

The Effect of Different Irrigation Agitation Techniques on Postoperative Pain in Mandibular Molar Teeth with Symptomatic Irreversible Pulpitis: A Randomized Clinical Trial

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Abstract

Introduction: This study compared the effect of several final irrigation agitation techniques (sonic agitation, passive ultrasonic irrigation, and manual dynamic agitation [MDA]) in comparison with needle irrigation on postoperative pain in mandibular molar teeth with symptomatic irreversible pulpitis. **Methods:** One hundred sixty-eight patients with a single tooth diagnosed as symptomatic irreversible pulpitis were selected. Teeth were randomly assigned to 4 groups based on the final irrigation methods. In group 1 (needle irrigation), irrigation was conducted without agitation with a side-port needle; in group 2, sonic agitation was used; in group 3, passive ultrasonic irrigation was used; and in group 4, MDA was used. 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 the 6- and 24-hour time intervals, group 4 patients reported more intense postoperative pain than those patients in groups 1, 2, and 3 ($P < .05$). There was no significant difference among the groups at the other time intervals ($P > .05$), and in all groups the intensity of postoperative pain decreased over time. **Conclusions:** MDA caused greater postoperative pain after endodontic therapy in mandibular molar teeth with symptomatic irreversible pulpitis compared with the other methods in the first 24 hours. (*J Endod* 2018; ■:1–6)

Root canal irrigation is a key part of successful root canal treatment (RCT). It has several important functions that may vary according to the irrigant used. It reduces friction between the instrument and dentin; improves the cutting effectiveness of the files used; dissolves tissue; cools the file and tooth; and, furthermore, it has both a washing effect and an antimicrobial/antibiofilm effect. Irrigation is also the only way to impact those areas of the root canal wall not touched by mechanical preparation (1, 2).

Conventional manual irrigation with a syringe and needle remains a widely accepted technique in RCT. However, this method has been shown to be incapable of reaching areas that are difficult to access such as the apical and isthmus regions. Thus, different irrigation agitation techniques have been proposed to improve the efficacy of irrigation solutions within the root canal system (3, 4). These techniques include the agitation of irrigation solutions with gutta-percha cones, lasers, brushes, and sonic and ultrasonic devices (5).

Manual dynamic agitation (MDA) has been described as a cost-effective technique for cleaning the walls of the entire root canal. It involves repeated insertion of a well-fitting gutta-percha cone to the working length (WL) of a previously shaped canal. The gutta-percha cone is applied using short, gentle strokes to hydrodynamically displace and activate an irrigant (6). Passive ultrasonic irrigation (PUI) was introduced to increase the effectiveness of canal disinfection by agitating an irrigation solution previously placed inside the canal. An ultrasonic tip is activated in the canal up to the WL and is moved passively in an up-and-down motion to ensure it does not bind with the root canal walls (7).

The EndoActivator (Dentsply Tulsa Dental, Tulsa, OK) is designed to improve the irrigation phase. It is a cordless, battery-powered handpiece with a sonic motor. Its design allows for the safe agitation of intracanal solutions and can produce vigorous intracanal fluid agitation (8). Several etiologic factors are attributed to postoperative pain (PP) including a history of preoperative pain, periapical disease, and extrusion of debris and/or irrigation solution into the periapical tissue (9, 10). Materials extruded into the periapical tissue have been suggested as a major source

Significance

This study showed that manual dynamic agitation caused greater postoperative pain than the needle irrigation, passive ultrasonic irrigation, and sonic agitation techniques after root canal treatment in teeth with symptomatic irreversible pulpitis at the first 24 hours.

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Consort Randomized Clinical Trial

of pain after RCT. It has been stated that irrigation methodologies and devices have an effect on apical extrusion of debris and irrigants (11, 12).

Some studies have evaluated the effect of different variables (ie, the number of appointments, intracanal medicaments, and canal preparation techniques) on PP during the RCT procedure (13–15). However, no study has evaluated the effect of different final irrigation agitation techniques on PP after RCT in molar teeth with symptomatic irreversible pulpitis. Therefore, this study evaluated the effect of needle irrigation (NI) (no agitation), sonic agitation (SA), PUI, and MDA techniques 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 final irrigation agitation technique used.

Materials and Methods

This randomized clinical trial was approved by the Ethics Committee of Erciyes University of Medical Sciences, Kayseri, Turkey (187/2017). In this clinical trial, Consolidated Standards of Reporting Trials guidelines were followed (Fig. 1), and the study was registered at www.clinicaltrials.in.th (TCTR identification number: 20180219003). To determine the sample size, a pilot study was conducted. According to the data obtained from the pilot study conducted on 20 patients, the sample size for each group should be a minimum of 34. This value was determined by projecting the power as 0.80, the effect size as 0.291, and the significance level as 0.05. Finally, 42 participants matching 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 March 2017 to October 2017, allowing for loss because of a lack of follow-up.

Eligibility Criteria

The inclusion criteria were as follows:

1. Healthy persons between the ages of 18 and 60 years
2. Mandibular molar teeth that were diagnosed with symptomatic irreversible pulpitis
3. Patients with preoperative pain scores ranging from moderate to severe (45–100 mm) on a visual analog scale (VAS, 0–100 mm)

The exclusion criteria were the following:

1. Patients who had taken analgesic or anti-inflammatory drugs within the last 12 hours
2. Pregnant or lactating patients
3. Patients having severe malocclusion associated with a traumatic occlusion
4. Teeth with severe damage
5. Teeth with calcified canals
6. Teeth with pain to percussion
7. Teeth with periapical radiolucency
8. Teeth with root resorption
9. Teeth with an immature/open apex
10. Teeth with previous RCT

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. For each tooth, a diagnosis of symptomatic irreversible pulpitis was made based on clinical findings. The periapical status was examined using periapical radiographs, and radiographic examination revealed healthy periapical tissue. Patients were also given adequate information regarding the required treatment. Participation in the study was voluntary, and written consent was obtained from

each patient. Then, 168 patients were randomized into 4 groups based on the method used for the final irrigation after root canal preparation using a program (available at www.randomizer.org) by 1 of the investigators. Because of the nature of the interventions, the clinician who performed the treatment procedures was not blinded to the interventions. However, the patients were blinded and not informed of the allocation.

Treatment Procedures

All RCT procedures were performed by an experienced clinician in a single visit. Teeth were anesthetized using 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 using periapical radiographs. A glide path was established with K-files up to a size #15, and the canals were instrumented with nickel-titanium rotary files (SmartTrack X3; NIKINC Dental, Eindhoven, Holland). The established WL was checked repeatedly throughout the procedure. Depending on the individual tooth, the final apical preparation size was determined as being 3 sizes larger than the first file binding at the WL. During the instrumentation process, each canal was irrigated with 5 mL 3% sodium hypochlorite (NaOCl) using a syringe with a 31-G double side-port needle (NaviTip; Ultradent, South Jordan, UT) placed 2 mm short of the WL. The final irrigation procedure after canal preparation was divided into 4 groups as follows (Fig. 2).

Final Irrigation Protocols

NI Group. In this group, the final irrigation after the completion of canal preparation was performed with 5 mL 3% NaOCl using a syringe and a 31-G double side-port needle (NaviTip) placed 2 mm short of the WL for 1 minute in each canal. Each canal was then irrigated with 2 mL 17% EDTA for 1 minute.

SA Group. Each canal was filled with 5 mL 3% NaOCl, and then the EndoActivator (medium tip size 25/.04 taper) was inserted into the canal to 1 mm short of the WL and activated for 1 minute at 10,000 cycles per minute. Two milliliters of 17% EDTA was then introduced into each canal, and the EndoActivator was again activated for 1 minute.

PUI Group. In this group, 5 mL 3% NaOCl and 2 mL 17% EDTA in each canal were passively agitated using an ultrasonic device (Piezon Master 400; EMS, Le Sentier, Switzerland) for 1 minute. A smooth ultrasonic file (size 15, .02 taper) (ESI Instrument, EMS) was placed into the canal to 1 mm short of the WL without touching the walls, enabling it to vibrate freely. The ultrasonic file was activated at a power setting of 6.

MDA Group. Each canal was flooded with 5 mL 3% NaOCl solution and activated at the WL using a gutta-percha cone corresponding to a master apical file for 1 minute in each canal. The frequency of the activation used was 100 push-pull strokes/min. The canals were then flushed with 2 mL 17% EDTA and activated in the same manner. In all groups, the final irrigation was completed with 5 mL distilled water using a syringe and a 31-G double side-port needle (NaviTip).

In all groups, all teeth were then obturated in the same session with gutta-percha and a resin-based sealer (MM-Seal; Micro-Mega, Besancon, France) using the cold lateral compaction technique. Radiographs were then taken at 2 different horizontal angulations to ensure quality of the obturation. The coronal access cavity was then restored with composite resin (Filtex Z350; 3M ESPE, St Paul, MN), and the occlusion was checked and adjusted. Each

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