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Effectiveness of Nasopalatine Nerve Block for Anesthesia of Maxillary Central Incisors after Failure of the Anterior Superior Alveolar Nerve Block Technique

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The purpose of this study was to assess the effectiveness of nasopalatine nerve block for anesthesia of maxillary central incisors after failure of the anterior superior alveolar nerve (ASAN) block technique. Secondarily, the possible innervation of the maxillary central incisors by the nasopalatine nerve was also investigated. Twenty-seven healthy, young adult volunteers (age: 17-26 years; gender: 9 males and 18 females) were enrolled in this study. All participants were undergraduate dental students of the University of Vale do Rio Verde de Três Corações. The volunteers had the anterior superior alveolar nerves anesthetized and a thermal sensitivity test (cold) was performed on the maxillary central incisors. The volunteers that responded positively to cold stimulus received a nasopalatine nerve block and the thermal sensitivity test was repeated. All participants were anesthetized by a single operator. Three patients presented sensitivity after both types of bilateral blocks and were excluded from the percentage calculations. In the remaining 24 patients, 16 had their maxillary central incisors anesthetized by the anterior superior alveolar block and 8 remained with sensitivity after the ASAN block. All these 8 patients had their maxillary central incisors successfully anesthetized by the nasopalatine block. In this study, 33.3% of the subjects had the innervation of one or both maxillary central incisors derived from the nasopalatine nerve, whilst most subjects (66.7%) had such teeth innervated by the anterior superior alveolar nerve. The nasopalatine nerve block was effective in anesthetizing the maxillary central incisors when the anterior superior alveolar nerve block failed.

Key Words*:* maxillary central incisor, anterior superior alveolar nerve, nasopalatine nerve, local anesthesia failure, tooth innervation.

INTRODUCTION

When dentists try to anesthetize the maxillary central incisors by anterior superior alveolar nerve (ASAN) block, failures may happen. Apart from technical factors, anatomical issues can also explain such failures. A frequent explanation for this fact is the possibility of innervation of the maxillary central incisor by branches of the nasopalatine nerve (NPN), instead of the usual distribution of dental nerves from the ASAN.

Although this kind of innervation has been mentioned in buccal anatomy and anesthesiology treatises (1-4), as far as it could be ascertained, there are no published papers referring to this subject on large scientific research databases, such as Medline and LILACS. The German Sicher and Tandler textbook (5), published in 1928, mentions that the NPN can innervate the maxillary central incisor. However, this book has no cited references and the authors do not inform their source to make such a statement. The American Sicher and DuBrul textbook (2) was originated directly from Sicher and Tandler's textbook and the same statement is made, again, without mentioning any references. This fact was repeated in the Brazilian Rizzolo & Madeira's

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textbook (3). Other textbooks on anatomy used by dentists (6,7) do not mention anything about this question. Another possible anatomic explanation for ASAN block failure is the crossing of ASAN branches from one side to the other of the maxilla, mentioned in two textbooks (8,9), but again, without references to support this statement.

Anyway, it may actually happen that the maxillary central incisor is not adequately anesthetized by ASAN block. How frequently this failure occurs, however, is unknown. The purpose of this study was to assess in human volunteers the effectiveness of nasopalatine nerve block for anesthesia of maxillary central incisors after failure of the anterior superior alveolar nerve block technique. Secondarily, the possible innervation of the maxillary central incisors by the nasopalatine nerve was also investigated.

MATERIAL AND METHODS

The study methodology was designed in compliance with the guidelines of the Committee on Bioethics of the University Vale do Rio Verde de Três Corações (UNINCOR – Brazil). All subjects were asked to sign an approved informed consent form prior to the anesthetic procedures.

Twenty-seven healthy, young adult volunteers (age: 17-26 years; gender: 9 males and 18 females) were enrolled in this study (Table 1). All participants were undergraduate dental students of the University of Vale do Rio Verde de Três Corações. Other volunteers were excluded from the study. The exclusion criteria were significant anxiety, chronic use of analgesics, major systemic diseases, extensive restorations on the maxillary central incisors, previous endodontic treatment in this tooth and lack of response to the preanesthetic thermal sensitivity test.

Pre and Postanesthetic Sensitivity Testing Protocol. Before anesthesia, all patients were submitted to a thermal sensitivity test (cold stimulus). Empty sterile anesthetic cartridges were filled with water and stored at 4 ^{o}C until ice was formed.The tooth was isolated with gauze and the cartridge was put into contact with the buccal surface of the tooth for up to 20 s, being immediately removed after a painful response. The test was repeated 10 min after the anesthetic procedures.

Anesthetic Protocol. The anesthetic techniques were adapted from Bennett (9). All volunteers were anesthetized using 3% prilocaine with felipressin (0.03 IU/mL; Biopressin; Dentsply Indústria e Comércio Ltda., Petrópolis, RJ, Brazil), in 1.8 mL cartridges packed in a Carpule syringe (Duflex, S.S.White, Rio de Janeiro, RJ) with a 30G gingival needle. One cartridge was used for each ASAN block. For the NPN block, 0.6 mL of the anesthetic solution was used. All patients were anesthetized by a single operator.

RESULTS

The outcomes of this study are summarized on Table 1. Three out of 27 subjects presented sensitivity in their maxillary central incisors after both ASAN and NPN blocks and they were excluded from the percentage calculations. Among the remaining 24 patients, 16 (66.7%) had their maxillary central incisors anesthetized by the anterior superior alveolar block and 8 (33.3%) remained with sensitivity after the ASAN block. Among these 8 subjects, the ASAN block was effective in anesthetizing the right maxillary central incisor in 5 cases, while the left maxillary central incisor was anesthetized in 1 case. Two other patients had none of their maxillary central incisors anesthetized by the ASAN block. All these 8 patients had their maxillary central incisors successfully anesthetized by the nasopalatine block.

DISCUSSION

Every type of anesthetic block is subject to failure (9,10) that may have technical, pharmacological or anatomical causes. Failures due to anatomic reasons are usually related to variations in tooth innervation (11). The knowledge of such variations is essential to attaining a high success rate in local anesthetic procedures.

Anesthetic blocks of the maxillary and mandibular central incisors can also fail for such reasons. Mandibular incisors can be innervated by branches of the mylohyoid nerve, a fact that has already been studied in Brazil by cadaver dissections and is well documented (12). Other studies (13-18) have also addressed the supplementary innervation of the mandibular teeth. On the other hand, there is lack of studies referring to the alternative innervation patterns for the maxillary central incisors, although this is mentioned in textbooks of human anatomy. In clinical settings, there is a number of failures when dentists try to block these teeth by

ASAN block at or inside the infraorbital foramen, which is a technique based on the anatomical information that this nerve is the trunk from which originate the branches that innervate the central incisors. Such failures may be caused by an anatomical variation, that is, the dental nerves originating from the NPN rather from the ASAN.

The present study investigated the failure rate of ASAN block in anesthetizing the maxillary central incisors, as well as the effectiveness of NPN block in anesthetizing these teeth after ASAN block failure. Indirectly, this raises the question on whether the maxillary central incisors can be innervated by the NPN. We have also tried to calculate the rate by which such variation occurs in healthy young adults. The outcomes of this study confirmed that when the ASAN block fails to anesthetize the maxillary central incisor, the NPN block is a viable alternative. In other words, there are clinical findings supporting this alternate innervation pattern. In this study, there was a 2:1 relationship between ASAN and NPN innervation (66.7% *vs.* 33.3%). Furthermore, the results suggest that, when the ASAN does not innervate both maxillary central incisors, the right incisor is preferably supplied with fibers originated from this nerve, while the left maxillary incisor is more frequently innervated by the NPN.

In the present study, there were 3 cases of complete anesthetic failure after both ASAN and NPN blocks. This cannot be explained by anatomical factors.

Table 1. Patient information and results of anesthetic procedures.

Patient	Age (years)	Gender	Teeth anesthetized by ASANB	Teeth anesthetized by NPNB
1	20	F	11, 21	NPNB not needed
2	20	F	11, 21	NPNB not needed
3	19	F	11, 21	NPNB not needed
4	21	F	11, 21	NPNB not needed
5	20	F	11, 21	NPNB not needed
6	21	F	11, 21	NPNB not needed
7	19	F	11, 21	NPNB not needed
8	19	F	11, 21	NPNB not needed
9	19	F	11, 21	NPNB not needed
10	19	F	11, 21	NPNB not needed
11	19	F	11, 21	NPNB not needed
12	18	F	11, 21	NPNB not needed
13	21	F	11, 21	NPNB not needed
14	26	M	11, 21	NPNB not needed
15	19	M	11, 21	NPNB not needed
16	19	M	11, 21	NPNB not needed
17	17	M	21	11, 21
18	26	F	11	11, 21
19	18	M	11	11, 21
20	20	F	11	11, 21
21	19	M	11	11, 21
22	19	M	11	11, 21
23	20	F	None	11, 21
24	19	M	None	11, 21
25 (excluded)	18	F	None	None
26 (excluded)	18	F	None	None
27(excluded)	19	M	None	None

ASANB = anterior superior alveolar nerve block; NPNB = nasopalatine nerve block; 11 = maxillary right central incisor; 21 = maxillary left central incisor.

The same technique and the same materials were used in all patients and a single operator did all anesthetic blocks. These failures may be attributed to technical factors or defect of the anesthetic agent. These 3 cases were excluded from percentage calculations. However, these reasons cannot be invoked to explain ASAN block failure in 8 patients because all of them were anesthetized by the NPN block. On the other hand, it would be quite unlikely that the small volume of 0.6 mL used for NPN block could infiltrate through the thick hard palate and reach the dental nerve at the root apex.

An issue that was not directly addressed in this work is the possibility that sensory nerves may cross the midline, innervating contralateral teeth, as it seems to happen with mandibular incisors (19). This could be investigated by blocking the ASAN first at one side and, in case of failure, at the other side. Although we faced difficulties in enrolling the volunteers, in spite of performing all procedures in a single session, it would be desirable to increase the number of subjects in future works, in order to lessen the chances of failures, evaluate cross-innervation and have better statistical background. It is the authors' opinion that this is still a field open to investigation, no matter how old such discussion may seem to be. In daily practice, failures in local anesthesia go on happening today, as they happened in the past.

The findings of this study may provide some benefits, including helping dentists to understand failures of anesthesia of the maxillary central incisors, providing dentists with data to perform nasopalatine nerve blocks in case of failure o ASAN and quantifying the prevalence of an alternate innervation pattern of the maxillary central incisors.

In conclusion, the NPN block was effective when the ASAN block failed to anesthetize the maxillary central incisor. As much as 33.3% of the subjects had innervation of one or both maxillary central incisors derived from the nasopalatine nerve, while most subjects (66.7%) had such teeth innervated by the anterior superior alveolar.

RESUMO

O objetivo deste estudo foi avaliar a eficácia do bloqueio do nervo nasopalatino após falha na anestesia dos incisivos centrais superiores pelo bloqueio no nervo alveolar superior anterior (NASA). Secundariamente, investigou-se a possível inervação do incisivo central superior por ramos do nervo nasopalatino (NNP). Foram avaliados 27 voluntários saudáveis, adultos jovens (idade: 17-26 anos; sexo: 9 homens e 18 mulheres). Todos eram estudantes de Odontologia da Faculdade do Vale do Rio Verde de Três Corações. Os voluntários tiveram os nervos alveolares anteriores superiores anestesiados e em seguida foram submetidos a um teste de sensibilidade térmica nos incisivos centrais superiores. Aqueles pacientes que ainda apresentavam sensibilidade após o bloqueio do NASA receberam bloqueio do NNP e então o teste térmico foi repetido. Todos os pacientes foram anestesiados por um único operador. Três pacientes ainda apresentaram sensibilidade após ambos os bloqueios bilaterais (NASA e NNP) e foram excluídos das análises de percentagem. Dos 24 pacientes restantes, 16 tiveram seus incisivos centrais superiores anestesiados pelo bloqueio do NASA e 8 permaneceram com sensibilidade após este procedimento. Estes 8 pacientes submeteram-se ao bloqueio do NNP, o que resultou em sucesso na anestesia dos incisivos centrais superiores. Neste estudo, 33,3% dos pacientes tinham a inervação de um ou de ambos os incisivos centrais superiores derivada do nervo nasopalatino, enquanto a maioria dos pacientes (66,7%) tinha tais dentes inervados pelo nervo alveolar superior anterior. O bloqueio do NNP foi eficaz para anestesiar os incisivos centrais superiores, nos casos em que falhou o bloqueio do NASA.

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