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ANESTEZIJA SA PALATINALNE STRANE ZA PREDNJE I SREDNJE GRANE GORNJEG ZUBNOG PLEKSUSA KAO PRIMARNA TEHNIKA U ORALNO-HIRURŠKIM INTERVENCIJAMA

THE PALATINAL SIDE ANESTHESIA FOR THE ANTERIOR AND MIDDLE BRANCHES OF THE SUPERIOR ALVEOLAR PLEXUS AS A PRIMARY TECHNIQUE IN ORAL SURGICAL INTERVENTIONS

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Sažetak

Uvod: *Anestezija za prednje i srednje grane gornjeg alveolarnog pleksusa (AMSA) se smatra sprovodnom tehnikom, za prvih pet maksilarnih zuba (od centralnih sekutića do drugog premolara). Naime , ova tehnika do sada je opisana kao dopunska tehnika anestezije koja cilja na subneuralni dentalni pleksus koji se nalazi u blizini vrhova korena premolara.*
Cilj *istraživanja je bio da se utvrdi da li AMSA tehnika anestezije može poslužiti kao primarna i samostalna metoda za vađenje prvih pet zuba gornje vilice (sekutića, očnjaka i pretkutnjaka).*
Materijali i metode: *Studijom su obuhvaćena 24 zdrava pacijenta raspoređena u I grupu (primili 4% artikain sa adrenalinom) i II grupu (primili lidokain sa adrenalinom), koji su imali avitalne maksilarne zube (od sekutića do premolara). AMSA tehnika je korišćena kao primarna anestezija za ekstrakciju zuba. Praćeni parametri anestezije obuhvatali su: percepciju bola tokom primene anestezije i tokom hirurške procedure, ukupan uspeh anestezije, vreme početka, trajanje anestezije i postekstrakcione komplikacije.*
Rezultati: *Trajanje anestezije u prvoj je bilo 52±17,10 min, dok je u drugoj 40,25±7,629 min (p=0,044). Nivo bola tokom ekstrakcije bio je 3,42±1,73 dok je u drugoj grupi 5,25±2,41 sa statistički značajnom razlikom između grupa (p=0,046). Potreba za dodatnom anestezijom bila je 2 (16,66%), u prvoj i 5 (41,66%). u drugoj grupi.*
Zaključak: *AMSA tehnika anestezije sa upotrebom artikaina može poslužiti kao primarna tehnika lokalne anestezije za ekstrakciju prvih avitalnih maksilarnih zuba, dok manju anestetičku efikasnost kao primarna tehnika uspoljava u slučaju upotrebe lidokaina.*

Ključne reči: *AMSA, ekstrakcija zuba, artikain, lidokain*

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Abstract

Introduction: *Anterior Middle Superior Anesthesia (AMSA) is considered a conductive technique for the first five maxillary teeth (from central incisors to the second premolar). This alternative anesthesia is considered a supplementary technique targeting the subneural dental plexus located near the root apices of the premolars.*
The study aimed *to determine whether AMSA anesthesia technique can serve as a primary and independent method for extracting of the first five upper jaw teeth (incisors, canines, and premolars).*
Materials and methods: *The study included 24 healthy patients allocated in the group I (received 4% articaine with adrenaline) and the group II (received lidocaine with adrenaline) . The patients had avital maxillary teeth (from incisors to premolars). AMSA technique was used as primary anesthesia for extraction. The monitored anesthesia parameters included: pain perception during the application of anesthesia and the surgical procedure, overall success of anesthesia, onset time, and duration of anesthesia and post extraction complications.*
Results: *The duration of anesthesia was 52±17,10 min in the first group, while it was 40,25±7,629 min (p=0,044).in the second The level of pain during the extraction was 3,42± 1,73in the first group, while it was 5,25±2,41 in the second, with statistically significant difference between groups (p=0,046). The need for additional anesthesia was 2 (16,66%), in the first and 5 (41,66%). in the second group.*
Conclusion: *The AMSA technique has demonstrated high efficacy for simple extractions when articaine is used; it shows less anesthetic efficacy when lidocaine is used. The AMSA anesthesia technique with articaine may be considered a primary local anesthesia technique for the extraction of the first five maxillary teeth when they are not vital.*

Key words: *AMSA, tooth extraction, articaine, lidocaine*

Introduction

The extraction of upper jaw teeth is enabled by local anesthesia, which is performed by injecting an anesthetic solution subperiosteally into the region of the buccal and palatal branches of the superior dental plexus at the root apex of the tooth. This anesthesia technique requires a minimum of two punctures—one on the buccal and one on the palatal side. The buccal injection is always accompanied by varying degrees of numbness in the soft tissues of the cheek and upper lip, with potential complications such as hematoma, transient paralysis of the oculomotor nerve[1].

The superior dental plexus consists of the anterior, middle, and posterior alveolar nerves, which innervate the incisors and canines (anterior), premolars (middle), and molars (posterior alveolar nerves). The middle and anterior superior alveolar nerves originate from the infraorbital nerve. The anterior superior alveolar nerve arises from the lateral side of the infraorbital nerve, approximately at the mid-point of the infraorbital canal. It travels through the infraorbital canal, medially toward the nose, before turning downward and branching out to supply the incisors and canines, contributing to the formation of the superior dental plexus. The anterior superior alveolar (ASA) nerve originates approximately 5–8 mm posterior to the infraorbital foramen and provides pulpal innervation to the central incisor, lateral incisor, and canines.

The middle superior alveolar nerve runs downward and forward within the infraorbital canal, along the lateral wall of the maxillary sinus. The middle superior alveolar (MSA) nerve arises about 10 mm posterior to the infraorbital foramen, and is responsible for the pulpal innervation of the premolars and the mesio- buccal root of the first molar. The branches of the middle superior alveolar nerve merge with the posterior and anterior superior alveolar branches, forming the superior dental plexus[2]. The middle superior alveolar nerve is a variable branch—it can be duplicated or even absent. Human dissection studies have shown that the MSA nerve is not always present, with its occurrence varying between 30% and 72% of cases[3].

Neurovascular (nutrient) canals on the palate are most commonly located in the premolar region. The palatal cortex is generally more porous, with a greater average width and number of canals. These neurovascular canals contain the terminal branches of the greater palatine artery and nerve. The presence of these canals and the porosity of the palatal cortex create favorable conditions for the diffusion of anesthetic solution during conduction anesthesia for the anterior and middle alveolar nerve branches via a palatal approach[4].

In 1997, Friedman and Hochman introduced this maxillary anesthesia technique under the name Anterior Middle Superior Anesthesia (AMSA)[5], which targets the subneural dental plexus located near the root apices of the premolars. In this technique, the anesthetic is injected once from the palatal side, at a site with nutrient canals that allow diffusion through the maxillary bone, blocking these nerves without inducing anesthesia in the buccal soft tissues.

Since the needle penetrates the hard palate between the first and second premolars, approximately midway between the mid-palatine raphe and the free gingival margin, the local anesthetic (LA) solution spreads beneath the mucoperiosteum. This diffusion allows the anesthetic to reach the branches of the greater palatine and nasopalatine nerves, effectively numbing most palatal tissues.

Given the clinical significance of AMSA anesthesia for specific indications in dentistry, this study focuses on evaluating the success of this local anesthesia technique with different anesthetic agents for maxillary tooth extraction.

The aim of this study was to evaluate the overall success rate of anesthesia when applying the AMSA local anesthesia technique using the two most commonly used local anesthetics in dentistry for the first five maxillary teeth. Additionally, the study aimed to determine whether this anesthesia technique could serve as a primary and independent method for the extraction of the first five upper jaw teeth (incisors, canines, and premolars).

Materials and Methods

This prospective, double-blind, crossover randomized study included healthy volunteers classified as ASA I and II according to the American Society of Anesthesiologists. Participants were patients who had one or more avital maxillary teeth, in the region of incisors, canine or premolars. The routine dental extractions were performedat the Department of Oral Surgery, Clinic for Dental Medicine Niš, Serbia. After obtaining the Ethics Committee's approval of the Clinic for Dental Medicine Niš (No:2069/2-E-P;2024.), the study was performed respecting ethical principles outlined in the Declaration of Helsinki[6].

After obtaining medical data, patients were fully informed about the study and provided written consent for participation. Before the procedure, relevant data on the anesthetic effect were collected for each subject and recorded in a research chart (Figure 1).

The patients did not consume any medication that could alter their pain perception.

Patients partly completed the questionnaire at the clinic, partly at home, and returned it after completing, at the first check-up.

Twenty-four participants of both genders and varying ages (18-65) who had one or more avital maxillary teeth were included in the study and divided into two groups.

Group 1 (12 participants) received 4% articaine with epinephrine 1:100,000 (Pierrel S.p.A, Italy) as the local anesthetic.

Group 2 (12 participants) received 2% lidocaine with epinephrine 1:100,000 (Galenika a.d., Belgrade).

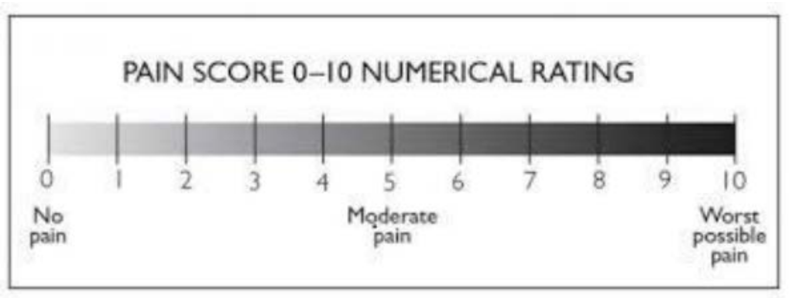
All patients received a topical anesthetic spray on the palatal side before the injection.

The total amount of anesthetic administered using the AMSA technique was 1,5 mL of articaine in the first group and 1,5 mL of lidocaine in the second group.

Technique of AMSA anesthesia: The procedure was performed with the position of the patient's head and neck slightly extended. A topical anesthetic was applied with a cotton ball soaked in anesthetic to the injection area for 30 seconds. The target point was located at the intersection of imaginary lines drawn between the premolars towards the middle of the palate, exactly halfway between the tip of the palatal suture and the edge of the free gingiva of the premolars; The needle was positioned so that the bevel was in contact with the palatal tissue, and was rotated 45º clockwise followed by 45º counterclockwise during insertion. The anesthetic solution was then delivered slowly at a consistent amount of 1.5 ml. Once the proper amount of anesthetic was in place, the needle was left undisturbed for 5 seconds before being withdrawn

The monitored anesthesia parameters included:

Subjective Pain Assessment (evaluated by patient): The Numeric Rating Scale (NRS) was used to assess subjective pain during surgery, represented horizontal line ranging from 0 (no pain) to 10 (worst possible pain)[7].



1. Pain perception during anesthesia was evaluated while needle insertion and anesthetic application at the target point on the palate.

2. Pain perception was also evaluated perioperatively, during the surgical procedure, while the tooth was extracted.

Anesthesia was considered successful if the tooth was simply extracted and the patient reported no pain (NRS score 0-2), or mild pain (NRS score 3-4).

3. Onset Time (min): The time elapsed from the administration of anesthesia to the first signs of its effect, manifested loss of sensitivity of palatal mucosa during puncture with a blunt instrument

4. Duration of Anesthesia Effect: The time from the onset of anesthesia to the cessation of its effects, including the appearance of sensitivity of palatal mucosa during puncture with a blunt instrument.

5. Appearance of post-extraction pain, was evaluated using NRS scale

6. Appearance of post-extraction complications, was noticed at the first tomorrow check- up.

The patient who experienced certain pain that required the addition of local anesthetic, received the dose of 1,8 ml of the same anesthetic of the belonging group, using the buccal infiltration technique.

Immediately after anesthesia administration and tooth extraction, patients recorded their pain intensity during these procedures.

Statistical analysis

For each parameter, the mean, standard deviation and standard error were calculated.

The statistical difference between the means of different groups was calculated using the independent samples T test. The significance level was established at p<0,05. Statistical analysis was performed using SPSS 21.0 (SPSS Inc, Chicago, IL, USA).

Results

Twenty-four adult patients participated in this study, 12 men and 12 women equally allocated in two groups of 6 patients of both sexes (total 12 patients per group), with an average age of 47,8 and 50,2 years. All the patients received an AMSA nerve block using a conventional syringe, in total amount of 1,5 ml of atricaine with ardenaline (group I) or lidocaine with adrenaline (group II). The anesthetic success of the AMSA nerve block technique using a conventional syringe with two different aneshtetics is presented in Table 1.

The onset of anesthesia ranged from 2 to 8 minutes (on average 3,92± 1,73 min.) in the first group, and from 3 to 9 (on average 5,08± 1,73 min) in the second. Pain assessed during anesthesia application ranged 2-6 in both groups (on average 3,33±1,43 and 4,42±1,56) with no statistical difference. Pain during the extraction ranged from 2-7 in the first group (on average 3,42±1,730), while 3-9 in the second group (on average 5,25±2,417) with statistically significant difference between groups (p=0,046) Figure 1. Duration of anesthesia was 52±17,10 min in the first group, and 40,25±7,629 min in the second, with statistically significant difference between groups (p=0,044) Figure 2. Additional anesthesia was needed in two cases in the first group 16,66% (both for incisors), and in five casesin the second 41,66% (3 for premolars, 2 for incisors). The pain after the procedure was noticed in four cases in the first group, with NRS ranging from 3-4 (mild pain). The post-extraction pain occurred in one case on the third day, and was treated successfully. Detailed average and statistical data are presented in Table 1. and Table 2.

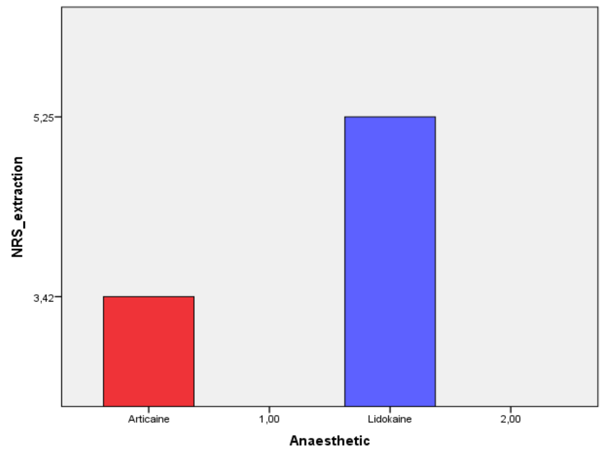


Figure 1. NRS of pain during the extraction

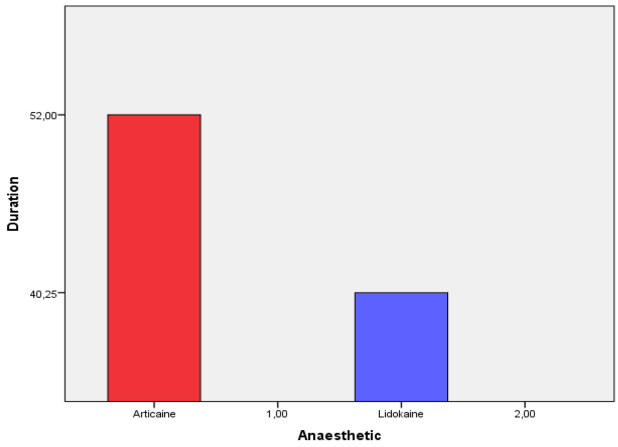


Figure 2. Duration of anesthesia

Table 1. Comparison of anesthetic parameters

	Anaesthetic	N	Mean	Std. Deviation	Std. Error Mean
NRS_anaesthesia_pain	Articaine	12	3,33	1,435	,414
	Lidocaine	12	4,42	1,564	,452
NRS_extraction_pain	Articaine	12	3,42	1,730	,499
	Lidocaine	12	5,25	2,417	,698
Onset_time	Articaine	12	3,92	1,730	,499
	Lidocaine	12	5,08	1,730	,499
Duration	Articaine	12	52,00	17,104	4,937
	Lidocaine	12	40,25	7,629	2,202
NRS_post-extraction_pain	Articaine	12	1,17	1,749	,505
	Lidocaine	12	,25	,622	,179

Table 2. Statistical analysis of anesthetic paremeters

Independent Samples Test											
		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
NRS_anaesthesia	Equal variances assumed	,063	,804	-1,768	22	**,091**	-1,083	,613	-2,354	,188
	Equal variances not assumed			-1,768	21,840	,091	-1,083	,613	-2,355	,188
NRS_extraction	Equal variances assumed	3,607	,071	-2,137	22	**,044***	-1,833	,858	-3,613	-,054
	Equal variances not assumed			-2,137	19,928	,045	-1,833	,858	-3,623	-,043

Onset_time	Equal variances assumed	,004	,952	-1,652	22	**,113**	-1,167	,706	-2,631	,298
	Equal variances not assumed			-1,652	22,000	,113	-1,167	,706	-2,631	,298
Duration	Equal variances assumed	7,678	,011	2,173	22	,041	11,750	5,406	,538	22,962
	Equal variances not assumed			2,173	15,210	**,046***	11,750	5,406	,240	23,260
NRS_postextraction_pain	Equal variances assumed	25,192	,000	1,710	22	,101	,917	,536	-,195	2,028
	Equal variances not assumed			1,710	13,734	**,110**	,917	,536	-,235	2,068

Discussion

The AMSA (Anterior Middle Superior Alveolar) nerve block technique is used for anesthesia of the central and lateral incisors, canines, and premolars in the maxilla. The injection site corresponds to the region where the anterior and middle superior alveolar nerve branches merge into the dental neural plexus, allowing a single AMSA block to effectively anesthetize the entire area including pulp and surrounded palatal soft tissue in the same region[8]. This technique could be advantageous, as the bilateral AMSA nerve block is believed to anesthetize 10 maxillary teeth, ranging from the second premolar on one side to the opposite side, without affecting the facial muscles. This makes it particularly beneficial for restorative dentistry. Research indicates that this technique allows for pulpal anesthesia while preserving sensation in the soft tissues, including the upper lip, cheek, and surrounding structures. This anesthetic technique was previously defined as infiltration rather than conduction anesthesia[9]. Certainly, AMSA anesthesia could also be defined as an intraosseous technique, since the anesthetic solution is deposited directly into the bone tissue. This method of applying anesthetic into highly vascularized bone tissue facilitates rapid absorption of the local anesthetic. Nevertheless, most of the authors advocated it as a conduction technique[10].

The results of this study show that this technique of anesthesia provides success in non- complicated extraction of non -vital teeth. Better results in the group treated with articaine could be explained by the pharmacology of articaine and its local anesthetic potential[11]. Articaine is an amide local anesthetic notable for its molecular structure that differs from the other amide local anesthetic thanks to the presence of a thiophene ring. The structure of the ring improves its lipid solubility, allowing articaine to more easily diffuse through soft tissue and bone compared to other local anesthetics and higher potency for anesthetic solution to penetrate through the alveolar and palatal bone. Articaine has partition coefficient of 17 (due to its lipophilicity), whlile lidocaine has 4, so articaine enables a greater concentration of active molecules to effectively penetrate the lipid nerve membrane, which accounts for its high anesthetic potency. The longer duration of anesthesia achieved with articaine could be explained by its higher binding affinity to proteins at the receptor site (95%), compared to lidocaine—the gold standard (65%)—which results in a prolonged anesthetic effect of articaine[2].

Success rates were observed in both groups during the extraction. Tomić at al. recorded high success in painless extraction of the upper premolars using AMSA technique, regardless of the local anesthetic or injection system that was used[11]. Chuorasia at al.[4] reported a success rate of AMSA anesthesia in 71.5% of cases, while Lee et al[12] reported a success rate of 35 to 58%. In our study, additional anesthesia was used in two cases in the first group (16,66%), while it was used in five cases in the second (41,66%). The greatest addition of anesthesia was demanded for extraction of the first premolar (66,6% of all additional anesthesia) in the lidocaine group. This could be related to anatomical variations in the innervation of the first premolar region. The first premolar usually has two separate roots, while the second premolar typically has a single connected root. The buccal root of the first premolar is positioned on the buccal side, meaning that an anesthetic solution administered on the palatal side must diffuse over a longer distance to reach it. The width of the maxilla in this region is wider than in the mesial region, so lidocaine with its low lipophilicity could not achieve the buccal branches of the medial superior alveolar nerve. Additionally, the buccal root of the first premolar may receive innervation from accessory branches of the posterior superior alveolar nerve, which is not influenced by anatomical structures on the palate. Other studies have also reported the unpredictable effect of the AMSA technique on the buccal periodontium[13].

Additional anesthesia was also needed during the extraction of the incisors, in both groups. In the lidocaine group the need for additional anesthesia for incisors was 44,4% (of all additional anesthesia), while in the articaine group it was 100% (of all additional anesthesia). The greater distance between the central incisor's root and the injection site may hinder the diffusion of the anesthetic solution, resulting in a relatively lower success rate of bone anesthesia. Velasko at al. noticed the similar success rate in pulp anesthesia[14]. The vestibular root of the first premolar, as well as the position of the central incisor's root, are located further away compared to the roots of the other teeth in the upper jaw, considering the injection site on the palatal side. This distance may reduce the success of AMSA palatal anesthesia technique. Research has shown that the AMSA technique is particularly effective for orthodontic premolar extractions, In cases of periodontally compromised premolars, success rates are similarly high. The complete success of second premolar extractions in the articaine group further supports our findings. Some studies also highlight the advantages of this technique in pediatric dentistry, where increased bone porosity allows for faster and more effective anesthetic diffusion.

Previous studies have reported that when the AMSA nerve block is administered using 2% lidocaine with epinephrine, the onset time with conventional injection techniques typically falls between 6 and 12 minutes[15]. The onset of anesthesia in this study was 5,07 minutes in the lidocaine group, and in 3,83 minutes in the articaine group, likely due to the presence of nutrient foramina and canals in the maxilla. Articaine exhibited a faster onset compared to lidocaine, attributable to its high liposolubility. Conversely, the anesthetic effect lasted longer in the lidocaine group, which is expected given its slower metabolism and longer half-life compared to articaine. This was expected, because the spreading of anesthetic through palatal mucosa and periosteum is fast, while we did not test the pulpal anesthesia (all teeth were non vital).

Ćetković at al.[16] noticed anatomical morphology bases of AMSA anesthesia success. Female skulls exhibited significantly wider nutrient canal foramina compared to male skulls. Despite the increased thickness, the palatal cortex at the AMSA injection site displayed slightly greater porosity than the buccal cortex. They also noticed a significantly higher number of micro canals fully penetrated the cortical thickness in the palatal bone compared to the buccal cortical bone, so the structural features of the palatal cortex offer a strong anatomical foundation for achieving a high success rate with the AMSA injection technique[16]. In this study male/female portion was equal, so gender had no effect on the overall success of anesthesia.

One of the main drawbacks of the AMSA technique is the pain experienced during anesthetic administration on the palate, often perceived as the most painful part of the procedure. Even with the use of topical anesthesia, the pain was rated as moderate to intense, consistent with the findings of Wahl et al., who reported that palatal injections cause significantly more pain than other intraoral applications due to the pressure of anesthetic infiltration[17].

As an alternative, infraorbital anesthesia can provide adequate anesthetic effect but carries risks such as hematoma, transient muscle paralysis of the eye, and prolonged facial numbness. The success rate of pulpal anesthesia using the infraorbital technique ranges 57.9%[18] to or 75-92%, though articaine administration via this method has been associated with transient ocular muscle paralysis in 15% of cases.

A key advantage of the AMSA technique is the preservation of facial muscle mobility, which is particularly significant in aesthetic dentistry as it prevents lip and facial numbness, maintaining the natural smile line. Additionally, this technique has proven beneficial in periodontal surgery due to its excellent hemostatic effect on the palate.

However, our study results indicate that the success of AMSA anesthesia varies depending on the tooth group. Success rates were lower for incisors and canines, likely due to anatomical variability in the maxilla, specifically the presence of the middle superior dental nerve branch in certain patients. Dissection studies have shown that this anatomical variant occurs in 30% to 72% of cases, which may explain the differences in anesthesia effectiveness among patients[19].

Conclusion

The AMSA local anesthesia technique has broad applications in conservative dentistry and periodontology, and it is particularly advantageous due to its preservation of facial muscle function. It can also be especially suitable for minor oral surgery depending on interventions. While it has demonstrated high efficacy for simple extractions when articaine is used, it shows less anesthetic efficacy when lidocaine is used. AMSA anesthesia technique with articaine may be considered a primary local anesthesia technique for the extraction of the first five maxillary teeth when they are not vital, or a supplementary technique for the overall anesthetic effect of lidocaine for the same purpose.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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