Original Article

Identification of gender by radiographic analysis of mental foramen in a sample of Iraqi patients

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Abstract

Objective: The mandible is the strongest bone in the human skeleton. The uses of the morphological characters of such jawbone is a predominantly used approach in forensic dentistry to determine the gender of a severely damaged cadaver**.** Distinguishing sex, race and personal stamp of the unknown skeleton still has been the most challenging job in forensic dentistry**.** This research aimed to clarify the gender of Babylon population by mental foramen (MF) assessment using Orthopantomography (OPG).

Method: The present retrospective study was conducted on 120 digital panoramic radiographs. The radiographs were of 60 male and 60 female dentate patients aged between 18-62 years. Morphometric analysis was performed on bilateral mental foramina. Lines were drawn from superior (S) and inferior (I) borders of the foramen and perpendiculars to the lower (L) border of the mandible (S-L and I-L lines respectively). Data were distributed and subjected to statistical analysis using the Independent-Samples T test.

Results: The average values of S-L and I-L were significantly higher in males than in females ($p<0.05$).

Conclusion: The distance from the MF to the lower border of the lower jaw reveals gender differences in Babylon city population. Findings also suggest that OPG could be a useful technique for gender identification from the remnants of the human body skeleton. There was a statistical significant difference in the average S-L distance and average I-L distance between males and females at 3 different age groups (young adult, middle age and old age groups), except in the average I-L distance at the middle age group ($p<0.05$).

Keywords: Forensic dentistry; OPG; mental foramen; gender.

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Introduction

The clarification of sex is a vital part of forensic medicine and dentistry[1-3]. Dentistry as a part of the forensic team can play a significant role in removing the dilemma about the gender and age of the remnant of human skeleton relying on dental forensic science. The dentist can assist in determining the sex of the victims, even if the bodies breakdown to unrecognized limits like in an explosion or a natural disasters[4]. Metric and morphometric features of lower jaws is a

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definitive analysis in forensic science[5]. Based on its hard structure, the lower jaw preserves its landmarks in a well-condition in comparison with the other hard tissues. Thus, the lower jaw morphological characters were used in the clarification of the gender for a forensic purpose[6]. Papers have established many differences between males and females in different areas of the lower jaws. For instance, the height of mandible, gonial angle, bigonial distance, bicondylar distance, and the position of mental foramen (MF)[7,8].

The features of the human skeleton have a broad spectrum of variability among different populations. Thus, there is a demand for using specific characters for each skeleton part[9]. One of the most stable characters on the lower jaw was the MF[10]. It is an opening on the lateral surface of the lower jaw at the very end of the mental canal, lying close to the apices of the premolars. It contains mental nerves and vessels. This opening is directed outward, upward and posteriorly. Their radiographs are used in forensic anthropology. The accuracy of the measurement is based on the quality of the radiograph[11]. MF was classified into; Type I: Mental canal is continuous with the mandibular canal. Type II: The foramen is distinctly separated from the mandibular canal. Type III: Diffuse with a distinct border of the foramen. Type IV: Unidentified type, in which the MF cannot be identified on panoramic radiographs under ordinary exposure and viewing conditions[12].

Orthopantomography (OPG) clearly shows the bilateral location of the MF, mandibular foramen, ramus of the mandible, angle of the mandible and body of the mandible in both transverse and vertical dimensions[13,14]. Data for gender determination which is based on the MF location in association to the inferior border of the mandible, and the height of the lower jaw using orthopantomography (OPG) are not clearly stated in Iraqi population. Therefore, the aim of this study was to determine the gender by comparing the distance from the superior border of the MF to the lower border of the mandible (S-L) with the distance from the inferior border of the MF to the lower border of the mandible (I-L) between males and females, as well as the height of mandible from the alveolar crest to the lower border of the mandible using OPG[15].

Method

The protocol of this retrospective study was confirmed and registered at the Research Ethical Committee in the College of Dentistry, University of Babylon. The study was commenced on 200 digital orthopantomographs (OPG) obtained for different diagnostic purposes from dentate patients. The radiographs were taken between November 2018 and March 2019 within a duration of 5 months using OPG (GXDP-700-1, Hatfield, USA) with a power requirement of 15A, 100/120V~50/60 HZ. The exposure time was different from person to another, depending on the patient size. 120 radiographs of 60 males and 60 females were selected for this study. The inclusion criteria were; patient aged between 18-63 years, high-quality OPG with respect to angulation and contrast, and separated type foramen (type II). While the exclusion criteria were; patients who have had surgical intervention as orthognathic surgery of the mandible, patients with radiolucent and radiopaque lesions in the mandible, patients with a congenital anomaly and periodontal lesions, patients suffering from malignancies of mandible and tongue, and patients with missing lower molars and premolars.

After locating and tracing the MF on the OPG image, the distances of the superior and inferior borders of the foramen in relation to the lower border of the mandible (S-L and I-L) were measured. The measurement performed by reference lines drawn from the anatomical landmarks using the AutoCAD software. The distances were measured on a radiograph in millimetres using a magnification factor of 1.2.

Statistical analysis

Statistical calculations were performed using the statistical package for the social sciences (SPSS) software version 19 (IBM, New York, USA). The Independent-Samples T test was applied to measure the significant differences at $p<0.05$.

Results

The bilateral S-L and I-L line distances, and the height of the mandible were calculated and compared in both genders.

The S-L distance on the left side in males was slightly higher than the right side, with no significant difference ($p<0.05$). In females, the S-L distance on the right side was higher than that on the left side, with no significant difference ($p<0.05$). *See* Table 1.

Table 1: The mean ± SD and the *p values* of the right and left S-L distances (mm) in males and females.

P-value	Left S-L	Right S-L	Gender
α = 0.80	16.81 ± 0.88	16.69 ± 0.81	Male
α = 0.53	14.75 ± 0.60	15.11 ± 1.07	Female

The average of right and left S-L distances in males was 16.75 ± 0.85 mm and in females was 14.93 ± 0.90 mm. The comparison between genders showed a statistically significant difference (*p<0.05*).

The I-L distance on the left side in males was slightly more than the right side, with no significant differences (*p<0.05*). In females, the I-L distance the left side was more than the right side, with no significant differences (*p<0.05*). *See* Table 2.

Table 2: The mean ± SD and the *p values* of the right and left I-L distances (mm) in males and females.

P values	Left I-L	Right I-L	
α = 0.86	11.39 ± 0.20	11.29 ± 0.92	Male
α = 0.17	11.08 ± 0.63	10.90 ± 0.61	Female

The average I-L distance in males was 11.34 mm and in females 10.90 mm. The comparison between the genders showed a statistically significant difference (*p<0.05*).

Table 3. shows the S-L and I-L distances of both genders at 3 different age groups (young adult, middle age and old age groups), and on both right and left sides of the mandible. The average S-L distance in males was 16.66 ± 0.85, 16.78 ± 0.77 and 16.81 ± 0.92 for the young adult, middle age and old age groups, respectively. The average S-L distance in females was 14.93 ± 0.87, 14.89 ± 0.89 and 14.97 ± 0.92 for the young adult, middle age and old age groups, respectively. The average I-L distance in males was 11.45 ±0.66, 11.27 ± 0.68 and 11.30 ± 0.65 for the young adult, middle age and old age groups, respectively. I-L distance in females was 11.12 ± 0.92, 11.02 ± 0.11 and 10.83 ± 0.10 for the young adult, middle age and old age groups, respectively. Statistical analysis, showed that there was a significant difference in the average S-L distance and average I-L distance between males and females at the 3 age groups, except in the average I-L distance at the middle age group (*p<0.05*).

Table 3: The mean ± SD of the right and left S-L and I-L distances (mm) in males and females at three different age groups (young adult, middle age and old age.

Old age (48-63 years old)				Middle age (33-48 years old)				Young adult (18-33 years old)				
I-L		S-L		I-L		S-L		I-L		S-L		
Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	
11.43±0.20	11.27±0.91	16.84±0.99	16.80±0.88	11.43±0.23	11.11±0.91	17.02±0.72	16.54±0.76	11.43±0.13	11.48±0.94	16.59±0.91	16.72±0.80	Male
10.75±0.62	10.91±0.63	14.77±0.61	15.16±1.13	11.13±0.66	10.92±0.68	14.55±0.52	15.23±1.05	11.38±0.43	10.86±0.60	14.92±0.64	14.94±1.07	Female

The height of mandible was 28.32 mm in males and 20.71 mm in females with a highly significant difference between the genders (*p<0.001*).

Discussion

The most well-demarcated position of MF is on the anterolateral area of the body of the lower jaw. The anterolateral aspect introduces a path for the mental innervation[15]. The MF is a highly recommended skeletal landmark to introduce a high reproducible way for surgical, local anaesthetic, and other massive surgical procedures like sagittal split osteotomies. Besides its clinical vitality, the MF is also vital in forensic medicine for gender clarification[16,17]. This paper aimed to clarify the morphological and morphometric characters of the MF in relation to adjacent landmarks. The mandibular lower border is used here as a reference point because the distance from the MF to this border remains relatively fixed during life[18,19]. While, the distance between the MF and the alveolar crest due to resorption of the later[19,20]. It was also reported that the length from the lower border of the lower jaw to the MF shows gender dimorphism, and orthopantomography or panoramic radiography (OPG) is a sufficient way for the assembly of planned measurements and determination of sex from skeletal remnant[21-23].

In the same way, a study showed that the height of the lower jaw and the S-L and I-L dimensions could be used to evaluate gender[10]. The radiographic appearance of the MF is of four types, as discussed previously. In the separate type (Type II), the foramen is clearly separated from the inferior alveolar and appears as well-demarcated radiolucency with a

distinct border of condensing bone. This type is easy to identify on panoramic radiographs, and only this type has been selected for the present study.

In the present study, the mean values of S-L and I-L are significantly higher in males than in females ($p<0.05$). These findings are similar to the findings of Atallah *et al* [24]. On the other hand, another study presented that the mean value of I-L does not reveal gender differences[25]. This contradiction maybe because of the racial spectrum of the sample. Furthermore, in this article, it was presented that the distance (S-L and I-L) for the right and left sides of an individual were approximately similar, with no significant difference ($p<0.05$), and this applied for both gender groups. Thus, the distance from any sides can be used as representative of gender determination.

Additionally, these results clarify that if a distance is above 16.754 mm for S-L and 11.34 mm for I-L, the gender will be male in 95% of the cases. Also, if a distance is less than 14.939 mm for S-L and 10.903 mm for I-L, the gender will be female in 95% of the cases.

Furthermore, for comparison of the average S-L distance and average I-L distance between males and females at the 3 different age groups (young adult, middle age and old age groups), there was a statistical significant difference between males and females at the 3 age groups, except in the average I-L distance at the middle age group ($p<0.05$).

Last but not least, in this paper, it was presented that the height of the lower jaw from the alveolar crest to the lower border of the mandible in males was 28.32 mm and in females was 20.71 mm, and for comparison between them, the difference was significant ($p<0.05$).

Conclusion

The distance from the MF to the lower border of the lower jaw reveals gender differences in Babylon city population. Besides, this study clarifies that the OPG is a good technique for determining gender through imaging of mandible. It was also noticed that there was a statistical significant difference in the average S-L distance and average I-L distance between males and females at the 3 different age groups (young adult, middle age and old age groups), except in the average I-L distance at the middle age group ($p<0.05$).

Availability of data and material

The raw data of the research is available with the first author.

Conflict of interest statement

The authors declare that they have no conflict of interests.

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Authors' contributions

All authors contributed in the designing of the study and collecting data. Also they all involved in revising and approval of the final the manuscript.

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