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Original Research Article

Clinical significance of accessory foramina in adult human mandible

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ABSTRACT

Background: The mandible is the strongest and largest bone of facial skeleton. It consists of one horseshoe-shaped body and a pair of rami. On external surface of body in the midline there is a faint ridge i.e. symphysis menti indicating the line of fusion of two halves of mandible during development. The aim of this study is to describe the position and incidence of accessory foramina on the inner surface of the body and rami of both sides of mandible to provide simple important reliable surgical landmarks.
Methods: The present study was conducted on 100 dried adult human mandibles. Bones which had deformities, asymmetries, external pathological changes and fractures were excluded from the present study.
Results: In 97% cases at least one accessory foramen was observed on inner surface of mandible. The accessory lingual foramen was found to be constant finding with incidence of 81%. Frequency of infraspinous or sublingual foramen was 58%, of lateral foramen was 50% and that of accessory mandibular foramen was 39%.
Conclusions: The anatomical knowledge about the common location and incidence of accessory foramina in mandible are important for surgeons and anaesthetists performing surgeries in the area around mandible. These accessory foramina transmit neurovascular bundles which provide accessory innervations to the roots of teeth. Thus proper knowledge of accessory foramina are important in relation to achieving complete inferior alveolar nerve block and for avoiding injury to neurovascular bundle passing through them.

Keywords: Accessory foramina, Foramen, Mandible, Neurovascular bundle

INTRODUCTION

The mandible is the strongest and largest bone of facial skeleton. It consists of one horseshoe-shaped body and a pair of rami. On external surface of body in the midline there is a faint ridge i.e. symphysis menti indicating the line of fusion of two halves of mandible during development.[1] The mandibular foramen is present on the medial surface of ramus of mandible a little above the centre. It transmits inferior neurovascular bundle i.e. inferior alveolar branch of mandibular nerve and vessels into the mandibular canal which extends into the body of mandible up to the mental foramen to supply mandibular teeth.[2] It is important surgical landmark for inferior nerve blocks. The inferior nerve is commonly injured during dental surgeries. The mental foramen is present on external surface of body of mandible, below the second molar tooth. Branches of inferior alveolar nerve and vessels pass through this foramen.[3]

The openings present in mandible other than alveolar sockets, mandibular and mental foramen are known as

accessory foramina.[4] They are more common on the internal surface of the mandible, although number may vary.[4-8] They are more commonly located in the symphyseal region of the mandibular body ([4,6,9-12]). Different researchers used different names for the accessory foramina lying on lingual surface. Few authors named it as lingual foramen, if present in the midline and superior to or within the area of genial tubercles and other named it, as the midline foramen as superior retromental foramen, whereas others referred it as supraspinous foramen.[4,10,12-15]

Accessory foramen lying in the midline inferior to the genial tubercles is referred as inferior lingual foramen, Inferior retromental foramen and infraspinous foramen.[10,12,14] Accessory foramina present lateral to genial tubercles or in lateral regions of mandible i.e. close to posterior end of mylohyoid line are named as lateral retromental foramina and internal mental foramina.[14,16] Different names are used for the foramen present near the Mandibular foramen as Accessory Mandibular Foramina and Conduct of Serres.[17-19]

The accessory mandibular foramina were observed commonly on the medial surface of ramus of mandible than on lateral surface.[20] It may result in inferior alveolar nerve block failure when anatomical variants of this nerve pass through it and provide additional supply to the inferior teeth. [11] This is supported by embryological basis, i.e. around the inferior alveolar nerve the ossification of the mandibular canal takes place. If this nerve shows variations, the mandibular canal might open posteriorly in the accessory foramen or foramina in the mandibular ramus.[21, 22]

In newborn mandibles, earlier workers proved the presence of accessory Mandibular foramen in 100% of the studied cases as the posterior opening of an accessory mandibular canal-the Conduct of Serres (CS)- which is present during the embryological stage i.e. mandibular development and in the temporary teeth phase where it gives passage to a vein, the vein of Serres , which drains blood of the inferior teeth in an accessory manner.[17,18,22-25] The contents of Conduct of serres itself may persist in the adult, varying between 16.6% and 42.6%.[17,23]

These accessory foramina transmit neurovascular bundle i.e. An artery, a vein, and a nerve to provide additional blood supply and accessory innervation to the anterior mandibular teeth. The morphological knowledge of these accessory foramina is clinically important. The dental surgeon should be aware while giving anaesthesia during surgery as anaesthetic drug may fail to achieve proper nerve block if these nerves or their branches pass through these accessory foramina. The blood vessels passing through the accessory foramina might cause complications like haemorrhage during dental surgeries. If the artery is of sufficient size, it may pose difficulty in controlling bleeding. The vessels passing through these accessory foramina might also have role in the metastasis of tumours in this region.

METHODS

The present study was conducted on 100 dry adult human mandibles obtained from the Departments of Anatomy, Gian Sagar Medical College, Banur and Govt Medical College, Chandigarh, India.

The origin, exact age and sex of mandibles were not known. Bones which had deformities, asymmetries, external pathological changes and fractures were excluded from the present study. In case of any doubt, a metallic wire was introduced in the foramen to ascertain its presence. The present study was approved by the institutional review board and local ethics committee. All mandibles were properly examined with magnifying glass to observe the presence and positions of accessory foramina.

RESULTS

In the present study, accessory foramina on the inner surface of mandible were observed in 97% cases. The number of foramina varied from 0 to 6. In some mandibles, the accessory foramina were present bilaterally. Total 270 accessory foramina were observed on internal surface of 97 mandibles. They were grouped into following four types-

- Lingual foramen i.e. foramen present superior to or within the area of genial tubercles.
- Sublingual or infraspinous foramen i.e. foramen present inferior to the genial tubercles.
- Lateral foramina i.e. foramen present lateral to the genial tubercles, or in lateral area of mandible i.e. close to posterior end of mylohyoid line.
- Accessory mandibular foramen i.e. foramen present near the Mandibular foramen or in relation to main foramen.

Table 1: Incidence of accessory foramina in mandible.

Name of foramen	Incidence			None
	Unilateral/ midline	Bilateral	Three	
Lingual foramen	81%	-	-	19%
Infraspinous foramen	52%	6%	-	42%
Lateral foramen	28%	22%	-	50%
Accessory Mandibular foramen	26%	12%	1%*	61 %

The incidence of accessory foramina found in the present study has been depicted in Table 1.

In one mandible, there were 3 accessory mandibular foramina i.e. 2 on left side and 1 on right side.

DISCUSSION

A number of studies have mentioned that in mandible, accessory foramina are present on inner surface, indicating their importance in clinical procedures.[26] Knowledge of position of accessory foramina in mandible is very helpful for the dental surgeons in oral surgery procedures like dental implant techniques, reconstructive surgeries of the mandible, in local anaesthesia and also for the radiologist and oncologist while planning radiation therapy. These foramina contain neurovascular bundle i.e. extra blood vessels and branches of inferior alveolar nerve fibres which supply the bone.

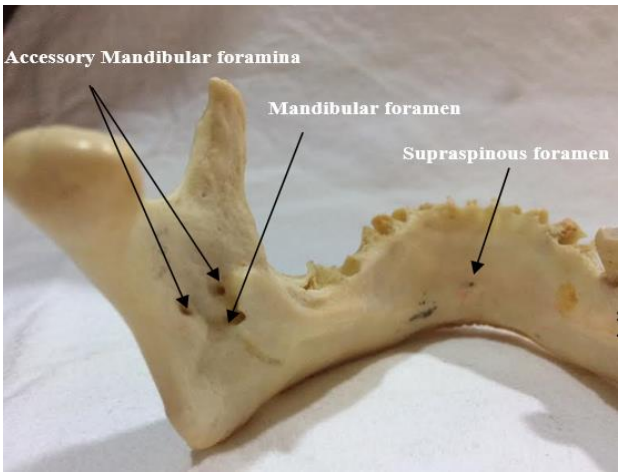

Figure 1: Accessory mandibular, supraspinous and mandibular foramen.

These nerve fibres cause failure of gaining local anaesthesia given during dental extraction as branches of nerve fibres passing through these accessory foramina escape the drug.[27] Inferior nerve block is the commonest technique used in dental procedures.

Variation in the distribution of accessory foramina is the main cause for failure rate of this technique.[3,28] The awareness of alternate route through accessory foramina is important for gaining proper inferior nerve block. The accessory foramina are functionally important in supplying the neurovascular components to mandible.

The contents of these accessory foramina are well defined neurovascular bundle, i.e. branches of lingual nerve and artery at the lingual foramen and branches of nerve to mylohyoid, sublingual artery as well as vein entering the infraspinous foramina.[29] The accessory mandibular foramina transmit number of branches of nerves i.e. buccal, facial, transverse cutaneous or mylohyoid and these are responsible for failure rate of anaesthesia as these branches are not completely anaesthetized.[2,5,30]

In present study, the lingual foramen may be considered as constant finding with high incidence of 81%. Present results are comparable with the previous studies by Seema et al i.e. 88%), Sutton i.e. 85%, Przystanska et al i.e. 86%, Nagar et al i.e. 72% and Shiller et al i.e. 88.9%.[4,12,26,27,31] It was mentioned by previous authors that the lingual surface of mandible has both midline as well as laterally placed foramina.[32]

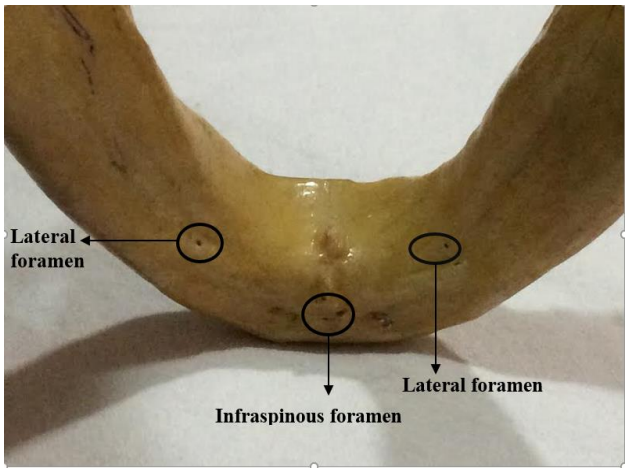

Figure 2: Lateral, Infraspinous foramen.

In cadaveric dissection, a supraspinous foramen was present in 55.5% cases. A single slender artery which was a branch of the left sublingual artery was entering the foramen confirmed during cadaveric dissection. Sublingual artery also gives a branch to the alveolar ridge. No accompanying vein was found.[31] The incidence of infraspinous foramen in present study was 58% which was lower than lingual foramen. It was double in number in 6 mandibles. The lower incidence of infraspinous was also supported by Przystanska et al i.e. 60% and SEEMA et al i.e. 70%.[26,27]

Lateral accessory foramina in present study had an incidence of 50%. It was bilateral in 22 mandibles and unilateral in 28 mandibles. The commonest position of this foramen was to the left of the genial tubercles which was also reported in the previous study.[27] The frequency of lateral foramina reported in earlier studies varied to a large extent i.e. 28%, 30%, 60% and 80%.[7,8,10,27]

The incidence of accessory mandibular foramina in present study was 39%. It was present unilaterally in 26 mandibles, bilaterally in 12 mandibles. In 1 mandible, it is 3 in number, 2 on left side and 1 on right side. Our results are in accordance with the previous studies i.e 41.5%, 48%, 42.6%, 43.2 %, 16.6%, 50.0 %.[2,17,18,23,27]

Accessory Mandibular foramina present on the medial surface of the mandible, are important in respective of their numbers and distribution because they provide a

direct pathway into the cancellous bone and facilitate the tumours infiltration from the floor of the mouth.[7] As per literature, during development, initially, mandibular teeth are innervated by three inferior alveolar nerves. Later, these nerves fused to form single inferior alveolar nerve.

Due to incomplete fusion of these 3 nerves two mandibular canals may formed. Few authors reported that, in 60% of the cases, the entire inferior alveolar nerve pass through the mandibular canal, while, in the remaining 40% cases, they were found to be scattered.[27,34]

The frequency of occurrence of accessory foramina may be influenced by the developmental modelling processes, starting from the internal surface of the mandible, where the Meckel's cartilage is found. Presence of Accessory foramina in this portion of mandible, suggest their connection to the development from the accessory symphyseal ossicles and the medial portions of the opposing Meckel's cartilage.[2]

In foetus these accessory foramina have connection with mandibular canal. It indicates that these accessory foramina provide passage for vessels and nerves.[35] Because of high incidence of these foramina, the professionals must know of such anatomical variations to avoid failure of complications during dental and surgical procedures.[36]

Failure of achieving anaesthesia in inferior nerve block is due to presence of anatomical variations in the form of accessory foramina as well as inferior alveolar nerve and its branches.[37-39] The professionals must be aware of the presence of these anatomical variations i.e. accessory foramina and course of structures passing through them. These have great importance in surgical procedures like in insertion of dental implants, removal of dentures and in prosthetic operations.[40] By identifying these anatomical variations the complications like pain, numbness, discomfort, paraesthesia can be prevented in the treatment of mandible.[41]

CONCLUSION

It is important for the dentist to know the incidence and positions of accessory foramina in mandible so that he can plan the anaesthesia at an appropriate site while performing the extraction procedure to prevent complications like nerve damage and incomplete nerve blocks. It will also beneficial for oncologist, radiologist and oromaxillofacial surgeons in planning graft implant and in development of newer techniques in their clinical practice.

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