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Mandibular Ramus - A Guide in Determination of Gender

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Abstract

Aim: To measure the dimensions of the mandibular ramus and determine its usefulness as a guide in gender determination.

Materials and Methods: The present study includes 80 digital panoramic radiographs. Dimensions of mandibular ramus are measured that are condylar height, maximum ramus breadth, minimum ramus breadth, the projective height of ramus, coronoid height. All the measurements were statistically analysed, and the formula was derived for determination of gender. Prediction accuracy of the results was also performed.

Results: All the measurements obtained significant values in determining sexual variability, except the maximum ramus breadth and the prediction accuracy was 81.3%.

Keywords: Mandibular Ramus, Coronoid height, Sexual variability, Panoramic Radiograph, Gender.

Introduction

Sex determination has become a crucial part of a study in Anthropology and forensic science, which is used as the first tool in the identification of a person. Skull bones are considered as more long-standing than and are used for forensic purposes. Mandibles have been used for sexual dimorphism as it is considered as more reliable than other

facial bones. Panoramic radiographs are playing a crucial role and are widely being. These have become a routine diagnostic procedure used by the clinicians for oral diseases [1, 4-7]. Among various regions of the facial skeleton, mandibular ramus can strongly express univariate sexual dimorphism. Sex differences can also be well identified in bony pelvis and skull[2]. The present study was conducted on mandibular ramus measurements to determine sexual dimorphism.

Materials and Method

A retrospective study was conducted, and 80 (40 males and 40 females) panoramic radiographs were collected which were previously taken for various diagnostic and treatment procedures. Age of the patient ranges from 20-60 years. Panoramic radiograph was taken with a digital OPG machine with specifications MODEL: - VATECH, PaX-400C, Power source:-110V/ 230V-50/60Hz, 2.0KVA (MAX) and Weight: - 200kg.

Inclusion Criteria

Standardized digital panoramic radiographs within the age range of 20-60 years. Exclusion criteria: - Radiographs with developmental anomalies in which the measurements may be affected.

Measurements were performed on digital panoramic radiographs using mouse-driven cursor regarding length and width measurements of ramus of the mandible

Five measurements were taken that are **(Figure 1)**:

- Maximum ramus breadth (A), which is the distance between the most anterior and most posterior point of the condyle
- Minimum ramus breadth (B), which is the smallest anteroposterior width of the ramus
- Condylar height (C), also called as maximum ramus height which is the distance between the most superior portion of condyle and tubercle on the inferior border of the ramus
- Projective ramus height (D), is the distance most superior point of the condyle
- Coronoid height (E), is the distance between the most superior points of coronoid to the tubercle on the inferior border of the ramus.

Statistical analysis was done using IBM SPSS VERSION 24.0. The following statistics were performed like independent samples T-test, linear discriminate function, and prediction accuracy.

Results

The present study included 80 panoramic radiographs, of which 40 were of males, and 40 were of females. The mean age group of males is 39.68, and that of females is 40.73. The mean value of each measurement for both males and females was derived (TABLE 1) and depicted in **Figure 2.**

In the present study except for maximum ramus breadth, all other four measurements were significant. A linear discriminate function was done to derive equations for sex determination (TABLE 2).

Equations derived for sex determination:

For males= -278.695+ 6.069 (max. ramus breadth) + 2.690 (min. ramus breadth) -4.738 (condylar height) + 7.277 (projective height of ramus) + 2.427 (coronoid height).

For females= -245.447+5.828(max. ramus breadth) + 2.729(min. ramus breadth-4.584(condylar height) + 6.841(projective height of ramus) + 2.258(coronoid height)

The values greater than -0.831 are males and less than -0.831 are considered as females (TABLE 3). Overall prediction accuracy was 81.3%.

Discussion

Forensic dentistry is an evolving branch which is proving its importance in age and gender determination relating to person identification. Sex determination stands first in

identifying a person next followed by age, and it is an essential part of a study in the field of anthropology and forensic sciences as further interpretations and analysis are based on it [5, 6, 10]. According to Loth SR et al.[12] three basic criteria should guide the choice of skeletal elements that may be useful indicators of sex: 1) Their morphology should clearly reflect anatomic and or physiologic sex differences, 2) They should be able to withstand the rigors of skeletonization and fossilization, and 3) Ideally the trait should be recognizable through time and across paleospecies. At 95% accuracy, the complete pelvis is the most reliable site for sex determination in healthy adults. But complete pelvis recovery is not possible in all cases. Skull is next most easily sectioned part of the human body after pelvis [4, 13]. The mandible is one of the most durable bones and accurately determines gender after pelvis. The shape and size range of the mandible varies according to a different lifestyle and chewing habits[14]. Therefore the morphological variations exist between different ethnic groups. Dental radiography is playing an important role in forensic dentistry in the determination of gender and age[2]. Among various measurements of the facial skeleton, the mandible is the strongest and most durable and ramus has been reported to express sexual dimorphism strongly in mandible. According to Slaus and Tomicic 20 craniofacial features determine sex (TABLE 5).

In the present study all the values are higher for males than females.The mean maximum ramus breadth for males and females is 33.330 with a standard deviation of 1.9357 and 32.320 with a standard deviation of 2.5576 respectively and values were not significant (0.050).

The minimum ramus breadth was 22.208 for males with a standard deviation of 1.8826 and 21.773 females with a standard deviation of 1.8782 and values were not significant(0.304).

The condylar height was 64.098 with a standard with a standard deviation of 4.2509 and 3.7333 and 58.125 for males and females respectively with significant values (<0.000).

The projective height of ramus is 62.330 and 56.293 with a standard deviation of 4.1932 and 3.9664 for males and females respectively with significant values(<0.000).

The coronoid height is 59.345 and 54.530 with a standard deviation of 3.8551 and 4.4964 for males and females respectively with significant values (<0.000).

In a study conducted by Tejashree Bhagwatkar et al. all the above five measurements were significant. Saraswathi.K.Gopal et al. also included gonial angle, intercondylar distance, inter coronoid distance and in their study they measured in CBCT and reported it as accurate measurements and gender determination was accurate with all above used measurements and gonial angle[3]. In the study conducted by Samatha K et al., mandibular ramus height had significance in determining sex[11]. Hu KS et al., conducted a non-metric morphological analysis of mandibles like the shape of the chin, contour of the lower border of the mandible, divergence of gonial angle etc., and in their study shape of the lower border of mandible was reliable[14]. According to Ruchi Bhuyan et al. mandible plays an important role in determining both age and gender, thus playing a critical role in forensic odontology.

In the present study, all the measurements except maximum ramus breadth had significant values in determining gender with a prediction accuracy of 81.3%.

Conclusion

Sex determination by using dimensions of mandibular ramus yields most accurate predictory results in the facial skeleton. In the present study of all the five measurements, three measurements yielded significant values with 81.3% prediction accuracy and still more accurate values can be yielded with further large sample size. As mandible is

considered as the most long-standing bone in the human body and it has accuracy in the determination of sex after the pelvis, it plays an essential role in forensic dentistry.

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Legends Figures and Tables

Figure 1 (A): Five Measurements of Mandibular Ramus Taken For Study

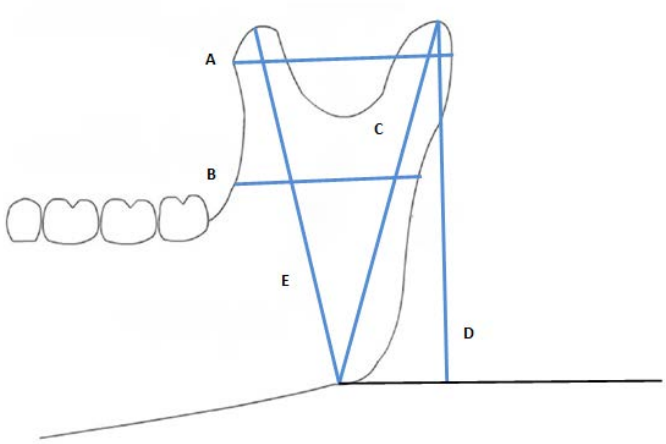

Figure 1b: Measurements taken on digital panoramic radiograph

Table 1: Group Statistics					
	Sex	N	Mean	Std. Deviation	Std. Error Mean
AGE	Male	40	39.68	10.946	1.731
	Female	40	40.73	11.773	1.862
MAX_RB	Male	40	33.330	1.9357	.3061
	Female	40	32.320	2.5576	.4044
MIN_RB	Male	40	22.208	1.8826	.2977
	Female	40	21.773	1.8782	.2970
CONDYLAR_HT	Male	40	64.098	4.2509	.6721
	Female	40	58.125	3.7333	.5903
PROJ_HT_RAMUS	Male	40	62.330	4.1932	.6630
	Female	40	56.293	3.9664	.6271
CORONOID_HT	Male	40	59.345	3.8551	.6095
	Female	40	54.530	4.4964	.7110

Figure 2: Mean Values For Each Measurement For Both Genders

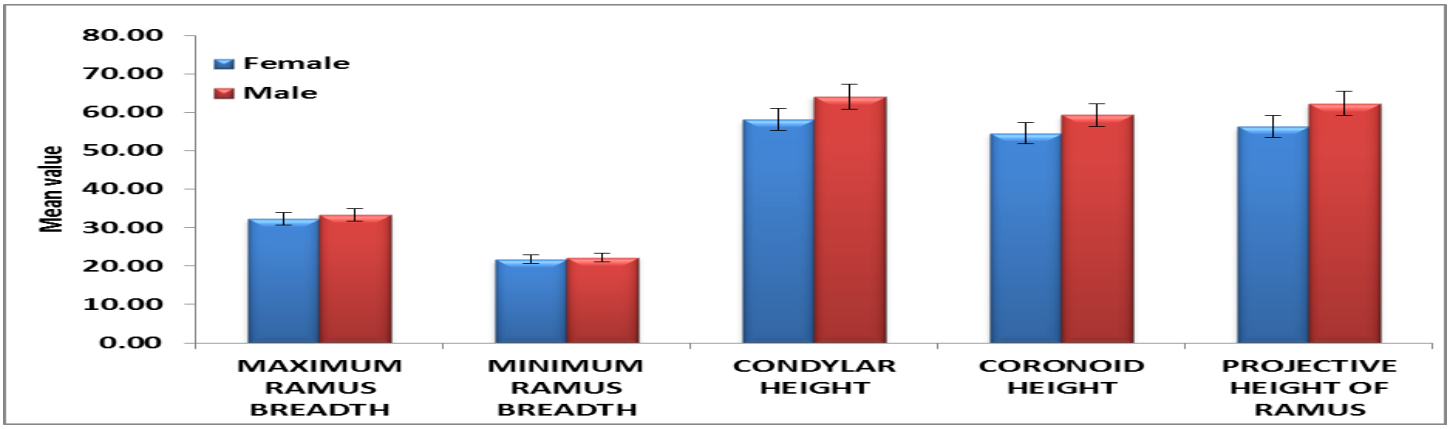

Table 2: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	P Value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AGE	Equal variances assumed	.288	.593	-.413	78	.681 NOT SIG	-1.050	2.542	-6.110	4.010
	Equal variances not assumed			-.413	77.589	.681	-1.050	2.542	-6.111	4.011
MAX_RB	Equal variances assumed	4.134	.045	1.992	78	.050	1.0100	.5071	.0003	2.0197
	Equal variances not assumed			1.992	72.641	.050 NOT SIG	1.0100	.5071	-.0008	2.0208
MIN_RB	Equal variances assumed	.615	.435	1.035	78	.304 NOT SIG	.4350	.4205	-.4021	1.2721
	Equal variances not assumed			1.035	78.000	.304	.4350	.4205	-.4021	1.2721

CONDYLAR_HT	Equal variances assumed	.000	.993	6.677	78	<0.0001 VHS	5.9725	.8945	4.1916	7.7534
	Equal variances not assumed			6.677	76.721	.000	5.9725	.8945	4.1911	7.7539
PROJ_HT_RAMUS	Equal variances assumed	.002	.964	6.616	78	<0.0001 VHS	6.0375	.9126	4.2206	7.8544
	Equal variances not assumed			6.616	77.760	.000	6.0375	.9126	4.2205	7.8545
CORONOID_HT	Equal variances assumed	1.502	.224	5.142	78	<0.0001 VHS	4.8150	.9365	2.9506	6.6794
	Equal variances not assumed			5.142	76.223	.000	4.8150	.9365	2.9499	6.6801

Table 3: Linear Discriminant Function Classification Function Coefficients

	Sex	
	Male	Female
MAX_RB	6.069	5.828
MIN_RB	2.690	2.729
CONDYLAR_HT	-4.738	-4.584
PROJ_HT_RAMUS	7.277	6.841
CORONOID_HT	2.427	2.258
(Constant)	-278.695	-245.447

Table 4: Standardized And Unstandardized Coefficients In The Original Samples

	Raw coefficients	Standardised Coefficients	Structure Coefficients	Sectioning point
MAX_RB	0.145	0.329	0.268	-0.831
MIN_RB	-0.023	-0.044	0.139	
CONDYLAR_HT	-0.092	-0.369	0.898	
PROJ_HT_RAMUS	0.263	1.072	0.890	
CORONOID_HT	0.102	0.426	0.692	
(Constant)	-19.998			

Table 5: Prediction Accuracy					
	SEX	Predicted Group Membership		Total	% Accuracy
		Male	Female		
Count	Male	33	7	40	81.3%
	Female	8	32	40	
%	Male	82.5	17.5	100.0	
	Female	20.0	80.0	100.0	

Table 6: Craniofacial Feature Useful For Sex Determination[15]
1. Overall skull shape and size
2. Robustness of the brow ridges
3. Sharpness of the superior orbital border
4. Presence or absence of superciliary arches
5. Shape of the glabellar region
6. Eye orbit shape
7. Shape of forehead, frontal bossing
8. Shape of the nasal bone
9. Width of the mandibular ramus
10. Gonial angle
11. Robustness of the nuchal crest
12. Presence or absence of the external occipital protuberance
13. Robustness of the temporal line
14. Robustness of the zygomatic process
15. Robustness of the mastoid process
16. Configuration of the chin
17. Size of the teeth
18. Shape of the palate
19. Shape and size of the mandibular condyles
20. Shape and size of the occipital condyles