The Effect of Maxillary First Molar Root Length on the Success Rate of Buccal Infiltration Anesthesia

Ehsan Moradi Askari, DMD, *Masoud Parirokh, DMD MSc,*[†] *Nouzar Nakhaee, MD,*[‡] *Hamid Reza Hosseini, DMD MSc,*[§] *and Paul V. Abbott, MDS*[¶]

Abstract

Introduction: Several variables may influence anesthesia success in maxillary molars. This investigation was conducted to evaluate the effect of root length on the success rate of infiltration injections of 2% lidocaine with 1:80,000 epinephrine. **Methods:** One hundred maxillary first molars with irreversible pulpitis were treated. After the administration of a buccal infiltration injection of 2% lidocaine with 1:80,000 epinephrine, the patients' pain during dentin cutting, pulp exposure, and root canal instrumentation were evaluated using the Heft-Parker visual analog scale. No or mild pain was considered as success. Data were analyzed by the point-biserial correlation test and receiver operating characteristic curve analysis. **Results:** Overall, 61% of the teeth had successful anesthesia after the administration of a single buccal infiltration injection of anesthetic solution. The point-biserial correlation test showed that the teeth that had palatal and distobuccal roots with longer root lengths showed significantly higher anesthesia failure ($P < .05$). However, receiver operating characteristic curve analysis did not show a clinically useful cutoff point of root length corresponding with anesthesia failure. **Conclusions:** Maxillary first molars having irreversible pulpitis with longer roots may have more anesthesia failures after a single buccal infiltration injection with 2% lidocaine and 1:80000 epinephrine. (*J Endod 2016;■:1–5*)

Key Words

Anesthesia, infiltration, irreversible, length, lidocaine, maxillary, molar, pulpitis, root, success

O ne of the most important aspects of endodontic treatment is to control pain during and after treatment (1–6). Numerous investigations have been performed for pain management during root canal treatment (7–15). There are various variables that may affect pain felt by patients during root canal treatment (16). It has been shown that providing profound anesthesia in teeth with irreversible pulpitis is much more difficult than for teeth with healthy pulps (16). Moreover, mandibular teeth with irreversible pulpitis are much more difficult to anesthetize compared with maxillary teeth. Therefore, most studies have focused on anesthetic success for mandibular teeth (9–15) even though it has been shown that 12%–46% of maxillary molars with irreversible pulpitis may not be completely anesthetized after a buccal infiltration injection with 2% lidocaine (7, 8, 17). Several investigations on anesthesia success of maxillary molars have focused on the efficacy of anesthesia during extraction of the teeth (18–20) and anesthesia success after the use of various anesthetic techniques or solutions (8, 21–23).

It has been shown that soft tissue anesthesia cannot guarantee pulp anesthesia (16, 24, 25). In addition, soft tissue anesthesia does not necessarily mean dental pulp anesthesia success; however, management of pulp anesthesia during root canal treatment is an important issue in endodontic practice (1, 11). Several reasons have been described for the failure of infiltration injections such as a longer root length, pulp inflammation, pulp status, and the type of supplementary anesthesia used for overcoming pain during access cavity preparation and root canal instrumentation (16, 26). A previous investigation reported that maxillary molar teeth with longer root lengths may have more anesthesia failures after infiltration injections compared with teeth with shorter root lengths (26). However, the sample size of the teeth in that study was small, and 2 different anesthetic solutions were used. Therefore, the purpose of the present study was to evaluate the effect of root length on anesthesia success in maxillary molars with irreversible pulpitis after the administration of 2% lidocaine with 1:80,000 epinephrine.

Significance

This study focused on 1 of the variables that may influence anesthesia success after infiltration injections for maxillary molar teeth with irreversible pulpitis. Results showed significantly higher anesthesia failure in teeth with longer palatal and distobuccal roots.

Materials and Methods

The protocol of this study was approved by the Ethics Committee of Kerman University of Medical Sciences, Kerman, Iran (Ir.kmu.rec.1394.292). The sample size was

Clinical Research

calculated to be 100 cases considering a 95% specificity of root length in the prediction of anesthesia success with a 95% confidence interval and no more than 4% error.

Inclusion Criteria

Healthy adult male and female patients over 18 years of age who had a maxillary first molar tooth with irreversible pulpitis and normal periapical radiographic appearance with no root resorption were included in this study. A positive response to an electric pulp tester and a prolonged response to cold (Roeko Endo Frost; Roeko, Hangenav, Germany) were considered as indicating irreversible pulpitis.

Exclusion Criteria

The presence of systemic disorders, sensitivity to 2% lidocaine with 1:80,000 epinephrine, sensitivity to percussion, presence of widening of the periodontal ligament space, presence of a periapical radiolucency, pregnancy, using any type of analgesic medication in the preceding 12 hours before the treatment, unrestorable teeth, teeth with severe periodontal involvement, and spontaneous pain were the criteria for exclusion.

One hundred patients were eligible to participate in this prospective clinical study. The patients received endodontic treatment in the postgraduate clinic of the endodontic department of Kerman Dental School from January 2013 to February 2016. All patients signed an informed consent form in which the nature of the procedure and the possible discomforts and risks were fully described. All endodontic treatment was provided by 2 postgraduate students.

Before commencing treatment, patients rated their pain on a Heft-Parker visual analog scale. The visual analog scale scores were divided into 4 categories. No pain corresponded to 0 mm, mild pain was defined as being >0 mm and ≤54 mm, moderate pain was defined as being >54 mm and <114 mm, and severe pain was defined as being ≥114 mm.

A standard buccal infiltration injection for maxillary molars was performed for each tooth. After applying topical anesthesia (20% Benzocaine; Premier, Philadelphia, PA) to the site of the injection, the needle penetrated (27-G 25-mm needle; Nik Rahnama Kar Co, Tehran, Iran) between the mesiobuccal and distobuccal root apices of the maxillary first molar into the alveolar mucosa. The amount of needle penetration was estimated by the initial radiograph that was taken with the parallel technique so that the injection was given above the apices of the buccal roots of the teeth. The anesthetic solution was 1.8 mL 2% lidocaine with 1:80,000 epinephrine (Persocaine; Daru Pakhsh, Tehran, Iran).

Five minutes after administration of the anesthetic solution, the practitioners isolated the tooth with a rubber dam and commenced treatment by preparing an endodontic access cavity. The patients were asked to rate their pain using the Heft-Parker visual analog scale during each step of the treatment including during cutting within dentin, when entering the pulp chamber, and during root canal instrumentation. The absence of pain or the presence of only mild discomfort was considered as success, whereas moderate or severe pain was considered as failure of anesthesia (27). If pain was reported at any stage during the treatment, another method of anesthesia (palatal or intrapulp injection) was used to relieve the patients' discomfort.

The root length was measured by using a Root ZX apex locator (J. Morita Corp, Kyoto, Japan) and confirmed by taking a radiographic image. The length of each root was measured from its corresponding cusp tip (ie, mesiobuccal, distobuccal, and mesiopalatal cusps).

The point-biserial correlation test was used to examine the correlation between maxillary first molar root lengths and anesthesia success.

Receiver operating characteristic curve analysis was used to determine whether the root canal length could correctly discriminate anesthesia success. Sensitivity, specificity, and positive likelihood ratio (+LR) were calculated at different cutoff points of root canal length. P values <.05 were considered significant.

Results

One hundred patients were eligible to participate in this study. The patients consisted of 72 women and 28 men. The mean age of the patients was 29.2 ± 7.3 years. Overall, the success rate of anesthesia was 61% (Table 1), with 45 (62.5%) female and 16 male (57.1%) patients having successful anesthesia. There was no significant difference between men and women in the anesthesia success rate ($P > .05$). The mean root length of the palatal roots was significantly higher than for the mesiobuccal and distobuccal roots (Table 2). The point-biserial correlation test showed that longer palatal and distobuccal roots showed a significantly higher failure of anesthesia ($r_{pb} = 0.26$, $P < .05$ and $r_{pb} = 0.21$, $P < .05$, respectively) in contrast to longer mesiobuccal roots that showed no significant correlation with success ($P > .05$).

Fourteen patients needed supplemental anesthesia during dentin cutting, and for all of these patients, the palatal injection was successful. Twenty patients had pain when the pulp was exposed, and either a palatal or an intrapulp injection was used as supplemental anesthesia. Five patients had pain during root canal instrumentation, and an intrapulp injection was successfully used for all these cases.

The results of sensitivity, specificity, +LR, and area under the curve (AUC) for various cutoff levels of the 3 root canal lengths are shown in Table 3. The lower limits of the 95% confidence intervals of AUCs did not reach the 0.5 threshold for statistical significance. The highest +LR was obtained for the distobuccal root lengths (Table 3).

Discussion

The results of the present study showed that maxillary molars with irreversible pulpitis that had longer distobuccal and palatal roots were significantly correlated to anesthesia failure after the administration of a single buccal infiltration injection of 2% lidocaine with 1:80,000 epinephrine. However, no clinically useful cutoff point for the root lengths could be determined (Table 3). Although the AUCs of all cutoff points for the 3 roots were significantly higher than the 0.5 value, it should be considered that ROC curves with "an AUC ≤0.75 are not clinically useful" (28). Furthermore, the best cutoff point predicting anesthesia success was observed with the distobuccal root length of 22.75 mm corresponding to a +LR of 4.7. In other words, the likelihood that anesthesia success would be expected in a patient with a distobuccal root length below 22.75 mm compared with the likelihood that the same result would be expected in a patient with greater root length is roughly 5, which could be interpreted as a "small" likelihood ratio (29).

In the present study, 2% lidocaine with 1:80,000 epinephrine was used because it has been the most popular anesthetic solution used by dental practitioners (30).

There are only a few investigations that have evaluated the success rate of anesthesia in maxillary molars with irreversible pulpitis (7, 8, 26, 31–33). The success rate of anesthesia in maxillary molars with irreversible pulpitis has been reported to be between 54% and 80% after the use of 2% lidocaine with epinephrine (7, 8). The results of the present study showed that 61% of the teeth were successfully anesthetized after the use of a single buccal infiltration of 2% lidocaine with 1:80,000 epinephrine, which was in the range of anesthesia success reported in previously published investigations (7, 8).