Several studies have shown that large areas of the main root canal remain untouched by instruments during root canal preparation, especially in the apical part of the root canal (2, 3). Root canal irrigation plays a key role in cleaning and disinfecting areas where the instrument cannot reach during canal preparation (4, 5). Irrigation solutions have traditionally been delivered to the root canal space with positive pressure and needles of different sizes and tip designs (6). Although needle irrigation is the most commonly used technique for root canal irrigation in endodontics, predictable delivery of irrigation solution to the working length (WL) with needle irrigation is not often attained (7). When practitioners apply a pressure that is too low, the irrigant cannot reach close to the WL. However, if they increase the pressure, the irrigant may extrude into periapical tissues from the apical foramen (8). The EndoVac (EV) apical negative pressure irrigation system (Discus Dental, Smart Endodontics, Culver City, CA) was claimed to safely irrigate root canals; this system uses negative pressure in the apical terminus of the root canal to move the irrigation solution through negative pressure gradients (9, 10).

Postoperative pain (PP) is defined as the unpleasant sensation of any degree of pain that occurs after RCT is initiated (11). The development of PP after RCT is usually because of an acute inflammatory response in the periradicular tissues. Several factors may be involved in the development of pain, such as mechanical injury, chemical irritation, and microorganisms (12). Many studies have shown that dentin chips, pulp tissue, microorganisms, and/or irrigants may be extruded into the periradicular tissues during root canal preparation and irrigation procedures. This extrusion into the periapical tissues could cause postoperative discomforts such as pain, swelling, and persistent inflammation (13–15).

From the *Department of Endodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey; †Oral and Dental Health Hospital, Kayseri, Turkey; and ‡Department of Endodontics, Faculty of Dentistry, Ataturk University, Erzurum, Turkey.

Address requests for reprints to Dr Hüseyin Sinan Topçuoğlu, Department of Endodontics, Faculty of Dentistry, Erciyes University, Melikgazi, Kayseri 38039, Turkey. E-mail address: topcuogluhs@hotmail.com

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Previous studies have evaluated the effect of preparation techniques, the number of appointments, and intracanal medicaments on PP during RCT (16–18). There is 1 study evaluating the effect of different irrigation techniques (syringe irrigation and sonic activation) on PP after RCT in molar teeth with symptomatic irreversible pulpitis (19). The present study evaluated the effect of conventional needle irrigation (positive pressure) and the EV system (negative pressure) on PP in mandibular molar teeth with symptomatic irreversible pulpitis. The null hypothesis was that the incidence of PP is not affected by the type of irrigation technique used.

Materials and Methods

This randomized clinical trial was approved by the Ethics Committee of Erciyes University of Medical Sciences, Kayseri, Turkey (585/2017). In this clinical trial, Consolidated Standards of Reporting Trials guidelines were followed (Fig. 1), and the study was registered at www.clinicaltrials.in.th (Thai Clinical Trial Registry identification number: 20180118004). To determine the sample size, a pilot study was conducted. According to the data obtained from the pilot study, the sample size for each group should be a minimum of 45. This value was determined by projecting the power as 0.90, the effect size as 0.854, and the significance level as $\alpha = 0.05$. Finally, 58 participants fitting the inclusion criteria described in the following section in each group were recruited from a pool of patients referred to the department of endodontics for RCT from February 2017 to October 2017, allowing for loss because of no follow-up.

Eligibility Criteria

The inclusion criteria were as follows:

1. Healthy persons between the age group of 18 and 62 years
2. Mandibular molar teeth that were diagnosed with symptomatic irreversible pulpitis were only included
3. Patients with preoperative pain score ranging from moderate to severe (45–100 mm) on a visual analog scale (VAS, 0–100 mm)

The exclusion criteria were:

1. Patients who had taken analgesic or anti-inflammatory drugs within the last 12 hours
2. Pregnancy or lactation
3. Teeth with calcified canals
4. Teeth with periodontal diseases
5. Teeth with sensitive to percussion and palpation
6. Teeth with root resorption
7. Teeth with immature/open apex
8. Teeth with previous RCT

For each tooth, the diagnosis of symptomatic irreversible pulpitis was made from the chief complaint and the clinical examination. Preoperative pain was the main diagnostic sign of symptomatic irreversible pulpitis. Pulp sensitivity was confirmed by a positive response to electric pulp testing and a prolonged response with moderate to severe pain to cold testing. During clinical examination, the teeth were not sensitive to percussion or palpation. Periapical status was examined via periapical radiographs, and radiographic examination revealed healthy periapical tissues. Patients were also given adequate information regarding the required treatment. Participation in the study was voluntary, and written consent was obtained from the patients. Then, 116 patients were randomized into 2 groups by 1 of the investigators according to irrigation methods using the Research Randomizer program (version 4.0; Geoffrey C. Urbaniak and Scott Plous, Lancaster, PA; available at www.randomizer.org). Because of the nature of the interventions, the operator who performed the treatment procedures was not blinded to the interventions. However, the patients were blinded and not informed of the allocation.

Treatment Procedures

An experienced endodontist performed all RCT procedures in a single visit. Teeth were anesthetized with a local anesthetic solution containing 4% articaine with 1:200,000 epinephrine (Ultracaine DS Fort; Hoechst-Marion Roussel, Frankfurt, Germany). After rubber dam isolation, the cavity access was prepared using high-speed burs (Dentsply Maillefer, Ballaigues, Switzerland). Pulp vitality was confirmed visually by the presence of bleeding when entering the pulp chamber. The WL to the apical constriction was confirmed by an electronic apex locator (ProPex Pixi, Dentsply Maillefer) and periapical radiographs. A glide path was established with K-files up to a size #15, and the canals were instrumented with nickel-titanium rotary instruments (Revo-S; Micro-Mega, Besancon, France). The Revo-S files were operated with a torque-controlled electric motor (X-Smart, Dentsply Maillefer) and were used with a rotation speed of 300 rpm and a torque of 0.8 Ncm. Canals were irrigated intermittently with 2.5% sodium hypochlorite (NaOCl) and recapitulated with a size 10 K-type file. The established WL was checked repeatedly throughout the procedure. Depending on the individual tooth, the final apical preparation size was determined as 3 sizes larger than the first file binding at the WL. The irrigation procedure during canal preparation was divided into the following 2 groups:

1. The conventional needle irrigation (CNI) group: in this group, the irrigation protocol during canal preparation was performed with 20 mL 2.5% NaOCl using a syringe and a 31-G double-side port needle (NaviTip; Ultradent, South Jordan, UT) placed 2 mm short of the WL. The final irrigation was performed with 5 mL 17 % EDTA followed by 5 mL distilled water.
2. The EV group: in this group, apical negative pressure irrigation was used. The EndoVac system was used with 20 mL 2.5% NaOCl during canal preparation, and the macrocannula tip was used to deliver irrigation up and down the root canal for 30 seconds. This was followed by 3 cycles of microcannula irrigation. Each cycle of microcannula irrigation consisted of the tip being placed at the full WL for 6 seconds and then withdrawn 2 mm from the full WL for 6 seconds. This process was repeated 5 times during a period of 30 seconds, and the final irrigation was performed with 5 mL 17% EDTA followed by 5 mL distilled water.

In both groups, all teeth were then obturated in the same session with gutta-percha and resin-based sealer (MM-Seal, Micro-Mega) using the cold lateral compaction technique. Radiographs were then taken from different angulations to ensure quality of the obturation. The coronal access cavity was then restored with composite resin (Filtex Z250; 3M ESPE, St Paul, MN), and the occlusion was checked and adjusted. Each patient was given a prescription for ibuprofen (if contraindicated, paracetamol) with instructions to take only if needed for severe pain.

PP Evaluation. PP was assessed with a VAS at 6, 24, 48, and 72 hours and 7 days after RCT completion. The VAS consisted of a 100-mm horizontal ruler with marks every 10 mm and no numbers except a 0 at the first part of the scale and a 10 in the last part of the scale. All participants were trained to use the scale by an investigator blinded to the study groups. The pain levels were classified as no pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), or severe pain (75–100 mm) (20).