THE COURSE, BRANCHES OF THE INFERIOR ALVEOLAR NERVE AND ITS ANATOMICAL FORMS IN THE MANDIBULAR CANAL

V.B. Shadlinski, A.S. Abdullayev

Azerbaijan Medical University, Department of human anatomy, Baku, Azerbaijan

ABSTRACT — The purpose of the study is investigation of branching of the inferior alveolar nerve and its forms in the mandibular canal.

MATERIAL AND METHODS. Using the macro-microscopic method (preparation), the inferior alveolar nerves were studied in adults, as well as in some age groups (fetuses, newborns, early childhood). The total number of cadavers was 30, 54 nerves were examined. Nerve dissection was performed under the control of a stereoscopic microscope MBS-2 on preparations previously fixed in 3–5% formalin solution. Opening of the mandibular canal was made both from the inner and the outer surface of the mandible. Attention was drawn to the topographic relationships of the inferior alveolar nerve with the inferior alveolar artery, the roots of the teeth and the canal walls.

RESULTS OF THE RESEARCH. In a macro-microscopic study, it was established on all the preparations that the inferior alveolar nerve starts from the mandibular nerve at a different level. It is accepted to distinguish two forms of the beginning of the nerve: high and low. The topography of the nerve in the mandibular canal is not the same at different levels. This is due to differences in the levels of branching from the nerve trunk of the large branch to the molars, the presence of variants in its branching (1, 2 or 3 branches), as well as differences in the relationship of the nerve to the inferior alveolar artery. The main trunk of the inferior alveolar nerve after giving the branch to the molars directs respectively the configuration of the mandibular canal downward and forward and at the level of the first premolar or canine reaches the level of the mental foramen. Here it is divided into its terminal branches - the mental and incisive nerves. Grouping all the variants that we have established in the branching of the nerve under consideration (taking into account the literature data), we can distinguish 6 basic forms. The inferior alveolar nerve in the canal consists of one trunk. The branch to the molars differs from the trunk relatively low (at the root level of the teeth). This form can be considered as a magistral. It was observed in 67% of the studied preparations. The inferior alveolar nerve is formed higher than the mandibular nerve and divides into two trunks before entering the mandibular foramen. In the canal, one of the trunks, in turn, is divided into two main branches. Thus, the channel contains three main branches. This form can be considered as scattered (2%).

CONCLUSION. Knowledge of the anatomical features of branching and forms of the inferior alveolar nerve is the main guarantee of success when performing operative procedures on the mandible. In the mandibular canal, the inferior alveolar nerve in most cases consists of a single trunk. The branches from this trunk to the molars depart relatively low.

KEYWORDS — the inferior alveolar nerve, the mandibular canal, magistral form, scattered form.

INTRODUCTION

The study of the anatomy of the trigeminal nerve, especially from the point of view of its variations, has both theoretical and clinical significance (1–4). The inferior alveolar nerve, due to difficult anatomical access, requires special careful preparation of the researcher (5). Also, an in-depth knowledge of the anatomy of the nerve and mandible should be demonstrated by the doctor performing the anesthesia; since both the nerve itself and the mandible containing this nerve are subjects to considerable anatomical variations. In particular, this concerns the structure of the mandible, the location of the mandibular foramen, which is the entrance to the canal, of the angle of mandible — all these structures also vary greatly with age (6–8). Without considering the whole range of this diversity, it is usually not possible to achieve a successful surgical intervention on the mandible. In the literature, the anatomical features of the inferior alveolar nerve are widely considered; however, most of the researches have a descriptive character of *non-standard* cases of the course of the inferior alveolar nerve (usually on the one preparations) or these studies are generalizing, so-called literature reviews (9, 10). Taking into account the above and the extreme importance of the detailed anatomy of this nerve, we conducted a comprehensive study using the entire arsenal of morphological methods — macro-microscopy, histology, X-ray examination, craniometry. In the article presented to you, we limited ourselves to the data obtained with a macro-microscopic study.

MATERIAL AND METHODS

Using the macro-microscopic method (preparation), the inferior alveolar nerves were studied in adults, as well as in some age groups (fetuses, newborns, early childhood). The total number of cadavers was 30, 54 nerves were examined. The actual material of the research was recruited in the morgues of the Union of Forensic Medicine and Pathological Anatomy of the Ministry of Health of the Republic of Azerbaijan and the Department of Human Anatomy of the Azerbaijan Medical University.

When working with sectional material, the requirements of the Federal Law of 12.01.1996 No. 8 *On Burial and Funeral Affairs* are taken into account.

Nerve dissection was performed under the control of a stereoscopic microscope MBS-2 on prepara-

tions previously fixed in 3–5% formalin solution. For a very laborious process — the opening of bone channels during the preparation of nerves, bone nippers, bits of different sizes and a drill were used. When studying the inferior alveolar nerve on the sagittal cuts of the head, the mandibular nerve was first found, and then, in the process of dissecting its branches, the masticator muscles, vessels and other soft tissues that were not related to the nerve we studied were removed. Opening of the mandibular canal was made both from the inner and the outer surface of the mandible. Attention was drawn to the topographic relationships of the inferior alveolar nerve with the inferior alveolar artery, the roots of the teeth and the canal walls.

RESULTS OF THE RESEARCH

According to our research, the level of beginning of the inferior alveolar nerve from the mandibular nerve is different. Despite this, two forms of the beginning of the inferior alveolar nerve can be distinguished: high and low. With a high form, the inferior alveolar nerve departs directly from the mandibular nerve. In this case, the mandibular nerve usually branches in a scattered form. Coming out of the foramen ovale into the infratemporal fossa, it gives branches to the mastication muscles and divides into the lingual, auriculo-temporal and inferior alveolar nerves. In the adult human the mandibular nerve has a different length at the part, which is characterized as extracranial; its branching occurs at a distance of 6 to 14 mm below the foramen ovale. This variant (high form) was observed on 10 of 30 preparations (in adults).

On 6 preparations, the mandibular nerve beneath the foramen ovale firstly ramificated within the muscles and gave off the auriculo-temporal nerve; after followed down like nerve trunk, which divided into two branches-the lingual and inferior alveolar nerves. At the same time, the lingual nerve also directed forward, and the inferior alveolar nerve followed down, being a direct continuation of the main trunk of the mandibular nerve. This form of the beginning of the inferior alveolar nerve was accepted as low; the level of the inferior alveolar nerve was 18–20 mm below the foramen ovale.

The inferior alveolar nerve, begins from the mandibular nerve in the infratemporal fossa, follows back and down between the lateral and medial pterygoid muscles, and then deviates outward and along the external surface of the medial pterygoid muscle approaches the branch of the mandible. The length of this segment of the nerve from its beginning to the mandibular foramen — at its high origin — is 21–36 mm, and at a low is 11–14 mm. Before entering the mandibular canal, the inferior alveolar nerve gives forward and down a large branch - the mylohyoid nerve. According to our data, this nerve in one case (out of 30) began together with the inferior alveolar nerve directly from the mandibular nerve.

The topography of the inferior alveolar nerve in the mandibular canal is different at different levels, which is caused by differences in the levels of branching from the nerve trunk of the large branch to the molars, the presence of variants in its branching (1, 2 or 3 branches), as well as differences in the relationship of the nerve to the artery with the same name. The inferior alveolar nerve, entering the mandibular canal, immediately sends a relatively large branch to the region of molars (fig. 1).

The latter often starts from the anterior periphery of the described nerve 5–10 mm below the mandibular foramen, is directed forward and downward and forms a small arch with convexity downward, followed below the roots of molars, being from their apexes at a distance of 2.5–3.6 mm. This nerve most often gives off branches to the roots of last two molars. Less often (8 preparations) it only innervates the last molar. In addition, a number of its small branches directed to the gum or lost in the bone substance of the mandible. These branches usually begin with common trunks with the inferior dental branches.

The main trunk of the inferior alveolar nerve after giving the branch to the molars directs respectively the configuration of the mandibular canal downward and forward and at the level of the first premolar or canine reaches the level of the mental foramen. Here it is divided into its terminal branches — the mental and incisive nerves.

On our macro-microscopic preparations (60) in the external structure of the inferior alveolar nerve, expressed individual variability was observed. On a number of preparations, the nerve was divided at different levels into 2 or 3 large branches. There were also noted some features in the levels of the formation of branches that extend from the trunk of the nerve to the teeth. Grouping all the variants that we have established in the branching of the nerve under consideration (taking into account the literature data), we can distinguish 6 basic forms (fig. 2).

I form. The inferior alveolar nerve in the canal consists of one trunk. The branch to the molars differs from the trunk relatively low (at the root level of the teeth). This form can be considered as a magistral. It was observed in 67% of the studied preparations.

II form. The branches of the inferior alveolar nerve to the molars are formed at the level of the alveolar border of the mandible. The nerve consists of one trunk (10%).

III form. The branch to the molars is formed high — at the level of the opening of the mandibular foramen or 3–5 mm below (8%).

IV form. The nerve trunk after entering the mandibular canal is divided into two main branches at a distance of 10–12 mm from the mandibular foramen (5%).

V form. The nerve trunk after entering the mandibular canal is divided into two branches, between which there is a large number of connections. It occurs at a distance of 10–12 mm from the mandibular foramen (8%).

VI form. The inferior alveolar nerve is formed higher than the mandibular nerve and divides into two trunks before entering the mandibular foramen. In the canal, one of the trunks, in turn, is divided into two main branches. Thus, the channel contains three main branches. This form can be considered as scattered (2%).

So, on eight preparations the inferior alveolar nerve was divided into two branches at different levels (IV and V forms). One of the branches of a smaller diamet er directed forward, was located closer to the alveolar process of the mandible, under the apexes of the roots of the teeth and gave the lower dental branches to the teeth. In some cases, the distal parts of this branch ended in the region of the incisors, while in others they were joined by the lower branch. Another, inferior, branch of the inferior alveolar nerve follows along the lower wall of the mandibular canal and continues into the mental nerve. These branches along their course are connected among themselves by small nerve trunks.

Thus, a complex macroscopic and microscopic study made it possible to more fully represent the topography of the inferior alveolar nerve in the mandibular canal. The high form of the beginning of the inferior alveolar nerve is more common in the scattered form of the branching of the mandibular nerve, and the lower form — in the magistral.

DISCUSSION

Given the above, the effect of surgical interventions on the mandible directly depends on a detailed knowledge of the anatomical structures located in the mandibular canal (11). The size and length of the canal are related to the degree of development of the body of mandible. This is confirmed by literary data (12). On the studied adult preparations (senile age), features were established in the topography of the inferior alveolar nerve. The main role in changing the topography of the nerve was the safety of the dentition and the morphological condition of the alveolar process. The inferior alveolar nerve, according to macroscopic studies, entered the mandibular canal more often with a single trunk.

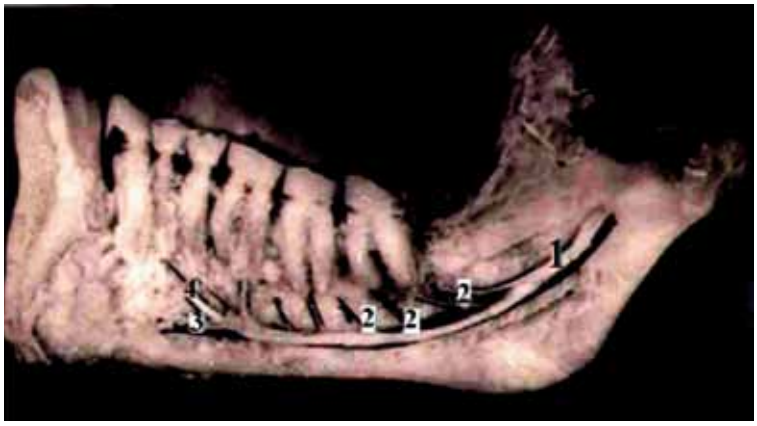

Fig. 1. *Inferior alveolar nerve, right. Photograph of the preparation (man 51 years old). 1- inferior alveolar nerve; 2 – the branches to molars; 3 – the incisive nerve; 4 – the branches to premolars*

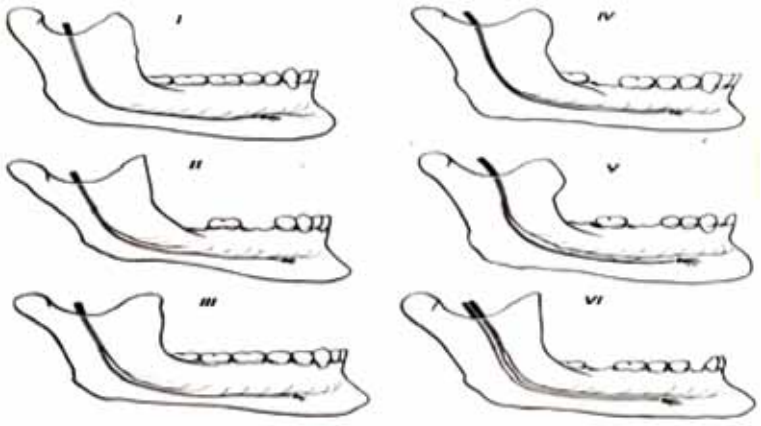

Fig. 2. *(Explanation in the text)*

CONCLUSION

Knowledge of the anatomical features of branching and forms of the inferior alveolar nerve is the main guarantee of success when performing operative procedures on the mandible. In the mandibular canal, the inferior alveolar nerve in most cases consists of a single trunk. The branches from this trunk to the molars depart relatively low.

REFERENCES:

1. **Joo W, Yoshioka F, Funaki T, Mizokami K, Rhoton AL Jr.** Microsurgical anatomy of the trigeminal nerve. Clin Anat 2014 Jan; 27 (1): 61–88.
2. **Zheng JP, Song M, Zhan XX, Li CZ, Zong XY, Zhang YZ.** Endoscopic approach to the trigeminal nerve: an anatomic study. J. Craniomaxillofac.Surg. 2014, Jul; 42 (5): 674–82.

3. **Fortes FS, Sennes LU, Carrau RL, Brito R, Ribas GC, Yasuda A, Rodrigues AL Jr, Snyderman CH, Kassam AB.** Endoscopic anatomy of the pterygopalatine fossa and the transpterygoid approach: development of a surgical instruction model. Laryngoscope, 2008, Jan; 118 (1): 44–9.

4. **Mangala M. Pai, Ravindra S. Swany, Latha V. Prabhu.** A variation in the morphology of the inferior alveolar nerve with potential clinical significance. Biomedicine International, 2010, 1: 93–95.

5. **Kieser JA, Paulin M, Law B.** Intrabony course of the inferior alveolar nerve in the edentulous mandible. Clin Anat 2004, Mar; 17 (2): 107–11.

6. **Shiozaki H, Abe S, Tzumori N, Shiozaki K, Kaneko Y, Ichinohe T.** Macroscopic anatomy of the sphenomandibular ligament related to the inferior alveolar nerve block. Cranio, 2007, Jul; 25 (3):160-5.

7. **Narayana K, Vasudha S.** Intraosseous course of the inferior alveolar (dental) nerve and its relative position in the mandible. Indian J Dent Res. 2004, Jul–Sep;15(3):99–102.

8. **Khoury JN, Mihailidis S, Ghabriel M, Townsend.** Applied anatomy of the pterygomandibular space: improving the success of the inferior alveolar nerve blocks. Australian Dental Journal 2011, 56: 112–121.

9. **Azeredo RA, Cesconetto LA, Torres LHS.** Anatomical variation of te inferior alveolar nerve: a case report. J. Morphol. Sci, 2016, vol. 33, № 4, p.183–185.

10. **Anderson LC, Kosinski TF, Mentag PJ.** A review of the intraosseous course of the nerves of the mandible. J Oral Implantol. 1991; 17 (4) :394–403.

11. **Lee MH, Kim HJ, Kim DK, Yu SK.** Histologic features and fascicular arrangement of the inferior alveolar nerve. Arch Oral Biol. 2015 Dec; 60 (12) : 1736–41.

12. **Gowgiel JM.** The position and course of the mandibular canal. J Oral Implatol 1992; 18 (4) : 383–5.