DETERMINATION OF SEX FROM VARIOUS MEASUREMENTS OF MANDIBULAR RAMUS AND MENTAL FORAMEN PARAMETERS USING DIGITAL PANORAMIC IMAGING IN A SAMPLE OF SOHAG GOVERNORATE POPULATION

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ABSTRACT

Determination of human skeletal remnants is a vital step during mass disasters, from decayed and damaged dead bodies. In forensic investigations and medicolegal cases, identification of sex is an essential aspect, followed by age determination**.** Skeletal components most often investigated for gender determination are pelvis and skull, with the mandible being a practical element to analyze sexual dimorphism in fragmented bones**.** The mandible is the largest, strongest, and movable part of the skull**. Objectives**: The present study was designed to compare mandibular ramus measurements and mental foramen parameters on both sides to determine sex through digital panoramic radiography. **Methodology**: The present study included 150 adult patients, 75 were males, and 75 were female who performed panoramic x-ray. Their ages ranged from 25 to 50 years**. Results**: The present study revealed no significant difference between right and left sides regarding all measured mandibular and mental foramen parameters in males and females. A significant statistical increase in all measured mandibular and mental mean values was no significant statistical difference between males and females. The mean values of right and left Condylar Ramus height and distance from the superior margin of the mental foramen to the mandible (SM-IB) inferior margin were the correct predictors of both genders.

Keywords: Mandibular ramus measurements, mental foramen parameters, digital panoramic radiography, sexual dimorphism.

INTRODUCTION

Identification of human skeletal remnants from putrefied and destroyed dead bodies during mass disasters represents an important step. In medicolegal cases and forensic investigations, the determination of sex represents an essential step, followed by age determination **(Bhagwatkar et al., 2016).**

Sex identification, age, and ethnicity play essential roles in identifying an unknown individual. Sex identification specifically remains a crucial aspect of identifying unknown human remains in forensic medicine, mainly when it is impossible to obtain whole skeletons or remains for analysis **(Kiran et al., 2014).**

The most common investigated skeletal components for sex determination are pelvic bones and the skull with the mandible. They are a practical part of analyzing sexual dimorphism in an incomplete skeleton **(Jambunath et al., 2016).** Mandible represents the biggest, strenuous, and movable part of the skull **(Kumar and Lokanadham, 2013).**

The difference between males and females in the development of mastication muscles in size, power, and angulation can be one of the causes of mandibular dimorphism in males and females **(Franklin et al., 2008).**

Most of the studies were conducted using the manual method of metric analysis on the dry bone, which is time-consuming, and the technique is prone to error. As panoramic radiography is a part of the routine radiographic examination for a large population segment for the diagnosis of many oral diseases, the emergence of digitization has image accuracy and simplified image storing and sharing. The advent of user-friendly software has made metric analysis easy and less time consuming **(Tsorovas and Karsten, 2010).**

The most important advantages of this specialized radiography include broad coverage, a small dose of radiation, easy examination, and a short time is required to make images and perfect for the different measurements on mandibles **(Kartheeki et al., 2017).**

AIM OF THE WORK

The present work aims to assess and compare various mandibular ramus and mental foramen parameters in sex determination using digital panoramic imaging in a Sohag governorate population.

SUBJECTS AND METHODS

1- Subjects:

The present study was carried out on 150 subjects (75 females and 75 males) who performed panoramic x-ray in a private dental conducted radiology center in Sohag on their teeth, upper and lower jaws for various reasons. However, their panoramic x-rays did not show any pathological findings. Their ages ranged from 25 to 50 years. The age and sex of the patients were recorded.

Exclusion criteria:

Subjects excluded from the study those with a history of:

1-Trauma of the mandible.

2- Fracture or malunion of the mandible.

3- hereditary facial asymmetry (Congenital anomalies in the mandible).

4-Any mandibular pathology.

5. Completely edentulous mandible.

6-Mandibular surgical interference. (facial interventions in the lower jaw).

The study was approved by scientific, ethical committees of Sohag Faculty of Medicine, and informed written consent obtained from all subjects.

2-Apparatus: -

All the digital panoramic radiograph images were obtained from the patients using a Promax unit (Planmeca Oy, Helsinki, Finland) at a private dental radiology center at Sohag. The formatting and enhancement of images obtained from this high-quality apparatus provide perfect and reproducible measurements.

3-Methods: -

Ideal orthopantomographs of completely dentate patients were performed with right head alignment, contrast, and visible mandibular borders, condyles, rami, and mental foramina were selected for the study. After imaging, mandibular ramus measurements and mental foramen parameters on both sides were evaluated and compared to determine the sex using Romexis 4.2.r software, built-in software with the apparatus by using the mouse-driven method. It is conducted by moving the mouse and drawing lines using specific points on the digital panoramic radiograph.

(A) Ramus measures: **(Jambunath et al., 2016).**

- Maximum ramus breadth (Max.R.Br.): The distance between the most anterior point on the mandibular ramus and a line connecting the most posterior point on the condyle and the angle of the jaw.
- Minimum ramus breadth (Min.R.Br.): Smallest anterior-posterior diameter of the ramus.
- Condylar ramus height (Condylar.R. Ht): Height of the mandibular ramus from the highest point on the mandibular

condyle to the tubercle, or most protruding portion of the inferior border of the ramus.

● Coronoid ramus height (Coronoid.R.Ht): Projective distance between the highest point of coroniod to the most protruding portion of the ramus's inferior border.

(B) Mental foramen parameters:**(Vijay and Jigna, 2018)**

➢ Distance from superior margin of mental foramen to alveolar crest of the mandible (SM-AC).

➢ Distance from the superior margin of the mental foramen to the mandible's inferior margin (SM-IB).

➢ Distance from the inferior margin of the mental foramen to the mandible's inferior margin (IM-IB).

Statistical analysis: -

Data were analyzed using the SPSS computer program version16.0. Quantitative data were expressed as means ± standard deviation in tables. The percentage of correct prediction of sex is calculated for both males and females using the benchmark scale that Landis and Koch proposing the extent of agreement can be qualified depending on the magnitude of kappa (Landis and Koch, 1977).

RESULTS

(A) Ramus measurements: -

No significant difference was detected between the mean values for both left and right Max.R.Br., and the mean values for the left and right Min.R.Br in the male participants of this study as p-value was (0.96 and 0.31 respectively) as shown in (table 1 & fig. 1).

No significant difference was detected between the mean values for the left and right Max.R.Br and the mean values for the left and right Min.R.Br. in the female participants of this study as p-value was (0. 908 and 0. 954 respectively) as shown in (table 1 & fig. 2).

The mean values of the right Max.R. Br in males were higher (39.37) as compared with females (35.20), where P-value was (0.021). However, no statistical difference was found between the means of the right Min.R.Br. between males and females (28.18 and 26.43 respectively) where P-value was (0.118) as shown in (table 2).

A significant statistical increase in the mean values of the left Max.R. Br in males (39.36) was found as compared with females (35.17) where P-value was (0.011). However, no significant difference was detected between the mean values for the left Min.R. Br between males and females (28.27 and 26.41 respectively) where P-value was (0.120) as shown in (table 2).

Among male participants of the present study, no statistical difference was detected between the mean values of the left and right Condylar.R. Ht (67.78 and 67.77 respectively) where p-value was (0.979). Also, it was no statistical difference detected between the mean values of the left and right Coronoid.R.Ht (58.91 and 58.87 respectively where the P-value was (0.932), as shown in (table 3 & figure 3).

Among female participants of the present study, no significant difference was found between the mean values of the left and right Condylar.R. Ht (58.77 and 58.76, respectively) where the P-value was (0.789). Also, no significant statistical difference was detected between the mean values of the left and right Coronoid.R.Ht (53.74 and 53.73 respectively) where p-value was (0.977), as shown in (table 3 & figure 4).

Among male and female participants, a significant statistical increase in the mean values of the right Condylar.R.Ht was found in males (67.78) as compared with females (58.77) where P-value was (0.001). Also, a significant statistical increase in the mean values of the right Coronoid.R.Ht was found in males (58.91) as compared with females (53.74), where P-value was (0.001) as shown in (table 4).

Among male and female participants, there was a highly significant statistical increase in the mean values of the left Condylar.R.Ht in males (67.77) as compared to females (58.76) where P-value was (0.001). Also, there was a highly significant statistical increase in the mean values of the left Coronoid.R.Ht in males (58.87) as compared with females (53.73), where the P-value was (0.001) as shown in (table 4).

(B) Mental foramen parameters:-

Among male participants of the present study, there was no statistical difference between the mean values of the left and right SM-AC (15.26 and 15.88, respectively), where the P-value was (0.962). There was no statistical difference between the mean values of the left and right SM-IB (15.20 and 15.39, respectively) where the P-value was (0.692). Also, there was no statistical difference between the mean values of the left and right IM-IB (11.50 and 11.60 respectively) where the P-value was (0.936) as shown in (table 5 &figure5)

Among female participants of the present study, no significant statistical difference was found between the mean values of the right and left SM-AC (14.40 and 14.35, respectively) where P-value was (0.808). No significant difference was detected between the mean values of the right and left SM-IB (13.70 and 13.63, respectively), where P-value was (0.818). Also, no significant statistical difference was found between the mean values of the right and left IM-IB (10.38 and 10.33, respectively) where P-value was (0.872), as shown in (table 5 & figure 6).

Among male and female participants, a significant statistical increase in the mean values of the right SM-AC was found in males (15.26) as compared with females (14.40), where P-value was (0.030). A high significant statistical increase was found in the mean values of the right SM-IB in males (15.20) as compared with females (13.70), where P-value was (0.001). Also, a highly significant statistical increase was found in the mean values of the right IM-IB in males (11.50) as compared with females (10.38) where P-value was (0.001)**,** as shown in (table 6).

Among male and female participants, a significant statistical increase in the mean values of the left SM-AC was found in males (15.88) as compared with females (14.35) where P-value was (0.032) also a highly significant statistical increase in the mean values of the left SM-IB was found in males (15.39) as compared with females (13.63) where P-value was (0.001). Also, a highly significant statistical increase was found in the mean values of the left IM-IB in males (11.60) as compared with females (10.33), where P-value was (0.001)**,** as shown in (table 6).

- The percentage of correct prediction of sex:-

The percentage of correct prediction of sex is calculated for both males and females using the benchmark scale that **Landis and Koch (1977)** proposing the degree of agreement can be qualified as "Poor" (k<0), "Slight" (k=0-0.20), "Fair" (k=0.21-0.40), "Moderate"(k=0.41-0.60), "Substantial" (k=0.61-0.80), and "Almost perfect"(k=0.81-1.00) depending on the magnitude of kappa.

- Mandibular ramus measurements in the prediction of sex:-

For the right Max.R.Br, the kappa coefficient was (k=0.46, p<0.001), indicating a moderate agreement degree. 68% of males & 74% of females were correctly predicted using the right Max.R.Br. While the right Min.R.Br, the kappa coefficient was (k=0.11, P <0.001), indicating a slight agreement degree. 55% of males & 59% of females were correctly predicted using right Min.R.Br, as shown in (table 7).

Regarding the right Condylar.R.Ht, the kappa coefficient was (k=0.95, P <0.001), indicating a perfect agreement degree. 97% of males & 100% of females were correctly predicted using the right Condylar.R.Ht. While the right Coronoid.R.Ht were as follows: the kappa coefficient was (k=0.80, P <0.001), indicating a substantial agreement degree.

90% of males & 95% of females were correctly predicted using right Coronoid.R.Ht as shown in (table 7).

For the left Max.R.Br, the kappa coefficient was (k=0.47, p<0.001), indicating a moderate agreement degree. 78% of males & 63% of females were correctly predicted using left Max.R.Br. For the left Min.R.Br, the kappa coefficient was (k=0.10, P <0.001), indicating a slight agreement degree. 60% of males & 52% of females were correctly predicted using left Min.R.Br, as shown in (table 7).

Regarding the left Condylar.R.Ht, the kappa coefficient was (k=0.96, P <0.001), indicating a perfect agreement degree. 97% of males & 100% of females were correctly predicted using left Condylar.R.Ht. The left Coronoid.R.Ht were as follows: the kappa coefficient was (k=0.73, P <0.001), indicating a substantial agreement degree. 86% of males & 92% of females were correctly predicted using left Coronoid.R.Ht as shown in (table 7)

- Mental foramen parameters in the prediction of sex:-

The right SM-AC results in the kappa coefficient was (k=0.52, P <0.001), indicating a moderate agreement degree. By using the right SM-AC, 79% of males & 85% of females were correctly predicted. In comparison, the right SM-IB the kappa coefficient was (k=0.89, P <0.001), indicating a perfect agreement degree. By using the right SM-IB, 96% of males & 100% of females were correctly predicted. The right IM-IB was as follows: the kappa coefficient was (k=0.75, P <0.001), indicating a substantial agreement degree. Using the right Coronoid.R.Ht, 89% of males & 90% of females were correctly predicted, as shown in (table 8).

In the left SM-AC results, the kappa coefficient was (k=0.56, P <0.001), indicating a moderate agreement degree. 81% of males & 85% of females were correctly predicted using left SM-AC. While the left SM-IB, the kappa coefficient was (k=0.90, P <0.001), indicating a perfect agreement degree. 100% of males & 93% of females were correctly predicted using left SM-IB. The left IM-IB was as follows: the kappa coefficient was (k=0.78, P <0.001), indicating a substantial agreement degree. 95% of males & 83% of females were correctly predicted using left Coronoid.R.Ht as shown in (table 8).

Table (1): Comparison between the mean values and SD of right and left Max.R.Br and Min.R.Br in males and females (N=150).

Subjects	**Males**		**Females**	
Items	**Max.R.Br**	**Min.R.Br**	**Max.R.Br**	**Min.R.Br**
	Mean ± **SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Right	39.37 ± 2.34	28.18 ± 1.96	35.20 ± 1.92	26.43 ± 1.69
Left	39.36 ± 2.33	31.27 ± 2.67	35.17 ± 1.89	26.41 ± 1.66
***P-value by t-test**	0.964	0.318	0.908	0.954

***** Significant statistical difference at P<0.05 **SD=standard deviation

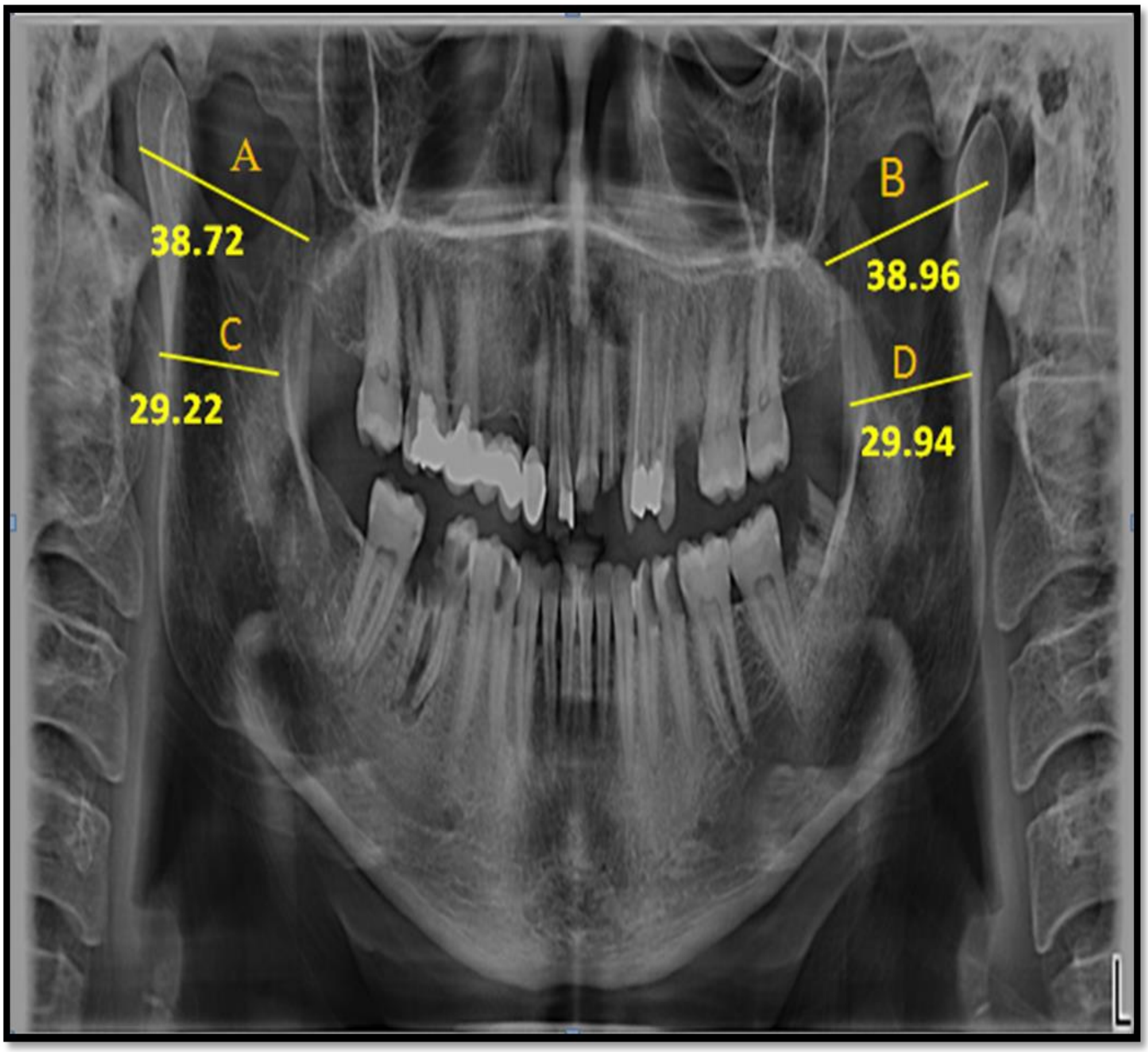

Figure (1): Panoramic radiograph showing Max.R.Br and Min.R.Br on both right and left sides in one of the males participants: **(A)** right Max.R.Br; **(B)** left Max.R.Br; **(C)** right Min.R.Br; **(D)**left Min.R.Br.

Table (2): Comparison between males and females in the mean values and SD of right and left Max.R. Br and Min.R.Br (N=150).

Items	**Right Max.R.Br**	**Right Min.R.Br**	**Left Max.R.Br**	**Left Min.R.Br**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Males	39.37 ± 2.34	28.18 ± 1.96	39.36 ± 2.33	28.27 ± 2.67
Females	35.20 ± 1.92	26.43 ± 1.69	35.17 ± 1.89	26.41 ± 1.66
P-value by t-test	0.021*	0.118	0.011*	0.120

*** Significant statistical difference at P<0.05** ****SD=standard deviation**

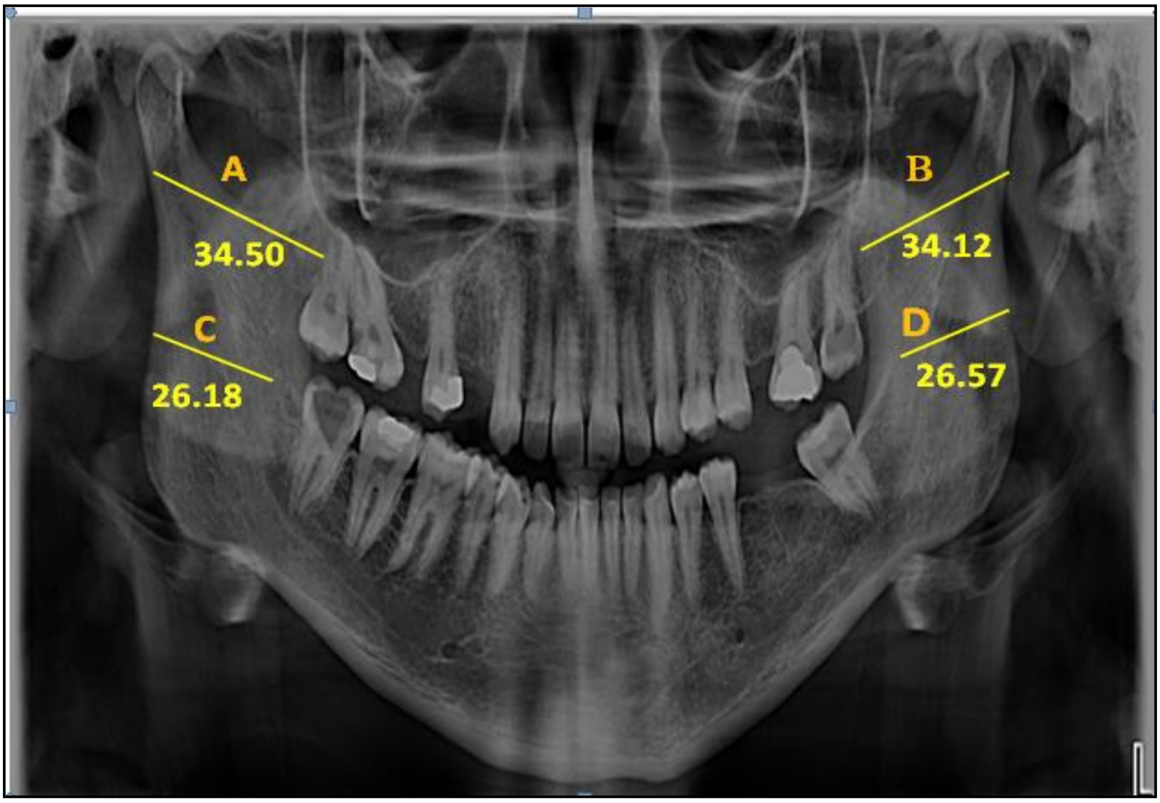

Figure (2): Panoramic radiograph showing Max.R.Br and Min.R.Br on both right and left sides in one of the females participants: **(A)** right Max.R.Br; **(B)** left Max.R.Br; **(C)** right Min.R.Br; **(D)**left Min.R.Br.

Table (3): Comparison between the mean values and SD of right and left of Condylar.R.Ht and Coronoid.R.Ht in males and females (N=150).

Subjects	**Males**		**Females**	
Items	**Condylar.R.Ht**	**Coronoid.R.Ht**	**Condylar.R.Ht**	**Coronoid.R.Ht**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Right	67.78 ± 2.73	58.91 ± 2.99	58.77 ± 2.38	53.74 ± 2.63
Left	67.77 ± 2.77	58.87 ± 2.93	58.76 ± 2.38	53.73 ± 2.67
P-value by t-test	0.979	0.932	0.789	0.977

*** Significant statistical difference at P<0.05 **SD=standard deviation**

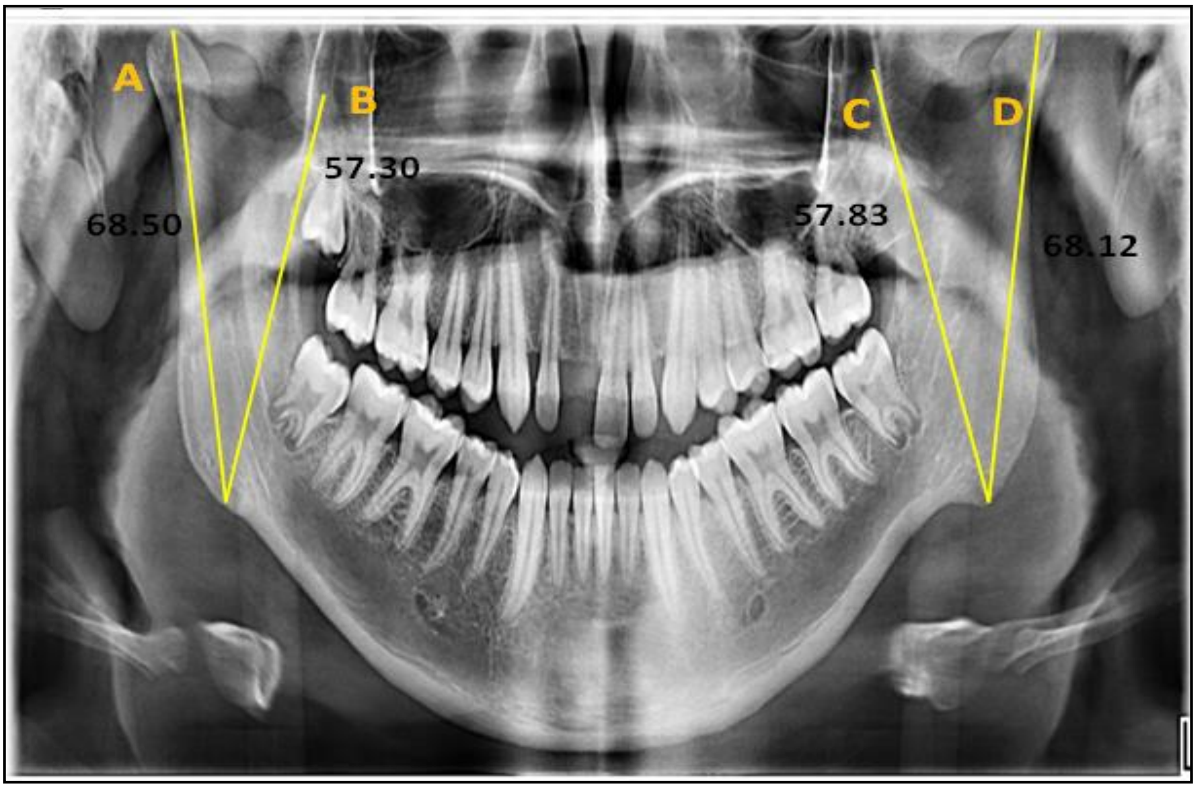

Figure (3): Panoramic radiograph showing Condylar.R.Ht and Coronoid.R.Ht on both right and left sides in one of the males participants: **(A)**right Condylar.R.Ht**; (B)** right Coronoid.R.Ht; **(C)** left Coronoid.R.Ht; **(D)**left Condylar.R.Ht

Table (4): Comparison between males and females in the mean values and SD of right and left Condylar.R.Ht and Coronoid.R.Ht (N=150).

Items	**Right Condylar.R.Ht**	**Right Coronoid.R.Ht**	**Left Condylar.R.Ht**	**Left Coronoid.R.Ht**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Males	67.78 ± 2.73	58.91 ± 2.99	67.77 ± 2.77	58.87 ± 2.93
Females	58.77 ± 2.38	53.74 ± 2.63	58.76 ± 2.38	53.73 ± 2.67
P-value by t-test	0.001*	0.001*	0.001*	0.001*

*** Significant statistical difference at P<0.05 **SD=standard deviation**

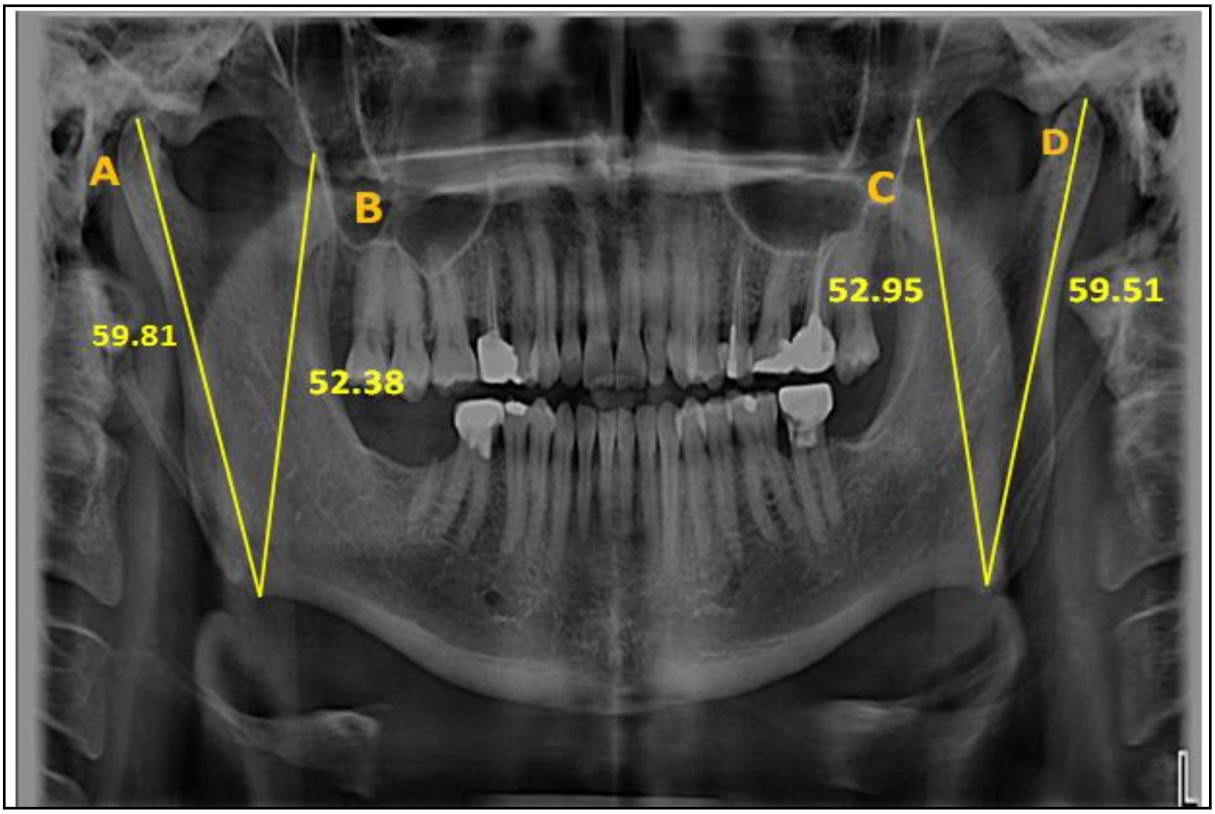

Figure (4): Panoramic radiograph showing Condylar.R. Ht and Coronoid.R. Ht on both right and left sides in one of the females participants: **(A)**right Condylar.R. Ht**; (B)** right Coronoid.R.Ht; **(C)** left Coronoid.R.Ht; **(D)**left Condylar.R.Ht.

Table (5): Comparison between the mean values and SD of right and left sides mental foramen parameters in males and females (N=150).

Subjects	**Males**			**Females**		
Items	**(SM-AC)**	**(SM-IB)**	**(IM-IB)**	**(SM-AC)**	**(SM-IB)**	**(IM-IB)**
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Right	15.26 ± 2.08	15.20 ± 1.28	11.50 ± 1.34	14.40 ± 1.20	13.70 ± 1.68	10.38 ± 2.02
Left	15.88 ± 2.01	15.39 ± 1.27	11.60 ± 1.41	14.35 ± 1.27	13.63 ± 1.69	10.33 ± 2.01
P-value by t-test	0.962	0.692	0.936	0.808	0.818	0.872

*** Significant statistical difference at P<0.05 **SD=standard deviation**

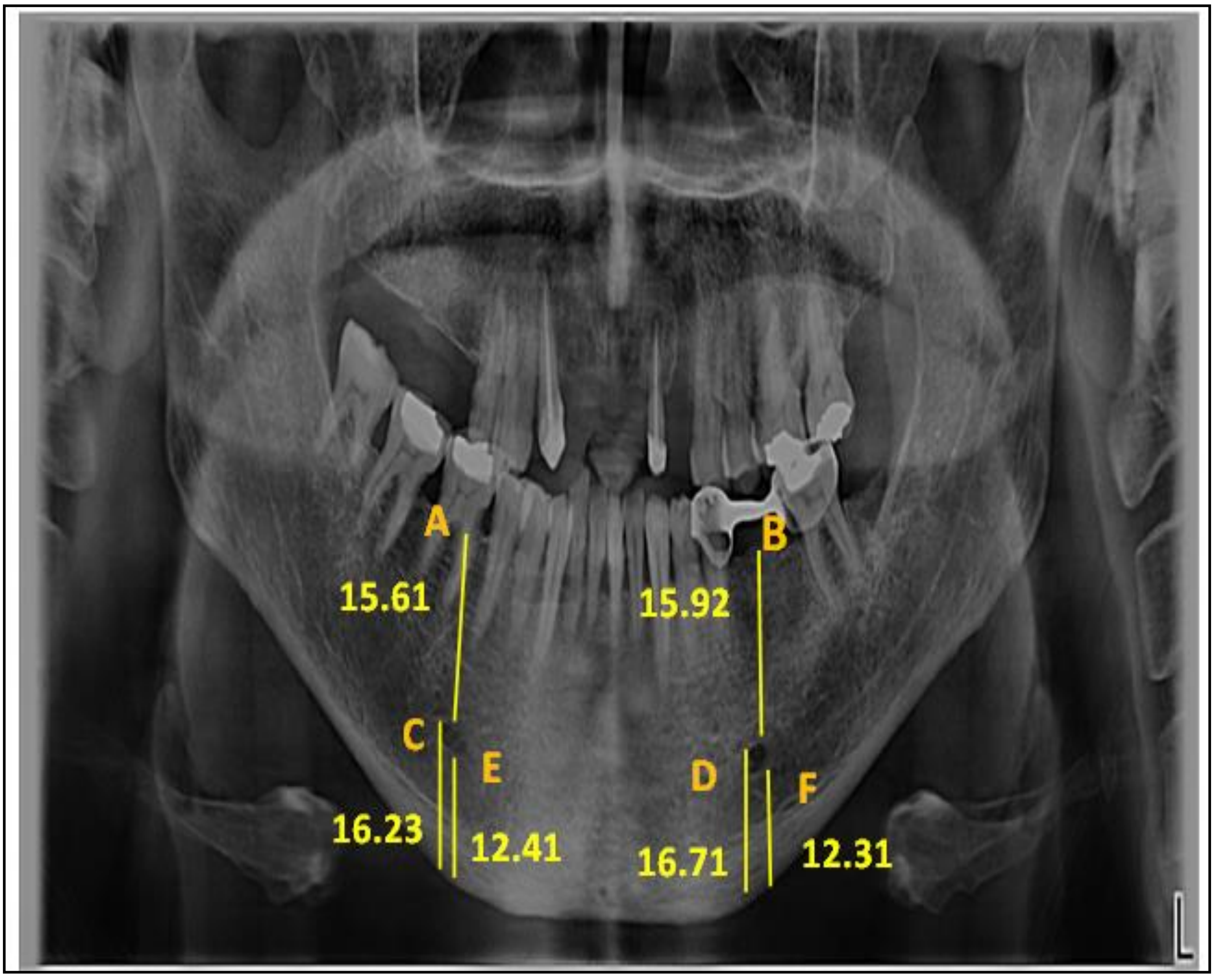

Figure (5): Panoramic radiograph showing mental foramen parameters on both right and left sides in one of the male's participants: **(A)** right (SM-AC); **(B)** left (SM-AC); **(C)** right (SM-IB); **(D)** left (SM-IB); **(E)** right (IM-IB); **(F)** left (IM-IB).

Table (6): Comparison between males and females in the mean values and SD of right and left mental foramen parameters (N=150).

Items	**Right (SM-AC)**	**Right (SM-IB)**	**Right (IM-IB)**	**Left (SM-AC)**	**Left (SM-IB)**	**Left (IM-IB)**
	Mean± SD	**Mean± SD**	**Mean± SD**	**Mean± SD**	**Mean± SD**	**Mean± SD**
Males	15.26 ± 2.08	15.20 ± 1.28	11.50 ± 1.34	15.88 ± 2.01	15.39 ± 1.27	11.60 ± 1.41
Females	14.40 ± 1.20	13.70 ± 1.68	10.38 ± 2.02	14.35 ± 1.27	13.63 ±1.69	10.33 ± 2.01
P-value by t-test	0.030*	0.001*	0.001*	0.032*	0.001*	0.001*

*** Significant statistical difference at P<0.05 **SD=standard deviation**

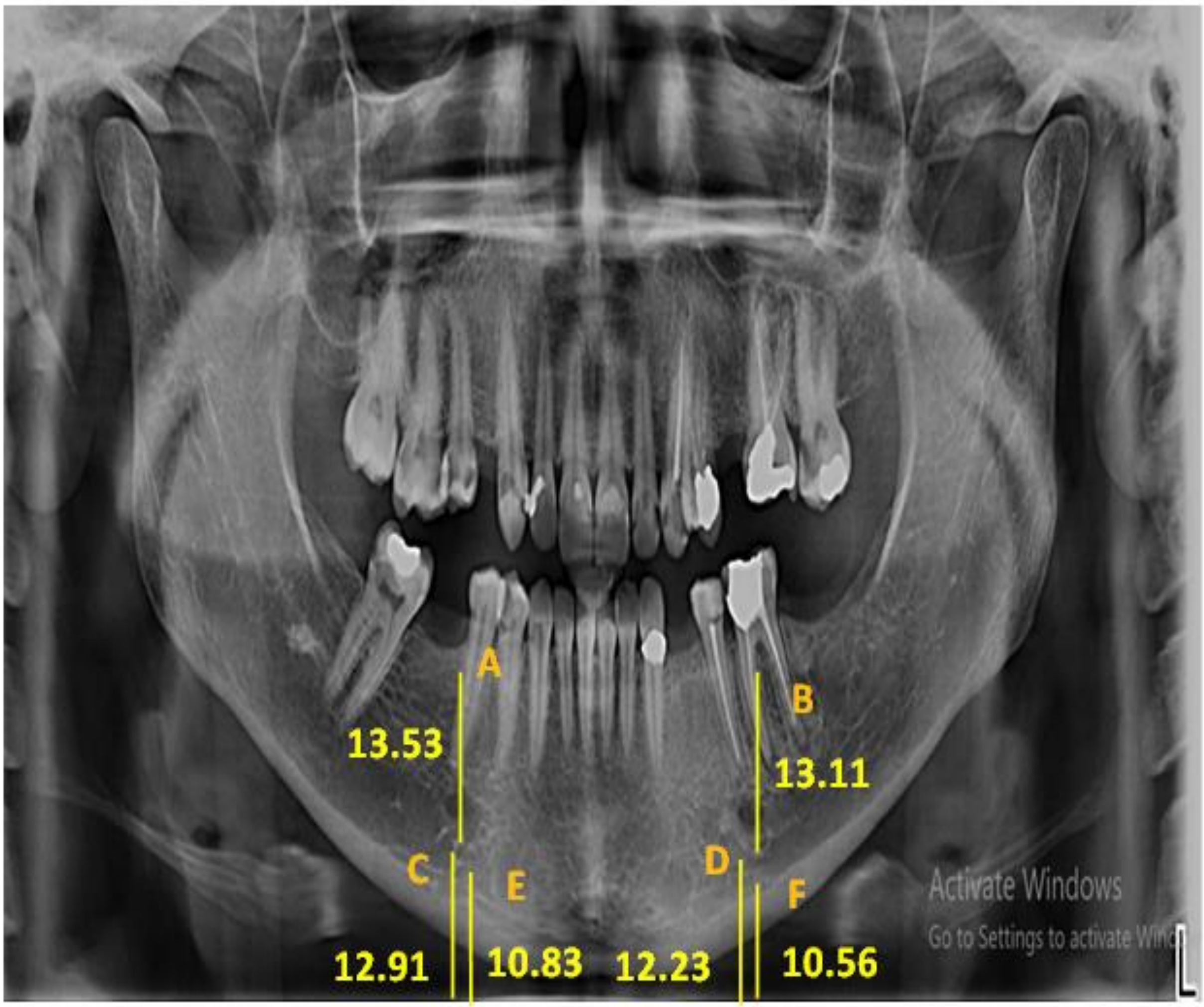

Figure (6): Panoramic radiograph showig mental foramen parameters on both right and left sides in one of the females participants: **(A)** right (SM-AC); **(B)** left (SM-AC); **(C)** right (SM-IB); **(D)** left (SM-IB); **(E)** right (IM-IB); **(F)**left (IM-IB).

Table (7): The degree of predictability of the mandibular ramus measurements on both right and left sides regarding sex determination.

Measure	**Percentage of Correct Predictions**		**Kappa (K)**	**P-value**
	Male	**Female**		
Right Max.R.Br	68%	74%	0.46	<0.001
Right Min.R.Br	55%	59%	0.11	<0.001
Right Condylar.R.Ht	97%	100%	0.95	<0.001
Right Coronoid.R.Ht	90%	95%	0.80	<0.001
Left Max.R.Br	78%	63%	0.47	<0.001
Left Min.R.Br	60%	52%	0.10	<0.001
Left Condylar.R.Ht	97%	100%	0.96	<0.001
Left Coronoid.R.Ht	86%	92%	0.73	<0.001

Table (8): The degree of predictability of the mental foramen parameters on both right and left sides regarding sex determination.

Measure	Percentage of Correct Predictions		Kappa (K)	P-value
	Male	Female		
Right SM-AC	79%	85%	0.52	<0.001
Right SM-IB	96%	100%	0.89	<0.001
Right IM-IB	89%	90%	0.75	<0.001
Left SM-AC	81%	85%	0.56	<0.001
Left SM-IB	100%	93%	0.90	<0.001
Left IM-IB	95%	83%	0.78	<0.001

DISCUSSION

For a long time, mandibles were used to detect the sex of a person as they show a sexual difference in morphology. Also, there are high risks from the difference in the operators' skill. So, there is a need for many morphometric measures to be used as a standard for sex determination with other features. Many studies have reported that the skeletal criteria differ between populations, so there is a demand to put standards for the different populations (**Suazo et al., 2008 and Saini, 2013**).

The present study included 150 adult subjects (75 males and 75 females). Their ages ranged from 25 to 50 years. This age group was selected as the sex can be identified accurately from mandible after puberty. Because the mandibular growth process normally ends between 22 and 25 years of age, which is influenced by the complete eruption of the third molar tooth, which ends at the age of 25 in most populations. However, it may also be influenced by nutrition and socio-economic status. While above 50 years of age, the loss of teeth is higher, affecting the mandible size. This, in addition to the effect of hormonal changes in menopausal females **(Francesquini et al., 2007).**

(A) Ramus measurements:-

In the present study, it was no statistical difference in the mean values of both left and right sides regarding Max.R.Br and Min.R.Br. in both females and males.

The current results agree with results reported by **Noha & Dina (2015**) that used panoramic radiography to determine sex from the mandible and found that it was no significant difference found between the left and right sides regarding the Max.R.Br and Min.R.Br in males and females.

The present work showed a significant statistical increase in the mean values of both left and right, Max.R.Br in males compared to females. However, it was no detected statistical difference in the means of both left and right Min.R.Br between males and females.

In harmony with the present results, **Sairam et al. (2016)** reported that the mean values of male left and right Max.R.Br were higher than the female ones when used digital panoramic radiographs to determine sexual dimorphism.

While in contrast to the present work by using digital panoramic radiography**,** **Ajit et al. (2016)** and **Tejavathi et al. (2017)** found that the means of both left and right Max.R.Br were not differing statistically among males and females in the Indian population. This could be explained by differences in nutritional, geographic, and racial features **(Patil et al., 2005)**.

The current findings were also in harmony with the findings reported by **Altaf et al. (2019)**. They also detected by using orthopantomograms that both left and right Min.R.Br were not differing statistically among males and females in the Indian population.

In the present study, no significant statistical difference was determined between the mean values of both right and left sides regarding Condylar.R.Ht. and Coronoid.R.Ht. in males and females.

In harmony with the present work, **Alves and Deana (2019)** conducted a study to predict sex from macerated mandibles of Brazilian adults using metrical analysis and found no statistical difference in the mean values of the left and right regarding Condylar.R.Ht. and Coronoid.R.Ht. in both males and females.

While in contrast to the present result **Amin (2018)** demonstrated that among all mandibular linear measures, there was a significant difference in both left and right sides regarding Condylar.R.Ht. and Coronoid.R.Ht. in males and females with higher mean values in the right side compared to the left side in cone-beam computed tomography images and it was suggested that this difference possibly because of using the right side much more than the left side, with more contraction of mastication muscle as mastication temporalis, which is attached to the coronoid process.

It was a highly significant statistical increase in the right and left Condylar.R.Ht in males compared with females between male and female participants. Also, there was a highly significant statistical increase in the mean values of the left and right Coronoid.R.Ht in males compared to females.

The present work matched with a study by **Neeru et al. (2018),** who used panoramic radiography to compare sex and founded that males had greater mean values of both left and right Condylar.R.Ht and Coronoid.R.Ht in males as compared with females.

Similarly, **Indira (2012) and Noha and Dina (2015)**, who used digital panoramic imaging, also found that the length of the left and right Condylar.R.Ht and Coronoid.R.Ht was more in males as compared to females with a highly significant difference.

In contrast to the present work, **De Oliveira et al. (2015)** assessed sexual dimorphism and age from analysis of the Condylar.R.Ht and Coronoid.R.Ht in lateral cephalometric radiographs. They reported that this measurement was reliable only for estimating the individual's age in the Brazilian population but presented no difference between sexes. This could explain the body's differences and development in different populations in males and females **(Humphrey et al., 1999).**

(B) <u>Mental foramen (M.F.) parameters: -</u>

The present work was carried out in detail on Type II MF. Because the borders of this type can be traced, various markings can record various measurements. In the case of other types, i.e., Type I continuous and Type III diffuse, the M.F. margins cannot be visualized and therefore were not included in the study.

Many studies were performed using the M.F. position, and the results were documented. The vertical distance from the M.F. to the mandible's basal bone persists without change all over life. This part's fixedness may be attributed to high resistance against the alveolar process's resorption above the foramen (**Guler et al., 2005**). Due to the M.F. position's stability during life, it was chosen as a reference parameter in the present work.

The present work found no statistical difference in the mean values of both left and right sides regarding SM-AC, SM-IB, and IM-IB in males and females.

In harmony with the present work, **Abha et al. (2019)** found no statistical difference between both left and right sides regarding mental foramen parameters in males and females using panoramic radiography.

In contrast to the present work, **Subash et al. (2019)** used cone-beam computed tomography to determine sexual dimorphism by mental foramen analysis among the south Indian population and reported a significant statistical difference between right and left sides considering

SM-IB and IM-IB in both males and females with higher values in the right side, and this was not in agreement with several researches by **Mahima (2009) and Chandra et al. (2013)** who found no significant variation between right and left sides of M.F. in panoramic radiography. He suggested that this difference in the results may be due to variations in population and radiographic techniques.

In the present study, a comparison between male and female groups showed that the male group had statistically significantly higher values for both rights and left SM-AC, SM-IB, and IM-IB than females.

The present results were in accordance with the results obtained by **Abha et al. (2019)**, who used panoramic radiography to differentiate sex among the West Bengal population using mental foramen relations and reported that males had higher mean values as compared to females with a highly significant difference regarding both right and left SM-AC, SM-IB, and IM-IB.

Similarly, **Thomas et al. (2014) and Burak et al. (2018)** applied a mandible radiographic study to determine sex. They found that SM-AC, SM-IB, and IM-IB exhibit high sexual dimorphism with higher values in the male group.

The present work showed similar results obtained by **Sairam et al. (2016)**, who used digital panoramic radiograph to determine sex from mandibular measurements and found that the SM-AC and SM-IB had higher values for males in comparison with females with the high significant statistical difference among Indian population.

The M.F. site's variance can be attributed to the variability of craniofacial skeletons' growth and development that depend on the sex hormones and local factors like muscles of mastication and mastication forces. As women have lesser developed muscles and weaker mastication force than men, so they have lesser deposited bone along the basal bone of the mandible **(Jayam et al., 2015).**

The variability between research can be since researchers work on variant sample sizes, instruments, inclusion criteria, positions or reference points, or variable analysis methods. Additionally, variability may be due to other factors, like the difference in group ancestry, including height, skeleton size, and environmental factors in different age and sex groups, in addition to the presence or absence of teeth **(Sharan and Madjar, 2008)**.

In the current study, the benchmark scale was used to assess the percentage of the tested measurements' correct prediction of sex. The scale revealed that among all mandibular ramus measurements, the right and left Condylar.R. Ht were the best discriminate variables between genders with an overall accuracy of 97% in males and 100% in females. In comparison, the least predictor for sexual dimorphism was the Min.R. Br with an overall accuracy of 55% in males and 59% in females for the right side and 60% in males and 52% in females for the left side.

The present results matched with **Indira et al. (2012) and Altaf et al. (2019)**, who used digital panoramic radiography to determine sex and concluded that among all mandibular parameters, the highest sexual dimorphism was seen with Condylar.R.Ht as the overall prediction rate was 87% in males and 90% in females with least sexual dimorphism was seen with Min.R.Br.

Similarly, **Bhagwatkar et al. (2016)** measured all the parameters in mandibles of 100 Indian subjects by using digital orhopantomograph and concluded that mandibular ramus height, specifically Condylar.R.Ht was the most significant with the best-predicting accuracy rate of 85%.

In agreement with the current results, **Aspalilah et al. (2018)** applied a retrospective study by using postmortem computed tomography scans of a sample of the Malaysian population and demonstrated that all mandibular parameters were found to be more generous in male mandibles than in female one with an overall accuracy of 78.5%. However, by stepwise discriminant function analysis, from nine parameters, Condylar.R.Ht and Coronoid.R.Ht were the best parameters for predicting sex correctly.

The present work demonstrated that among all mental foramen relations, the SM-IB was the best predictor of sex between male and female groups with an overall accuracy of 96% in males and 100% in females for the right side and 100% in males and 93% in females for the left side. On the other hand, the least discriminant variable was the SM-AC with an overall accuracy rate of 79% in males and 85% in females for the right side and 81% in males and 85% in females for the left side.

The present results matched with **Sairam et al. (2016)**, who concluded that among all linear measurements of mental and mandibular foramina, the SM-IB was the best measurement tested in the prediction of sex in digital panoramic radiographs with an overall accuracy of 85% in males and 90% in females.

In harmony with the current results, **Girish et al. (2016)**, who established a retrospective study on the Indian population using 100 panoramic radiography for subjects of known gender, concluded that among all mental foramen parameters, the SM-IB and IM-IB exhibited the best predictors of sex.

In contrast to the present work, **Nimi et al. (2017) and Sandeepa et al. (2017)** used panoramic imaging. They reported that Min.R. Br and Max.R. Br on both sides were the best measurements in predicting sex among Indian and Saudi Arabian populations. This difference may be postulated to racial variety.

Conclusion

The present study revealed no significant statistical difference between right and left sides regarding all measured mandibular and mental foramen parameters in both males and females. A significant statistical increase in the mean values of the left and right, Max.R.Br was found in males compared to females. Simultaneously, no significant statistical difference was found in the mean values of left and right Min.R.Br between males and females.

A significant statistical increase in the mean values of the left and right Condylar.R.Ht and Coronoid.R.Ht was found in males compared to females. A significant statistical increase in the mean values of the left and right SM-AC, SM-IB, and IM-IB was found in males compared with females. Finally, the mean values of left and right Condylar.R.Ht and SM-IB were the correct predictors of both genders.

RECOMMENDATIONS

- It is recommended to use another type of radiation as cone-beam computed tomography (CBCT) or three-dimensional computed tomography (3D-CT). These types will be more accurate than panoramic radiographs in detecting the different landmarks of the measured parameters.
- It is better to use a larger sample size than that was chosen in the present work to have the availability to determine a specific range and cut off point to the different parameters.
- It is recommended to select a broader range for the age group to correlate between different age groups and the best parameter in determining sex in each age group.

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تحديد الجنس باستخدام عدة قياسات لفرع الفك السفلي وعلامات الثقبة الذقنية باستخدام التصوير البانورامي الرقمي في عينة من اهالي محافظة سوهاج

رضا محمد السيد، مها عبد الحميد هلال، هند محمد محمود، احمد محمد سعيد
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يعتبر التعرف على رفات الهياكل العظمية البشرية من الجثث المتحللة والمتضررة خلال الكوارث الجماعية خطوة مهمة في تحقيقات الطب الشرعي وفي القضايا الطبية. ويعتبر تحديد الجنس جانبًا مهمًا، يليه تحديد العمر. ويمكن تحديد الجنس من عظام الحوض والجمجمة مع الفك السفلي. حيث يعتبرالفك السفلي هو أكبر وأقوى جزء متحرك في الجمجمة. الهدف من الدراسة: صممت هذه الدراسة للمقارنة بين قياسات فرع الفك السفلي وعلاقات الثقبة الذقنية على كلا الجانبين لتحديد الجنس من خلال التصوير الشعاعي البانورامي الرقمي. طريقة الدراسة: تضمنت الدراسة الحالية 150 مريضاً بالغاً 75 منهم من الذكور و 75 من الإناث. النتائج: أوضحت الدراسة الحالية عدم وجود فروق ذات دلالة احصائية بين الجانبين الأيمن والأيسر فيما يتعلق بجميع مقاييس الفك السفلي والثقبة الذقنية في كل من الذكور والإناث. وكانت هناك زيادة ذات دلالة إحصائية في متوسط القيم لجميع قياسات فرع الفك السفلي ومتغيرات الثقبة الذقنية المقاسة في الذكور مقارنة بالإناث باستثناء قيم أصغر عرض لفرع الفك السفلي علي الجانبين الأيمن والأيسر. فلا توجد فروق ذات دلالة إحصائية بين الذكور والإناث. وكانت القيم المتوسطة Condylar. R. Height علي الجانبين الأيمن والأيسر و SM-IB هي المؤشرات الأفضل في تحديد الجنس عند الذكور والإناث.