Original Article

Study Of Morphometric Evalaution Of Cadaver Mandible

Dr. Pavan Kumar Sisodia[1]*

[1]*Assistant Professor, Dept. of Anatomy, Shri Balaji Institute of Medical Sciences, Mowa, Raipur

Dr. Deepak Jaiswal[2]

[2]Assistant Professor, Dept. of General Medicine, Shri Balaji Institute of Medical Sciences, Mowa, Raipur

Dr. Sushma BJ[3]

[3]Professor and Head, Dept. of Biochemistry, National Institute of Medical Sciences, Jaipur

***Corresponding Author:** - Dr. Pavan Kumar Sisodia

*Assistant Professor, Dept. of Anatomy, Shri Balaji Institute of Medical Sciences, Mowa, Raipur

ABSTRACT

Background: The largest and strongest bone of the face, the mandible has several morphometric features that serve in identification of sex which is the first step towards age, stature and ethnicity determination. Increase in natural calamities, accidents and violent crimes have resulted in increase in mutilated faces or unidentified bodies parts that pose a great challenge for forensic experts, plastic and maxillofacial surgeons. Mandible is one of the most durable bones of skull, and mandibular remains from excavation sites is representative of the population and is of interest to anthropologists. Features of the lower jaw is of interest to orthodontic and plastic surgeons due to more people wanting to correct dental and facial asymmetries.

Objectives of the study: The present study aims to explore and measure bi-condylar and bi-gonial width, angle of mandible, goniognation length, mandibular height and Bonwill's triangle of mandibles in our population. Materials and methods: The present study was conducted in Department of Anatomy at our hospital 80 (44 male, 36 female) dry adult human mandibles were studied. Fractured, pathological or deformed bones were excluded. Digital vernier callipers and mandibulometer were used to measure: Height of Mandible, Angle of Mandible, Bicondylar width, Bi-gonial width Goniognation Length and Bonwill's Triangle.

Results: Only 16% were equilateral in males and 40 % in females, rest of the triangles are isosceles in both genders. The mean length of the sides were less than 10cm and lesser for females. Dimensions of Bonwill's triangles show strong positive correlation in both genders between mid-incisor to right condyle and mid-incisor to left condyle.

Conclusion: Sex determination has always been an integral part in biological profiling. The mandible has dimorphic traits which can be successfully applied for sex determination. But reliability lies on population-specific morphometric data. Applying an average Bonwill's

triangle values for making articulators and prosthetics for all races has resulted in errors in full mouth reconstruction.
Key-words: mandible, bi-condylar width, bi-gonial width, angle of mandible, mandibular height and bonwills triangle.

INTRODUCTION

The largest and strongest bone of the face, the mandible has several morphometric features [1,2] that serve in identification of sex [3], which is the first step towards age, stature and ethnicity determination [4,5,6]. Increase in natural calamities, accidents and violent crimes have resulted in increase in mutilated faces or unidentified bodies parts that pose a great challenge for forensic experts, plastic and maxillofacial surgeons [7]. Mandible is one of the most durable bones of skull, and mandibular remains from excavation sites is representative of the population and is of interest to anthropologists [8]. Features of the lower jaw is of interest to orthodontic and plastic surgeons due to more people wanting to correct dental and facial asymmetries [9,10]. Anaesthesiologists and ENT surgeons too need knowledge about mandibular parameters of a population for their procedures [11,12]. Skeletal characters vary between sex and race, so it is necessary to document sex and ethnicity-based standards.

Modern occlusal concepts began with G. Bonwill's [13] works who described an equilateral triangle with sides 10cm formed by joining the middle condylar points and mid-incisal point on mandible. This is considered to be the ideal arch. Some investigators later agreed with Bonwill's theory [14], while some showed that sides of Bonwill's triangle were rarely equal and depended on ethnicity and sex[15,16,17]. This triangle helps to simulate the temporomandibular joint movements and gives the cusp angulations to construct complete dentures, articulators for reproducing mandibular movements, making of jaw prosthetics and is of anthropological interest too. There is paucity of data on parameters like goniognation length and dimensions of Bonwill's triangle of mandibles from Eastern India. Previous studies show that there is intra-population difference in mandibular features depending on region of residence and cultural practices.

The present study aims to explore and measure bi-condylar and bi-gonial width, angle of mandible, goniognation length, mandibular height and Bonwill's triangle of mandibles in our population.

MATERIAL AND METHODS:

The present study was conducted in Department of Anatomy at our hospital 80 (44 male, 36 female) dry adult human mandibles were studied. Fractured, pathological or deformed bones were excluded. Digital vernier callipers and mandibulometer were used to measure:
Height of Mandible (at symphysis) – distance between infradentale and gnathion.
Angle of Mandible– Angle between lower and posterior borders of ramus.
Bicondylar width– Distance between the lateral poles of right and left mandibular condyles.
Bi-gonial width– Distance between right and left angle angles of mandible.
Goniognation Length– Distance between angle of mandible (gonion) and gnathion (lowest point of mandible in anterior median plane).

Bonwill's Triangle– 3
- Distance between right mid-condylar point and mid-incisal point
- Distance between left mid-condylar point and mid-incisal point
- Distance between left and right mid-condylar points.

In case of angle of mandible and goniognation lengths, average of right and left sides was computed. SPSS was used for statistical analysis, p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Shows dimensions of male and female mandibles			
Parameters	Male	Female	p value
Bi-condylar width	10.98±0.68	11.10±0.58	NS
Bi-gonial length	9.38±0.67	8.34±0.68	S
Age of the mandible	120.1±1.56	129.8±2.34	HS
Height of the mandible	2.81±0.54	2.72±0.46	S
Gonio-gnation length	8.34±0.48	7.62±0.41	S

It is evident from the above table that Except bi-condylar width, all above parameters showed statistically significant gender difference.

Table 2: Shows dimensions of Bonwills triangle male and female mandibles			
Parameters	Male	Female	p value
Mid right condyle to incisal length	9.87±0.42	9.62±0.38	S
Mid left condyle to incisal length	9.76±0.54	9.58±0.62	S
Mid bi-condylar length	9.52±0.36	9.48±0.42	NS

Table 3: Shows correlation coefficient between dimensions of Bonwills traingles in male and female mandible			
Variable	Male	Female	p value
Mid incisor to right condyle vs mid incisor to left condyle	0.82	0.96	Strong positive correlation
Mid incisor to right condyle vs bi-condylar midpoint	0.72	0.62	Strong positive correlation
Mid incisor to left condyle vs bi-condylar midpoint	0.76	0.58	Strong positive correlation

Bonwill's Triangle: Only 16% were equilateral in males and 40 % in females, rest of the triangles are isosceles in both genders. The mean length of the sides were less than 10cm and lesser for females (Table 2). Dimensions of Bonwill's triangles show strong positive correlation in both genders between mid-incisor to right condyle and mid-incisor to left condyle (Table 3).

Discussion

The present study was conducted in Department of Anatomy at our hospital 80 (44 male, 36 female) dry adult human mandibles were studied. Fractured, pathological or deformed bones were excluded. Digital vernier callipers and mandibulometer were used to measure: Each bone was measured for 6 parameters, compared with earlier studies to utilise the information to identify the gender and create a database for reference for further studies,

Bi-condylar width: In this study mean value for male mandibles was greater than in females but not significant. In 207 mandibles studied by Jayakaran F et al [22] found a mean of 11.26 ± 0.53 cm in males and 10.77 ± 0.53 cm in females of Karnataka. Datta A et al[21] got a mean of 11.27 ± 0.56 cm in males and 10.75 ± 0.77 cm in females in Devangere, Karnataka. The gender differences were statistically significant . Similarly, Sreelekha et al[19] found highly significant gender differences for bi-condylar width for population of South India. Ongkana N et al[3] had similar results for Thai population , Bertsatos et al[29] for Greek population and Steyn et al[30] for South African whites. Kumar et al[27] studied mandibles from Morgantown (USA); values were 11.29 ± 1.31 cm and 7.27 ± 1.69 cm for males and females respectively. Unlike our findings, Ranganath V et al[23] found females had greater bicondylar width than males.

Bi-gonial length: The mean value in male mandibles was more in males compared to female mandibles in this study, with statistically significant gender difference. Datta A et al[21] too recorded highly significant difference between male (9.57 ± 0.52 cm) and females (8.88 ± 0.68 cm) bi-gonial length. Jayakaran F et al[22] similarly concluded that mean length in males (9.38 ± 0.54 cm) was more than in females (8.71 ± 0.48 cm) . Sreelekha et al[19] recorded a very highly significant gender difference ; mean bi-gonial length in males and females were (8.94 ± 0.69 cm) and (7.78 ± 0.52 cm) , respectively. Study on Thai population by Ongkana et al[3] showed similar results (males : 9.68 ± 0.77 cm , females : 8.97 ± 0.59 cm).

Angle of mandible: We found that this angle was less in males than in, with was statistically highly significant. Datta A et al[21] derived 126.6 ± 6^{o} and 139 ± 72^{o} for males and females respectively . Jayakaran F et al[22] too found mean mandibular angle in males (121.43^{o}) was less than in females (124.19^{o}). Sreelekha et al[19] also found significant difference between males (106 ± 5.05^{o}) and females (116.36 ± 5.5^{o}). Ranganath V et al[23] and Leversha J et al[18] showed similar results.

Height of Mandible: In this study , mean value in males more compared to females. Similar results were provided by Datta A et al[21] (males: 2.88 ± 0.32cm, females: 2.28 ±0.38 cm). Sreelekha et al[19] reported male and female values as 2.99 ±0.31cm and 2.83 ±0.28cm respectively.

Goniognation Length: Our study shows males have greater goniognation length than females and the difference is statistically significant. Ongkana[3] found significant gender difference between Thai males (8.32 ±0.52 cm) and females (7.92 ±0.46 cm). In South African whites, Styne M et al[30] showed similar significant gender differences (males: 7.68 ±0.57 cm; females: 7.27 ±0.53 cm). We could not find record of goniognation length for Indians.

Bonwill's Triangle: In our study, Bonwill's triangle is equilateral in only 16% males and 40% females. Majority are isosceles triangles, with the sides formed by midcondylar-incisal length being equal and statistically significant gender differences existed. All the sides were larger in males than females, although the difference for mid-bicondylar length was not significant. All sides were <10.16cm. Bonwill[13] measured 6000 skulls and 4000 living persons and deduced that the triangles were equilateral and named it after himself. He showed that the average side length was 4" (10.16cm). Ohm E et al[17] studied Norwagean population to show that all sides of the triangle were nearly equal, less than 10cm and sexually dimorphic. Shen Y W et al[28] showed in the Taiwanese population length of sides of Bonwill's triangle were consistent with Bonwill's theory but larger by 2mm. Lotric N et al[16] showed Yugoslav mandibles rarely had equilateral triangle, the mid-bicondylar breadth

was lesser than 10cm and the other 2 sides recorded sexual dimorphism. Zivanovic S et al[15] found in East African Bantu-speaking males, the triangles were isosceles, but in females they were nearly equilateral; all sides were larger in males. Nikolopoulou F et al[14] showed the Greek population had equilateral Bonwill's triangle, the sides of which were greater in males with a mean of 10.1cm. Such studies on Bonwill's triangle are scanty in India.

Conclusion:

Sex determination has always been an integral part in biological profiling. The mandible has dimorphic traits which can be successfully applied for sex determination. But reliability lies on population-specific morphometric data. Applying an average Bonwill's triangle values for making articulators and prosthetics for all races has resulted in errors in full mouth reconstruction.

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Conflicts of Interest

There are no conflict of interest.

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