A Comparison of the Traditional Injection and a New Anesthesia Technique (The Wand®) for Non-surgical Periodontal Therapy

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The purpose of this study was to compare conventional local anesthesia with a newly developed anesthesia technique, called anterior middle superior alveolar nerve block (AMSA) for non-surgical periodontal therapy (scaling, root planing). Twenty patients with chronic periodontitis (8 females, 12 males; mean age: 45 ± 8.5 years) with good general health received non-surgical periodontal therapy in the upper jaw under local anesthesia. The local anesthesia was performed according to a split-mouth design with either AMSA or with the conventional palatal infiltration technique. Pain response was recorded and evaluated with a standardized visual analogue scale (VAS) ranging from 0–10. The results of the present study showed a statistically significant lower level of pain ($p < 0.001$) for local anesthesia with the AMSA-technique, compared to conventional palatal anesthesia. Moreover, the AMSA-technique resulted in a complete anesthesia of the vestibular gingiva in the area delineated by the upper first incisors and first molars. Patient acceptance was significantly higher with the AMSA-technique than with conventional local anesthesia. No adverse side effects such as necrosis, swelling or wound-healing complications, which could be related to the local anesthesia, were observed.

Key words: local anesthesia, AMSA-technique, pain perception, traditional injection, pain rating

INTRODUCTION

Local anesthesia is one of the most frequently performed and important procedures in the daily practice of dentistry. Temporary anesthesia is a prerequisite to ensure painless treatment and is therefore important for the success of various dental therapeutic procedures. Furthermore, a comfortable and consistent local anesthesia can increase the level of trust between the patient and the operator, since the thought of an intraoral injection still causes considerably anxiety in many patients (Krochak et al, 1998). However, a failure can lead to increased stress. The use of local anesthesia dates back to William Stewart Halsted who achieved the first nerve block using cocaine (Spirling and Daniels, 2002). In order to achieve pain control for the treatment of maxillary teeth, infiltration anesthesia (cartridge syringe) is routinely used in everyday practice. The traditional method of administration of local anesthesia to the maxillary teeth is the supraperiosteal infiltration in the mucobuccal fold and the subsequent diffusion of the anesthetic solution through the porous maxillary bone, resulting in anesthesia of the corresponding radicular nerve fibers (Lipp, 1992). Although this approach is usually effective in achieving pulpal anesthesia and pain elimination, patients often feel uncomfortable when experiencing this method of injection. Possible side effects such as collateral anesthesia of the face, lips and muscles of facial expression, resulting in facial numbness, can occur. Moreover, if the smile line becomes distorted, it can be temporarily invalidated as an esthetic reference for restorative and prosthetic dentistry. Furthermore, several injections are necessary for extensive treatment of multiple maxillary teeth.

A computer-assisted local anesthetic delivery system (The Wand®; Milestone Scientific, Livingston, NJ, USA; Fig. 1) has recently been introduced,

Fig. 1 The Wand® computer-controlled local anesthetic delivery system.

which allows for painless maxillary anesthesia by means of a single-site injection, using a novel injection technique called the anterior middle superior alveolar (AMSA) nerve block (Nicholson et al, 2001; Primosch et al, 2002). The flow rate and the infusion pressure are regulated by means of a computer microprocessor and an electronically driven motor to deliver an anesthetic solution at a slow, controlled rate (Friedman and Hochman, 1997). With the conventional manual syringe, however, the volume flow and pressure parameters cannot be precisely controlled (Pashley et al, 1981). An ultra-lightweight plastic disposable handpiece permits the operator to use a stable pen grip, affording fingertip precision and good control of needle penetration (Friedman and Hochman, 2000). The injection site for the anterior middle superior alveolar (AMSA) nerve block is palatal halfway between the gingival margin and the middle of the palate at the first and second premolar (Fig. 2). After diffusion of anesthetic solution through the porous maxilla from the palatal side to the vestibular (labial) side using the AMSA-technique, pulpal anesthesia, extending from the central incisor to the second premolar, as well as anesthesia of the palatal tissues, extending, from the mid-palate to the free gingiva and from the central incisor to the first molar, is supposed to be achieved (Fig. 3).

Fig. 2 The AMSA-injection site is located between the first and second maxillary premolars, and midway between the free gingival margin and the mid-palate suture.

According to the manufacturer, collateral anesthesia to the facial soft tissues can be avoided by this palatal AMSA nerve block. Another advantage of the computerized local anesthetic delivery system (The Wand®) is that the controlled slow flow rate is thought to create an anesthetic pathway in order to minimize discomfort during needle penetration and to provide a painless palatal injection (Friedman and Hochman, 2000). The aim of the present controlled clinical study was to compare in the course of a non-surgical periodontal therapy (scaling, root planing) the conventional palatal infiltration technique (cartridge syringe) in the maxillary region with the new AMSA-injection technique using a computer-controlled local anesthetic delivery system (The Wand®).

STUDY DESIGN AND RESULTS

Twenty patients (8 females, 12 males), aged 26–74 years (mean age: 45 ± 8.5 years) suffering from chronic periodontitis (probing depth ≥ 5 mm), participated in the present controlled clinical study. All participants were given verbal and written information concerning the study and they gave their written consent prior to the clinical examination. Exclusion criteria were long-term med-

Fig. 3 A broad zone of blanching is observed during administration of the AMSA nerve block.

Fig. 4 Palatal view of the 30-gauge extra-short needle, in the final position for the AMSA-injection technique.

ication, systemic use of antibiotics within the last 6 months, systemic diseases and conditions contraindicating the use of local anesthetics. Pregnant women were also not eligible for the study. All participants had multiple periodontal lesions in both arches, and all patients had at least 20 natural teeth. After the initial clinical examination, all patients received oral hygiene instructions and a professional tooth cleaning as part of the initial periodontal therapy. Before the respective non-surgical therapy (scaling, root planing) was performed, anesthesia was administered in the upper jaw, using a split-mouth design. Each of the participants received two injections during one appointment. This was done in such way that pain control was achieved in the right upper quadrant using the conventional palatal anesthesia technique (cartridge syringe), and in the upper left quadrant by means of the AMSA-injection delivered by a new computer-controlled local anesthetic delivery system (The Wand®). Anesthesia with The Wand® was performed with the computer-assisted slow-flow-function and was carried on for a period of three minutes. The injection site was palatal in the middle between the gingival margin and the middle of the palate at the first and second premolar. A 5-second aspiration cycle was activated by tapping the foot pedal. Conventional infiltration anesthesia, using the cartridge syringe, was performed in the same location in the opposite quadrant for a period of 25s. All patients received in each quadrant 1.4 ml. of 4% articaine with 1/200000 epinephrine (Aventis Ultracaine D-S). The anesthetic solution was administered in each participant using a 30-gauge short needle (Monojet Corp.®) for both injection techniques (Fig. 4). All clinical assessments were performed by the same person. Immediately after the injections, patients' sensitivity to pain in the respective quadrant was recorded employing a visual analogue scale (VAS) ranging from 0–10, on which the patients placed a mark where it best described their pain level. The VAS was a 10 cm horizontal scale, where 0 was on the far left, describing that the patient did not feel any pain (0–3) and 10 on the far right, when the patient experienced severe pain. The soft tissue anesthesia was tested by probing the palatal tissue with the tip of a dental explorer. Moreover, inspections for any possible side effects such as necrosis, swelling or adverse effects on wound healing were performed immediately after injection and three days later.

Statistical analysis was carried out using the SPSS-X package. For the evaluation of the fixed variables, mean values, median, minima and maxima were calculated. The Wilcoxon test was used to determine significant differences in the measured parameters. The level of significance was set at 5%.

Twelve men and eight women, ranging in age from 26–74 years (mean age: 45 ± 8.5 years) participated in the present study and received a total of 40 injections. No blood aspiration occurred during the 40 injections administered in the present study.

All 20 patients enrolled in the study, rated the AMSA-injection technique with The Wand® as painless. Only one of the participants declared both injection technique to be similar in terms of pain

Sensitivy	AMSA	Conventional Syringe
painless	20	0
painfull	1	19

Fig. 5 Number of subjects evaluating sensitivity to pain during anesthesia with AMSA-technique and with conventional palatal infiltration anesthesia (n=20).

quality, whereas 19 patients experienced the conventional palatal anesthesia as painful (Figs. 5,6). The difference between subjective statements of the patients concerning pain quality was statistically significant ($p = 0.0001$). Thus, patient acceptance was significantly higher with the AMSA-technique than with conventional local anesthesia. The mean value for the subjective sensitivity to pain on an visual analogue scale (VAS) ranging from 0–10 was 7.2 ± 1.9 for the conventional palatal infiltration anesthesia, while for the AMSA-injection technique with The Wand® the mean value for pain sensitivity was 2.1 ± 0.6 (Fig. 7). Local anesthesia with the AMSA-technique produced a statistically significant lower level of pain ($p = 0.0001$) in comparison to the conventional palatal anesthesia. Moreover, both the AMSA-technique and the conventional palatal injection achieved a complete anesthesia of the vestibular gingiva in the area delineated by the upper first incisors and first molars as well as of the corresponding palatal tissues. Therefore, the AMSA-technique was as effective as the conventional palatal technique in producing anesthesia. When performing non-surgical periodontal therapy, no significant differences were found between test and control sites in terms of pain quality. No immediate or long-term side effects such as necrosis, swelling or wound healing complications, which could be related to the local anesthesia, were observed in any of the patients.

Pain Scale (1–10)	AMSA	Conventional Syringe
1	2	1
2	13	0
3	5	0
4	0	0
5	0	0
6	0	0
7	0	10
8	0	8
9	0	0
10	0	1

Fig. 6 Pain rating after the two different injection techniques, using a visual analogue scale (VAS) ranging from 0–10 (n=20).

DISCUSSION

In dentistry, local pain management has a significant influence on clinical procedures and patient comfort. The perception of pain during administration of an intraoral injection can be attributed primarily to tissue puncture, fluid pressure and flow rate of the injected anesthetic (Hochman et al, 1997). Palatal injections are considered to be particularly unpleasant and are ranked as the most painful among the dental injections; their administration is therefore regarded as a traumatic injection technique. The results of the present study showed that local anesthesia employing the AMSA-injection technique delivered by a new computerized anesthetic delivery system (The Wand®) was clearly less painful than the conventionally delivered palatal anesthesia, even in the absence of a topical anesthetic.

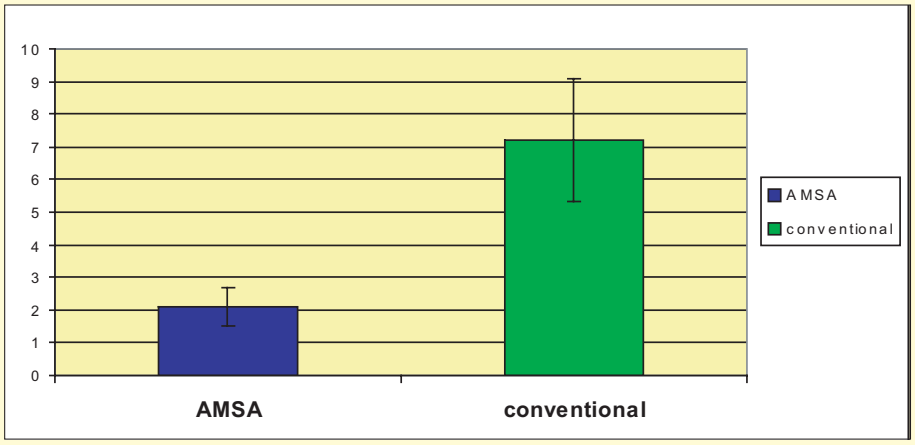

Fig. 7 Comparison of the mean sensitivity to pain, employing a pain scale ranging from 0–10, when using the AMSA- injection technique and conventional anesthesia (n=20).

All patients (100%) described only the quadrant where local anesthesia was performed with the AMSA-technique as painless, whereas the same degree of pain control was achieved with both administered anesthesia techniques. The results confirm the thesis that control of the flow rate and fluid pressure with The Wand® can minimize the perception of pain during injection which is nearly impossible to achieve when using a conventional syringe. The results of the present study are similar to those of other authors describing pain control by use of the AMSA-technique. A study by Fukayama et al (2003) demonstrated that none of the patients treated with the AMSA-technique experienced severe pain. Hochman et al (1997) reported that 48 of 50 patients found the computer-controlled AMSA-injection less painful and indicated that the injections with the AMSA-technique (The Wand®) were two to three times less painful than anesthesia with conventional syringes. Only one participant found both techniques to be equivalent, and one found the Wand® injection less comfortable.

Gibson et al (2000) compared pain-related behavior in children receiving anesthesia with a computerized anesthesia delivery system (The Wand®) or traditional palatal injection. The results revealed that adequate anesthesia was achieved in all children, but significantly more children exhibited disruptive behavior when anesthetized with the conventional syringe when compared to the computer controlled device. In the present study, an effective multiple-tooth anesthesia, extending from the mesiobuccal root of the first molar to the central incisor was achieved by means of a single palatal infiltration using the The Wand® and enabled therapeutic periodontal scaling and root planing. Collateral anesthesia to the lips, face and muscles of expression was not observed in any of the patients, independent of which anesthesia technique was employed.

The positive effect of this anesthesia system may be explained by the ability of the Wand® to produce high pressure at a low flow rate, so that the anesthetic solution diffuses into the underlying bone and anesthetizes the anterior middle superior alveolar nerve plexus without being dispersed into the surrounding soft tissues. Based on the clinical observations this kind of injection can be characterized as intraosseous.

Further clinical investigations are still required in order to study the possible application of this anesthetic delivery system prior to periodontal surgery (e.g. flap surgery). The study demonstrated a statistically significant reduction in perception of injection pain with the computerized local anesthetic delivery system (The Wand®) compared to the conventional anesthesia technique. Furthermore, sufficient anesthesia of the maxillary teeth could be achieved by means of a single palatal injection without any side effects such as facial numbness or postinjection pain. Therefore, another possible benefit of the Wand® is the use of this system for desensitizing of patients with anxiety about dental injections.

CONCLUSIONS

Based on the present results, the AMSA-technique can be regarded as an alternative to conventional local anesthesia for non-surgical periodontal therapy (scaling, root planing) for maxillary posterior teeth.

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