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An Anatomico-Radiological Study of Inter-Relationship between the Mandibular Foramen and Accessory Mandibular Foramina in Population of Rajasthan State

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ABSTRACT

The Mandibular foramen (Mf) is present on the inner surface of the ramus of the mandible. It leads into the mandibular canal giving passage to Inferior Alveolar Nerve (IAN) and vessels which enter the roots of the teeth and the periodontal septa. Many unnamed accessory foramina are present on the lingual side of the mandible which are very variable in their distribution but they are observed more often on the internal surface of the mandible in position above or below the MF. A dental surgeon performing tooth extraction should be aware of Accessory Mandibular Foramina (AMf) for planning anaesthesia at an appropriate anatomical site as the branches of the facial nerve, mylohyoid nerve, buccal nerve and transverse cervical cutaneous nerve are known to pass through these foramina. Nerve block techniques by local anaesthetics might fail if any of these nerves or their branches pass through these AMf and escape the nerve block. The present research paper reports the presence of AMf around Mf in 25 dry human mandibles out of 100 mandibles studied and emphasizes the inter-relationship between Mf and AMf in certain cases studied radiologically. Precise knowledge and awareness of such AMf would therefore be important for dental surgeons performing nerve block and also for oncologists in planning radiation therapy.

Key Words: Accessory mandibular foramina, mandibular foramen, mandibular canal, nerve block.

INTRODUCTION

The Mandibular foramen (Mf) is an irregular foramen which is located just above the centre of the medial surface of the ramus of the mandible. [1] The Mf curves downwards and forwards into the body of the mandible to form the mandibular canal which exit opens into mental foramen. The Inferior Alveolar Nerve (IAN) and vessels pass through it which supplies the mandibular teeth, which runs further down in the mandibular canal to emerge out from the mental foramen. [2]

Any other openings in the mandible other than Mf, sockets of teeth, mental foramen and lingual foramen are labelled as Accessory Mandibular foramen (AMf). [3]

The incidence of AMf has been found to be greater on the medial surface than on the lateral surface. [4,5]

Many unnamed accessory foramina are present on the lingual side of the mandible which are very variable in their distribution but they are observed more often on the internal surface of the mandible in position above or below the mandibular foramen. [6]

These foramina were studied immuno histochemically and proved that their contents included an artery and a nerve. Injecting an anaesthetic solution into the pterygomandibular region, where the IAN is found in the Mf, is an anaesthetic technique which is commonly employed in the dental clinics. It was reported that the local anaesthesia which was given during dental extractions might fail, if the branches of IAN pass through these accessory foramina and thus escape the drug. [7-9]

Awareness of the presence of AMf may be important in achieving successful IAN anaesthesia and so this is best

performed at a higher level using the technique also known as the "Gow-Gates technique". [10]

This procedure involves the administration of the anaesthetic solution at a higher level before the division of the mandibular nerve. [11]

The presence of anatomical variations in human mandible such as the AMf, presents clinical implications, if not previously identified, can cause complications to clinical dental practice. [12]

Furthermore, failures in the anaesthesia by regional blockage of the IAN are reported due to the presence of these foramina. [13]

Knowledge of the anatomical details of AMf may then be of significant clinical interest to surgeons and oncologists in clinical practice.

Therefore, the aim of present study was to radiologically analyse the inter-relationship between the Mandibular Foramen (Mf) and Accessory Mandibular Foramina (AMf) in dry human mandibles of Rajasthan State.

MATERIALS AND METHODS

The present study included 100 dry human mandibles procured from the Department of Anatomy, Mahatma Gandhi Medical College & Hospital, Jaipur, the Department of Anatomy, SMS Medical College & Hospital, Jaipur, the Department of Anatomy, NIMS Medical College & Hospital, Jaipur.

The mandibles were examined for the presence of AMf around the Mf and 25 out of 100 mandibles reported the presence of AMf.

Out of the 25 mandibles with AMf incidences, 8 mandibles were selected for detailed radiological analysis and interrelationship between Mf &AMf was studied after inserting probed wire in respective canals/foramina (Fig. 1).

For this purpose, OPG of mandibles with AMf incidences was undertaken.

Procedure of OPG:-

I. An OPG which stands for "Orthopantomogram", gives a panoramic view of the mouth, giving information on the teeth and the bones of the upper and lower jaw.

II. An OPG machine (Fig. 2) is specifically designed to produce X-rays of the teeth, jaws and temporomandibular joints. The image provides an overview of the state of the dentition, as well as information regarding the bones of the jaw (the mandible and maxilla), the air sinuses in the upper jaw and the joints between the jaw and the skull (the temporomandibular joints).

III. During the procedure, the patient's chin is placed on a 'chin rest'. The jaws are held in place by biting down on a small disposable plastic guide. Most OPGs are performed with the patient standing. An OPG aims to view the jaw, while blurring out the other structures of the face and skull. This is done using a technique called "tomography". During the exposure, the X-ray tube and film cassette rotate around the jaws. As the X-ray tube moves around the head, the x-ray film moves in the opposite direction behind the head.

IV. An exposure lasts a few seconds during which time the patient must remain still. The film cassette is then removed to allow development of the exposed X-ray film.

V. This generates an image where the mandible and teeth are in focus, and the other structures are blurred.

VI. OPG procedures can take up to 15 minutes.

While performing OPGs for the purpose of present study, the dry mandibles with inserted probed wire in the canals/foramina were fixed on the 'chin rest' (Fig. 3) one by one by using surgical tape for proper adhesion. After that, the

above mentioned procedure of OPG (Fig. 4) was conducted repeatedly and images were thus obtained for studying the interrelationship between Mf and AMf.

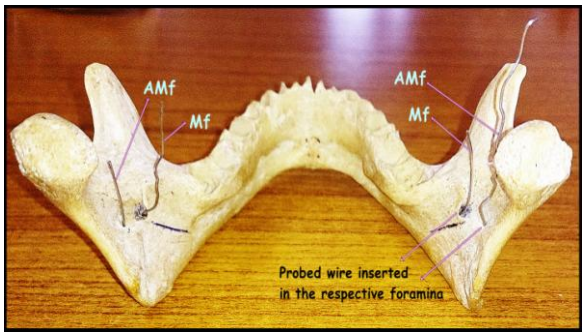

Fig.1:- Picture showing a mandible with inserted probed wires in the Mf and AMf to study the interrelationship between them.

Fig.2:-An OPG machine with mandible placed over the 'chin rest'.

Fig.3:- Picture showing the adhesion of mandible by using surgical tape on the 'chin rest' of the OPG machine.

Fig.4:- Picture showing the different positions of an OPG procedure being undertaken.

RESULTS

The details of mandibles with incidences of AMf which have undergone the procedure of OPG have been depicted in tabulated form in the Table 1:-

Table 1:- Details of radiologically analysed mandibles with AMf incidences.

S.No. of Radiographically studied Mandibles	No. of Accessory Mandibular Foramina (AMf)	
	Right half	Left half
1.	1	
4.		2
7.	1	
8.		1
16.	1	1
17.		1
18.	1	1
23.		

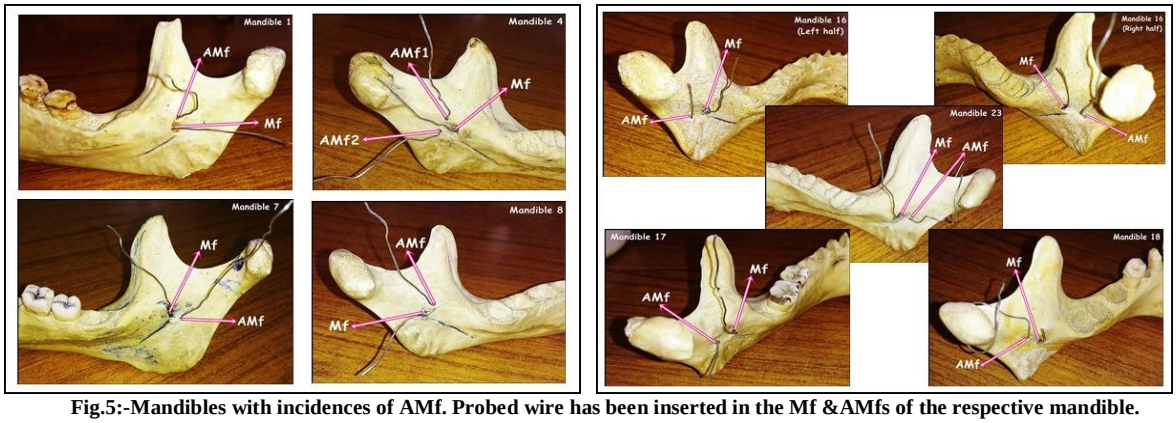

Fig.5:-Mandibles with incidences of AMf. Probed wire has been inserted in the Mf &AMfs of the respective mandible.

After conduction of OPGs of the above mentioned mandibles (Fig. 5) the X-ray digital images were obtained for the purpose of studying the interrelationship

between Mf and AMf and thus the following observations were made:-

I. Mandible No. 1:-

Here, the AMf was single and present on the right half of the mandible. The probed wires had been inserted in the Mf and AMf of the right half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimposes to form a single mandibular canal [Fig. 6(a)].

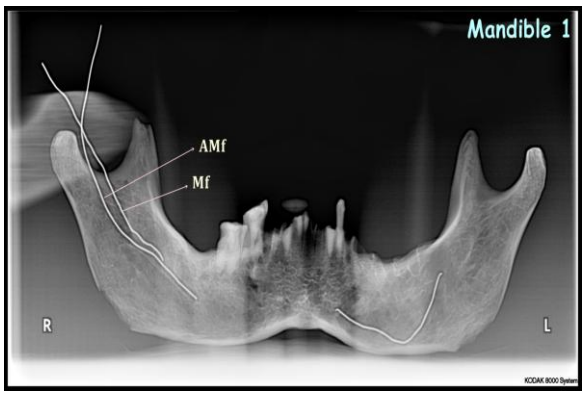

Fig. 6(a):- The probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimpose to form a single mandibular canal.

❖ **Special case study:-**While performing the OPG of this mandible, it was observed that a wire was already present within the substance of the left half of the mandible. So, for the purpose of finding out the reason for the presence of a wire prior to inserting probed wires through the foramina, another OPG of the same mandible was conducted by inserting probed wire through the Mf of left half. It was observed that the wire already present inside the mandible superimposes with the probed wire inserted through the Mf of left half. Thus, the reason for the presence of such wire might be due to accidental insertion of the wire without folded head of a probe into the Mf by the students during osteological study/practice of aforesaid sample in the medical college [Fig. 6(b)].

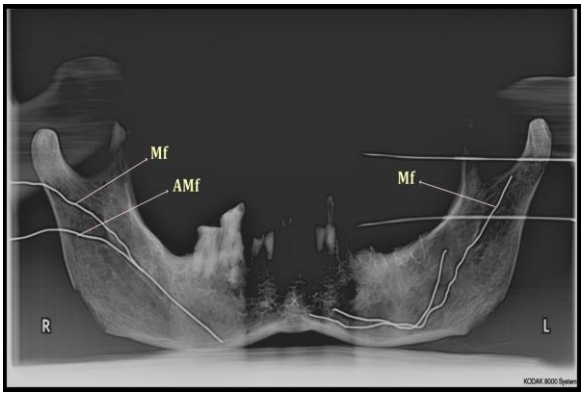

Fig. 6(b):- The wire already present inside the mandible superimposes with the probed wire inserted through the Mf of left half.

II. Mandible No. 4:-

Here, the AMf were double and present on the left half of the mandible. The probed wires had been inserted in the Mf and the two AMf (AMf 1 &AMf 2) of the left half. It was observed that the probed wires inserted in the Mf and AMf 2 traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal whereas the probed wire inserted in AMf 1 traverses within the mandible and superimposes with the probed wired inserted through the Mf, thus forming a single mandibular canal [Fig. 7].

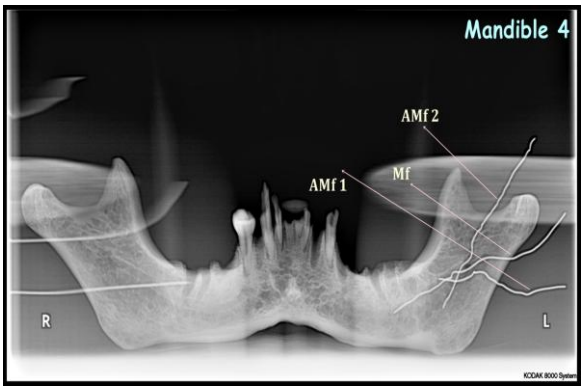

Fig. 7:- The probed wires inserted in the Mf and AMf 2 traverses within the mandible through separate canals and do not superimposes whereas that in AMf superimposes with the probed wired inserted through the Mf forming a single mandibular canal.

III. Mandible No. 7:-

Here, the AMf was single and present on the right half of the

mandible. The probed wires had been inserted in the Mf and AMf of the right half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal [Fig. 8].

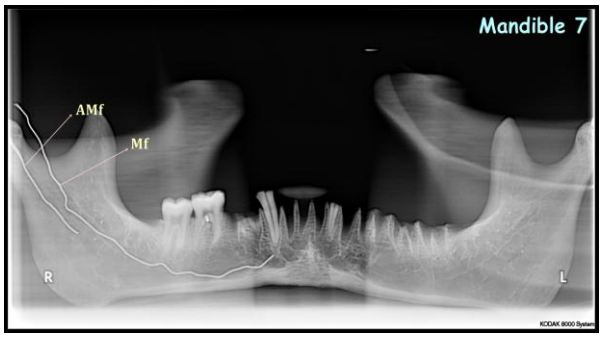

Fig. 8:-The probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal.

IV. Mandible No. 8:-

Here, the AMf was single and present on the left half of the mandible. The probed wires had been inserted in the Mf and AMf of the left half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimposes to form a single mandibular canal [Fig. 9].

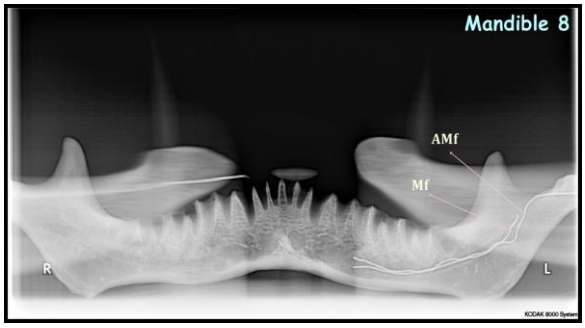

Fig. 9:-The probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimpose to form a single mandibular canal.

V. Mandible No. 16:-

Here, two AMf were observed, one single AMf on the right half and another single AMf on the left half of the mandible. The probed wires had been inserted in the Mf and AMf of both the halves. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal on either side [Fig. 10].

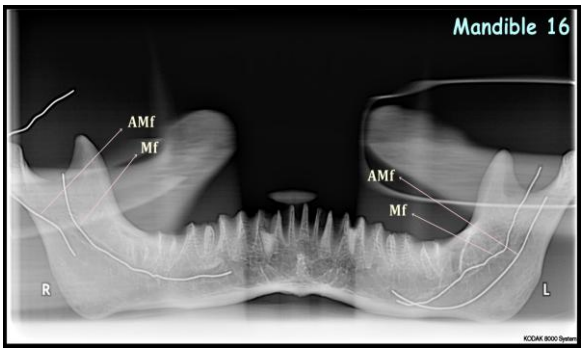

Fig. 10:-The probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal on either side.

VI. Mandible No. 17:-

Here, the AMf was single and present on the left half of the mandible. The probed wires had been inserted in the Mf and AMf of the left half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal [Fig. 11].

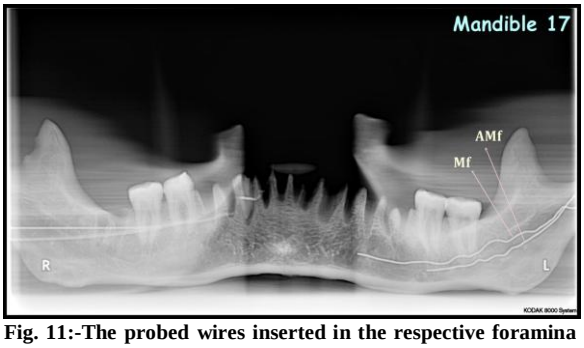

Fig. 11:-The probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal.

VII. Mandible No. 18:-

Here, the AMf was single and present on the left half of the mandible. The probed wires had been inserted in the Mf and AMf of

the left half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimposes to form a single mandibular canal [Fig. 12].

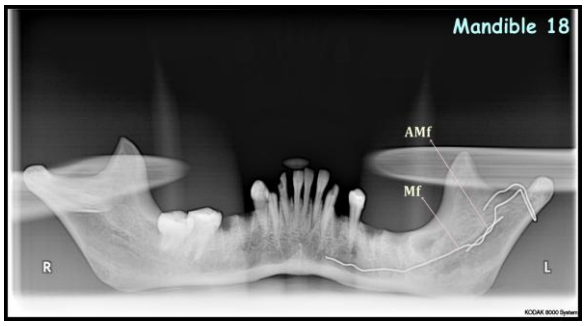

Fig. 12:-The probed wires inserted in the respective foramina traverses within the mandible through same canal and thus superimpose to form a single mandibular canal.

VIII. Mandible No. 23:-

Here, the AMf was single and present on the right half of the mandible. The probed wires had been inserted in the Mf and AMf of the right half. It was observed that the probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal [Fig. 13].

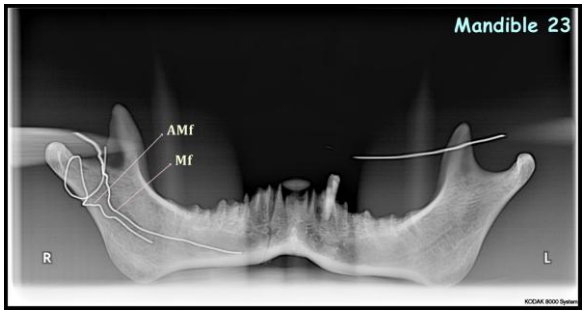

Fig. 13:-The probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal.

In one of the mandibles, with incidence of AMf the probed wires were inserted in the Mf and AMf of same side and another probed wire was inserted in the Mf of other side with no incidence of AMf. The mandible was studied radiographically and X-ray digital image was obtained [Fig. 14].

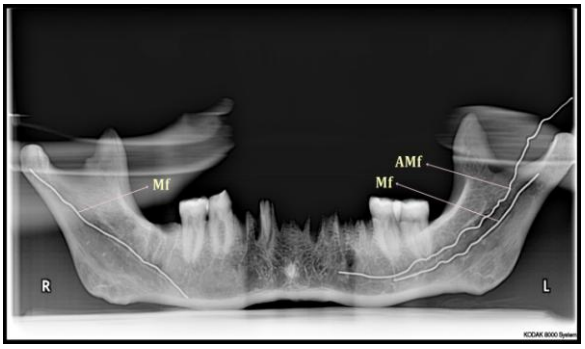

Fig. 14:-The probed wires have been inserted in the Mf and AMf of same side and another probed wire is inserted in the Mf of other side with no incidence of AMf.

DISCUSSION

Literature evidences regarding radiological analysis of the inter-relationship between Mf and AMf are very few.

Das and Suri et al (2004) passed a metallic wire through an AMf and examined it radiologically and found that the neurovascular bundle passing through it supplied the root of the third molar tooth. [2]

- In the present study, the interrelationship between Mf & AMf was studied radiologically by the procedure of OPG after inserting probed wire in respective canals/foramina and it was observed that in certain mandibles, the probed wires inserted in the Mf and AMf traverses within the mandible through same canal and thus superimposes to form a single mandibular canal whereas in certain other mandibles, the probed wires inserted in the respective foramina traverses within the mandible through separate canals and do not superimpose to form a single mandibular canal. Thus the presence of Accessory Mandibular canal was observed.

The reason for the presence of Accessory Mandibular canal can be explained by the branching pattern of IAN. The branching pattern of the IAN may also show several variations within the mandibular canal. It may either run as single trunk giving branches to molar and premolar teeth or give a major and minor trunk near the Mf, the major trunk after traversing through the mandibular canal comes out

through mental foramen whereas, the minor trunk after innervating molar and premolar teeth becomes incisive nerve. The IAN may also give branches for molar and premolar teeth, for canine and incisor teeth and for mental foramen near the Mf. [14]

Developmentally, the presence of double mandibular canals can be explained as the incomplete fusion of three IANs, that develop initially to innervate three groups of mandibular teeth and the inferior alveolar artery passes through the small-sized AMf located behind the Mf. [15,16]

CONCLUSION

The present research concludes that the presence of AMf might be important for orthognathic or reconstructive surgery of the mandible and also during dental implants. In view of the clinical importance of AMf, prior anatomical knowledge of such anomalies may be helpful for dental and maxillo-facial surgeons and oncologists performing irradiation in day to day practice.

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