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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Efficacy of the anterior and middle superior alveolar nerve block in achieving pulpal anesthesia of maxillary teeth

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SUMMARY

Introduction The anterior and middle superior alveolar (AMSA) nerve block is an alternative technique of local anesthesia in the maxilla, unpredictably efficient for pulpal anesthesia.
The aim of this study was to determine the anesthetic efficacy of the AMSA injection for pulpal anesthesia, using computer-controlled injection system or conventional syringe, and two local anesthetic solutions with or without adrenaline.

Methods The authors administered two AMSA injections during two separate appointments, utilizing the computer-controlled system and conventional syringe to 40 subjects, divided into two groups of 20 subjects each depending on the local anesthetic used. A pulp tester was used to test the achieved anesthesia of the central and lateral incisors, canine, first and second premolars, and the first molar in 10-minute cycles over a period of 60 minutes. Duration of anesthesia for all the mentioned teeth was also determined for both the anesthetic solutions and ways of application.

Results The AMSA injection with both types of equipment was successful, showing slow onset, satisfying intensity, and declining duration of pulpal anesthesia at the last two measurements. Local anesthetic with vasoconstrictor exhibited a significantly longer pulpal anesthesia.

Conclusion The AMSA nerve block could be recommended for achieving pulpal anesthesia of maxillary teeth from the region of the first incisor to the second premolar.

Keywords: AMSA nerve block; pulpal anesthesia; maxillary teeth

INTRODUCTION

Traditionally, local anesthesia for the many dental procedures in the maxilla is achieved by administering an infiltration injection on the buccal or labial aspect of the targeted tooth. However, this technique is sometimes inadequate for relieving pain during tooth extraction in cases of teeth affected by acute periodontal infection; also, paresis of muscles of facial expression, which occurs to some degree, may interfere with aesthetic dental work in the region. The anterior and middle superior alveolar (AMSA) nerve block, introduced in 1998, represents an alternative technique that might compensate the mentioned shortcomings [1]. It derives its name from the fact that both the anterior and the middle (if existing) alveolar nerves are blocked, providing anesthesia of several maxillary teeth (including incisors, canines, both premolars and mesial roots of the first molars) [2].

Some studies have shown that effective pulpal anesthesia after the AMSA nerve block is questionable [3–6]. Moreover, palatal injections with the conventional syringe are known to be unpleasant and painful. Several studies have shown that computer-assisted injection system technique resulted in less pain than the conventional syringe [7–10]. Therefore, conventional syringes, according to some researches, were claimed to be too unpredictable to be recommended for clinical use as the first choice [3]. Finally, there are no available studies in the literature that compare success of the AMSA injection in achieving pulpal anesthesia depending on the type of local anesthetic solution.

This prospective, randomized, double-blind study (concerning the anesthetic used) was aimed at determining the efficacy of the

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AMSA nerve block for pulpal anesthesia, applied with a computer-controlled injection system or a conventional syringe, when local anesthetics with different contents of adrenaline were used.

METHODS

The clinical trial was conducted at the Faculty of Medicine in Foča, Bosnia and Herzegovina. The study protocol was approved by the Ethical Committee of the Faculty of Medicine (registration number 01-8/111, issued 11/2/2009). The study was conducted in accordance with the accepted ethical standards for research practice (guidelines of the Declaration of Helsinki of 1975, as revised in 1983). All participants signed an informed consent form.

Subjects

Forty adult subjects of both sexes, with intact teeth from the first molar on one side to the first molar on the other side, voluntarily participated in this study. All participants were in good health (determined by a written medical health form), ranging from 20 to 25 years of age, and not taking any medication that could alter their pain perception. Participants were students of the Faculty of Dental Medicine in Foča, University of East Sarajevo.

Method

All the participants were divided into two groups of 20 participants each, depending on the content of adrenaline in the local anesthetic used – 0.9 mL of 3% mepivacaine plain (Septanest®, Septodont, Saint-Maur-des-Fosses, France) and 0.9 mL of 4% articaine with adrenaline 1:100,000 (Ubistesin forte®, 3M ESPE, Seefeld, Germany).

All subjects randomly received two AMSA injections at two separate appointments, the time between the sessions being at least one week. All the participants received the AMSA injection using computer-controlled injection system at the first appointment, and the same amount of appropriate local anesthetic solution with a conventional syringe at the other appointment. In total, 80 injections were administered and each subject served as his/her own control. Forty AMSA injections were administered on the left side, and the same number on the right side. The side of the injection was randomly chosen for the first injection.

All the participants received the AMSA nerve block as previously described [1, 2]. They were positioned supine in the dental chair, with slight hyperextension of the neck in order to have good accessibility and visibility (Figure 1). They were informed that the procedure will last slightly longer than usually, especially when receiving a computer-controlled injection (approximately 3 minutes).

The depth of anesthesia for all the mentioned teeth was monitored with the electric pulp tester of 10 mA, with a scale of 0–10. Every 10 minutes within an hour, the pulp tester recorded the level of anesthesia, seven times in total. The mandibular intact canine was used as control. No response to the maximum output of the pulp tester was used as the criterion for good pulpal anesthesia. Also, for the same subjects, the duration of anesthesia was determined, regardless of the way of administration.

Figure 1. The anterior and middle superior alveolar nerve block done with conventional syringe and slight hyperextension of the neck

Statistical analysis

Data was analyzed using Kruskal–Wallis test and exact Wilcoxon rank sum test, using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA). Statistical significance of p-values was determined in relation to Bonferroni correction α value ($\alpha_1 = 0.05 / 3 = 0.0167$). For graphical data display, MS Office Excel 2003 (Microsoft, Redmond, WA, USA) was used.

RESULTS

Essentially, the results of the intensity of pulpal anesthesia of the central and lateral incisors were similar when articaine was used, regardless of the equipment used for anesthesia. The intensity of pulpal anesthesia of the mentioned teeth was less intense when mepivacaine was used, regardless of the equipment (Figures 2 and 3). Based on the obtained results, a statistically significant difference in the intensity of anesthesia was observed after the use of anesthetics with adrenaline compared to that without the vasoconstrictor ($p < 0.05$).

Concerning the success of pulpal anesthesia of canines and premolars, intensity of the achieved anesthesia, for the whole observational period (60 minutes), was better when articaine was used, regardless of the equipment used. The intensity of anesthesia decreased when mepivacaine had been already used after second measurement, regardless of the equipment used (Figures 4, 5, 6). Regardless of the mode of administration, a statistically significant difference existed in the intensity of anesthesia achieved with different anesthetic solutions ($p < 0.05$).

Anesthesia of the first molar achieved by mepivacaine was not satisfactory; anesthesia achieved by articaine with adrenaline was better but short-lived, regardless of the

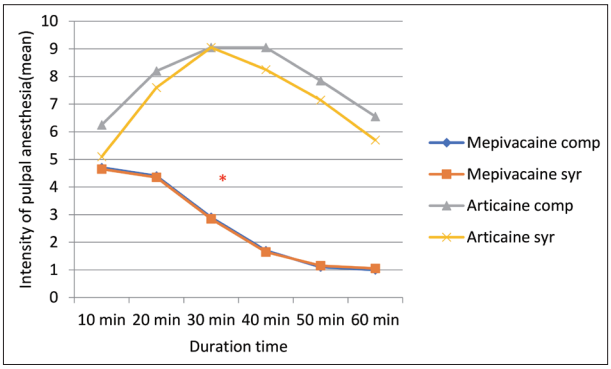

Figure 2. Intensity of central incisor pulpal anesthesia as determined by the lack of response to electrical pulp testing

*p < 0.05, statistically significant difference in the intensity of pulp anesthesia between two different anesthetic solutions, regardless of the manner of administration after the second measurement and further on

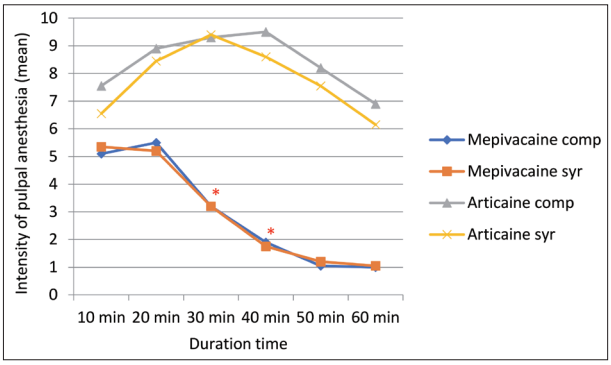

Figure 3. Intensity of lateral incisor pulpal anesthesia as determined by the lack of response to electrical pulp testing

*p < 0.05, statistically significant difference in the intensity of pulp anesthesia between two different anesthetic solutions, regardless of the manner of administration after the second and third measurement

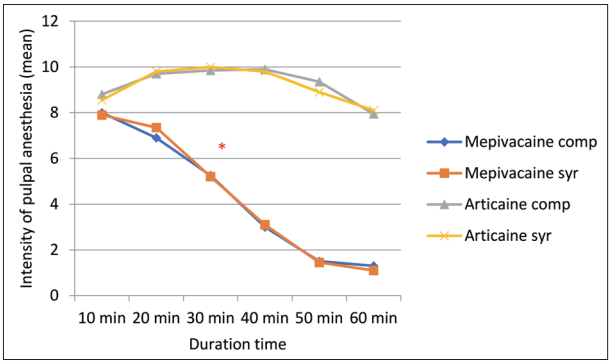

Figure 4. Intensity of canine pulpal anesthesia as determined by the lack or response to electrical pulp testing

*p < 0.05, statistically significant difference in the intensity of pulp anesthesia between two different anesthetic solutions, regardless of the manner of administration after the third measurement and further on

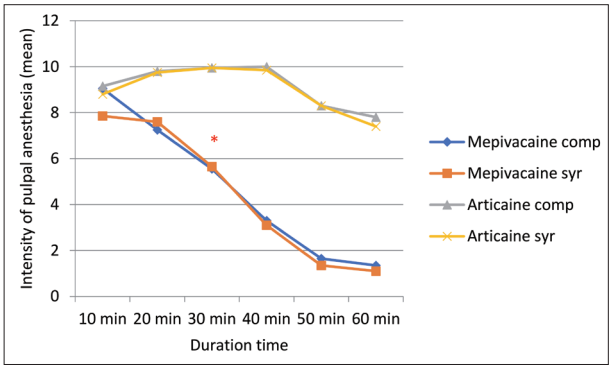

Figure 5. Intensity of the first premolar pulpal anesthesia as determined by the lack of response to electrical pulp testing

*p < 0.05, statistically significant difference in the intensity of pulp anesthesia between two different anesthetic solutions, regardless of the manner of administration after the third measurement and further on

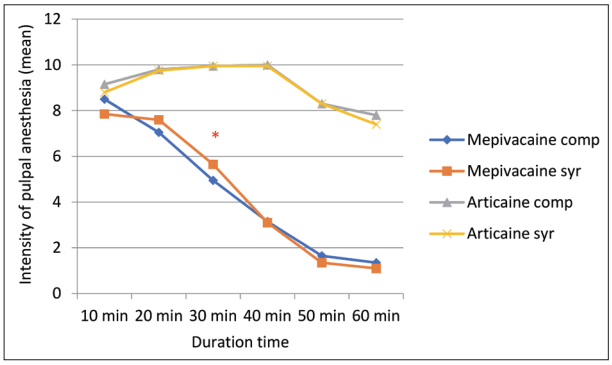

Figure 6. Intensity of the second premolar pulpal anesthesia as determined by the lack of response to electrical pulp testing

*p < 0.05, statistically significant difference in the intensity of pulp anesthesia between two different anesthetic solutions, regardless of the manner of administration after the third measurement and further on

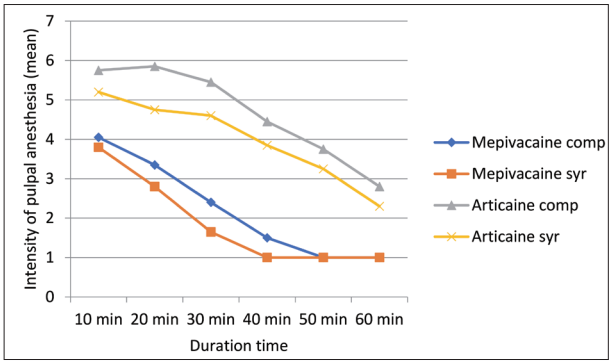

Figure 7. Intensity of the first molar pulpal anesthesia as determined by the lack of response to electrical pulp testing

*p > 0.05, there is no statistical significance in any parameter, neither in the application mode nor in the type of local anesthetic solution

equipment used (Figure 7). In regard to the first molar, statistical significance was not found in the intensity of anesthesia, regardless of the type of local anesthetic solution and the manner of application ($p > 0.05$).

Regarding the length of anesthesia, the descriptive data, presented in Tables 1 and 2, clearly indicates that the duration of anesthesia was significantly shorter when anesthetic without vasoconstrictor was used.

DISCUSSION

The use of no response to 10 mA (maximum output of the pulp tester), as a criterion for complete pulpal anesthesia, was based on the clinical studies by Dreven et al. [11] and Certosimo and Archer [12].

It is believed that the palatal application of anesthetics to achieve the AMSA block is more efficient if the Wand system (Milestone Scientific, Inc., Livingston, NJ, USA)

Table 1. Descriptive data on the duration of anesthesia for all teeth (in minutes) in relation to the equipment used

Type of anesthetic	Anaeject device	Carpule syringe	Total
Mepivacaine plain			
n	20	20	40
Average (SD)	41 (5.68)	40 (5.77)	40.50 (5.6)
Median (range)	40 (35–50)	40 (30–50)	40 (30–50)
Articaine with vasoconstrictor			
n	20	20	40
Average (SD)	81.5 (8.18)	77 (12.06)	79.25 (10.29)
Median (range)	82.5 (65–90)	80 (55–90)	82.5 (55–90)

There is a statistically significant difference in the duration of anesthesia in relation to the type of the anesthetic (Kruskal–Wallis test; $\chi^2 = 40.518$; $p = 1.59 \times 10^{-9}$)

Table 2. The results of testing the duration of anesthesia in relation to the types of anesthetic (regardless of the way of administration)

Group	Exact Wilcoxon rank-sum test	
	W	p#
Mepivacaine vs. articaine	0	1.45×10^{-11}

#Significance of p-value is determined in relation to the Bonferroni correction ($\alpha_1 = 0.05 / 3 = 0.0167$)

is used instead a classic syringe [13, 14]. However, the results of this study indicate that the use of conventional syringe might be practically equally effective as the use of the computer-controlled injection system equipment.

Concerning the presence of vasoconstrictor in the anesthetic solution, the use of local anesthetics with adrenaline resulted in successful pulpal anesthesia for all the mentioned teeth except the first molar, regardless the equipment used. Some studies have shown that 4% articaine with adrenaline in the 1:100,000 ratio has significantly lower effect than 2% mepivacaine with adrenaline in the 1:100,000 ratio, in the width of the anesthetic field and the duration of anesthesia [15].

The use of the AMSA injection for clinical anesthesia of the mentioned five teeth and bucco-mesial root of the first molar may be accepted as advantageous because with only one injection, all these teeth (upper incisors, canine, and both premolars) can be anesthetized for almost 60 minutes, without numbness of the lips and muscles of facial expression [16]. The main theoretical advantage of this AMSA nerve block is that it reduces the number of injections and the quantity of anesthetic solution administered in comparison with the conventional supra-periosteal infiltrative anesthesia applied in multiple injections for each tooth. There is also evidence that the effect of AMSA is equal to a total of five supra-periosteal injections on one side of the maxilla, with less discomfort and less anesthetics [17].

According to our results, the AMSA injection seems to be successful for clinical requirements of pulpal anesthesia of both incisors, canines and premolars. This success is largely dictated by the pattern of diffusion of the local anesthetic solution across the bony canal from the palatal nutritive canal and the region of upper dental plexus. This is the reason the AMSA injection has been called a nerve block. It is possible that the success of the AMSA injection in anesthesia of the first molar might somehow depend on the presence/absence of the medial superior alveolar nerve, whose absence was found in 30–72% in a cadaver dissection study [18]. The superior alveolar nerve's course lateral to the maxillary sinus and the greater palatine nerve travels through the hard palate. This difficult three-dimensional anatomy has led some dentists and oral surgeons to a critical misunderstanding of the development of the AMSA nerve block. In one research, authors concluded that the AMSA and palatal-anterior superior alveolar nerve blocks, as currently described, are not based on accurate anatomy [19]. A similar study of a comparative evaluation of anesthetic efficacy showed that 4% articaine proved to be more effective than 2% lidocaine in securing anesthesia of maxillary anterior teeth and premolars [20]. The advantages of the AMSA injection when compared to conventional infiltration can be particularly evident in patients who may be sensitive to vasoconstrictors. Thus, the results found here seem to indicate that the AMSA injection could be considered an alternative to the standard infiltration technique for patients in whom increased vasoconstrictor concentrations may be undesirable, especially in multiple endodontic procedures.

CONCLUSION

Having in mind all the presented results, the AMSA nerve block used for pulpal anesthesia was quite successful. Therefore, the AMSA nerve block may be recommended for clinical use in endodontics. In conclusion, we can add that anesthetic solution without a vasoconstrictor can be used for short-term procedures, regardless of the significantly short duration in relation to anesthetics with a vasoconstrictor.

Conflict of interest: None declared.

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Успешност блока предњих и средњих горњих алвеоларних нерава у постизању анестезије зубне пулпе горњих зуба

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САЖЕТАК

Увод Успешност блока предњих и средњих горњих алвеоларних нерава (блок *AMSA*), алтернативне технике локалне анестезије горњих зуба, непредвидива је када је у питању постизање анестезије зубне пулпе ових зуба.

Циљ ове студије био је да утврди ефикасност блока *AMSA* у постизању анестезије зубне пулпе применом компјутерски контролисаног система за апликацију локалне анестезије или класичне карпул-бризгалице и коришћењем два локална анестетичка раствора, са адреналином или без њега.

Методе Аутори су дали инјекције за блок *AMSA* у две одвојене посете, користећи компјутерски контролисани систем за апликацију локалног анестетика или конвенционалну карпул-бризгалицу за 40 испитаника, подељених у две групе од по 20 испитаника у зависности од примењеног локалног анестетичког раствора. Пулп-тестером је на сваких 10 минута у току једног сата одређиван интензитет постигнуте анестезије пулпе централног и латералног секутића, очњака, оба преткутњака и првог кутњака. Такође, одређивана је и дужина трајања анестезије за поменуте зубе у односу на примењене анестетичке растворе и начин апликације.

Резултати Блок *AMSA* је био успешан после примене обе врсте бризгалице и карактерисао се спорим почетком, задовољавајућим интензитетом, као и опадањем интензитета приликом последња два мерења. Локални анестетички раствор са вазоконстриктором показао је статистички значајно дуже трајање анестезије.

Закључак Блок *AMSA* се може препоручити за анестезирање пулпе горњих зуба, од централног секутића до другог преткутњака.

Кључне речи: локална анестезија; анестезија пулпе; горњи зуби