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VARIATIONS OF THE MANDIBULAR CANAL, MANDIBULAR AND MENTAL ORIFICES

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Summary

The present study assesses variabilities of mandibular canal, the relative position, size and shape of its mandibular and mental foramina, evaluates their measurement and relationship with various landmarks of the mandible in adults. The current study traced out that some of the mandibles had accessory mandibular and mental foramina.

Rezumat

Variabilitatea canalului mandibular, orificiului mandibular și mental

Studiul de față elucidează variabilitatea canalului mandibular, poziția relativă a orificiilor lui mandibular și mental, evaluează datele de morfometria a acestora și demonstrează raporturile lor cu diverse puncte de reper ale mandibulei la adulți. În acest studiu au fost constatată prezența orificiilor supranumerare.

News Theme

Knowledge of mandibular and mental foramina location is useful for the oral and maxillofacial surgeon in orthognatic surgery, especially in vertical ramus osteotomy procedure, in local anesthesia making. The development of implant techniques increased the interest in the mandible anatomy, specially the mandibular foramen localization. Despite this interest a small number of papers has been published on the position of mental foramen. The knowledge of the additional foramina may be important for the radiotherapists while planning radiation therapy. This knowledge is also important for orthognathic or reconstructive surgeries of the mandible and dental implant procedures.

Aim

The aim of this study is to describe morphological variability of mandibular canal and to analyse the position, shape and size of the mandibular and mental foramina in order to provide simple and reliable surgical landmarks.

Materials and methods

The study of location, shape and size of the mandibular and mental foramina was performed on directly measures and observations on 37 dry human mandibles which were selected from the skeletal collection of the Department of Anatomy of our university and 30 radiographs taken from Department of Stomatology. All were adult mandibles, the exact ages of which were unknown. The measurements were performed with a digital pachymeter of 0.01 mm accuracy. Images of the mandibles were obtained using a digital camera.

Discussions and results

The mandibular canal is a canal within the mandible that contains the inferior alveolar nerve, inferior alveolar artery, and inferior alveolar vein. It runs obliquely downward and forward in the ramus, and then horizontally forward in the body, where it is placed under the alveoli and communicates with them by small openings. On arriving at the incisor teeth, it turns back to communicate with the mental foramen, giving off a small canal known as the mandibular incisive canal, which run to the cavities containing the incisor teeth.^[1] The location and configuration of mandibular canal variations are important in surgical procedures involving the mandible, such as extraction of an impacted third molar, dental implant treatment, and sagittal split ramus osteotomy (Naitoh m et al., 2007). The mandibular canal is fairly close to the apices of the second molar in 40% of the radiographs. In 50%, canal is away from the root apices, and in only 10% of the radiographs the root apices appeared to penetrate the canal.

In root canal therapy of the second molar one should be cautious of over extending the reamer or the root canal filling materials because there is a possible risk of inferior alveolar nerve injury. It was reported that in 60% of the cases, the mandibular canal was found to have the entire inferior alveolar nerve passing through it, while in the remaining 40% cases, the nerves were found to be scattered. This observation of the spread of the inferior alveolar nerve suspects the possible presence of some other nerves which pass through the mandibular canal, probably the nerves to the mylohyoid.

In the present investigation position of mandibular and mental foramina in relation to other landmarks were studied. The prevalence rate and the laterality were analyzed. The morphological knowledge of the MF is of paramount importance during the dental procedures of the lower jaw, as structures that go through this foramen should be preserved.

The mandibular foramen (MF) is a prominent feature on the medial surface of the ramus of the mandible which is located just above its centre. This foramen is at approximately the midpoint of the internal surface of the ramus. It is the opening into the mandibular canal. It provides passage to the inferior alveolar branch of the mandibular nerve and its accompanying vessels. This study assessed the mandibular foramen (MF) position variability in dentate and edentate mandibles. 23 dentate and 14 edentate mandibles of unknown sex were measured bilaterally using a digital caliper (0.1-mm precision).

Horizontal linear measurements were done from the MF to the anterior border of the mandibular ramus and from the MF to the posterior border of the mandibular ramus. Vertical linear measurements (VM) were done from the MF to the most inferior point of the mandibular notch (MF-N) and from the MF to the inferior border of the mandibular ramus (MF-D).

Tab.1. The results obtained in the study of MF position

<i>Mean distance between</i>	<i>Right side</i>	<i>Left side</i>
MF- anterior border of the mandibular branch	16,72 mm	16,78 mm
MF- posterior border of the mandibular branch	14,21 mm	14,41 mm
MF- center of mandibular branch	Posteriorly 0,54 mm	Posteriorly 0,63 mm
MF- lowest point of mandibular notch	22,41 mm	22,23 mm
MF- inferior border of the mandibular branch	30,56 mm	29,83 mm
Narrowest anteroposterior diameter of the branch	32,8	32,05

Dentate mandible measurements showed statistically significant differences compared to the edentate mandibles, except for MF-N. The mandibular foramen position changes with loss of teeth and this variability may be responsible for occasional failure of inferior alveolar nerve block (tab.1).

The mandibles were observed for the presence of AMF and if they were present, a further observation was made about their numbers. Their prevalence rate and laterality were also analyzed. A magnifying lens was used for the observations. There are a few cases which have been reported on the accessory mandibular foramina (AMF) and the incidence of the AMF has been found to be greater on the medial surface than on the lateral surface [3-5]. The branches of the facial, mylohyoid, buccal and the transverse cervical cutaneous nerves are known to pass through these accessory foramina. It has been described that the presence of an AMF in the mandible also indicates that extra blood vessels traverse it, which supply the bone.



Fig. 1. Photograph of the lateral surface of the right half of the mandible showing a single accessory mental foramen.

The current study observed that some of the mandibles had accessory foramina (two or three mandibular foramina). These foramina are clinically important as they can lead to diagnostic and therapeutic misinterpretations. The operating surgeons should be aware of these foramina and they should plan the anaesthesia at an appropriate site. During surgical procedures which involve the ramus of the mandible, it is important to be familiar with the incidence and the configuration of these foramina, since complications including unexpected bleeding, paraesthesia and traumatic neuroma are known to occur because of trauma to the accessory canal. The morphological knowledge of these foramina is important as they transmit the branches of the nerves which supply the roots of the teeth. The local anaesthetic drug which is given in this region may

fail if these nerves or their branches pass through the accessory foramina.

From our observations, it was found that the accessory mandibular foramen was present in 12.3% of the mandibles. It was present unilaterally in 8.9% of mandibles (3 on the right side and 3 on the left side) and bilaterally in 7.5% cases. The gender wise frequency was recorded as 6:5 in the male and female mandibles. The accessory foramen was single in 9 cases and double in 2 cases. In all the cases, the accessory foramen was directed downwards towards the alveolar margin.

A large accessory mandibular foramen (AMF) was present postero-superior to the normal MF (left side) in 1 of mandibles observed. The diameters of this foramen were 10 mm antero-posteriorly and 5 mm vertically, and that of MF were 7 mm antero-posteriorly and 5 mm vertically. The distance between these 2 foramina was 11 mm, and between the AMF and the apex of the lingula was 4 mm. The distances from the posterior limit of AMF to the posterior border of the ramus and angle were 18 mm and 52 mm, respectively.

The position of the mandibular foramen was found to be variable. However, the foramen was predominantly located at the anteroposterior midpoint of the ramus halfway between the mandibular notch and the lower surface of the mandible and two thirds of the way down a line joining the coronoid process to the angle of the mandible. In the majority of the mandibles studied the foramen was located below the occlusal surfaces of the molar teeth.

The mental foramen (MeF) is a structure, through which the inferior alveolar nerve and blood vessels pass together to the buccal gingiva in front of the second premolars to the lower lip and chin. The orientation and position of the mental foramen was visually inspected. According to its orientation it was classified as posterior-superior, superior and posterior. The posterior-superior direction is the most common orientation of exit of the mental foramen.

In order to determine the position of the mental foramen in relation to the anterior and posterior borders of the mandible a horizontal line was drawn from the most prominent point of the mandible symphysis to the posterior border of the ramus of the mandible. The following distances were measured (tab.4):

1) from the most prominent point of the mandibular symphysis to the anterior border of the MeF;

2) from the posterior border of the MeF to the posterior border of the mandible;

3) from the inferior border of the mandible to the inferior border of the MeF.

There was no significant variation of the shape of the MF. The mental foramen may be round or oval (60,15%) in shape, it may be absent, unilateral or bilateral and in some cases may be multiple on one or both sides of the mandible. Its diameter is 3-7 mm.

Comparison of the study results with the other studies

Table 2 - Position of the mental foramen

Mean distance from	Prabodha et al.	Study results
Mandibular symphysis	26.52 mm	27,14 mm
Posterior border of the ramus of the mandible	65.38 mm	64,72 mm
Inferior border of the body of the mandible	12.25 mm	13,83 mm

Table 3 - Shape of the mental foramen

Shape	Mbajjorgu et al.	Gershenson et al.	Prabodha et al.	Study results
Oval	56.3%	65.52%	66.67%	60,15%
Round	43.8%	34.48%	33.33%	39,85%

In an adult with the advancement of the age MF was moved towards the superior border of the body of the mandible (fig.). This is mainly because of the loss of teeth and alveolar bone resorption. There is a significant variation of the position of the MF with age. This is also compatible with Prabodha et al. study.

Simple percentage evaluation was used to determine the frequency of the mental foramen in relation to the lower teeth. In 50% of cases it is located at the edge of the second premolar root, in 25% it is between the first and second premolars and 25% it is behind the second premolar.

It is important to report on the risk of anatomical variation of mental foramina, in order to avoid nerve damage in connection with surgical procedures. The absence and variation of accessory mental foramina has been reported in dry human mandibles and on radiographs previously, and can range from (0.2%) to (10.6%) on one side. A double mental foramen in our study appears in approximately 1% on the left side and in 1.1% on the right side of the mandible .

Gershenson et al. (1986) who examined 525 dry mandibles focusing on variation, shape and site

of the mental foramen related to the teeth, reported that 4.3% mandibles had double mental foramina, and 0.7% mandibles had triple mental foramina. Finally they found one mandible that had four mental foramina on one side (0.1%).

Katakami et el. (2008) examined 150 patients retrospectively with limited cone-beam computed tomography and depicted 16 double foramina (10.6%) and triple mental foramina on one side (0.6%).



Fig. 2. Photograph of the anterior surface of the mandible two accessory mental foramina on the right side.

The location of the mental foramen in relation to the mandibular teeth was assessed in the dentate mandible. The location of the mental foramen is an important factor when considering the mental and incisive anesthetic block and surgeries in the outer premolar mandibular region.

The present study shows the location in line with the long axes of the second premolar as the most common position of the mental foramen, followed by the position between the first premolars. In the present study this parameter is not influenced by gender.

Mental foramen was often observed in the apical of second premolar, while the accessory mental foramen was detected between apical of second premolar and first molar or between apical of canine and lateral incisor.

In most cases mental foramen of adult dentate mandible is located halfway between the lower border of mandible and alveolar crest in a vertical line with the supraorbital notch.

The retromolar foramen (RMF) was found to occur in forth of 37 adult human mandibles studied (10.7%). No statistically significant difference was found between left and right sides or between sexes.

Additional foramina are clinically important as they can lead to diagnostic and therapeutic misinterpretations.

Conclusions

- 1) The location and configuration of the mandibular canal is variable and should be carefully observed using cross-sectional images of the mandibular canal and images perpendicular to them when conducting surgical procedures such as implant treatment involving the mandible.
- 2) A number of studies have shown: a) variability of distance between the MF and mandibular notch; b) difference in the position of the mental foramen in relation to the second premolar and to the alveolar crest; c) the presence of additional mandibular, mental and retromolar foramina.

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MORPHOLOGICAL VARIABILITIES OF THE SKULL

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Summary

The article describes different aspects of variability of the human skull: gender, age and ethnic. An attempt of systematization of the structural features of the skulls is undertaken .

Rezumat

Variantele morfologice ale craniului

În articol se descriu diferite aspecte referitoare la variabilitatea craniului uman: de sex, de vârstă și apartenența etnică. Este întreprinsă încercarea sistematizării particularităților structurale ale craniilor.

News Theme

One of the most important aspects of behavior management in pediatric dentistry is pain control. Basically, in order to have a rapid, deep and safe local anesthesia, location of MF in relation to the occlusal plane should be acquired. As the child grows up, the position of MF changes. Hence, for a successful mandibular local anesthesia, consideration to such changes is imperative. Differences between male and female skull and between individuals of different races are very important in forensics to determine the sex of the skull which has been recovered and in the establishment of a victim's ethnic origin.

Aim

The aim of this study is to investigate the influence of age and gender on the structure of the human skull. The purpose of this investigation was to establish how the mandibular angle changes with age and loss of teeth among the sexes.

Materials and methods

A wide range of literature on the subject was studied, and made an observations were made on 30 human skulls which were selected from the skeletal collection of the Department of Anatomy of our university, College of Medicine and 20 radiographs taken from the Department of Stomatology. Ten of them were child and twenty adult skulls. Images of the skulls were obtained using a digital camera.

Discussions and results

The skull is the bony section of the head. The skull encases and protects the brain, houses the brain senses, provides attachments for muscles of the head and neck, and helps to form the first