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ORIGINAL ARTICLE

Variations in position of mandibular foramen with age and its efficacy in sex estimation

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Abstract

Forensic Odontology is a rapidly evolving branch of dentistry which deals with the identification of an individual. In instances of deceased individual, establishing identity may still pose difficulties depending upon the time that has elapsed since death. The oral structures are very well preserved for a long time since death as they are protected from the external environment by the facial soft tissues and bone. So these structures can reliably be used for establishing identity of the deceased. The mandibular foramen has been used in this study for the reason that it is amongst the core structures of Oral Cavity and remains unaffected after death. The mandibular foramen has been used for age estimation with reliable degree of accuracy using radiographs which is a non-invasive and easily reproducible technique hence we decided to assess its importance in establishing gender. Digital Orthopantomograph (OPG) were used for the study as they are taken for all dental procedures and can be preserved as records and may facilitate comparison of ante-mortem and post-mortem records. Various dimensions from the mandibular foramen were recorded and we found statistically significant correlation of Anteroposterior and Posteroanterior dimensions in position of mandibular foramen to gender.

Keywords

Mandibular foramen; OPG; Gender; Dimensions

Introduction

Identification of the individual followed by identification of gender is a very important and necessary tool in Forensic anthropology and every document in the field of forensic medicine begins with identification (either a live person or remains – dead body or skeletal remains).[1] The Mandible is extensively used in Forensic odontological studies as it forms a strong and nonperishable source of facial skeleton. In living individuals, remodeling of the mandible takes place throughout life and these changes are observed on dried mandible as well as on its radiographic image. The body of the mandible, the mental and the mandibular foramina has been used as points of reference in various morphometric analyses of the mandible, by virtue of their stable relation with the basal bone. The mandibular foramen (MF) is an important landmark on the medial surface of ramus of the mandible which transmits the inferior alveolar nerves and vessels.[2,3] Vast amount of data is available of the studies on either the mandibular basal bone or the other morphologic landmarks on the mandible but very few studies include the Mandibular Foramen as a landmark for evaluating age and fewer still for correlating Gender. Hence this study was designed to include the change in position of mandibular foramen and its morphology as the individual grows older and whether it can contribute to establishing Gender.

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Materials and Methods

This observational study consisted of 200 randomized digital OPG's from a database in the extra oral radiographic machine in the Department of Oral Medicine and Maxillofacial Radiology. Thus, patients were not unnecessarily exposed to radiation and their identities remained confidential. As this was an observational study on radiographs archived in the Department of Oral Medicine and Maxillofacial Radiology, ethical clearance was not sought. The radiographs were selected based on the criteria that they belonged to patients within the age group of 20 - 60 Yrs belonging to Nagpur Division population. Radiographs of good quality (with respect to contrast) OPG's with complete lower border of mandible were chosen. Individuals with all the teeth normally present for that particular age in right & left lower jaw. The radiographs did not include any jaw lesions and traumatic injuries in the mandible and were without radiographic exposure or processing artifacts. Radiographs with poor quality, presence of processing artifacts, jaw fracture in mandible or any pathology, bony abnormalities / bifid mandibular canal, any systemic diseases affecting bone remodeling in the mandible were excluded from the study. All radiographs were taken with a digital machine, Orthophos XG X-ray systemversion 2.53 SIRONA Germany with kilovoltage of 62-73 kVp, tube current of 8-15 mA for time duration of 15 s.

Position of Mandibular foramen was identified and measured in three directions superoinferiorly (SI) posteroanteriorly (PA) and anteroposteriorly (AP). Superoinferiorly it was measured as a line drawn from the deepest point of the mandibular notch to the mandibular foramen and was marked. Posteroanteriorly measurements were made by drawing a line from the posterior border of the ramus at the level of mandibular foramen to the actual mandibular foramen. Similarly measurements were made anteroposteriorly by drawing a straight (perpendicular) line from mandibular foramen to the anterior border of ramus (AP). The distances from the MF to various landmarks were recorded as an average of two measurements which were measured independently by two different people. The mean and standard deviation for each distance were calculated separately for right and left sides. Statistical analysis was performed that included mean values in males and females on the right and the left sides, Discriminate Function Test, *t*-test and p-value were calculated.

Results

The mean distance of the MF from anterior border of the mandibular ramus on the right side was 14.88±1.91mm and left side was 14.60±1.83mm. The MF was located 14.90±1.9 mm (Right side) and 14.62±1.83mm (Left Side) from the posterior border of Mandible. The distance of the MF from the mandibular notch was 22.70±1.57 mm and 22.02±1.57 mm on the right and left sides respectively. Table 1 shows the mean and std deviation of the distance of Mandibular Foramen from the anterior, posterior and superior borders of the Mandible respectively. The values of the Antero-posterior measurements on right and left sides was 14.18±1.60mm & 14.59±2.07mm in females and 15.17±1.70mm & 15.02±1.95mm in males, Postero-anterior dimensions recorded were 14.20±1.60mm & 14.61±2.07mm in females and 15.04±1.95mm & 15.19±1.7mm in males and Supero-inferior dimensions were 22.20±1.60mm & 22.88±1.59mm in males as compared to females 21.84±1.52 & 22.51±1.53mm.

Table 1: Comparison of parameters left and right side

		Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Anteroposterior	Right Side	14.88	200	1.91	0.13	2.10	0.036
	Left Side	14.60	200	1.83	0.12		
Posteroanterior	Right Side	14.90	200	1.91	0.13	2.10	0.036
	Left Side	14.62	200	1.83	0.12		
Superoinferior	Right Side	22.70	200	1.57	0.11	296.43	0.0001
	Left Side	22.02	200	1.57	0.11		

Table 2: Gender wise comparison of parameters left and right side

		Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Anteroposterior Right Side	Male	100	15.17	1.70	0.17	2.16	0.031
	Female	100	14.59	2.07	0.20		
Anteroposterior Left Side	Male	100	15.02	1.95	0.19	3.34	0.001
	Female	100	14.18	1.60	0.16		
Posteroanterior Right Side	Male	100	15.19	1.70	0.17	2.16	0.031
	Female	100	14.61	2.07	0.20		
Posteroanterior Left Side	Male	100	15.04	1.95	0.19	3.34	0.001
	Female	100	14.20	1.60	0.16		
Superoinferior Right Side	Male	100	22.88	1.59	0.15	1.65	0.099
	Female	100	22.51	1.53	0.15		
Superoinferior Left Side	Male	100	22.20	1.60	0.16	1.64	0.102
	Female	100	21.84	1.52	0.15		

Table 3: Discriminant Function Analysis

	Wilks' Lambda	F	df2	p-value
Anteroposterior Right Side	0.977	4.702	198	0.031,S
Anteroposterior Left Side	0.946	11.195	198	0.001,S
Posteroanterior Right Side	0.977	4.702	198	0.031,S
Posteroanterior Left Side	0.946	11.195	198	0.001,S
Superoinferior Right Side	0.986	2.746	198	0.099,NS
Superoinferior Left Side	0.987	2.707	198	0.102,NS

Table 2 shows Gender wise comparison of parameters left and right side which is statistically significant for Anteroposterior and Postero-anterior dimensions. The Anteroposterior and Postero-anterior dimensions are higher in males than in females and are greater on right side than on left side. Table 3 shows Discriminant Function Analysis, i.e, Tests of Equality of Group Means which demonstrates that the change in Anteroposterior and Posteroanterior dimensions to be statistically significant.

Discussion

The mandibular foramen is located on the medial surface of the ramus approximately midway between the mandibular notch and the angle of the jaw and also midway between the internal oblique line and the posterior border of the ramus. Its relation to the occlusal plane varies by approximately 10.00 to 11.00 mm above the occlusal surface of the mandibular first molar and can vary depending upon the reference tooth that is used for measurement. The mental and mandibular foramina have been used as points of reference in various morphometric analyses of

the mandible, by virtue of their stable relation with the basal bone.[3]It has been established that the mandibular foramen undergoes a shift in position from its location at birth into adulthood. This shift in its position is in a vertical plane and this study aimed to assess if there was a change in location with respect to gender of an individual and whether this information may have Forensic implication. In our study, the results showed that differences between gender for mandibular foramen at AP and PA was highly significant, which is similar to the study by Rashid et al,[2] Samanta PP,[3]andLinganna CS.[4]In our study the mandibular foramen shows a shift with age which is similar to the study by Lim MY et al.[5] The observation found in our study was a posterior shift because we studied adult population whereas in the study by Lim MY et al[5]the population studied were children. When compared between genders the mean values superoinferiorly were higher in males than females which is similar to the study conducted by Shendakar AT etal.[6] A similar finding was also reported by Direk F et al[7] who used Multi detector computed tomography to assess mandible and suggested that the ramus dimensions are higher in males. The posteroanterior and anteroposterior dimensions were higher for males in our study, this can be attributed to the stronger masticatory muscles in males imparting greater stability to the ramus of the mandible. Sairam V et al,[8] Lasemi Eet al,[9] Bhardwaj D et al[11] and Jalili MR[12] studied mandibles through OPG and concluded that superoinferior dimensions were higher in males. This difference was statistically significant between sexes, thus indicating a strong sexual dimorphism.

The difference in dimensions measured for the right and left sides showed values that were almost similar, with a non-significant difference and this applies for both the male and the female groups which is in accordance with study by C. Lavanya Varma et al[13] and Ashkenazi.[14] Thus the various parameters of the ramus of the mandible can be used for personal identification and also to identify gender, as they serve as stable landmarks and show gradual and steady modifications with age. These dimensional changes are greater in males than in females.

Conclusion

The different measurements of the ramus of the mandible can be used for personal identification to a reliable degree of accuracy and can also be used to identify gender, as they serve as stable landmarks and show gradual and steady modifications with age.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee

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