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CONTROVERSIES ON THE POSITION OF THE MANDIBULAR FORAMEN — REVIEW OF THE LITERATURE

Abstract: Foramen of mandible is the most important point considering the Halsted anesthesia. Position of this foramen seems to be stable, however there are lots of controversies regarded to its position. Based on the current literature authors revised datas from literature considering the location of the mandibular foramen.

Key words: mandible, mandibular foramen, mandibular canal, canal of Serres.

INTRODUCTION

Local anaesthesia of the inferior alveolar nerve both in adults as well as in children belongs to the most commonly performed anesthetic procedures in dental practice [1–5]. Knowledge of position of the foramen of mandible within the pterygomandibular space and its location on the ramus of mandible is essential for correct performing local anesthesia of the inferior alveolar nerve using classical Halsted's method, performed for the first time in 1885 [5–7]. Halsted's method is widely used, although it is estimated that in around 15–35% it is ineffectual [8–10]. In this technique to position the needle properly and to localize the foramen of mandible one uses certain anatomical points placed intraorally, assuming that position of the mandibular foramen is invariable [5, 11].

Until now all studies considered to the position of the foramen of mandible were carried out according to the human race, age and sex [12–17]. Evaluation of the position was made by the help of estimation of orthopantomographic pictures of patients or dry mandibles [16–18]. However no evaluations exist so far dealing with evaluation of the position of mandibular foramen in regard to 4 reference points marked on macerated mandibles, as well as on pantomographic pictures of the same specimens.

POSITION OF THE FORAMEN MANDIBULAE

First report on the local anesthesia of the inferior alveolar nerve performed in the vicinity of the foramen of mandible using cocaine solution was given by Halsted [19]. In 1952 Matas described the history of anesthesia and achievements associated with nerve blocks in a matter of nearly 100 years [20].

Murphy *et al.* (1969) described the role of position of mandibular foramen in blocking of the inferior alveolar nerve, they described also accessory foramina in the ramus of mandible and variability of lower dental innervation, including the course of the inferior alveolar neurovascular bundle [21].

Barker *et al.* (1972) defined localization of the mandibular foramen based on its relationships with the lingula. In about 47.7% apex of the lingula was placed 1–5 mm above the bite plane of the lower teeth. They paid attention to correlation between the height of ramus of mandible and lingula and described precisely structures of the mandible, and the pterygomandibular space [22].

Hayward *et al.* (1977) adverted to a greater distance between the mandibular foramen from anterior border of the ramus of mandible comparing to the distance from the posterior border. They did not find significant differences between the size of the ramus of mandible and location of the mandibular foramen, depending on the side, sex or race [23].

Nicholson M (1985) studying position of the mandibular foramen in individuals of Indian region finds out that it is positioned below the bite plane of inferior teeth. Author suggests that it's the variability of the position of this foramen which encumbers the failures in anesthesia of inferior alveolar nerve in this race [24].

Hetson *et al.* (1988) in their studies measured the distance between mandibular foramen and the anterior and posterior borders of the ramus of mandible and *gonion* point on the specimens [25].

Mwaniki *et al.* (1992) describe position of the mandibular foramen above lower teeth bite plane in about 60% of cases. They propose administration of the anesthetic slightly above the standard in black Kenyan individuals [16].

Kaffe *et al.* (1994) pay attention to the type of equipment used to make pantomographic pictures, because the negatives from different cameras do not give explicit pictures. They have described the dependence between the width of the ramus of mandible and location of mandibular foramen [26].

Doliwa-Młynowska (1998) accentuates that more personal variability deals with mental foramen. In her studies she described accessory mental foramen, foramen for canal of Serres (remnant of the fetal basal vein of Serres, associated with inferior alveolar vein), foramen of molar canal which leads from the dental alveolus of wisdom teeth (localized anterior to the mandibular canal) and canal of Robinson. Canal of Robinson leads fibers of inferior alveolar nerve and a ramus of inferior alveolar artery to retromolar triangle — it arises immediately below the

lingula within the mandibular canal. Author described also the cases of ossification of the mylohyoid sulcus [27].

Jerolimov *et al.* (1998) defined position of the mandibular foramen with respect to the temporal crest, not like in majority of authors with respect to the oblique line. They stated relatively small variability of position of the mandibular foramen for anterior border of ramus of mandible, in comparison to relatively high variability of the distance between the foramen and posterior border of the ramus, where it is much more variable. They did not find significant difference in a distance between mandibular notch and mandibular base (axis of mandibular ramus) [13].

Mbajjorgu (2000) in his studies carried out on mandibles of black Zimbabwean individuals finds out that mandibular foramen is variable for its position and is rarely located exactly in the middle of the ramus of mandible [15].

Keros *et al.* (2001) defined location of mandibular foramen with respect to the mandibular notch, mandibular angle, anterior and posterior borders of ramus of mandible using orthopantomographic pictures. They used negatives obtained from patients with incomplete and complete successful anesthesia of inferior alveolar nerve. They estimated correlation between length of the mandibular axis, distance between mandibular foramen and the posterior border of the mandibular ramus, and effect of anesthesia of the inferior alveolar nerve [7].

Oguz *et al.* paid much attention to practically indifferent dimensions of mandibular ramus on the right and left side, and the difference in location of the mandibular foramen in sagittal plane. Both on the right and left sides, mandibular foramen is slightly displaced posteriorly with respect to the vertical axis of mandibular ramus [17].

Radiographic studies carried out by Sanchis *et al.* (2003) on 2012 patients demonstrated occurrence of double mandibular canals in 0,35% of cases, more frequently in females [28].

Das *et al.* (2004) found that mandibular foramen is placed slightly above the midpoint of the mandibular ramus. The paid attention to its irregular structure and possible occurrence of accessory canals. Most of them were localized on the medial surface of mandibular ramus. In a situation when they were placed on the external surface of ramus, they may serve as foramina for buccal, mylohyoid nerves, or an accessory branch of the inferior alveolar nerve [29].

Kilarkaje *et al.* (2005) studied in their researches position of the mandibular foramen with respect to the bite plane of lower teeth, condylar process, symphysis menti, mandibular angle and anterior mandibular ramus. Authors exhibited that mandibular foramina are symmetrical independently on the age of analyzed cases [30].

Merrot *et al.* (2005) described changes in the mandible which occur with ageing. They analyzed both mandibular and mental foramina [31].

Prośba-Mackiewicz *et al.* (2005) showed high variability of the shape of mandibular foramen and different proportions of its length with respect to the

width. They pay attention to the importance of the course and topography of the mandibular canal according to the local anesthesia of the inferior alveolar nerve [32].

Fabian (2006) denoted the location of lingula with respect to the mandibular foramen and mylohyoid groove. The most common was the case when the sulcus originated on the medial aspect of the mandibular foramen [33].

López *et al.* (2006) paid attention to the double mandibular canal and coincidence of accessory foramina on the medial surface of the mandibular ramus. He describes possible mistakes in evaluation of positioning of the lingula, which in children is placed at the level of the imaginary plane used to anesthetize the inferior alveolar nerve, while in adults it is placed above this plane. In edentate individuals however it is placed higher than in dentate. Authors bring up the problem of sensory fibers carried by mylohyoid nerve to lower teeth. Authors postulate standardization of survey pantomographic pictures to evaluate position of the mandibular foramen and canal [11].

Auluck *et al.* (2007) postulated the need of survey pantomograms to choose the method of anesthesia, especially in case of double or even triple mandibular canal [34].

In the next article Galdames *et al.* (2008) bring up a problem of minor canal localized in the retromolar triangle, which joins with the mandibular canal. They proposed a technique of anesthesia, where the anesthetic is administered into retromolar triangle [35]. Effectiveness of this technique of anesthetizing the inferior alveolar nerve is rated till 27%. They suggest to use this technique in patients with blood coagulation disorders, despite its limitations [36].

Wadhvani *et al.* (2008) described double right-sided mandibular canal. The canal started with two openings located on the medial surface of mandibular ramus, and next united on the level of the right second molar. On the left side triple canal existed. Authors postulate careful revision of the survey pantomographic plates for an appropriate choice of local anesthesia of the inferior alveolar nerve [37].

In their studies Wychowański *et al.* (2008) criticized mental and mandibular foramina. They did not find relationships between edentulous mandibles and location of mentioned above foramina. According to their observation sex influences location of these foramina [38].

Ennes *et al.* (2009) defined position of mandibular foramen with respect to the anterior and posterior margin of mandibular ramus and to supero-inferior dimension with respect to designated vertical lines. Authors did not find significant statistical differences between left and right sides, although they proved high individual variability with respect to the position of mandibular foramen. They propose selection of needles appropriate to the width of the mandibular ramus. They suggest to treat the bite plane very carefully as a reference point. They found high level of correlation between the size of mandibular angle and location of mandibular foramen [39].

Galdames *et al.* (2009) in their study defined location of canal of Serres with respect to mandibular foramen. This canal contains mainly veins and is obliterated immediately during postnatal period. In neonates it exists in 100% of cases. In adults it can be found in 42,6%, more often in females. It is placed usually below and anterior or posterior to the mandibular foramen [40].

Karamifar *et al.* (2009) suggest change of methods of anesthesia because of double inferior alveolar nerve. Following these authors inferior alveolar nerve runs through a single canal in 60% of cases only [41].

Miloglu *et al.* (2009) describe double mandibular canal on the orthopantomographic negatives, both on the right and left sides. These canals have separate beginning on the ramus of mandible in the vicinity of the mandibular foramen, and the end presents as additional mental foramen. Thus authors postulate change of the method of anesthetizing the nerve. Because of variations described, classical methods can be insufficient to achieve full regional anesthesia [42].

From another hand however Bee *et al.* (2010) indicate in their researches lack of significant sexual differences of position of mandibular foramen. Although based on analysis of Afro-American and Caucasian skulls they indicate significant racial differences considering to the position of the mandibular foramen [12].

Juodzbalys *et al.* (2010) observed possible duplication of mandibular canal during its course through the mandible, while only one mandibular foramen exists. Duplication of mandibular canal in horizontal plane limits application of orthopantomographic examinations. Authors postulate application of computer tomography of mandible, as absolutely necessary before implantation procedures, to evaluate variability of the course of inferior alveolar nerve [43, 44].

Prado *et al.* (2010) reported a high variability in the field of the mandibular foramen in Brazilian population. They did not describe significant statistically differences between right and left sides in dental and edental mandibles, however they noticed smaller antero-posterior dimension in edental than in dental mandibles. Authors noticed decrease of the pressure onto alveolar process in edental mandibles, where bony structures work under a lesser load, and subsequently become reduced. This phenomenon considers both alveolar process and mandibular ramus. Mandibular notch deepens with ageing, what coincidences with a smaller activity of muscles of mastication [18].

Przystańska *et al.* (2010) describe numerous foramina localized on the internal aspect of mandible. Histochemical studies proved that these foramina contained nervous structures and in some of the also vascular, what suggests possible anastomoses between nerves and vessels running in the vicinity of mandible and contents of mandibular canal [45].

Finally Lipski *et al.* (2013) postulated variability of position of mandibular foramen depending on sex of individual and defined its position within the pterygomandibular space [46, 47].

CONFLICT OF INTEREST

None declared.

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