The Anesthetic Effect of Anterior Middle Superior Alveolar Technique (AMSA)

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Anesthesia of the soft and hard tissues of the maxilla may require up to 5 injections. Thus, the aim of this study was to evaluate the anesthetic efficacy of the anterior middle superior alveolar (AMSA) and supraperiosteal injection techniques during subgingival scaling and root planing (SRP). Thirty individuals with periodontitis were scheduled for SRP on the buccal aspect of teeth in the anterior maxilla. Before SRP, on a randomly chosen side of the maxilla, the supraperiosteal injection was performed in 1 session, while the AMSA injection was conducted in the contralateral side of the same patient in another session. Immediately after each SRP session, patients rated their pain perception during the procedure with a visual analog scale. No statistically significant differences in mean pain ratings during SRP were found after both anesthetic techniques ($P > .05$). This preliminary study demonstrated that the AMSA and supraperiosteal injection techniques provided similar anesthetic comfort during SRP. The AMSA injection could be an alternative to anesthetize the buccal aspect of maxilla, without the undesirable effects on facial structures such as the upper lip, nostrils, and lower eyelids. However, further randomized clinical trials with larger samples are necessary to confirm such results.

Key Words: AMSA injection; Periodontics; Local anesthesia; Pain; Scaling.

Patients with periodontal diseases often present deep pockets that require scaling and root planing (SRP), during which local anesthesia of the periodontal tissues may be required to control pain.¹ To achieve proper anesthesia of the mucogingival tissues in the maxilla, up to 5 injections of the anesthetic solution may be needed.¹ These injections are applied to anesthetize the posterior, middle, and anterior superior alveolar nerves, and the greater palatine and nasopalatine nerves.² Although these series of anesthetic injections are effective to anesthetize the tissues of the maxilla, they can unintentionally affect other structures of the face,³ causing

postoperative discomfort and hindering patient's ability to smile and show the upper lip. In order to minimize the side effects, and decrease the number of punctures and the amount of anesthetic solution injected to control pain, Friedman and Hochman⁴ described the anterior middle superior alveolar (AMSA) anesthetic injection for various dental procedures in the maxilla. With the AMSA injection, other facial anatomical structures apart from the periodontium and teeth such as the upper lip, the bridge of the nose, and lower eyelids are not affected by the anesthetic procedure.¹⁻⁴ The anesthetic solution is administered in a small area of the palate where the sensory fibers of the lips and face cannot be reached and, as a result, the activity of the muscles responsible for facial expressions is not altered.⁵ Additionally, the administration of just 0.6 to 0.9 mL of anesthetic is enough to induce the anesthesia of the pulpal and soft

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tissues of the palate region.^{6,7} This is a significantly smaller amount of anesthetic when compared with what is usually administered for the desired analgesia of dental and periodontal structures.

The biological plausibility of the AMSA injection is based on the resilience of palatal tissues and the application of the anesthetic solution with controlled flow pressure in order to reach the underlying bone and neurovascular anatomy. The penetration of the anesthetic into the palatal tissues promotes the diffusion of the solution through numerous nutrient channels and pores in the cortical bone of the palatal process.⁶ With the spread of the anesthetic into the tissues, structures typically innervated by the anterior superior, middle and posterior alveolar nerves, and the nasopalatine and greater palatine nerves are anesthetized.^{7,8}

Several reports have suggested that the AMSA injection is capable of effectively anesthetizing teeth and maxillary tissues extending from the mesial root of first molar to central incisors with a single infiltration.^{1–5,7} However, no controlled studies that specifically evaluate buccal tissue analgesia and, at the same time, the pain perception by the patient during SRP have been found in the literature.

Therefore, the aim of this study was to evaluate the anesthetic efficacy of the AMSA injection on tissues of the buccal aspect of the alveolar ridge and the level of pain perceived by patients during the SRP of periodontal pockets in the maxilla in comparison with the conventional suprapariosteal injection technique.

MATERIAL AND METHODS

Study Design

This was a randomized, controlled, split-mouth, double-blind study conducted according to the Consolidated Standards of Reporting Trials (CONSORT) statements. The Ethics Committee in Human Research of the State University of Maringá, Brazil, approved this study design in accordance with the Helsinki declaration. All patients included in the study before treatment was initiated signed a consent form.

Sample Selection

Thirty adult subjects in need of periodontal treatment of the buccal aspect of the maxilla, who sought treatment at the Dental Clinic of the Universidade Estadual de Maringá, Brazil from October 2009 to February 2010 were included in the study.

The inclusion criteria to participate in the study were: localized or generalized periodontal disease; ≥ 3 teeth with probing depth ≥ 5 mm on any aspect of anteroposterior teeth on each side of the maxillary dental arch; a minimum of 6 natural teeth in the maxilla (incisors, canines, and premolars); good overall systemic health; and absence of allergy to any component of the anesthetic used. Patients presenting any type of systemic conditions that could contraindicate periodontal treatment, as well as those who had taken any central nervous system depressants, such as alcohol, and non-opioid and opioid analgesics within 72 hours prior to the clinical procedures were excluded from the study.

Clinical Intervention

Premolars, canines, and central and lateral incisors of the maxilla presenting periodontal pockets ≥ 5 mm were selected for subgingival SRP. To guarantee the homogeneity of the test and control groups, probing pocket depth (PPD) and clinical attachment level (CAL) were measured at the buccal sites of maxilla with a conventional University of North Carolina periodontal probe (Hu-Friedy Manufacturing Company, Chicago, IL). Additionally, bleeding on probing (BoP)⁹ and plaque index (PI)¹⁰ were also registered during the same session. The patients were then scheduled for SRP sessions on 2 different occasions with at least a 2-day interval.

In the first session, 1 side of the maxilla was randomly chosen to be submitted to SRP under local anesthesia in a split-mouth design. The AMSA injection was used in 1 side (test group; Figure 1), while in the contralateral side the conventional suprapariosteal injection technique was employed (control group). The anesthetic injection technique was assigned following a simple randomization procedure with the use of computerized random numbers (BioEstat 5.0, Mamirauá Institute for Sustainable Development, Belém, PA, Brazil). The allocation sequence was concealed from the clinician, and randomization was performed using opaque, sealed, and stapled envelopes, which were opened only at the moment of the anesthetic procedure in the first session. Both anesthetic techniques were performed with conventional syringes (DUFLEX, S.S. White Artigos Dentários Ltda, Rio de Janeiro, RJ, Brazil) and 30G short needles (Terumo Medical Corporation, Tokyo, Japan). The anesthetic used was Mepivacaine 2% with epinephrine (adrenaline vasoconstrictor) 1 : 100.000 (Mepiadre 100, New DFL Industria e Comercio Ltda, Rio de Janeiro, RJ, Brazil).

Before the anesthetic injection procedures, a topical anesthetic gel (Benzocaine 200 mg/g, Benzotop, New

Figure 1. Anterior middle superior alveolar (AMSA) injection. Palatal blanching can be observed from the incisive to first molar region.

DFL Industria e Comercio Ltda) was applied in all patients in the region of the punctures for 2 minutes. The AMSA injection was performed according to Friedman and Hochman.⁴ The needle was introduced with the bevel towards the palate at a 45° angle and axially rotated (45° clockwise/45° counterclockwise) while 0.6 mL of the anesthetic was gently infiltrated for 1 minute. The supraperiosteal injection (infiltration) was applied at the bottom of the vestibule for 1 minute. The total amount of anesthetic (1.8 mL) was divided into 3 doses of 0.6 mL, infiltrated in the region of the incisors, canines, and premolars, respectively. All anesthetic procedures were performed by the same properly calibrated professional ($\kappa = 0.9$), different from the operator responsible for the SRP procedures.

SRP procedures started 2 minutes after the anesthetic injections were applied and was performed only on the buccal surfaces of premolars, canines, and lateral and central incisors during a period of 30 minutes. The treatment consisted of scaling and corono-radicular planing the involved teeth using Gracey curettes (Hu-Friedy Manufacturing Company). An operator who was unaware of the anesthetic technique used performed the clinical examinations and the SRP procedures.

Outcome Measures

Immediately after SRP, patients rated their perception of how painful the procedure was by placing a vertical line on a visual analogue metric scale¹¹ (primary outcome measure). Later, pain perception ratings of men and women were compared (secondary outcome measure). The visual analog scale (VAS) consists of a 100-mm horizontal line with 2 end points: 0 = no pain at all, and

100 = worst pain imaginable pain. Patients were instructed to mark in the VAS scale the point in the line between 0 and 100 that best represented their pain perception during SRP. The distance from the beginning of the scale to the mark on the line was measured with a millimeter ruler. The value obtained represented the level of pain felt by the patient. This evaluation was performed twice for each patient on different days, immediately after each experimental procedure. Subsequently, patients continued with their planned periodontal treatment for the whole mouth.

VAS ratings were classified into 5 categories (adapted from Williamson and Hoggart¹¹): (a) no pain (0 mm); (b) mild to low pain (> 0 mm to ≤ 30 mm); (c) moderate pain (> 30 to ≤ 70 mm); (d) strong or severe pain (> 70 mm to < 100 mm); and (e) worst pain imaginable pain (100 mm).

Statistical Analysis

Mean values and standard deviations of the variables VAS, PPD, CAL, BoP, and PI were calculated for test and control groups by taking the patient as the statistical unit. Comparisons between test and control groups were conducted with paired Student's *t* test for the parametric parameters PPD, CAL, BoP, and PI. Wilcoxon test was used to compare the nonparametric VAS ratings data obtained from test and control groups and women and men subgroups. Chi-square test was used to compare the percentage of individuals in each VAS category. All statistical analyses were conducted with the software BioEstat 5.0 (Mamirauá Institute for Sustainable Development) with a level of significance (α) equal to 5%.

RESULTS

A total of 30 periodontally compromised patients (17 women and 13 men) aged between 27 and 56 years (mean age 43.9 ± 9 years) participated in the study. All patients were included in both test and control groups. Mean periodontal clinical parameters data obtained from both test and control groups are presented in Table 1. No statistically significant differences were found between groups for any of the clinical parameters assessed.

Mean VAS ratings (primary outcome) for the test and control groups, as well as for men and women (secondary outcome), are presented in Table 2. No statistically significant differences were found between test and control groups ($P > .05$), and pain ratings were located within the range considered as “mild to low pain” (Figure 2). No statistically significant differences in pain

Table 1. Mean Values and Standard Deviation of the Clinical Periodontal Variables Obtained From Test and Control Groups at Baseline*

Periodontal Parameters	Test	Control	P
PPD, mm	3.75 ± 0.70	3.92 ± 0.83	.161
Central incisor	3.20 ± 1.35	3.57 ± 1.56	.106
Lateral incisor	3.43 ± 1.36	3.70 ± 1.73	.217
Canine	5.00 ± 1.81	3.87 ± 2.20	.007
First premolar	3.93 ± 1.90	4.83 ± 1.61	.031
Second premolar	3.17 ± 1.51	3.63 ± 1.56	.170
CAL, mm	4.03 ± 0.66	4.11 ± 0.76	.313
BoP, %	43.78 ± 23.57	46.79 ± 19.04	.257
PI, %	55.77 ± 17.60	58.59 ± 17.44	.260

* PPD indicates probing pocket depth; CAL, clinical attachment loss; BoP, bleeding on probing; and PI, plaque index.

ratings were observed between men and women in the control group ($P > .05$). However, in the test group, ratings reported by men were statistically lower than those reported by women ($P = .0122$).

Table 3 illustrates the frequency distribution, in percentage terms, of patients in the test and control groups according to the different VAS classifications. A total of 76.6% of individuals in test group and 83.2% in control group reported no pain or mild to low pain during SRP, with no significant difference between groups ($P > .05$).

DISCUSSION

The present study compared the effectiveness of the AMSA injection with the suprapariosteal injection technique (infiltration). The findings from the present study indicated that both the AMSA injection and the conventional infiltration were effective in controlling pain in the buccal tissues of the maxilla during subgingival SRP.

The results of the present study showed no significant differences between test and control groups concerning the pain perception of patients as indicated in the VAS scale. These findings are in agreement with some previous clinical studies, which demonstrated the ability of the AMSA injection to anesthetize the buccal tissues of the maxilla from the central incisor to the premolar.^{2,4–7,12} In 1 of these reports, Sculean et al¹² used a similar

methodology to compare conventional infiltration with AMSA injection during a nonsurgical periodontal procedure, and observed that both techniques were equally able to anesthetize the buccal region. These results indicate that the AMSA injection is effective in promoting anesthesia of oral tissues such as those in the buccal aspects of the maxilla.

In the present study, the AMSA injection technique was shown to promote proper analgesia of the buccal tissues during the entire SRP time (30 minutes). Friedman and Hochman⁴ evaluated the duration of the anesthetic effect of the AMSA injection in maxillary teeth. The authors observed that the anesthetic effect should be expected to last between 45 to 90 minutes. In 2010, Acharya et al¹³ demonstrated that the duration of the anesthetic effect of the AMSA injection was 90 up to 180 minutes. These findings suggest that the anesthetic effect of the AMSA injection was considerably longer than the 30 minutes required for SRP procedure in the present study.

One of the main differences of the AMSA injection is the use of smaller quantities of local anesthetic when compared to conventional infiltration. This can be especially advantageous in patients who may be sensitive to vasoconstrictors. The amount of anesthetic solution administered in the test group was 3 times less than that

Table 2. Mean and Standard Deviation of Visual Analog Scale Ratings in the Test and Control Groups, and in the Gender Subgroups

	Test	Control	P
Women	26.5 ± 29.6	18.1 ± 26.2	.127
Men	7.30 ± 12.7*	19.50 ± 25.5	.096
Overall	18.23 ± 25.4	18.46 ± 29.0	.484

* Statistically significant difference between men and women from the same group ($P = .0122$).

Figure 2. Graph of the individual pain rating outcomes.

Table 3. Frequency Distribution, in Percentage (Number of Individuals) of the Patients in the Different Visual Analog Scale (VAS) Pain Ratings Categories

Pain Categories (VAS)	Test	Control
No pain	36.6 (11/30)	46.6 (14/30)
Mild to low	40.0 (12/30)	36.6 (11/30)
Moderate	16.6 (5/30)	6.6 (2/30)
Strong to severe	3.3 (1/30)	6.6 (2/30)
Unsustainable pain	3.3 (1/30)	3.3 (1/30)

in the control group (0.6 mL vs 1.8 mL). Nonetheless, mean VAS ratings obtained from both groups presented no difference. This finding is in accordance with a surgical clinical study conducted by Holtzclaw and Toscano,² who reported that although the amount of anesthetic solution in an AMSA single injection was significantly lower than that used in the conventional technique, it was sufficient to anesthetize the buccal tissues. Thus, the results found here seem to indicate that the AMSA injection could be considered as an alternative to the standard infiltration technique for patients in whom increased vasoconstrictor concentrations may be potentially problematic.

Anxiety, fear, age, and gender, as well as cultural factors, can all affect pain perception by patients.^{14,15} Because the pain threshold in the elderly and children can greatly vary, only adults (43 ± 9 years) were included in the present study, ensuring a more homogeneous sample.¹⁴ As for gender, this study showed that women in the test group reported significantly higher levels of pain than men ($P = .0122$). This finding is in agreement with previous studies that showed that women have a lower pain threshold in the presence of pressure, thermal, and electrical stimuli when compared to men.^{16–18} Thus, although the AMSA injection has been shown to be effective for patients in general, in the present study, the technique seems to have been less effective for women when compared with the mucoperiosteal injection.

The feeling of pain during the infiltration of the anesthetic solution in the palatal tissues is a common complaint from patients. Several studies compared the pain felt during the application of the conventional anesthetic injection and a computer-controlled injection system.^{8,12,13,19–21} The results obtained by most of these studies showed that injections delivered by a computer-controlled infiltration system were less painful than the conventional infiltration with syringes.^{11,21,22} However, other studies showed no difference between the 2 methods.^{19,20} Although a conventional syringe was used in all patients in the present study, only 1 patient experienced excessive, worst imaginable pain or discomfort during needle insertion and delivery of the

anesthetic solution. In an attempt to control the pain during anesthesia, a topical anesthetic gel was applied 2 minutes before the injection, and each the 0.6 mL of anesthetic solution was infiltrated during 1 minute. Thus, it is suggested that the pain experienced during infiltration of the palate with a conventional syringe may be kept under control by carefully following the technique.

In this study, a possible confounder in the experimental design was that it was assumed that the palatal gingiva would be anesthetized by the AMSA injection so only the buccal tissues of the maxilla were studied since no palatal injections were performed in the suprapariosteal group. Because of lack of palatal soft tissue anesthesia in the suprapariosteal group, more pain may have been experienced in this group during SRP. However, we felt this was necessary to ensure that the AMSA injection was the only palatal injection to evaluate its efficacy on the buccal tissues.

Based on the results found in this preliminary study, it may be concluded that both the suprapariosteal and AMSA injection techniques were capable of effectively controlling pain during subgingival SRP procedures. Moreover, based on the pain perception reported by patients with the VAS scale, the 2 anesthetic techniques presented a similar anesthetic effect. Thus, the AMSA injection seems to be effective and predictable during SRP procedures. However, further randomized controlled trials with larger samples are necessary to confirm the present results.

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