

Distance from anterior margin of the mandibular ramus to the mandibular foramen in dentulous and total edentulous: An anatomical study in dry mandibles as reference in pterygomandibular anesthesia

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ABSTRACT

Introduction: Pterygomandibular anesthesia (PtAn) is very complex due the approach and localization of the inferior alveolar nerve (IAN) in medial side of mandibular ramus. However, the structural modifications in total edentulous mandible should difficult identification of anatomical structures during clinical management to perform this dental anesthesia. The purpose of this study was to determine if there is statistical difference in the mean distance between the retromolar fosse (RF) and the mandible foramen (MF) in dentulous and total edentulous dry mandibles. **Material e Methods:** 40 dry adult mandibles divided into 20 dentulous and 20 total edentulous were collected from Human Anatomy Laboratory of the Uberlandia Federal University and they were used in this study. **Results:** The results did not present statistical differences, revealing average measurements to all studied mandibles of 0.7 mm to the right antimeres and 0.3 mm to the left antimeres. The antimeres between each presented a mean difference of 0.3 mm in dentulous mandibles, and 0.7 mm in edentulous mandibles. These averages can be considered to 0.5 mm among all mandibles and 0.5 mm between antimeres. **Conclusions:** The distance among the anatomical structures here reported is not clinically significant to perform the pterygomandibular anesthesia both in dentulous and total edentulous mandibles. Basically, during the anesthesia there is not probably a significant variation to the needle penetration depth in these patients.

Keywords: alveolar bone; edentulous mandible; mandibular foramen; pterygomandibular anesthesia

INTRODUCTION

The anesthesia technique to block the inferior alveolar nerve, a branch of trigeminal nerve, is one of the most complex techniques for the student of dentistry. Thus, the knowledge about the anatomy of the mandible and its surrounded anatomical structures is essential to perform the anesthetic block of the IAN.

One of the biggest doubts about this technique is the depth of the needle to reach the mandibular foramen and consequently to promote the blockage of the IAN.

The MF is located on inner part of the lingual face of the mandibular ramus, above the occlusal plane of the lower teeth; however, its location can vary from each individual, which could make it difficult the anesthesia of the IAN [1]. Inferior

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alveolar vessels and nerve is running into the MF to the channel of mandible, reaching the incisors teeth, in which the nerve is called incisor nerve.

According to text above, the anesthetic must be deposited near the MF to block the IAN. However, the success rate of the blockage of IAN is lower than other nerves in oral cavity, due to anatomical variations in height of the MF, what could require a variation in the depth of penetration of the needle to cross soft tissues. For this reason, the study of topography of mandible is essential to increasing the success rate in that technique [3]. The MF is located with a major frequency in the midpoint of the anteroposterior distance of the MR, about 1 cm above the occlusal line [4]. This feature must be considered to perform the puncture of the needle.

According with Denipoti et al., in 2004, the anaesthetic solution should not be injected if the needle does not touch the bone in MR, as a reference to that technique. The injection in the posterior region can reach the parotid gland and the branches of facial nerve [5], leading to a temporary facial paralysis, a great discomfort to the patient. Otherwise, the injection anteriorly to the MR can reach only the lingual nerve.

Researches comparing anatomical structures in dentulous and edentulous are scarce, and it is for this reason that our study is emphasizing the distance between anatomical structures in both types of mandible, as a reference for dentist need for clinical management, since the anamnesis, clinical examination and diagnosis for planning of a suitable treatment.

The loss of all teeth leads to several structural modifications in mandible, visible clinically and radiographically. A suggested hypothesis is that the modifications in bone structure of total edentulous can become complicating factors to the performance of the pterygomandibular anaesthesia.

Considering the clinical approach of the edentulous total patients for the dentist, the aim of this study was to determine if there is statistical difference in the mean distance between the retromolar fosse and the mandibular foramen in dentulous and total edentulous dry mandibles, as a reference for the dental anaesthesia technique of the inferior alveolar nerve.

MATERIAL AND METHODS

This study was carried in agreement with the Brazilian law number 8.501 published in 1992 and the Declaration of Helsinki, which deals the use of corpse or anatomic pieces to the purpose of studies or scientific researches. The mandibles used herein are part of collection from the Laboratory of Human Anatomy of the Uberlandia Federal University (UFU). We studied a sample of 40 adults mandibles, which were divided into two groups, 20 dentulous and 20 edentulous jaws (Figure 1, A e B), regardless gender or race.

We determined the mean distances between retromolar fosse (located in the media point of the anterior edge of the mandibular ramus) and the centre of the mandibular foramen, in both sides. To perform that we have used a digital caliper (Mitutoyo MTI Corporation, Crystal Lake, Illinois, USA) and they are expressed in millimetres (Figure 2).

Four variables were studied, dentulous and total edentulous mandibles, and the right and left side, in which the mean distance from the RF to the centre of the MF.

The data collected were submitted to the Shapiro-Wilk test and equality of variance to determine the normality of the samples, and they were approved. Next, the data were submitted to the two-way ANOVA test (2x2) followed by Tukey test, and a value of $p \leq 0.05$ was considered statistically significant.

RESULTS

The data were approved by that analysis of normality and equality of variance. The mean distances between the RF and MF, considering dentulous and edentulous mandibles and their antimeres (right and left), varied from 16.5 to 17.5 mm (Table 1).

The values of different types of mandibles showed mean differences of 0.7 mm (right antimer) and 0.3 mm (left antimer). The mean difference of the antimeres was 0.3 mm in dentulous jaws and 0.5 mm in edentulous jaws (Table 1). The means between these values can be considered of 0.5 mm between different jaws, and 0.5 mm between antimeres.

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The average of distance between RF and MF are described in table 2. Despite the mean differences, there was not significant statistically difference among the types of mandibles studied, neither

among the antimeres nor in the interaction between the variables, mandibles and antimeres, with $\alpha=0,05$.

Figure 1. Mandibles: Total edentulous (A); Dentulous (B).

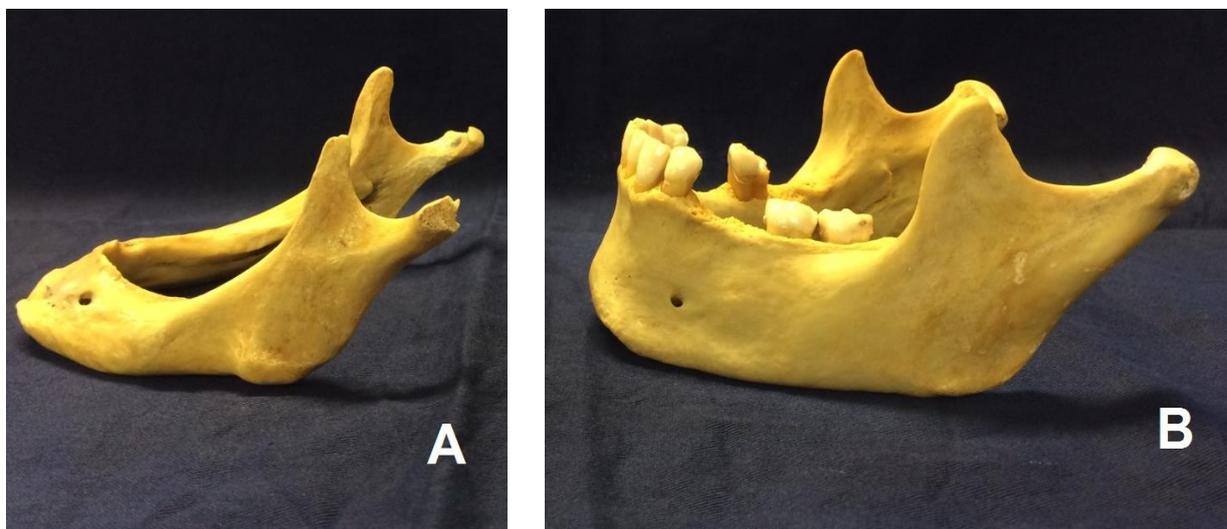


Figure 2. Distances between retromolar fosse and mandibular foramen noted with a digital caliper in dentulous (A) and total edentulous mandible (B).

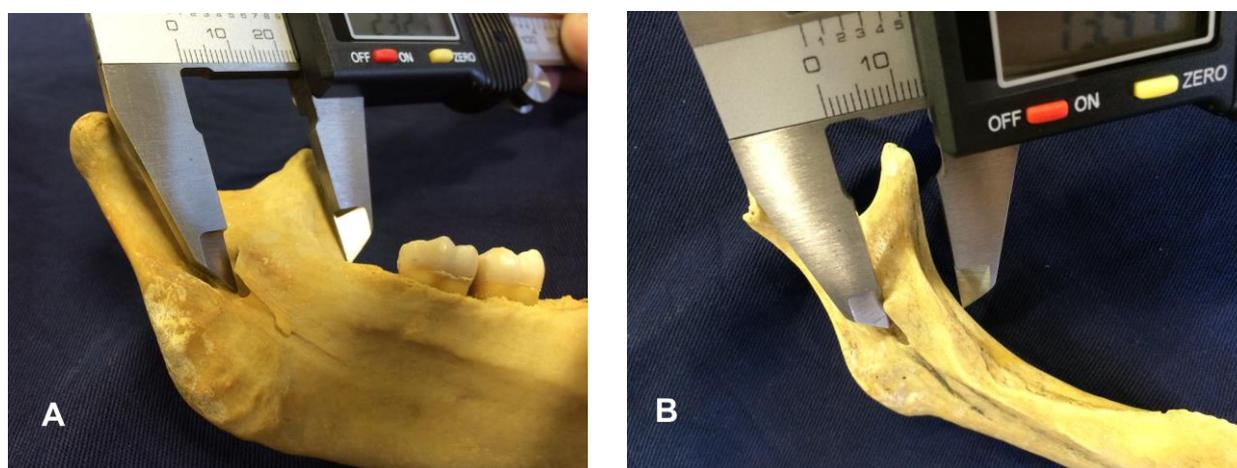


Table 1. Mean of dentulous and edentulous mandibles, and their antimeres.

Mandibles / Antimeres	Right	Left
Dentulous	17.2 mm	17.5 mm
Edentulous	16.5 mm	17.2 mm

Table 2. Mean and standard deviation (\pm) of the distance (mm) between the retromolar fosse and the mandibular foramen. All means not presented statistical difference between variables ($p < 0.05$).

Mandible	Right Antimere	Left Antimere
Dentulous	17.2 \pm 2.2	17.5 \pm 2.5
Edentulous	16.5 \pm 3.5	17.0 \pm 3.0

DISCUSSION

The total edentulous mandible presents a general structure quite modified regarding to dentulous. The alveolar bone process resorption is evident clinically and radiographically. The anatomical processes that are references for dental anaesthetic techniques in general and then also could present morphological variations in site and size. These features must be considered during a dental management and approach for each patient. Understanding of these characteristics can improve the success in dental anaesthetic blockage [7].

The RF on mandibular body, angle and ramus, retromolar trigone, and the pterygomandibular fold are structures generally used as reference to perform the PtAn, which is very complex especially for the student of dentistry school. IAN crosses the MF and runs straight into mandibular channel, and from there the dental branches reach all lower teeth on a mandibular hemi-arcade [8].

The severe resorption of alveolar bone, both the mandible and maxilla, results in a great-modified facial profile [9], leading a considerable difficulty for palpation of the anatomical structures, which are references for dental anaesthesia techniques.

The variables tested in our study revealed interesting results, which are refereed everyday in dental practical clinic as essential tools for dentist students and professionals. In all samples, the distance between related anatomical structures showed an average of 16.5 mm in right antimere and 17.5 mm in left antimere. That results did not revealed statistical differences among different mandibles and its antimeres, which clinically mean that the PtAn technique could not be more difficult or complex in the edentulous patient. All these reports provide for dentistry professionals the ideal

parameters to management and approach these patients.

In gross anatomy, we can notice that the position of the anatomical structures on mandibular ramus in anteroposterior direction was not significantly modified, despite the several structural modification of total edentulous mandible. Thereby, the height loss of alveolar bone does not seem to be decisive to perform the dental anaesthesia. Otherwise, another research stated that there is statistical difference in the height decreasing of the alveolar bone in total edentulous maxillae of 4 mm from infraorbital foramen to dental alveolar crest, when compared with that dentulous. This report is very clinically important to perform the infraorbital anaesthesia [10], which is another dental anaesthesia technique frequently used for dentists. Still as expected, and in regarding with these results of Poiani et al, in 2018, the antimere was not a significantly representative factor.

The anatomical structures that are considered important for a clinical management or surgical approach with more safety for patient are provided in world literature from the topographic and morphologic studies of the specific regions of human body [11,12,13], and then, decreasing the failure rate, including the trunk anaesthesia techniques. The site of anatomical structures in jaw also is important to do dental clinical examination or any invasive procedures.

Researches comparing total edentulous mandibles are scarce in world literature, especially that about distances of anatomical structures as reference for dental anaesthesia. However, various studies determined the site of mandibular foramen and its localization variation [6,14,15]. These works provide essential tools and theoretical bases to scientific society and the healthy professionals, as well as for the present study.

The aging also must be considered in our study, once all regions of the human body suffer

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structural modifications in that life stage. Regarding to face, that modifications can be several, especially after the teeth loss.

More than fifty years ago, Enlow (1966) discovered that the maxillae and mandible are the bones that reach its peak of projection in the adulthood, during the development of the face. In the aging there is a decreasing of basal metabolism, and consequently the bone resorption is more evident and seen by modification of the outer surface of bones [9,16], and by position of teeth. The modifications of the lower third of the face are less complex regarding to maxillae region (middle third) in normally physiologic conditions. This condition in elderly results in a prominent jaw regarding to maxillae [17], without regarding to teeth loss.

The loss of all lower teeth results in a severe resorption of the bone alveolar, which modifies even more the structure of mandible. It is reasonably to claim that the decreasing of muscular activity due the all teeth loss and decreasing of masticatory efficiency in an edentulous patient could lead to a absent of bone stress, absent of dissipation of masticatory forces to alveolar bone throughout the dental roots, which result in loss of bone tissue. This condition could lead to several modifications in the anatomical structures of mandible ramus. In fact, this situation occurs, but discreetly and not clinically significant for dentist i.e., the aging is not a trouble to perform the PtAn. A possible explanation about that is the major structural modification in total edentulous jaw occurs in the region of the body of this bone, and not in its ramus.

The local anaesthesia is frequently used in dental practices; meanwhile, the failures in performance of PtAn technique could occur by various features, such as little or no knowledge about local and topographic anatomy, no expertise of the professional, errors in technique performance, little or inadequate opening of mouth of patient, difficult of visualization of operatory field, deviation during needle puncture [18,19,20], anatomical variations in height and width of jaw [21], and also anatomical variations in branches of sensitivity nerves [22].

The MF also can present a quite variation of localization, depending each subject and antimeres,

however various researches stated that this anatomical variation is not significantly [23,24,25,26]. These reports can support our results, when considering the antimeres of the jaws studied here.

Various authors reported that is impossible to establish the precise location of MF [11,27,28,29], being its most frequently sited in middle third of mandibular ramus, with no regard to presence of teeth or to height of jaw body, which was confirmed by our results. Meanwhile, the MF location was simplified by some authors as being in the centre of mandibular ramus equidistant between anterior and posterior margins, and between base and mandibular notch, with no difference regarding sides, sex or age [3,4,5,15,30], taking support to what have been reported and demonstrated in this research.

Our findings become an essential tool for the dentist or dentistry student, and eliminate the hypothesis or the myth that to perform the PtAn in the total edentulous patient is more difficult or complex than in dentulous, once that there is not length or site alterations in the retromolar notch and mandibular foramen.

CONCLUSIONS

Our results led us to conclude that there are not statistically differences among the anatomical reference structures regarding the performance of pterygomandibular anaesthesia in dentulous and total edentulous mandibles, and their antimeres. Basically, our results can represent what occur in human being. Regarding this, there is not a significant variation to the depth of needle puncture during the performance of the anaesthetic technique mentioned below.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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RESUMO

Distância da margem anterior do ramo da mandíbula ao forame mandibular em dentados e edentados totais: Um estudo em peças anatômicas para referência na anestesia pterigomandibular

Introdução: A anestesia pterigomandibular (PtAn) é muito complexa devido à abordagem e localização do nervo alveolar inferior (IAN) na face medial do ramo mandibular. No entanto, as modificações estruturais na mandíbula edêntula total devem dificultar a identificação das estruturas anatômicas durante o manejo clínico para a realização dessa anestesia dentária. O objetivo deste estudo foi determinar se há diferença estatística na distância média entre a fossa retromolar (RF) e o forame da mandíbula (MF) em mandíbulas dentadas e desdentadas totais secas. **Material e Métodos:** 40 mandíbulas adultas secas, divididas em 20 dentuladas e 20 edêntulas totais, foram coletadas do Laboratório de Anatomia Humana da Universidade Federal de Uberlândia e utilizadas neste estudo. **Resultados:** Os resultados não apresentaram diferenças estatísticas, revelando medidas médias para todas as mandíbulas estudadas de 0,7 mm para o antímero direito e 0,3 mm para o antímero esquerdo. Os antímeros entre cada um apresentou uma diferença média de 0,3 mm nas mandíbulas dentadas e de 0,7 mm nas mandíbulas desdentadas. Essas médias podem ser consideradas em 0,5 mm entre todas as mandíbulas e 0,5 mm entre os antímeros. **Conclusões:** A distância entre as estruturas anatômicas aqui relatadas não é clinicamente significativa para a realização da anestesia pterigomandibular tanto em mandíbulas dentadas como em mandíbulas desdentadas totais. Basicamente, durante a anestesia, provavelmente não há variação significativa na profundidade de penetração da agulha nesses pacientes.

Palavras-chave: osso alveolar, mandíbula edêntula, forame mandibular, anestesia pterigomandibular