SHORT REPORT

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The relative position of the inferior alveolar nerve in cadaveric hemi-mandibles

V. Saralaya and K. Narayana

Department of Anatomy, Centre for Basic Sciences, Kasturba Medical College, Bejai, Mangalore – 575004, Karnataka, India

SUMMARY

The present study was planned to evaluate the position of the mandibular foramen (MF) and the course of the inferior alveolar nerve in 12 right and 14 left cadaveric hemimandibles. The soft tissue, including the muscle attachments of the mandible, was cleaned and the inferior alveolar neurovascular bundle was dissected up to the MF. The distances from the MF to the angle, symphysis menti, 3rd molar, and the lowest point of the mandibular notch were measured. The bone was chiseled from its lingual surface to expose the mandibular canal. The distances from the MF to the different landmarks did not show any side differences, except the one to the symphysis menti ($P<0.05$; Mann-Whitney 'U' test). Similarly, the distances from the nerve to the borders did not show any significant side differences either. These data indicate that, on average MF is located at a symmetrical point on the ramus of either side, although, not exactly at a fixed distance from any of the landmarks tested. Further, the canals were located either near to the middle or below, near to the base of the mandible. We conclude that the location of the MF varies from bone to bone, despite its bilateral symmetry. Further, the canal, and consequently the nerve, does not maintain a constant position in the mandible.

Key words: Mandible – Mandibular canal – Inferior alveolar nerve – Mandibular foramen

INTRODUCTION

The mandibular foramen (MF) is present on the medial surface of the ramus leading into the mandibular canal, which accommodates the inferior alveolar neurovascular bundle (Soames, 1995). The position of the MF is not constant and the distances from it to the other landmarks always vary (Mbajiorgu, 2000). This variable position of the MF forms the basis of the failure of inferior alveolar nerve blockade (Keros et al., 2001), and accidental puncture of the accompanying blood vessels during anesthetic procedures. Most studies conducted to evaluate the position of the MF have selected dry mandibles as the study material (Nicholson, 1985; Mbajiorgu, 2000), and very few studies have been carried out in cadavers. The mandibular canal starts from the MF and descends obliquely in the ramus; then horizontally forwards in the body, below the dental alveoli, and opens into the mental foramen (Soames, 1995). In an equal numbers of mandibles, the inferior alveolar nerve (IAN) coursed a few millimeters from the roots of the teeth or close to the lower border of the mandible (Nortje et al., 1977), usually lying on the buccal side, although in a few cases also on the lingual side (Miller et al., 1990). However, the mandibular canal is known to lie very close to the lingual cortical plate, traversing one centimeter above the inferior border of the mandible (Gowgiel, 1992). In the majority of cases, the mandibular canal and the neu-

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Correspondence to:
Dr. Kilarkaje Narayana. Department of Anatomy, Centre for Basic Sciences, Bejai, Mangalore-575004, Karnataka, India. E-mail: narayana68@yahoo.com

rovascular bundle within it traversed close to the dental roots (in 6 out of 8), although less commonly (2 out of 8) the nerve was closer to the inferior border of the mandible (Carter and Keen, 1971). The present study was planned to evaluate the positions of the MF, the mandibular canal, and the IAN in cadaveric hemi-mandibles.

Materials and Methods

This study was conducted in 12 right and 14 left cadaveric hemi-mandibles. The soft tissue including the muscle attachments of the mandible were cleaned and the inferior neurovascular bundle was dissected up to the MF. The distances from the MF to the angle, symphysis menti, 3rd molar, and the lowest point of the mandibular notch were measured.

The mandible was then chiseled from the mandibular foramen along the course of the IAN from the lingual surface. The IAN was cleaned in the canal and the distances from it to the alveolar and the inferior borders of the mandible were measured. Based on these measurements, the positions of the IAN were determined and classified into 2 types; middle and inferior. In fact, no canal was present exactly at the midpoint between the 2 borders. Thus, the canals classified under the middle type lay close to the midpoint, while under the inferior type they lay close to the inferior border of the mandible. The observations were recorded by measurements and photography.

The data were expressed as means ± S.D. for each group. The significance between the sides was analyzed by the Mann-Whitney 'U' test, with the level of significance set at $P<0.05$.

Results

The distances between the MF and the other landmarks did not differ, except the one to the symphysis menti. However, the measurements varied among the mandibles although without any statistical significance due to the high standard deviation (Table 1). The observations of the mandibular canal and the IAN revealed that the canal does not traverse exactly the middle of the mandible (Figs. 1, 2). On the right side (N=12), 5 (41.6%) and 7 (58.3%) canals traversed close to the middle, and close to the lower border of the mandible, respectively. On the left side (N=14), 5 (35.7%) and 9 (64.3%) coursed close to the middle and close to the lower border, respectively. The distances from the IAN to the alveolar and inferior borders did not show any side difference either, even though, marginally, the values were lower for the left side (Tables 2 and 3).

Discussion

This study was planned to evaluate the position of the MF and the course of the neurovascular bundle in the mandibular canal. Evaluation of the average measurements from the MF to the different landmarks indicated that, the distance from the angle and the third molar maintains bilateral symmetry. The distance from the angle to the MF is fairly similar to the one reported by Jerolimov et al. (1998). However, the distance from the lowest point of the mandibular notch was smaller in comparison to that study, especially on the left side (Oguz and Bozkir, 2002). The asymmetry was observed only in the distances from the symphysis menti, indicating that it is not possible to predict the position of the MF

Table 1.- Distances (in mm) from the MF to other landmarks.

Landmarks	Side	Mean ± S.D.	Z Value	P Value
Angle	R=11	23.82 ± 5.79	0.9890	0.323
	L=13	21.77 ± 5.63		
Symphysis	R=12	65.08 ± 8.15 *		
	L=14	7		

Figure 1.- Photograph of lingual surface of the mandible showing the mandibular canal and the IAN in it. Note that the canal and its contents lie close to the midpoint of the line joining the alveolar and inferior borders of the mandible.

with reference to this point. Since the measurements were to the mental spines, the error due to the section of the mandible did not arise. Other studies have reported the individual variations in the position of the MF in human mandibles (Nicholson, 1985; Mbajiorgu, 2000). The present study is in agreement with them, but in contrast to the one conducted in Indian children, in which it was possible to accurately determine the position of the MF with reference to the

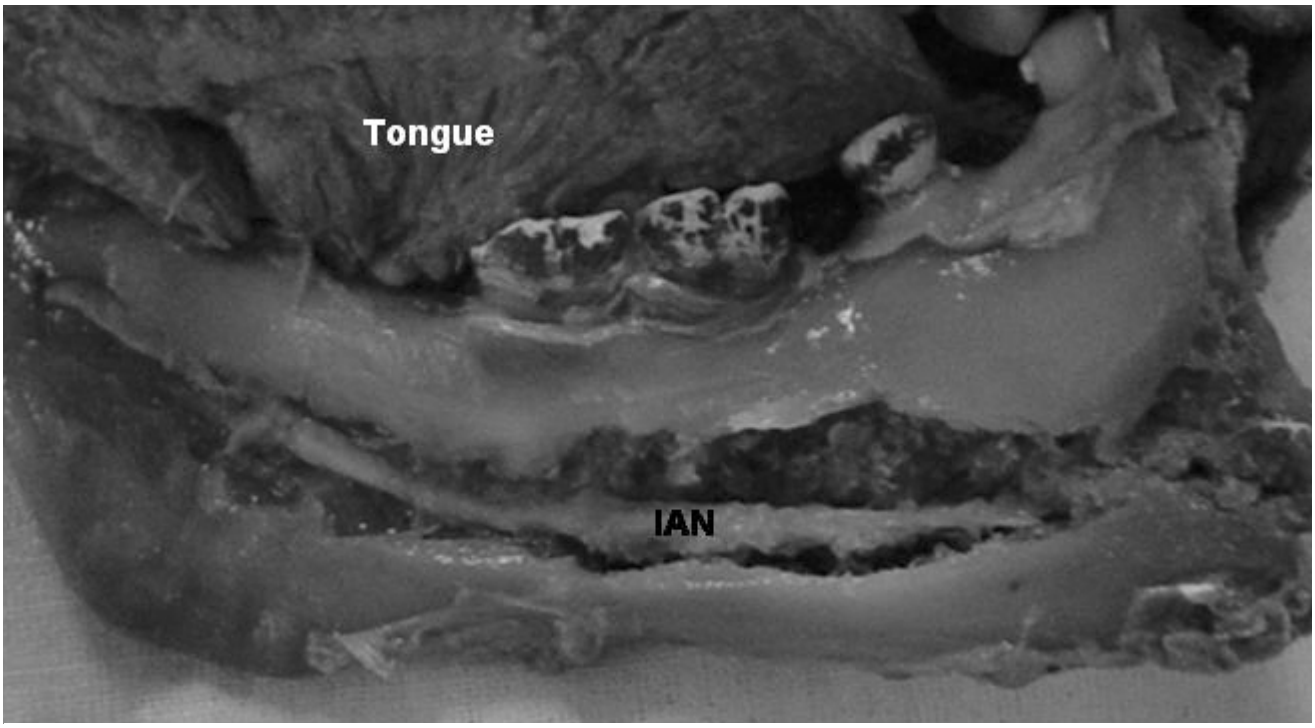

Figure 2.- Photograph of mandible showing the canal and its contents lying close to the lower border. In both figures note that the beginning of the canal at the MF is at or close to the midpoint.

Table 2.- Distances (in mm) from the inferior alveolar nerve (IAN) to the lower border of the mandible.

Level of measurement	Side (N)	Distances from IAN to lower border	Z Value	P value
Molar 3	R 10	12.70 ± 2.83		
	L 11	11.36 ± 2.91	1.02070	0.304
Molar 2	R=10	11.30 ± 2.41		
	L=11	10.78 ± 1.48	4.200 - 02	0.967
Molar 1	R=9	11.56 ± 3.57		
	L=8	10.50 ± 1.07	0.6270	0.531
Premolar 2	R= 8	11.63 ± 3.58		
	L=10	9.80 ± 1.93	1.0390	0.299
Premolar 1	R= 10	11.90 ± 4.77		
	L= 9	10.44 ± 2.19	0.1260	0.899
Canine	R= 10	14.10 ± 3.07		
	L= 8	11.75 ± 3.45	1.5220	0.128
Incisor 2	R= 10	16.30 ± 4. 24		
	L= 10	12.90 ± 2.99	1.8980	0.058
Incisor 1	R= 4	15.00 ± 3.56		
	L= 8	14.25 ± 3.20	0.2590	0.796

Values are means ± S.D.

Table 3.- Distances from the (IAN) to the upper border of the mandible.

Level of measurement	Side (N)	Distances from IAN to lower border	Z Value	P value
Molar 3	R=10	17.30 ± 2.79		
	L=11	16.55 ± 4.18	0.2490	0.804
Molar 2	R=10	18.20 ± 2.09		
	L=9	18.22 ± 2.91	0.3720	0.71
Molar 1	R=9	20.22 ± 2.22		
	L=8	19.25 ± 2.96	0.8270	0.408
Premolar 2	R= 8	22.13 ± 4.82		
	L=10	19.30 ± 2.75	1.2480	0.212
Premolar 1	R= 10	22.90 ± 7.02		
	L= 10	21.50 ± 4.65	0.4560	0.648
Canine	R= 10	24.90 ± 4.15		
	L= 9	24.33 ± 3.54	0.041	0.967
Incisor 2	R= 10	26.90 ± 4. 23		
	L= 10	25.80 ± 3.79	0.4560	0.648
Incisor 1	R= 4	27.75 ± 1.71		
	L= 8	27.50 ± 3.89	0.2590	0.796

Values are represented as means ± S.D.

landmarks employed (Osaka, 1989). This study indicates that, on an individual basis, the foramen does not show any fixed position when assessed from the landmarks employed here.

The mandibular canal perhaps is the only longest bony canal harboring a thick nerve and vessels. One of the pioneer works on its position in the mandible (Carter and Keen, 1971) reported that the canal, and consequently the neurovascular bundle, normally traverses close to the dental roots. This course is equivalent to the middle position (close to the mid-point) described here, since we measured the distances from the canal to the superior and inferior borders of the bone and the course close to the midpoint was classified as the middle type. Nevertheless, the canal more commonly coursed close to the inferior border. This is in contrast with the previous study, indicating that there is a difference in this trait between ethnic groups. In one study, it was reported that the canal was very close to the second molar and premolar and farthest from the first molar (Denio et al., 1992). In the present study, the distances between the roots of the teeth and the canal were not studied. However, the measurements to the upper border of the mandible were increased more as the canal coursed forwards, evidently because the canal lies close to the lower border. In another study, the neurovascular bundle of the canal was present 1 cm above the lower border of the bone (Gowgiel, 1992), and similar results were found in the present study for the posterior teeth, whereas the distances to the anterior teeth from the lower border were greater. Our classification of the canal into 2 types is completely different from that given by Carter and Keen (1971). The present classification was based on the measurements to the upper and lower borders with no reference to the dental roots. Thus, our data indicate that neither the canal, and consequently nor the neurovascular bundle, follow a pathway that lies at fixed distances from the borders of the mandible. We conclude that bilateral symmetry is maintained for the MF and the canal, although, the individual variations are greater, and that side differences do not exist for these traits. This should be borne in mind during anesthetic procedures of the IAN and surgical procedures of the mandible.

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