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Original Research Article

Morphometric analysis of the mandibular ramus and its clinical and medicolegal significance

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ABSTRACT

Background: During natural calamities entire skeleton of single person could not be found. In such case, determination of sex with fragments of the bone available required range of data with proven accuracy. Hence this study is aimed at to provide range of data for minimum number of parameters of the ramus of the mandible.
Methods: Three hundred dry mandibles of known sexes and bearing all teeth or intact alveolar margin were included in the study. Vertical height; maximum and minimum breadths of the ramus of the mandible were measured. All the data were analyzed for significance of the occurrence in relation to sex and laterality by means of paired t-test.
Results: On the basis of all the three parameters together, we got 95% accuracy in determination of sex. Statistically significant differences were found in all parameters between male and female mandibles. The laterality distributions for all the parameters were found to be insignificant.
Conclusions: Accurate determination of sex from the available bone fragments such as the ramus of the mandible required wide number of data from the least parameters that could be utilized medicolegally.

Keywords: Anthropometry, Mandibular ramus, Reconstruction surgeries, Sexual dimorphism

INTRODUCTION

Sexual dimorphism on the basis of available bones is an age old technique. If the entire skeleton is available, pelvis is used as the most specific tool for sexual dimorphism.[1] However, it would be difficult on occasion such as natural or manmade catastrophes to get the entire skeleton of individual, where only fragment of the bones is available.

In such cases it would be difficult to determine the sex with utmost accuracy. Sexual determination could be possible by seeing flexure on the posterior border of the ramus of the mandible, and other morphological features such as general size, chin shape, gonial angle, gonial flare, and muscular markings.[2] Humphrey et al, has given more emphasis on the sites of the mandible where bone deposition, resorption or remodeling occur are significantly dimorphic sexually, in that way the ramus of the mandible undergoes significant morphological changes during growing period.[3] Sometimes, only body or ramus of the mandible would be available, in such cases data of anthropometric analysis of ramus of the mandible would be useful to determine sex accurately.

The present study is aimed at morphometric analysis of the ramus of the mandible of known sexes to give the range of dimensions to determine the sex accurately.

METHODS

In this cross sectional study, authors included 300 dry mandibles of known sexes. Sexual determination has been carried out on the basis of presence or absence of a distinct flexure on the posterior border of the ramus at the occlusal plane, and other morphological features such as general size, chin shape, gonial angle, gonial flare, and muscular markings.[2]

Authors have included 150 male mandibles and 150 female mandibles for the study. All the mandibles were bearing all teeth or intact alveolar margin. The source of the study material is anatomy departments of different medical colleges of the Gujarat India. Exclusion criteria were set at mandibles without teeth or eroded alveolar margin. The bones were numbered serially.

The following parameters were measured by digital vernier calliper to analyze the ramus of the mandible:

Vertical height of the mandible was measured on right and left sides from the base of the mandible to the highest point of the condyle (Figure 1).

Figure 1: Vertical height of mandibular ramus.

Maximum breadth of ramus was measured horizontally on right and left sides as the largest antero-posterior distance of the ramus of the mandible (Figure 2).

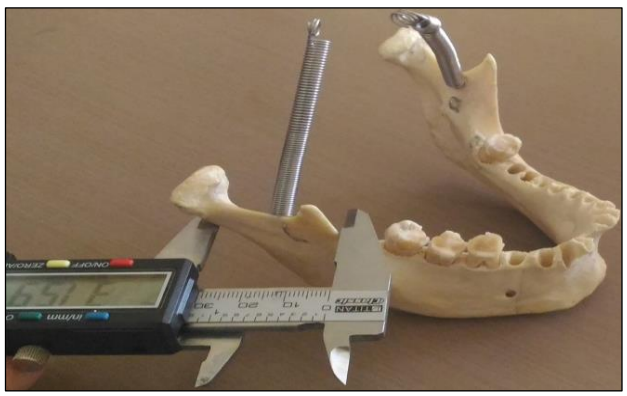

Figure 2: Maximum ramus breadth.

Minimum breadth of ramus was measured horizontally on right and left sides as the smallest antero-posterior distance of the ramus of the mandible (Figure 3).

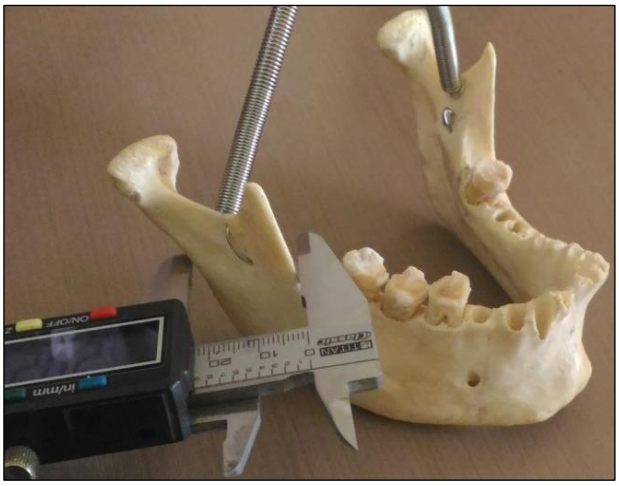

Figure 3: Minimum ramus breadth.

The data were analyzed for significance of the occurrence in relation to sex and laterality by means of paired t-test with the level of significance set at $p < 0.05$.

RESULTS

Mean, range and deviation from the mean for each parameter were calculated and noted in Table 1.

On the basis of all the three parameters together, authors got 95% accuracy in determination of sex. p-value of all the parameters were found to be significant statistically between male and female mandibles. The laterality distributions for all the parameters were found to be insignificant.

DISCUSSION

Determination of sex by available bones or bone fragments is having paramount importance medicolegally. The mandible is the most dimorphic part of the human skull and has been used for sexual dimorphism; however, to determine the sex accurately from the available fragment of the mandible such as the ramus is needed accurate range of the data to compare.[4]

Loth SR found 99% accuracy in determination of sex by finding flexure at posterior border of ramus of the mandible.[2] By observing flexure at the posterior border of the ramus of the mandible, Shivaprakash et al, determined sex with 80% accuracy in male and 71% in female mandibles.[5] Saini et al, has taken vertical height of coronoid process, and the combination of it with other measurements of ramus and found significant sexual dimorphism with an overall accuracy of 80.2%.[6] Dayal et al, found mandibular ramus height to be the best parameter in their study, with 75.8% accuracy.[7]

Table 1: Height, maximum and minimum breadths of the ramus of the mandibles.

Parameter	Male		Female	
	Right (mm)	Left (mm)	Right (mm)	Left (mm)
Height of ramus of the mandible				
Range	31.23- 64.75	28.52-68.80	34.77-67.14	37.06-63.78
Average	51.02	52.22	48.27	49.24
Standard deviation	6.15	6.50	6.03	5.87
Maximum breadth of ramus of the mandible				
Range	25.68-47.71	26.68-49.54	28.25-46.98	29.31-46.10
Average	40.11	41.14	38.18	38.78
Standard deviation	3.55	3.56	3.14	3.1
Minimum breadth of ramus of the mandible				
Range	21.06-38.84	24.06-40.36	23.00-38.84	21.92-40.36
Average	30.72	31.15	29.11	29.40
Standard deviation	2.85	2.87	2.80	2.90

Ranganath et al, showed that mean for minimum ramus breadth in males was 31.7 mm and for females was 31.1 mm. Standard deviation for male was 0.48 and for females was 0.38.[8] Ongkana studied data on 102 mandibles which showed that the mean value of minimum ramus breadth for male mandible was 32.8 mm and for female was 31.4 mm. Standard deviation for male was 0.34 and for females was 0.31.[9] Vinay et al, found mean for minimum ramus breadth in males was 31.6 mm and for females was 29.3 mm. Standard deviation for male was 0.27 and for females was 0.29.[10]

Similarly mean value for maximum ramus breadth in males was 38.8 mm and for females was 40.7 mm. Standard deviation for male was 0.52 and for females was 0.54.[8] Vinay et al, found the mean value for maximum ramus breadth of mandible was 41.7 mm in males and 38.9 mm in females. Standard deviation for maximum ramus breadth in males was 0.32 and in females was 0.32.[10]

The accuracy of sexual determination by taking different parameters of the mandibular ramus was 60%; 70.9-82.9%; 60.3-80.2%; and 76%.[6,11-13] For accurate

determination of sex one should consider all the three parameters together. In the present study authors took all the three parameters together to determine the sex and found them to be 95% accurate.

Larger sized mandible in the male is reflected anthropometrically as all dimensions would be higher in males. The differences observed in male and female mandibles may be explained on the basis of genetically determined factors, like the size of teeth, and local factors, like muscle forces. Chewing habits and nutritional factors are also other responsible factors for the sexual dimorphism in skeleton.[14]

CONCLUSION

Sexual dimorphism on the basis of anthropometric analysis of the ramus of the mandible is indeed possible with great accuracy. The range of the data for all the parameters measured in this study is having immense importance in determination of sex with the fragment of the bone available in mass disaster. All the mandibles used for study were procured from the Gujarat region only; however, larger numbers of mandibles should be studied from different regions of India to get wide range of data for all the three parameters studied for more accuracy. These data could be utilized by surgeons for reconstruction of lower face.

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