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ORIGINAL

Evaluation of sexual dimorphism by radiographic analysis of mental orifice and mandibular height in a sample of Kurdish population of Iraq

Evaluación del dimorfismo sexual mediante el análisis radiográfico del orificio mental y la altura mandibular en una muestra de población kurda de Iraq

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Abstract

Background: A vital part of forensic anthropology is to differentiate between sexes by morphologic analysis of osseous tissue. One of these osseous structures that displays a significant degree of sexual dimorphism is mandibular bone. Gender variances in the mandibular anatomy, from its height, position of mental orifice, gonial angle, bigonial width and bicondylar breadth have been observed in various studies.This study was aimed at evaluating the sexual dimorphism based on the average length between the upper and the lower edge of the mental orifice to the mandibular lower border and the mandibular height on right and left side of the jaw on digital panoramic radiographs in a sample of Kurdish population of Iraq.

Methods: Panoramic radiographs of 460 patients (230 males and 230 females) were included in the study. The length from both inferior and superior margins of mental orifice to the mandibular lower border and the mandibular height in the mental orifice region was measured on both left and right sides. The data was statistically analysed to estimate the differences among the sexes using Independent sample t-test.

Results: The mandibular height in the mental orifice region from alveolar crest to mandibular lower border was more in males as compared to the females, this being statistically significant. The length from superior margin and inferior margin of mental orifice to the mandibular lower border and the mandibular height was more in males as compared to females but was not statistically significant.

Conclusion: The height of the mandible in the mental orifice region showed significant sexual dimorphism in the sample of Erbil population.

Key words: Mandibular height, mental orifice, panoramic radiograph, sexual dimorphism.

Resumen

Antecedentes: Una parte vital de la antropología forense consiste en diferenciar los sexos mediante el análisis morfológico del tejido óseo. Una de estas estructuras óseas que muestra un grado significativo de dimorfismo sexual es el hueso mandibular. Este estudio tenía como objetivo evaluar el dimorfismo sexual basado en la longitud media entre el borde superior e inferior del orificio mental y el borde inferior de la mandíbula, así como la altura de la mandíbula en el lado derecho e izquierdo en radiografías panorámicas digitales en una muestra de población kurda de Iraq.

Métodos: Se incluyeron en el estudio las radiografías panorámicas de 460 pacientes (230 hombres y 230 mujeres). Se midió la longitud desde los márgenes inferior y superior del orificio mentoniano hasta el borde inferior de la mandíbula y la altura de la mandíbula en la región del orificio mentoniano, tanto en el lado izquierdo como en el derecho. Los datos se analizaron estadísticamente para estimar las diferencias entre los sexos mediante la prueba t de muestras independientes.

Resultados: La altura mandibular en la región del orificio mental, desde la cresta alveolar hasta el borde inferior de la mandíbula, fue mayor en los hombres que en las mujeres, siendo esto estadísticamente significativo. La longitud desde el margen superior y el margen inferior del orificio mental hasta el borde inferior de la mandíbula y la altura mandibular fue mayor en los hombres en comparación con las mujeres, pero no fue estadísticamente significativa.

Conclusión: La altura de la mandíbula en la región del orificio mental mostró un dimorfismo sexual significativo en la muestra de la población de Erbil.

Palabras clave: Altura de la mandíbula, orificio mental, radiografía panorámica, dimorfismo sexual.

Introduction

A significant part of forensic sciences has been distinguishing morphometric differences between sexes and among different racial groups. Forensic scientists and anthropologists have been commonly using morphologic features of the lower jaw for sex determination in human skeleton. Significant differences between sexes in the height of mandible (MH), mental orifice location (MF), gonial angle, bigonial width and bicondylar breadth have been shown in numerous studies[1-5].

In forensic field, the radiographs can be an indispensable tool for identification, provided sufficient antemortem records are available. Panoramic radiographs (OPG) show bilateral position of the body, ramus, angle of the mandible, mandibular orifice, and MF. OPG allows MF to be localized more accurately in horizontal and vertical dimensions. On an OPG, MF appears as either rounded, oblong, slit-like or irregular radiolucency, which may be partially or completely corticated, located in between the alveolar margins and inferior border in the mandible[6].

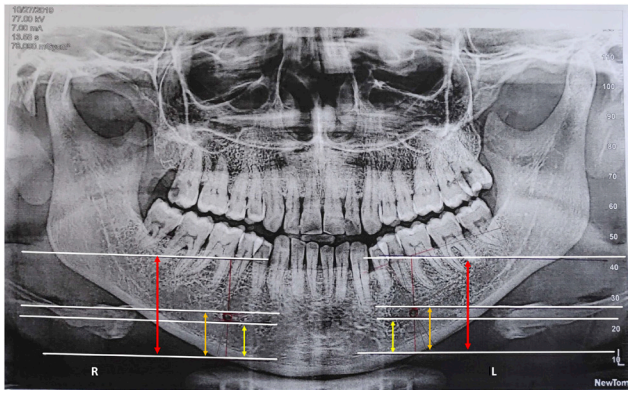
Data regarding gender differentiation in Kurdish population using panoramic radiography based on location of MF and mandibular height (MH) are sparse. With this background, current study was intended to evaluate the gender differences in measurements between the superior border of MF (SMF) and inferior border of MF (IMF) to the MLB and the height of mandible (MH) in the mental orifice region using OPG in a sample of Kurdish population.

Materials and methods

A retrospective study comprising of 460 patients (230 males and 230 females) aged between 20 and 78 years, who underwent conventional OPG for diagnostic, surgical, or periodontal reasons in the radiology department between March 2019 to March 2020. The OPG images were acquired using a Orthopantomograph machine (NewTom Giano, CEFLA s.c., Imola, Italy) with the following technical parameters: Exposure Parameters • Kvp - 72; mA - 8; Exposure time 18 sec Dose to the patient. The inclusion criteria were all patients aged 20 years and over and high quality OPG's with minimum radiographic errors. Exclusion criteria were all patient who had undergone any surgical intervention on mandible and any radiolucent or radiopaque lesions in the mental orifice region. After identifying and marking of the MF on OPG, tangents were marked from IMF, SMF, alveolar crest (AC), and MLB. Perpendicular lines were also marked from these tangents IMF, SMF and AC to the LBM bilaterally. The distance was recorded bilaterally from MLB-SMF, MLB-IMF and MLB-AC (MH) (**Figure 1**).

Standard deviations as well as mean were obtained for MLB-SMF, MLB-IMF and MLB-AC in both genders. Statistical Package for the Social Sciences (SPSS) software version 25 (Armonk, New York: IBM. Corporation) was used to perform the statistical calculations. Mean values calculated and independent sample t-test applied to see the significant differences; P value less than 0.05 was taken to be statistically significant[7,8].

Figure 1: Orthopantomogram showing the measurements – IMF-LMB (yellow line), SMF-LMB (orange line) and MH (red line).



Results

Overall mean measurements between sexes for both sides are shown (**Table I**).

Table I: Total mean measurements between genders on both sides combined.

Total mean measurements				
Gender		**SMF-LBM**	**IMF-LBM**	**MH**
Male	Mean	15.4	12.6	32.7
	N	460	460	460
	Std. Deviation	1.98	1.89	2.67
Female	Mean	13.5	11.1	29.1
	N	460	460	460
	Std. Deviation	1.24	1.19	2.27
Total	Mean	14.4	11.8	30.9
	N	920	920	920
	Std. Deviation	1.88	1.76	3.07

The mean MLB-SMF, MLB-IMF and MH measurements of the whole study sample was 13.9mm,11.4mm and 28.1mm respectively. The average MLB-SMF in males was 14.1mm and in females was 13.6mm. The average MLB-IMF in males was 11.5mm and in females was 11.4mm. The mean MH in males and females were 29.8mm and 26.4 mm respectively. Overall MLB-SMF, MLB-IMF and MH measurement showed significant difference among the genders($p<0.05$). (**Table II**).

Table II: Comparison of mean measurements between genders on both sides combined.

Group Statistics - Combined side						
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**Sig. (2-tailed)**
SMF-LBM	Male	460	15.4087	1.98022	.29197	0.000
	Female	460	13.5791	1.24180	.18309	
IMF-LBM	Male	460	12.6770	1.89415	.27928	0.000
	Female	460	11.1183	1.19806	.17664	
MH	Male	460	32.7887	2.67564	.39450	0.000
	Female	460	29.1378	2.27624	.33561	

On the left side (**Table III**), the average MLB-SMF in males was 14.3mm and in females was 13.7mm. The average MLB-IMF in males was 11.5mm and in females was 11.4mm. The mean MH in males and females were 29.9mm and 26.2mm respectively. Again, there was statistically significant difference in MLB-SMF, MLB-IMF and MH on the left side between the genders (p<0.05).

Table III: Comparison of mean measurements between genders on left side.

Group Statistics - Left side						
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**Sig. (2-tailed)**
SMF-LBM	Male	230	15.2861	2.06031	.42961	0.001
	Female	230	13.4809	1.23559	.25764	
IMF-LBM	Male	230	12.5543	1.95255	.40713	0.002
	Female	230	10.9774	1.31345	.27387	
MH	Male	230	32.6178	2.64212	.55092	0.000
	Female	230	29.0691	2.48332	.51781	

Comparing the right side (**Table IV**), the average MLB-SMF in males was 13.9mm and in females was 13.5mm. The average MLB-IMF in males was 11.4mm and in females was 11.4mm. The mean MH in males and females were 29.7mm and 26.6mm respectively. Mean MLB-SMF, MLB-IMF and MH measurements did show a statistically significant difference between the genders. (p<0.05).

Table IV: Comparison of mean measurements between genders on right side.

Group Statistics - Right side						
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**Sig. (2-tailed)**
SMF-LBM	Male	230	15.5313	1.93505	.40349	0.000
	Female	230	13.6774	1.26781	.26436	
IMF-LBM	Male	230	12.7996	1.86943	.38980	0.001
	Female	230	11.2591	1.08135	.22548	
MH	Male	230	32.9596	2.75711	.57490	0.000
	Female	230	29.2065	2.10267	.43844	

Discussion

Dental studies have been considered a big portion in medical sciences[9-11]. In forensic sciences, sex identification is an imperative aspect involved and many techniques have been utilized including study of skeletal remains, figure prints, polymerase chain reaction and DNA analysis[12-14]. A part from these, gender dimorphism has also been studied using orofacial structures including use of dental records, lip prints, palatoscopy, canine teeth dimorphism, and measurements of orofacial skeleton from radiological studies[15,16]. Radiographs are crucial tools as well as the simplest and cheapest method for age estimation and gender determination when related to the histological and biochemical methods[17].

Extensive studies have been done on gender dimorphism using radiological assessment of skull, maxilla and mandible. Mandible has been sought as a reliable source to study sexual dimorphism as it is a hard and durable bone18. If adequate ante mortem records are lacking, radiographs can perform a valued role in the identification of human remains. Numerous studies have investigated mental orifice in terms of its position concerning sexual dimorphism[19]. Wical et al determined that the distance of mental orifice from the inferior border of the mandible remains relatively constant throughout life despite the age-related resorption of alveolar bone above mental orifice[6]. Apart from this, mandibular height in this region has also been studied extensively for sexual dimorphism[19-21]. For this reason, mental orifice (SMF and IMF), alveolar crest (AC) and lower mandibular border (LMB) in this region was chosen for measurement.

In the present study, the mean of MLB to SMF values and MLB to IMF value were higher in males when comparing to females which was statistically significant(p<0.05). This is in agreement with studies done in other population of the world such as Catovie et al, Mahima et al, and Thomas et al.[2,22,23] This was similar comparing both right and left side between the sexes, which showed higher measurement in males than females. In contrast, Vodanovic et al detected that the mean value of MLB to IMF does not exhibit sexual dimorphism.[24] The differences observed in our study may be due to racial variance and small sample size of our study sample. Overall mean mandibular height in males (32.7± 2.6) was definitely more than the females (29.1 ± 2.2). This difference in the mandibular height was statistically significant (p<0.05). When comparing either sides (right side or left side) mean mandibular height in the premolar region was more in males as related to females and the difference was statistically significant (p<0.05). This result of current study is consistent with studies conducted in other populace of the world[24].

Based on the outcomes in this study, we can deduce that the mandibular height and the position of the mental orifice in relation to mandibular lower border does show sexual dimorphism in this small sample of Kurdish population in Erbil. The drawback of the current study was the small sample number because of which this study results may not be applicable to the whole Kurdish population of Iraq. Additional studies are required on a larger sample size to confirm the gender dimorphism in the mandible among this population group. The present survey showed that despite all advances in dental studies[25-30], several issues need to be assess in more accurate manner

Conclusion

Differentiating between sexes on an OPG based on the height of the mandible and position of mental orifice in relation to the mandibular lower border may be possible. Sexual dimorphism does exist in the mandible among the Kurdish populace. Further studies on a larger sample size can enhance the understanding of this sexual dimorphism in mandible.

Conflict of interests

The authors have no conflict of interest.

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