Original Article

Buccal Infiltration versus Inferior Alveolar Nerve Block in Mandibular 2nd Premolars with Irreversible Pulpitis

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ABSTRACT

Purpose: The purpose of this study is to compare the success rates of inferior alveolar nerve block (IANB) and buccal infiltration anesthesia of mandibular second premolar with irreversible pulpitis and to evaluate the level of patient discomfort with these methods. **Matherials and Methods:** Forty patients, who had irreversible pulpitis in the mandibular 2nd premolar teeth, were included in the study. Patients were randomly distributed in two groups. In one group IANB, in the other group buccal infiltration anesthesia were performed. The efficacy of these two different anesthesia techniques on the related teeth was investigated with the Heft–Parker visual analog scale. In addition, with a pulse oximetry device, the changes in the patients' heart rates were compared between the groups. The obtained data were evaluated statistically. **Results:** Both anesthesia techniques reduced the pain significantly in patients before the administration ($P < 0.05$), but there was no significant difference among the groups regarding the pain control and success rates of anesthesia ($P > 0.05$). Both of the anesthesia techniques increased the heart rate ($P < 0.05$). The increase in the heart rate of the patients was significantly higher in the buccal infiltration anesthesia group than the other anesthesia group ($P < 0.05$). **Conclusion:** Within the limitation of this *in vivo* study, there was no difference between the efficacies of the buccal infiltration anesthesia and IANB anesthesia in the mandibular 2nd premolar teeth with irreversible pulpitis. Buccal infiltration anesthesia caused more discomfort in the patients compared with the IANB during the administration.

KEYWORDS: *Efficacy of the anesthesia, Heft–Parker visual analog scale, infiltration anesthesia, pulse oximetry*

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INTRODUCTION

Successful anesthesia is one of the most important components of endodontic treatment. Effective pain control decreases the possible fear and anxiety of patients due to endodontic treatment.[1] Inflammation in teeth with irreversible pulpitis leads to hyperalgesia in patients and negatively affects the success of local anesthesia performed during emergency endodontic treatment.[2] As a result of inflammation, the sodium channels of nociceptors are four times more resistant to local anesthesia than healthy nerve fibrils.[3]

For anesthesia of teeth with irreversible pulpitis, various anesthesia techniques and anesthetic solutions have been utilized.[4] Articaine has been used as a local anesthetic in dentistry for >20 years, and it is considered a good alternative to lidocaine for healthy teeth and for patients with symptomatic pulpitis.[5] A previous study reported that in healthy mandibular teeth, a 4% articaine solution containing 1:100.000 epinephrine was better in ensuring pulpal anesthesia than a 2% lidocaine solution containing 1:100.000 epinephrine.[6]

Anesthesia of the second mandibular premolar and molar teeth is generally performed through inferior alveolar nerve block (IANB) anesthesia. However, IANB

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anesthesia frequently fails, especially in the mandibular teeth with inflammation. For example, in a study of the effectiveness of IANB anesthesia in teeth with irreversible pulpitis, the failure rate of this technique was reported to vary between 44% and 81%.[6] In such cases of IANB failure, infiltration, intraosseous, intraligamentary, and intrapulpal anesthesia are used as auxiliary anesthesia.[7] According to our literature review, a number of studies reported that when IANB anesthesia failed in mandibular molar teeth with irreversible pulpitis, a supplemental buccal infiltration anesthesia was successful.[8] However, few studies have evaluated the effectiveness of buccal infiltration anesthesia in the mandibular second premolar teeth when used as primary anesthesia. Various studies that compared the effectiveness of buccal infiltration anesthesia of molar teeth with that of IANB anesthesia reported that infiltration anesthesia might be a useful alternative to IANB anesthesia.[9-11]

The aim of the present study was to compare the success rates of IANB and buccal infiltration anesthesia of mandibular second teeth with irreversible pulpitis and to evaluate the level of patient discomfort with these methods. The null hypothesis was that there would be no difference between the success rates of IANB and buccal infiltration anesthesia or the levels of patient discomfort caused by these anesthesia techniques during the injection.

Matherials and Methods

This study was designed as a randomized clinical trial comparing the anesthetic effectiveness of 4% articaine with 1:100.000 epinephrine in IANB and buccal infiltration anesthesia. This study was approved by the Ethical Committee of Ondokuz Mayis University (Approval No. 2015/137). After a power analysis, 40 patients (20 patients in each group) were selected through simple random sampling, with a 99% confidence level and 5% sensitivity.

The 40 patients involved in this study were randomly divided into two groups. Random numbers were created in Excel (Microsoft Office Excel 2003; Microsoft Corporation, Redmond, WA, USA). To standard, the present study, 10 male and 10 female patients who had inclusion criteria were selected for each group.

All the patients who participated in the study were given detailed information about the treatment procedures and potential complications that could occur during the treatment and written and signed informed consent was obtained.

Approximately 100 patients attend monthly at the emergency center of the department of endodontics, which operates for 6 months in a year. This recruitment lasted one and half a years with an estimated 645 patients undergoing any procedure. Within these patients, 40 were selected to take part in this clinical trial. Each patient was experiencing spontaneous moderate-to-severe pain at the emergency appointment. Patients with no or mild pain, periradicular pathosis, or no vital coronal pulpal tissue on access were excluded from the study. A detailed medical history was obtained from each patient. All the patients were healthy and older than 18 years. Patients younger than 18 years, allergic to local anesthesia, pregnant women, patients using medications affecting the sense of pain (narcotics, analgesics, antidepressants, and sedative medications), and patients having active pathology at the injection site were excluded.

Before the treatment, the patients were asked to mark the level of pain they felt on the Heft–Parker visual analog scale (HPVAS), and these values were recorded. The 170-mm long l HPVAS is divided into four categories, namely, no pain (0 mm), mild pain (≤54 mm), moderate pain (>54–114 mm), and severe pain (≥114 mm).

After resting for 15 min, each patient's right index finger was connected to a pulse oximeter device (KMA 900, PETAŞ, Turkey). The heart rates of the patients were measured for 5 min at 1 min intervals, and the results were recorded.

Patients were blinded to the type of anesthetic solution. Topical anesthetic was not applied before the injection. Twenty patients were given 1.7-ml buccal infiltration anesthesia, with 4% articaine containing 1:100.000 epinephrine (Ultracain DS Forte; Hoechst AG, Mainz, Germany), and the other 20 patients received IANB anesthesia, with 4% articaine containing 1:100.000 epinephrine. During the 60 s of the injection, the heart rates of the patients were measured and recorded at 15-s intervals. All local anesthetic injections were given by a single operator who was not a part of the study process. This operator had no involvement with the study outcome.

After 10 min of resting after the local anesthesia, root canal treatment was initiated in the relevant teeth, after ensuring the insensitivity of the lips in the IANB group. If the patient had no lip insensitivity after administering the IANB anesthesia, the patient was excluded from the study and another patient was included. After the preparation of an endodontic entrance cavity, a #10 K-file was used to determine the working length using an apex locatar (Root ZX Mini; Morita, Osaka, Japan). Each patient was advised to alert the physician to any pain they felt by raising their hand. In cases where the patient felt pain, the process was stopped when the

patient raised his/her hand, and the pain level of the patient was marked on the HPVAS by the patient. Cases, where the patients indicated that the pain level was moderate or severe during the endodontic treatment, were considered "unsuccessful," and the treatment procedure was continued using auxiliary anesthesia (intrapulpal or intraligamentary). For patients what felt no pain or mild pain, the local anesthesia process was considered "successful," and the procedure was continued without using any auxiliary anesthesia.[12]

Statistical analysis

The Anderson–Darling test was used to test the normal distribution of the HPVAS and heart rate data, and the Levene test was used to test the homogeneity of group variances. In the comparisons of the groups, the Student's *t*-test was used for two independent groups. In all the calculations and interpretations, the level of significance was set at 5%. All the calculations were performed with the SPSS 21 (IBM SPSS Inc., Chicago, IL, USA) statistical package software.

Results

Comparison of Heft–Parker visual analog scale values

The comparisons of the age and gender distribution of the participating patients, their HPVAS scores before the process, and their pain scores during the root canal treatment operation are presented in Table 1.

According to the results of the present study, the pain scores of the patients in both groups significantly decreased after the anesthesia injection ($P > 0.05$). The difference between the pain scores of the patients in the two groups during the operation was not statistically significant ($P < 0.05$). The success rates of the anesthesia techniques used in the present study are presented in Table 2.

According to the results, there was no statistically significant difference between the success-failure rates of IANB anesthesia and buccal infiltration anesthesia in terms of the pain scores during the root canal treatment of the patients ($P < 0.05$).

Comparison of heart rate values

The heart rates of the participating patients, which were measured through a pulse oximeter device before and during the administration of the two different anesthesia methods, are presented in Table 1. During both IANB and buccal infiltration anesthesia, the heart rates of the patients significantly increased in proportion to the values measured before the anesthesia ($P > 0.05$).

Moreover, buccal infiltration anesthesia led to a significantly higher increase in heart rates, when compared to those recorded using IANB anesthesia ($P > 0.05$).

Table 1: Demographic and clinical features of the patients

	IANB (*n*=20) (%)	Buccal infiltration (*n*=20) (%)	*P*
Gender			
Female	10 (50)	10 (50)	>0.05
Male	10 (50)	10 (50)	>0.05
Age (years)[a]	39±1.3	38±1.4	>0.05
HPVAS			
Before treatment	131.1±1.1	131.1±3.78	>0.05
During treatment	35.45±6.63	41.35±5.04	>0.05
Heart rate			
Before injection	76.23±1.5	80.74±1.23	>0.05
During injection	80.11±1.68	86.82±1.52	<0.05

[a]Mean±SD. HPVAS=Heft-Parker visual analog scales; SD=Standard deviation; IANB=Inferior alveolar nerve block

Table 2: Success and failure rates according to techniques

	IANB (*n*=20) (%)	Buccal infiltration (*n*=20) (%)	Total
Failure	6 (30)	8 (40)	14 (35)
Success	14 (70)	12 (60)	26 (65)
Total	20 (100)	20 100)	40 (100)

*There was no statistically significant difference between groups ($P>0.05$). IANB=Inferior alveolar nerve block

Discussion

Local anesthesia is one of the most reliable methods for painless endodontic treatment, and it is the preferred method of most clinicians. Ease of administration, comfort for the patient and clinicians, no tongue insensitivity, and a very low possibility of nerve damage or intravenous injection of anesthetic solution make buccal infiltration anesthesia more advantageous than IANB. Various studies have compared the success rate of buccal infiltration anesthesia and IANB.[13,14] The failure rate of the IANB anesthesia technique in mandibular molar teeth with pulpitis was reported to be 23%.[5,15] Anesthesia failure was reported to be eight times more common in irreversible pulpitis cases when compared to asymptomatic cases.[16] Only one study comparing the anesthesia levels in mandibular second premolar teeth provided by buccal infiltration, and an IANB anesthesia technique was found in the literature, Aggarwal *et al*.[17] found no statistically significant difference between the success rate of anesthesia techniques. No previous studies evaluated the pain that patients felt during the administration of these two anesthesia techniques.

Among local anesthetics, articaine is unique in that it contains a thiophene and an ester ring. Studies showed that articaine was as effective as lidocaine, mepivacaine, and prilocaine in block anesthesia and buccal infiltration anesthesia. Furthermore, articaine can penetrate the

cortical bone, and it could be used in the mandibular molar region.[4,8,17-26] For these reasons, Ultracain DS Forte (Hoechst AG, Mainz, Germany) anesthetic solution containing 4% articaine and epinephrine (1:100.000) was used in the present study.

In a study on the use of topical anesthetic material before the administration of local anesthesia, the application of topical anesthetics to the relevant region before the injection did not change the patient's level of pain perception.[27] For this reason, no topical anesthetic was applied before the injection in the current study.

Kanaa *et al*.[28] reported that slow administration of IANB anesthesia (1.7 ml/60 s) was more acceptable to patients than fast administration (1.7 ml/15 s). A study on the success of computer-controlled slow injection systems reported that they did not decrease the injection pain level of patients.[29] Thus, we administered the anesthetic slowly (1.7 ml/60 s) in the present study.

Although some studies considered the absence of pain as success, others classified cases with a moderate level of pain as successful[11,21,30-33] and should not be classified as success in endodontics. For this reason, only the absence of pain (HPVAS = 0) and mild pain (HPVAS value ≤54 mm) were considered as success in our study.[12]

According to the results of the present study, using both the anesthesia techniques, the pain scores of the patients during the procedure (IANB = 35.45 ± 29.65, infiltration = 41.35 ± 22.52) were statistically significantly lower than those before the procedure (IANB = 131.1, infiltration = 131.1) ($P < 0.05$). These data are in agreement with those obtained by other studies of patients with irreversible pulpitis of mandibular molar teeth.[10,12]

In the present study, the success rate of the IANB technique was 70%, whereas that of the buccal infiltration anesthesia technique was 60%. However, when we compared the anesthesia techniques according to the accepted criteria for success, there were no statistically significant differences in the success of the two methods ($P > 0.05$). In common with the results of the present study, Aggarwal *et al*.[17] found no statistically significant difference between the success rate of mental incisive nerve (%555) block and the IANB technique (%72) in mandibular premolars.

The success/failure values of the anesthesia techniques in the present study are in accordance with those in literature, with most reported studies failing to achieve a 100% success rate.[10,12,33,34] Similar to our results, Foster *et al*.[35] reported that the success rates in cases where IANB and buccal infiltration anesthesia methods were used together (66%) and in cases where IANB was used alone (66%) were not statistically significantly different. In a study of 27 healthy volunteers, Corbett *et al*.[11] reported that IANB provided a 55.6% success rate in mandibular first molar teeth and that buccal infiltration anesthesia provided a success rate of 70.4%, but the difference was not statistically significant.

In the present study, the heart rates of the patients were higher with the buccal infiltration anesthesia method than the IANB method, and buccal infiltration anesthesia caused a greater sense of patient discomfort than IANB. Based on an extensive literature review, there are a limited number of similar studies were found.[34] The heart rates recorded in the present study were higher than those reported in Monteiro *et al*.[10] and Kanaa *et al*.[34] studies. The discord in the findings might be due to patients' perceptions that buccal infiltration anesthesia would be more painful than other methods and to differences in clinicians' practices.

Conclusion

Buccal infiltration anesthesia applied with a 4% articaine solution before root canal treatment of mandibular second premolar teeth with irreversible pulpitis may be a good alternative to IANB anesthesia.

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Conflicts of interest

There are no conflicts of interest.

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