Anthropometric Evaluation of Gonial Angle on Adult Human Dry Mandible in the Northern Zone of Bangladesh

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Abstract

Introduction:The mandible is the largest and strongest bone of the face and articulates with skull at temporomandibular joint. It consists of horseshoe shaped body and a pair of rami. The body of mandible meets the ramus on each side at the angle of mandible.

Objective: The objective of the study was to measure the anthropometric evaluation of gonial angle of adult human dry mandible in northern zone of Bangladesh.

Methods: This observational study was carried out in the Department of Anatomy, Rangpur Medical College, Rangpur during the period to July 2017 to June 2018. The study was conducted on 200 adult dry human mandibles which did not show any fracture, pathology or wear and tear irrespective of age and sex. All measurements of gonial angle of mandible were done on adult human dry mandibles by mandibulometer. Mandibular index was calculated for each mandible. The data obtained were statistically analysed by SPSS version

Result: Regarding gonial angle, the result was found in present study, mean ±SD 116.56°±10.2, The gonial angle in mandibular bones were measured as the angle formed by the base of mandible and the posterior border of the ramus by the scale of protractor of mandible, which is placed over the angle of mandible in such a way that the base of protractor coincides with the base of mandible.

Conclusion: The present study would provide valuable information about the parameters of the mandibles of the Bangladeshi population which would help the anatomists, forensic experts, orthodontist and anthropologists.

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Introduction

The mandible is bone of the lower jaw and is the only movable bone of skull. It articulates with the temporal bones to form synovial temporo-mandibular joints. In new born the body is composed of two halves, united at the symphysis menti by a fibrous joint which is replaced by bone within two years.[1] Mandible is formed to carry the lower teeth opposing those of upper jaw, give insertion to muscles of mastication, tongue, floor of mouth and some muscles of facial expression.[2] Anthropometry is a series of systematized measuring techniques that expresses quantitatively the dimensions of human body, their proportion and skeleton. They observe and compare the variation of body proportion between ethnic origins and to relate them to locomotors patterns, energy expenditure and lifestyle.[3] Anthropometry often viewed as a traditional and perhaps the basic tool of biological anthropology, but it has a long tradition of use in forensic medicine.[4] As the mandible is the last skull bone to cease growth, it is sensitive to the adolescent growth spurt. So, the stages of mandibular

development, growth rates and its duration are distinctly different, also masticatory forces not similar in both sexes, which influence shape of mandible.[5] The four main features of biological identity are sex, age, stature and ethnic back ground.[6] In the adult skeleton, sex determination is usually the first step of identification process as subsequent methods for age and stature estimation are sex dependent. The reliability of sex determination depends on completeness of the remains and degree of sexual dimorphism inherent in the population. Although many bones of skeleton present sex, age and race related differences, the distinctive morphology of some bones make them of interest from anatomical, as well as anthropological point of view. More over specimen identification and sex determination from skeleton remains has great importance in forensic medicine.[7] Thus by using metric techniques estimation of the age, sex and race of an individual could be tried.[8]When the entire skeleton is available for analysis, sex can be determined upto 100% accuracy, but in cases of mass disasters where usually fragmented bones are found, sex determination is not possible and depends largely on the available parts of skeleton. Skull is the most dimorphic and easily sexed portion of the skeleton after pelvis. But in cases where intact skull is not found, morphology of mandible play a vital role in sex determination by anatomist as well as for the anthropologist for population studies as it is one of the most sexually dimorphic (providing sex differentiation upto 98%) bone of the skull.[9] Many authors have considered different variables in human mandible for determination of sex by visual determination of its external features and by its various measurements of parameters.[10] Morphologically, mandible of male is more robust and defined than female.[11] Female mandible appears filed, smooth to touch.[12] Male mandible is larger, longer specially in length and height of body.[13]Again, shape of chin is square in males and rounded in female; Gonial flare is everted in male and inverted in female; muscle markings more prominent in males. In South African peoples shape differences in the symphyseal region and anterior body of mandible can be used to predict sex with above 80% accuracy. Regarding metrical study, some authors stated that angle of mandible are known to be highly sexually dimorphic.[14] There is statistically significant sex difference in mandibular angle (Gonial angle) in context to gender & race.[15] There is also sex related differences in body, ramus and condyles such as bicondylar breadth, bigonial breadth. Again most of the features of the mandibles that studied were from foreign countries.[16] A single study regarding mandible was done in Bangladesh at Dhaka Medical College but no study is still done in this northern part of Bangladesh.[17] Thus the present study on metric and non-metric features of mandible among population of Bangladesh would be helpful for our own data bank that are related to genetic, age, racial and environmental factors and helpful for anatomist, anthropologist, forensic experts and maxillofacial surgeons of this country.

Methods

This descriptive study was performed in the Department of Anatomy, Rangpur Medical College, Rangpur, on 200 (two hundred) adult human dry mandibles and mandibles were collected from 2nd year students of Rangpur Medical College, Prime Medical College and Army Medical College, Rangpur between the period to July 2017 to June 2018. The objectives and the procedures of the study were explained in detail to the students.The bones with gross pathological deformities were excluded from our study. The gonial angle in mandibular bones were measured as the angle formed by the base of mandible and the posterior border of the ramus by the scale of protractor of mandible, which is placed

over the angle of mandible in such a way that the base of protractor coincides with the base of mandible. The measurements were recorded in degree. This was measured only on left side. Mean±SD of all parameter was calculated by single sample 't' test.

Results

In present study the ranges, mean ±SD of gonial angle,. It was found that the mean ±SD of gonial angle, was 116.56°±10.22, No significant difference was found between the distances of both sides for other three measurements

Results of measurement of gonial angle (n=200), variable is gonial angle, ranges are between 95-150 in degree, Mean±SD is 116.56°±10.22

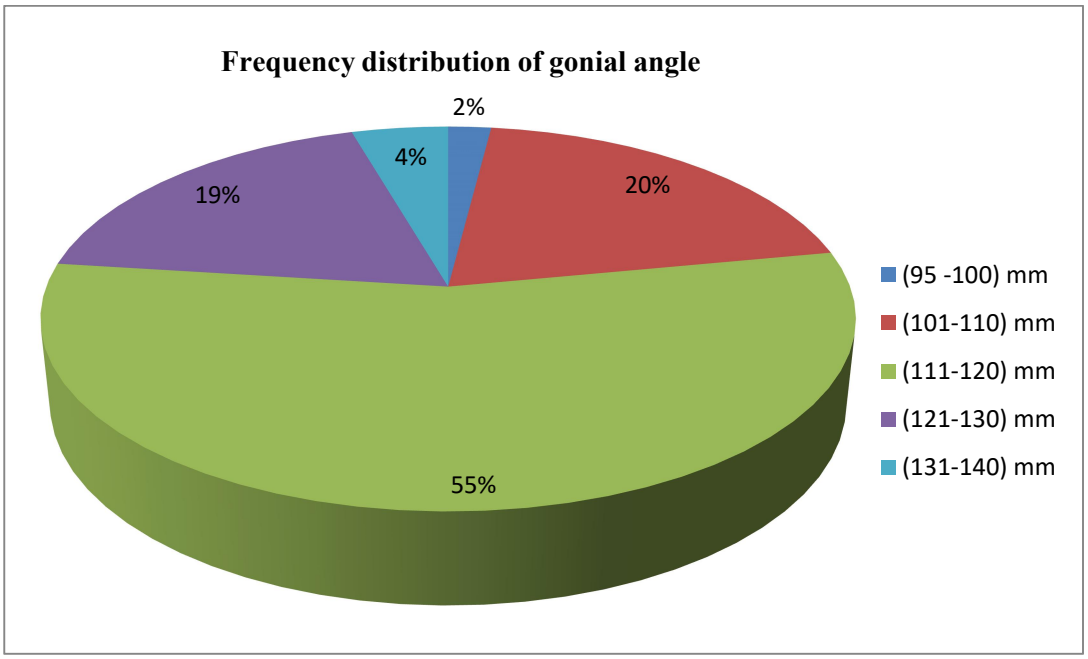

Figure 1. Frequency distribution of gonial angle

Discussion

To evaluate the gonial angle and to analyze the relationship of the angle and height and breadth of the ramus of the mandible according to gender, so as to study its role in the anthropological diagnosis is point of interest of researchers for long period.

The comparison of mean values on gonial angle of mandible with other studies is listed in Table I.I t is observed from the table that most of the workers found more obtuse gonial angle in females than males which were significantly higher (Kawale et al 2015, Kumar and Lokanadham2013, Datta et al. 2015, Chole et al. 2013, Lin et al 2014, Abu-Taleb & El Beshlawy 2015, Jambunath et al. 2016, Lopez 2017).[24] However Sharma et al (2015) found similar value in both sex.[25] On the other hand, Thakur et al. (2013) and Mondol & Chatterjee (2017) found higher value of the angle in males.[26]

The mean ± SD of gonial angle of mandible as studied by Kumar and Lokanadham(2013) was 122.55±67.83°, Srineeraja et al (2015) was 134.3°and that in the present study was 116.56 ± 10.22° done in mandibles of unknown sexes. The value was lowest in the present study.[?]

The highest value of gonial angle found by Datta et al. (2015) in both male and female and by Mondol & Chatterjee (2017) found a lowest value of the angle in both sexes than all other studies.[27] Kawale et al (2015) stated that mandibular angle has significant association with sex determination, Lopez et al (2017) found lowest accuracy but Sharma et al (2015) revealed there is no correlation between the gender and the gonial angle and stated that the angle increases in elderly mandibles.[20,24,25]

Mandible of White races have greater and everted gonial angle.[20] The gonial angle muscle function tends to preserve bone at its point of insertion of medial pterygoid and masseter muscles so the structure of thegoinal region will be maintained. When teeth are present, the muscular activity associated with mastication preserved the angle. With loss of teeth, the bone undergoes remodelling and causes an increase in size. The postural and functional interrelationships of the cheek, lips and tongue in edentulous individuals can alter the gonial angle. Resorption of the bone at the posterior or inferior border of this region, the area of the masseter muscle insertion, leads to increasing obtuseness of the mandibular angle. In subjects with strong masseter and anterior temporal muscles have small gonial angles.[25,]The forces of the elevator muscles attain their highest in young adult, and takes part in modeling the mandibular ramus which in turn contribute in the development of the mandubular ramus flexure.[25] The transformative changes in gonial angle may be affected by several factors throughout life and its reliability as sole indicator of age, gender, and dentition status questionable.[27,28]

Gonial angle can be implicated as a forensic tool for gender determination but not suitable for age determination[18,]There seems to be difference in the gonial angle with different age groups but not significant.[27,]There is significant sex difference in mandibular angle and mandibular length in context to gender and race.[25] The average mandibular angle of black Zimbabweans is greater than the Black African populations. Individuals with short and broad faces (Chamaeprosopic) has smaller angle than individuals with a long and narrow face (leptoprosopic).[29]

Table I: Comparison of mean value of gonial angle (degree) with other studies

Authors	Sex of the Subject	
	Male (degree)	Female (degree)
Chole et al. 2013	118.05 ± 6.47	123.10 ± 7.43 (S)
Thakur et al. 2013	118.67 ± 10	108.87 ± 8.17 (NS)
Lin et al 2014	122.53±6.64	124.30±6.09 (S)
Abu-Taleb & El Beshlawy 2015	122.66±4.18	125.12±4.43 (S)
Datta et al. 2015	126.6 ± 6	135.72 ± 8 (S)
Kawale et al. 2015	121.85 ± 9.60	130.94 ± 7.79 (S)
Sharma et al. 2015	124.0 ± 6.27	124.03 ± 5.30 NS
Jambunath et al. 2016	125.48 ± 5.67	129.55 ± 4.42 (S)
Lopez 2017	122.22±7.73	124.27±7.43 (NS)
Mondol & Chatterjee 2017	95.61±6.1	78.47±8.9 (S)
Kumar & Lokanadham 2013	122.55 ± 6.78 (Both sex)	
Srineeraja 2015	134.03 (Both sex)	
In present study 2018	116.56 ± 10.22 (Both sex)	

S- significant, NS- not significant

Conclusion

The present study would provide valuable information about the parameters of the mandibles of the Bangladeshi population which would help the anatomists, forensic experts, orthodontist and anthropologists.

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