

# Extraction of Maxillary Teeth Using Articaine Without a Palatal Injection: A Comparison Between the Anterior and Posterior Regions of the Maxilla



Anwar B. Bataineh, BDS, MScD, MDSc, CSOS, \*and Ghamedan A. Al-Sabri, BDS, MScD†

**Purpose:** The injection of a local anesthetic before tooth extraction is always associated with pain, and palatal anesthesia is the most painful type of injection for the patient. The specific aims of the study were to evaluate “pain control” using 4% articaine without palatal injection and to compare adequate anesthesia and pain control in the anterior and posterior regions of the maxilla.

**Materials and Methods:** This prospective controlled study followed a split-mouth protocol, in which patients served as their own control. Forty-eight patients who needed routine extraction of permanent maxillary anterior and posterior teeth were referred. After an injection of 4% articaine and a 5-minute wait, 1 posterior tooth and 1 anterior tooth were extracted using standard techniques. The patient’s perception of pain was assessed using a visual analog scale and a verbal rating scale after each injection and extraction. Statistical analysis consisted of descriptive statistics, paired-sample *t* test, and independent-samples *t* test to determine whether differences were statistically significant ( $P < .05$ ).

**Results:** In total, 48 anterior and 48 posterior teeth were extracted from 48 patients. Extraction of maxillary teeth was possible without an additional palatal injection for 87 teeth (90.6%), whereas only 9 teeth (9.4%) needed an additional palatal injection to complete the extraction. Of the total number of patients, 90% reported that the pain caused by tooth extraction in the anterior and posterior regions of the maxilla was mild. None of the patients rated the pain of extraction in the maxilla as severe.

**Conclusion:** There was no difference in pain perception when extracting anterior and posterior teeth. Of the total number of teeth, 90.6% were extracted without the need for palatal injection. In this study, extraction of erupted maxillary teeth using 4% articaine without manipulation of the palatal mucosa obviated palatal infiltration during extraction. Articaine anesthesia provides adequate palatal anesthesia for maxillary teeth extraction in the anterior and posterior regions without the need for a palatal block.

© 2016 American Association of Oral and Maxillofacial Surgeons

*J Oral Maxillofac Surg* 75:87-91, 2017

Local anesthesia remains the primary method to control pain in patients undergoing painful intraoral procedures. For satisfactory anesthesia, sufficient concentrations of anesthetic agents and vasoconstriction are needed. In Europe, articaine has become a very popular local anesthetic; it is a safe and effective local anesthetic agent for use in dental practice.<sup>1</sup> In the

United States, 4% articaine with epinephrine 1:100,000 was approved for clinical use in 2000.<sup>2</sup>

Of the different techniques used to inject local anesthesia, the most painful is the palatal injection. Because it is a rather painful injection, some techniques have been suggested to decrease the patient’s discomfort. However, those methods are not

---

Received from Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan.

\*Professor, Department of Oral Medicine and Surgery.

†Master’s Degree Student.

Address correspondence and reprint requests to Bataineh: Department of Oral Medicine and Surgery, Faculty of Dentistry, Jordan University of Science and Technology, BO Box 3030, Irbid, Jordan; e-mail: [anwar@just.edu.jo](mailto:anwar@just.edu.jo)

Received March 21 2016

Accepted June 25 2016

© 2016 American Association of Oral and Maxillofacial Surgeons

0278-2391/16/30588-2

<http://dx.doi.org/10.1016/j.joms.2016.06.192>

universally effective and the palatal injection remains a painful experience for most patients.

Uckan et al<sup>3</sup> compared pain experienced during extraction of permanent maxillary teeth using only buccal infiltration with 4% articaine and 1:100,000 epinephrine with pain experienced during the same procedure using a second palatal infiltration of anesthesia. They found that extraction of maxillary teeth was possible without an additional palatal injection. In a blinded randomized controlled trial, Badcock et al<sup>4</sup> reported the successful removal of maxillary third molars without the need for a separate palatal injection using 2% lignocaine with epinephrine 1:80,000. Lima-Júnior et al<sup>5</sup> investigated the diffusion of 4% articaine after buccal infiltration for the removal of an impacted upper third molar. They found that extraction of an impacted maxillary third molar was possible with only a buccal infiltration of 4% articaine without an additional palatal injection, and that 4% articaine with epinephrine 1:100,000 produced better vestibule and palatal diffusion than that with epinephrine 1:200,000. Fan et al<sup>6</sup> compared extraction of maxillary teeth with and without a palatal injection using 4% articaine with epinephrine 1:100,000. According to a visual analog scale (VAS), the difference in pain accompanying maxillary teeth extraction was statistically minor between the experimental and control sides.

The specific aims of the present study were to evaluate "pain control" using 4% articaine without palatal injection and to compare adequate anesthesia and pain control in the anterior and posterior regions of the maxilla.

## Materials and Methods

### STUDY DESIGN AND SAMPLE

This prospective controlled study followed a split-mouth protocol, in which patients served as their own control. Subjects were 48 patients who were referred to the oral and maxillofacial surgery clinics at the Faculty of Dentistry at the Jordan University of Science and Technology (Irbid, Jordan) for the extraction of anterior and posterior maxillary teeth (96 teeth). This study followed the 1964 Declaration of Helsinki and its amendments on medical protocol and ethics, and patients' rights were protected. The institutional review board at the Jordan University of Science and Technology approved the study, and written informed consent was obtained from all patients.

### VARIABLES

All participants were interviewed and examined by a single surgeon at the oral and maxillofacial surgery clinic to record the following data: name, gender,

age, job, marital status, address, phone number, medical history, medications, oral hygiene measures, and dental history.

### DATA COLLECTION METHODS

Patients were included in this study if they were older than 18 years, had no relevant medical history that might contraindicate tooth extraction, agreed to participate in the study, and required anterior maxillary and posterior maxillary teeth extraction with no or mild periodontal disease and nonsurgical extraction. Excluded from the study were patients who could not give informed consent; had an infection at the site of injection; had allergy, bronchial asthma, cardiac disease, hypertension, neurologic disease, or severe untreated sensitivity to sulfites or amide-type local anesthetics; used an analgesic within 24 hours before administration of the anesthetic; or were pregnant.

### ASSESSMENT OF PAIN

A VAS consists of a 10-cm horizontal line with one end defined as the complete absence of pain and the other as the worst pain imaginable and provides a reliable measurement of subjective parameters that is easy to use, sensitive, and valid. A verbal rating scale (VRS) contains different levels of verbal pain intensity, ranging from the least to the most intense. Three scales consisting of a 100-mm VAS and 2 VRSs (VRS1 and VRS2) were used for the evaluation of pain induced by the injection. Each patient was asked to make a vertical mark on the line corresponding to the pain that was experienced during the injection, and the distance from the left end of the scale to the patient's mark was used as a numerical index of the severity of pain experienced. The VRS1 has 3 categories of pain (mild, moderate, and severe). The VRS2 also has 3 categories (less pain than expected, expected, and greater than expected). All participants were asked to complete the VAS first. The presence or absence of pain was used to evaluate the effectiveness of each anesthesia technique.

Under sterile conditions, all local anesthetic injections and teeth extractions were performed by a single operator. The simple infiltration anesthesia was injected buccally along the long axis of the corresponding tooth, with the posterior teeth first, followed by the anterior teeth. Local anesthesia with 1.8 mL of 4% articaine hydrochloride with epinephrine 1:100,000 (Ubistesin 4%, ESPE, Seefeld, Germany) was administered as a maxillary buccal infiltration adjacent to each tooth to be extracted. The anesthetic solution was delivered using a dental syringe (ASA Dental, Massarosa, Italy) and a 27-gauge needle measuring 0.40 × 30 mm (Terumo Dental Needles,

Tokyo, Japan). After aspiration, the full cartridge was deposited over a period of 1 minute. After 5 minutes, the buccal and palatal gingiva were examined using a pinprick test. The test result was considered positive if a patient reported a sharp pain and negative if there was no sharp pain during the test. After an interval of 5 minutes to allow for an anesthetic effect on the anterior and posterior teeth, a maxillary molar and then a maxillary anterior tooth were extracted using a consistent technique involving extraction forceps. If an unacceptable level of pain or discomfort was perceived during extraction, an additional 5-minute interval was allowed. If the level of pain or discomfort remained unacceptable, then this level of pain was recorded on the VAS and VRSs and then one fourth of a cartridge was injected in the palate and the tooth was extracted. Immediately after the extraction of teeth, each patient rated the level of pain for the extraction on the VAS and the 2 VRSs. The VRS1 included 3 categories of pain (mild, moderate, and severe). Patients were asked to respond to the VRS2 to assess whether the extraction of the maxilla molar was less than expected, as expected, or greater than expected.

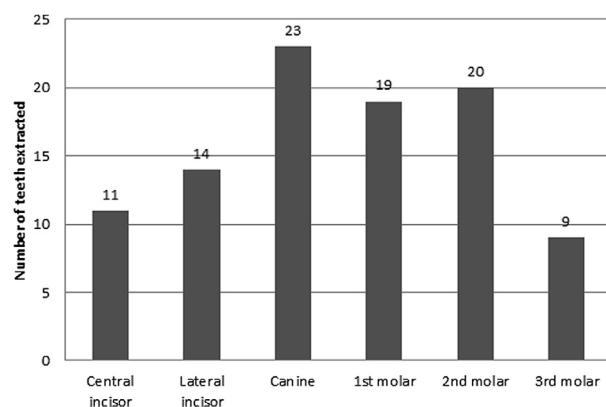
#### DATA ANALYSES

The data yielded from these scales and questionnaires were numerically coded before being analyzed with SPSS 15.0 (SPSS, Inc, Chicago, IL). Descriptive statistics, paired-sample *t* test, and independent-samples *t* test were used to determine statistically significant differences ( $P < .05$ ).

#### Results

The study consisted of 48 patients (96 teeth). Twenty-seven men (56%) and 21 women (44%) participated in the study. Patients' ages ranged from 28 to 84 years (average, 47 yr). Ninety-six maxillary teeth were extracted (48 anterior teeth and 48 posterior teeth). Of the anterior teeth extracted, 23 (24%) were canines; of the posterior teeth, 20 (21%) were second molars (Fig 1).

Extraction of maxillary teeth was possible without an additional palatal injection for 87 teeth (90.6%), and only 9 teeth (9.4%) needed an additional palatal injection for complete extraction. VAS scores for extraction-related pain in the anterior region ranged from 0.00 to 97 mm (mean score, 17.04 mm). VAS scores for the posterior region ranged from 0.00 to 63 mm (mean score, 16.02 mm). There was no significant difference between mean VAS scores for the posterior region and anterior region of the maxilla ( $P = .714$ ) when extracting maxillary teeth with only buccal infiltration using 4% articaine and without palatal anesthesia.



**FIGURE 1.** Type of teeth extracted in the study.

Bataineh and Al-Sabri. Maxillary Extraction Without Palatal Injection. *J Oral Maxillofac Surg* 2017.

VAS scores for anesthetic injection-related pain in the anterior region ranged from 1 to 74 mm (mean score, 15.96 mm). VAS scores for anesthetic injection pain in the posterior region ranged from 0 to 24 mm (mean score, 6.42 mm). The mean VAS score for pain caused by the anesthetic injection in the anterior region of the maxilla was significantly higher than that in the molar region ( $P = .001$ ; Table 1).

Of all patients, 90% reported that the pain caused by tooth extraction in the anterior region and posterior region of the maxilla was mild. None of the patients rated the pain of extraction in the maxilla as severe. There were no differences between the anterior and posterior regions in tooth extraction pain when using the VRS1 ( $P = 1.000$ ).

The same result was found for the anterior region and posterior region of the maxilla, with 83.3% of patients reporting that the extraction pain was less than expected for the extraction of teeth. The difference in tooth extraction pain using the VRS2 between the anterior and molar areas was not statistically significant ( $P = 1.000$ ). The pinprick test was performed in all 48 patients. Just before performing the extraction, the test

**Table 1. COMPARISON OF VISUAL ANALOG SCALE PAIN SCORES BETWEEN THE ANTERIOR AND POSTERIOR REGIONS FOR INJECTION AND EXTRACTION**

	Area	n	Mean	SD	P Value
Extraction	Anterior	48	17.0	22.8	.714
	Posterior	48	16.0	16.6	
Injection	Anterior	48	16.0	18.8	.001
	Posterior	48	6.4	6.5	

Abbreviation: SD, standard deviation.

Bataineh and Al-Sabri. Maxillary Extraction Without Palatal Injection. *J Oral Maxillofac Surg* 2017.

result was negative in 100% of all buccal cases, whereas 44 palatal cases (95.7%) reported a positive result.

## Discussion

As mentioned earlier, there are differences between the anterior and posterior regions of the maxilla in innervation and bone quality. The anterior region of the maxilla has greater innervation density than the posterior region, which can affect the diffusion and anesthetic ability of articaine when used as a buccal infiltration for tooth extraction without a palatal injection. Different regions of the maxilla have different bone compositions. Age, gender, and race are factors that contribute to variation in bone composition of the maxilla.<sup>6</sup> The anterior region of the maxilla has denser bone than the posterior region, which can affect the diffusion and anesthetic ability of articaine when used as a buccal infiltration for tooth extraction without a second palatal injection. Bone thickness also can have an effect, because it is thinner in the anterior region than in the molar region of the upper jaw. The specific aims of the study were to evaluate pain control using 4% articaine without palatal injection and to compare adequate anesthesia and pain control in the anterior and posterior regions of the maxilla. Palatal soft tissue sensation after a buccal infiltration of 4% articaine also was investigated.

The pain caused by palatal injection is poorly tolerated by patients.<sup>6</sup> Although different methods have been developed to decrease the pain of palatal injection, they have not been received with wide agreement.<sup>7</sup> Palatal injection remains a traumatic experience for patients.<sup>8</sup> A recent idea emphasizing the needlessness of palatal injection for the removal of maxillary teeth has gained increasing interest, and bone density is clearly affected by the region of the oral cavity.<sup>9,10</sup>

All patients were treated in the same clinic, with a safe, calm, and comfortable environment to minimize the effect of different environmental factors on pain perception during anesthetic injection and teeth extraction.

In the present study, no power or sample size calculations were performed; however, the sample of 48 patients was based on similar previous comparative trials.<sup>3,5</sup> All patients acted as their own control in this study. In this clinical trial, there was no difference in pain perception when extracting anterior and posterior teeth and no previous studies have compared the 2 regions. The mean VAS score for the perceived pain of extraction in the anterior region of the maxilla was comparable to that in the posterior region ( $P = .714$ ). This means that when extracting maxillary teeth with only buccal infiltration using 4% articaine and without palatal anesthesia, there is no relevant difference between

mean VAS scores in the posterior and anterior areas of the maxilla. This result was supported by the VRS1 and VRS2 scores. When VRS1 was considered, most patients (90%) rated the extraction pain as mild in the 2 areas of the maxilla. There were only 5 patients (10%) who rated their pain during extraction in the anterior area as moderate. The same results were found for the posterior teeth, and none of the patients rated the pain of extraction in the maxilla as severe. The same can be concluded by examining the VRS2 scores, which showed the exact same results for the anterior as for the posterior teeth extraction. Most patients (83.33%) rated the extraction pain as less than expected in the 2 areas of the maxilla. There were only 4 patients (8.33%) who reported their pain during extraction in the anterior area to be as expected, and the same results were found for the posterior teeth. Similarly, for anterior and posterior extractions, 4 patients (8.33%) rated their pain during anterior and posterior extraction as greater than expected.

This study included the extraction of 96 permanent teeth compared with 76 permanent maxillary teeth in the study by Uckan et al,<sup>3</sup> 102 maxillary third molars in the study by Bandcock et al,<sup>4</sup> and 142 permanent maxillary teeth in the study by Fan et al.<sup>6</sup> These results are comparable to those found by Badcock et al<sup>4</sup> when they extracted maxillary third molars using buccal infiltration of 2% lignocaine and normal saline for palatal injection. They found that 90% of extractions were reported as less painful than expected. These results also were comparable to those reported by Fan et al<sup>6</sup> who found that 90.1% of patients reported their pain as less than expected. These small differences among studies can be explained by the different pain thresholds among patients and the intense pressure perceived by some patients during the extraction, which can be difficult to differentiate from pain.

The mean VAS score for pain caused by the injection of anesthesia in the anterior region of the maxilla was significantly higher than that for the molar region ( $P < .05$ ). This might indicate that the oral mucosa in the anterior part of the maxilla is more sensitive to local anesthesia injection than that in the posterior part. No previous studies have investigated the differences between the anterior and posterior areas of the maxilla for pain caused by buccal infiltration of articaine in adults. A similar study conducted in children found that anesthetic injection in the anterior region of the maxilla was more painful than that in the posterior region.<sup>11</sup> Wahl et al<sup>12</sup> found no meaningful difference in perceived injection pain among maxillary buccal anterior infiltration, maxillary buccal posterior infiltration, and inferior alveolar block injections when they used plain prilocaine or bupivacaine with epinephrine. Therefore, a topical anesthesia might be more

effective to minimize the pain of local anesthesia injection in the anterior region of the maxilla when articaine is used as the anesthetic agent.

A pinprick test is used to examine the nerve endings innervated by the lightly myelinated delta and unmyelinated C-fibers in the palatal mucosa. The proper response is the sensation of sharp pain rather than pressure.<sup>13</sup> In this study, there was no palatal anesthesia detected in most cases. Approximately 95.7% of patients reported a sharp pain in the palatal gingiva when the sensation was tested by a sharp dental probe 5 minutes after a buccal injection with 4% articaine with epinephrine 1:100,000. This finding was true for the anterior and posterior parts of the maxilla, without any differences. Therefore, a buccal injection of articaine might not diffuse adequately to the palatal soft tissue. This is consistent with the results reported by Haas et al<sup>14</sup> who found that articaine did not produce anesthesia in any patients when used only as buccal infiltration. In their study, they did not use a pinprick test; instead, they used an electric pulp tester to investigate sensation in the palate soft tissue. They found that articaine produced anesthesia in the labial soft tissue in 90% of patients.

The pinprick test in the present study showed that the palatal soft tissue was not totally anesthetized; however, the extraction of maxillary teeth was possible without palatal injection. A possible explanation for this observation could be the minimal palatal soft tissue manipulation in this study. This suggests that buccal infiltration of 4% articaine only is not adequate when manipulation of the palatal soft tissue is needed and an extra palatal infiltration is recommended to produce pain-free extraction. There were no previous studies that examined the alteration in sensation of the palatal soft tissue after only buccal infiltration of 4% articaine. More studies are needed to explore the effect of buccal infiltration of 4% articaine on palatal soft tissue sensation.

There was no difference in perceived extraction pain between the anterior and posterior regions of the maxilla in smokers. Likewise, no difference was found in nonsmokers.

In the present study, it was possible to extract maxillary teeth without the need for a palatal injection. Approximately 87 teeth were extracted without the need for a palatal anesthesia injection, which accounts for 90.6% of the total number of teeth extracted (96 teeth). The finding of this clinical trial study is in agreement with other studies, which generally suggest that painless extraction of maxillary teeth without a second palatal injection is possible.<sup>3-6</sup> Conversely, it disagrees with the conclusions of those studies, which suggest that the painless extraction was because of the ability of 4% articaine to diffuse and anesthetize the palatal soft tissue.<sup>3,5</sup>

Extraction was always performed on the posterior teeth and then the anterior teeth to minimize the bleeding effect on visibility during extraction. Extracting the posterior teeth first might affect patients' experience of pain perception. In other words, an anterior tooth extraction was not performed under the same psychological status because posterior tooth extraction had been performed in each patient.

Extraction of maxillary teeth is possible using only buccal infiltration with 4% articaine without palatal infiltration. There was no difference in pain perception when extracting anterior and posterior teeth.

In this study, extraction of erupted maxillary teeth using 4% articaine without manipulation of the palatal mucosa did not require palatal infiltration during the extraction. There was no difference in pain perception when extracting anterior and posterior teeth. Of the total number of teeth, 90.6% were extracted without the need for palatal injection. Further studies involving larger groups of patients are needed for maxillary anterior and posterior teeth extraction using articaine as a buccal infiltration for tooth extraction, thereby obviating a painful palatal injection.

## References

- Kakroudi SH, Mehta S, Millar BJ: Articaine hydrochloride: Is it the solution? *Dent Update* 42:88, 2015
- Malamed SF, Gagnon S, Leblanc D: Efficacy of articaine: A new amide local anesthetic. *J Am Dent Assoc* 131:635, 2000
- Uckan S, Dayangac E, Araz K: Is permanent maxillary tooth removal without palatal injection possible? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 102:733, 2006
- Badcock ME, Gordon I, McCullough MJ: A blinded randomized controlled trial comparing lignocaine and placebo administration to the palate for removal of maxillary third molars. *Int J Oral Maxillofac Surg* 36:1177, 2007
- Lima-Júnior JL, Dias-Ribeiro E, de Araújo TN, et al: Evaluation of the buccal vestibule-palatal diffusion of 4% articaine hydrochloride in impacted maxillary third molar extractions. *Med Oral Patol Oral Cir Bucal* 14:E129, 2009
- Fan S, Chen WL, Yang ZH, et al: Comparison of the efficiencies of permanent maxillary tooth removal performed with single buccal infiltration versus routine buccal and palatal injection. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 107:359, 2009
- Kaltz J, Melzack R: Measurement of pain. *Surg Clin North Am* 79: 231, 1999
- Hannan L, Reader A, Nist R: The use of ultrasound for guiding needle placement for inferior alveolar nerve blocks. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 87:658, 1999
- Duncan JD, Reeves GW, Fitchie JG: Technique to diminish discomfort from the palatal injection. *J Prosthet Dent* 67:901, 1992
- Herbert H: Topical ice: A precursor to palatal injections. *J Endod* 15:27, 1989
- Aminabadi NA, Farahani RM, Oskouei SG: Site-specificity of pain sensitivity to intraoral anesthetic injections in children. *J Oral Sci* 51:239, 2009
- Wahl MJ, Schmitt MM, Overton DA, et al: Injection pain of bupivacaine with epinephrine vs. prilocaine plain. *J Am Dent Assoc* 133:1652, 2002
- Ziccardi VB, Zuniga JR: Nerve injuries after third molar removal. *Oral Maxillofac Surg Clin North Am* 19:105, 2007
- Haas DA, Harper DG, Saso MA, et al: Comparison of articaine and prilocaine anesthesia by infiltration in maxillary and mandibular arches. *Anesth Prog* 37:230, 1990