Sexual Dimorphism Of Human Mandible By Using Various Parameters In The Population Of Maharashtra

Dhanaji S Jadhav[1], Vivek K Nirmale[2], Dhapate S. S.[3]

Associate Professor[1], Assistant Professor[2], Professor and HOD[3]
Department of Anatomy
M.I.M.E.R. Medical College[1,2], Talegaon Dabhade, Pune, S.R.T.R. Medical College[3], Ambajogai,

Abstract: In medicolegal cases identification of sex, race and age of the diseased after a long-time period lapsed since death is very complicated. For any anthropologist the given task becomes easier specially when skull or pelvis is provided. Very few studies were designed for metrical parameters of mandible for the same purpose. The present anthropological study was conducted with a view to establish confirmative statistical formulae to determine the sex of mandible. 130 Adult mandibles (48 are of females and 82 of males) of both sides were examined with special reference to 24 parameters. The personal record of all bones for sex and race are all available with the bone bank. The instruments which are used for the measurements of various parameters are Sliding compass, thread, Osteometric board, Vernier calliper, steel tape and Goniometer. For all the twenty-four parameters, we measured range, mean, standard deviation, P value and demarcating point. All the observations were tabulated and analysed statistically and compared with the previous studies. All the parameters and indices are statistically significant. Further we combined all parameters in single group and applied multivariate analysis. From our study it become very clear that very large number of mandibles can be identified correctly i.e. 84% in males and 82% females (mean 83%). Thus, the sex of mandibles can be identified correctly in 83% cases by using these parameters.

Key words: anthropologist, multivariate analysis and mandible.

Introduction:

Mandible is the unpaired bone of the jaw. It consists of tooth bearing body and more vertically displaced ramus. The mandible forms the temporomandibular joint by articulating with temporal bone of the skull. It receives the insertion of muscles of mastication. During examination of medicolegal cases bones were brought in the form of single complete or few remnants or broken pieces. When complete skeletal is available, it is very easy to determine the age, sex and race of the individual. When single bone is provided like skull or pelvis, accuracy improved a lot. But when mandible alone is provided it becomes difficult to determine the sex. But with a perfect knowledge of different mandibular measurements and their variations we can reach to maximum accuracy in determination of sex. Previously Hanihara[1] (1959) and Giles (1964)[2] studied multivariate analysis of mandible. Jit and Sahani (1983)[3] have used multivariate analysis for determination of sex from clavicle.

In our present study a total of 130 (82 males and 48 females) mandibles were taken and analysed statistically. In the second part of our study we applied multivariate analysis and compared our findings with the previous studies.

Material And Methods:

130 Adult mandibles of known sex available in Bone bank of the department of Anatomy, Government Medical College, Aurangabad, Government Medical College, Ambajogai and Government Medical College, Solapur were used for the present study. Out of 130 hip bones 48 are of females and 82 of males. All the mandibles are dry, free of damage or deformity and are fully ossified. Unossified, broken damaged mandibles were excluded from the study.

The instruments which are used for the measurements of various parameters are Sliding compass, thread, Osteometric board, Vernier calliper, steel tape and Goniometer. The measurements of each half i.e. right and left were recorded separately wherever possible. The linear diameter was measured in millimetres and angular measurements were recorded in degrees.

For the present Study following points on the mandible were recorded.

1. Gonion: the most lateral point on junction of horizontal and ascending ramus of the mandible.
2. The medial most points on the external surface of mandibular angle.
3. Most medial points on the inner surface of mandibular angle
4. Most lateral, medial and superior points on the condyles of the mandible
5. Tip of the coronoid process

6. Line joining the- Gonion to the tip of coronoid process and Gonion to the most lateral point on condylar process.

The following measurements were taken.

A1: Bigonial Diameter - distance between right and left gonial points were measured in mm by means of Vernier calliper.

A2: Distance between two most medial points on internal surface of angular process of mandible.

A3: Distance between lower borders of mandibular foramina.

A4: Distance between two most medial points on condylar processes were measured.

A5: Distance between two most lateral points of condylar processes measured in mm by Vernier calliper.

A6: Distance between two most superior points of condylar processes measured in mm by sliding compass.

A7: Distance between two coronoid tips measured in mm by sliding compass.

A8: Distance between Gonion to the tip of coronoid process.

A9: Distance between Gonion to the most lateral point om mandible.

A10: Symphyseal height: Distance between infradental and gnathion measured by Vernier calliper.

A11: Minimum breadth of ascending ramus measured in mm by Vernier calliper

A12: The Angle of Mandible.

A13: Angle of Gonion- it is the angle between distance from gonion to the tip of coronoid process and distance between gonion to the most lateral point of condyloid process and was measured in degrees.

A14: length of the mandible: length of lower border of mandible measured by thread.

A15: maximum thickness at level of symphysis menti measured by Vernier calliper.

A16: mandibular body height: Distance between the bony spicule between the first and second molar teeth to the lower border of mandible, the two points forming a line perpendicular to the body of mandible.

A17: mandibular ramus height up to incisura mandibularis was measured by drawing perpendicular from the lowest point on incisurae mandibularis on the lower border of ramus of mandible.

A18: mandibular body thickness was measured in mm by Vernier calliper at the level of bony spicules between the first and second molar teeth.

A19: bicondylar breadth was measured with the help of sliding compass.

A20: Condylar width: the width of each condyle was measured and the mean value was considered for the present study.

A21: Coronoid process maximum width was measured in mm.

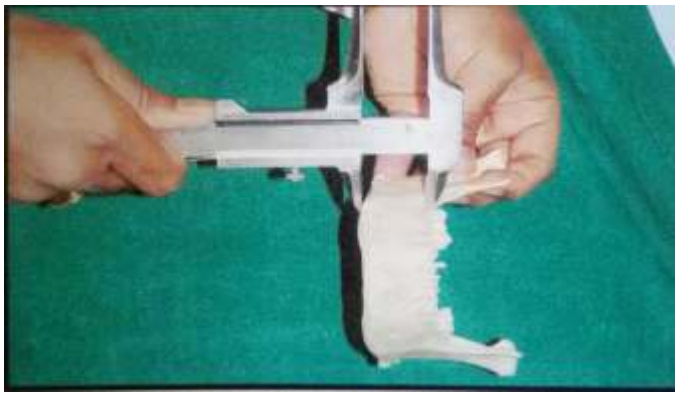
A22: Distance of mental foramina from lower border of mandible was measured in mm by sliding compass.

A23: intertubercular distance of mentum was measured in mm by sliding compass.

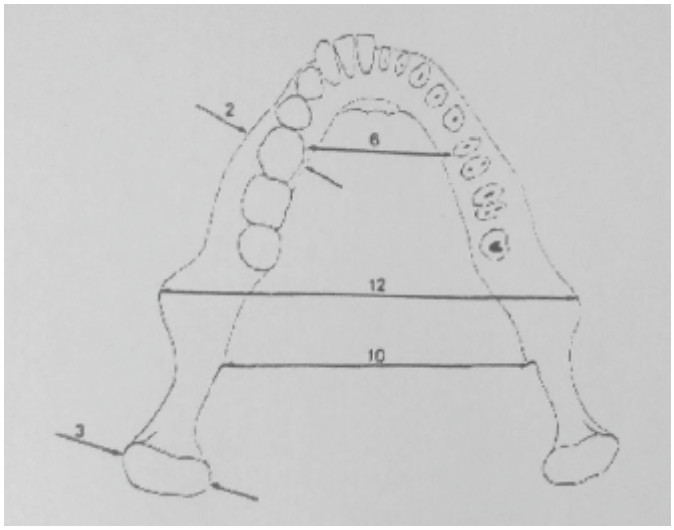
A24: Symphyseal angle was measured by keeping mandible on plain surface and measured in degrees.

Photograph 1: Distance between two most medial points on the internal surface of angle of mandible

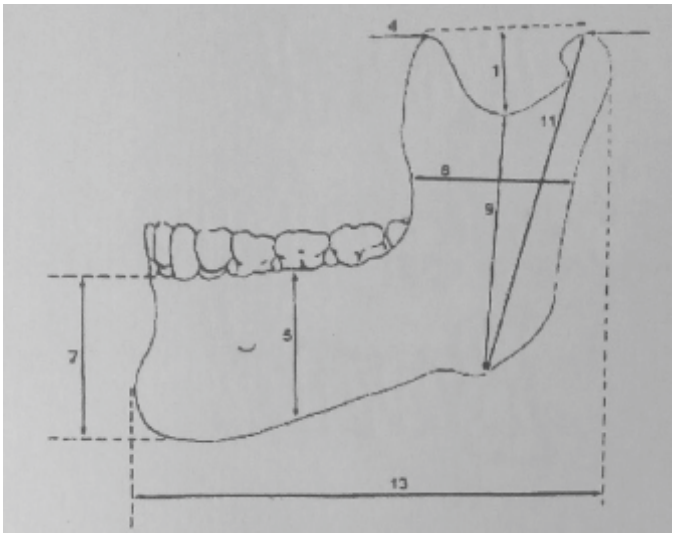
Photograph 2: measuring the Symphyseal height



Photograph 3: Measuring the mandibular body height



Photograph 4: Showing measurements of different parameters
2- Mandibular thickness, 3- Condylar thickness, 10- Distance between two most medial points on the internal surface of angle of mandible, 12-Distance between two coronoid tips



Photograph 5: Showing measurements of different parameters
5- Mandibular body height, 7- Symphyseal height, 8- Minimum breadth of Ascending ramus, 9- Mandibular ramus height up to incisura mandibularis

Results:
As the first part of the study all the values were tabulated and analysed statistically by routine methods. The values of mean, range, and standard deviation are obtained, demarking points are obtained and subsequently P value is obtained for each of these 24 parameters. In the second part of study, "Multivariate Linear discriminant function" as proposed by Armitage (1971)[4] is used. According to him all parameters were designated under one group, and the respective differential functional score as Z was calculated. SPSS (sum of products and sum of squares) is used for applying multivariate linear discriminant analysis. It is observed that 69 out of 82 male mandible bones scored on the male side of Z0 and 40 out of 48 female mandible bones scored on the female side of Zo. Thus 122 of 130 are accurately sexed.

Table No.1: Percentage of mandibles accurately sexed by multivariate analysis

GROUP OF VARIABLES	Percentage of mandibles sexed correctly		
	FEMALE	MALE	OVERALL
GROUP	40 (82%)	69(84%)	83%

Discussion:
Davingdons (1963)[5] has stated as a general rule the male bones are more massive and heavier than female bones. The crests, ridges, tuberosities and lines of muscles and attachments of ligaments are more strongly marked in males. This rules also governs the size of the joints and articular surface as well.

The extensive overlap between male and female ranges in various parameters of the mandible was felt awfully during this work. The probable reason for this overlapping are as follows.

a) Considerable frequency of hypermasculinity in male bones and hypofeminity in female bones.
b) The above factor is related to the genetics, dietary, Physical stress in individuals.
c) Using the formula of mean ± 3 S.D. certainly provides a broader range. In the studies where the dietary and physical factors cannot be ascertained in relation to the individual bones, such a wide range giving the coverage up to 99.75 % confidence limit was found to produce the overlap. The degree of overlap can, however can be reduced if the range was derived on the basis of "mean ± 2 S.D." which gives 95% confidence limit, thereby ensuring the statistical validity. This modification is being suggested because the aim of univariate methods in studying the sex differences is not limited only to giving the demarking point, but it is actually to enable in proper sex identification in the majority of bones. If this approach is adapted for each parameter being discussed and also if the frequency of the classifications, misclassification and the overlap were studied for each parameter in isolation as well as various parameters in combination, the utility of metric measurements and indices in studying sex

dimorphism will certainly increase and thereby will reduce the limitation of this approach. The hypothesis is based on the observations that the variations among the measurements within the sex as well as between the sexes were seen when the comparisons were made between the two races, two sexes and two countries and even within the regions of the same country. The continuation of such studies in different areas in a coordinated manner will certainly help in analysing which of the factors mentioned above are capable of exerting predominant influence on the phenotype. Thus, if genetic, geographic and racial factors were observed to be the important factors, we can safely presume that the standards laid down for a different area after the extensive and corelated studies will remain constant for a long period of time. Martin (1936)[6] achieved 83% accuracy by applying multivariate analysis by using six variables. Hanihara (1959)[1] achieved 85 % accuracy while Giles (1964) obtained 80-85% accuracy by using nine variables. Diwan C.V. (1984)[7] obtained 85% accuracy by using nineteen variables. However, if predominant influence is observed to be plastic ones (e.g. Dietary habits, lifestyles and physical stress), it is hypothesised that the anthropometric standards will have to be evaluated from time to time in the perspective of such influences for their validity.

References:

1. Hanihara. sex diagnosis of Japanese skulls and scapula by means of discriminant function analysis. Journal of Anthropological Society of Kippona. 1959; 67 (722): 21-27.

2. Giles E. sex determination by discriminant function analysis of mandible. American Journal of Physical Anthropology. 1964; 22(2): 129-36.

3. Jit and Sahani. Sexing the north Indian Clavicles. Journal of Anatomical Society of India.1983; 32(2): 61-72.

4. Armitage P. (1974) Statistical methods in medical research. Blackwell Scientific Publications, Oxford and Edinburgh, 325-355.

5. Devivongs V. the pelvic girdle of Australian Aborigine, sex differences and sex determination. American Journal of Physical Anthropology. 1963;21 (4): 443-445.

6. Martin. A study of an Egyptian series mandibles with special reference to mathematical methods of sexing, Biometrica.1936; 28: 148-178

7. Diwan C. V. (1984) M.S. dissertation, Marathwada university.

Corresponding Author

Dr. Vivek K. Nirmale
Assistant Professor, Department of Anatomy,
M.I.M.E.R. Medical College,
Talegaon Dabhade,
Pune - 410507
Maharashtra
E-mail: vivnir1101@gmail.com