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EVALUATION OF RACE BY GNATHIC INDEX AND FACIAL ANGLE OF ADULT HUMAN DRIED SKULLS

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ABSTRACT

A measurement of the relative amount of the jaw, expressed in terms of ratio of distance from the nasion to the basion (arbitrarily taken as 100) to the distance from the basion to middle point of the alveolar process called as gnathic index means angle of projection of face indicates presence of orthognathism or prognathism¹ Facial angle is distance between nasion to the ogonion intersected by horizontal line of Frankfurt. Facial angle indicates position of chin² When comparing skulls of different races and species, physical anthropologist makes use of measurements and indices which gives numerical expressions to certain features of the skulls. This constitutes craniometry which is the part of an anthropometry.³

Seventy five dried skull collected from different part of Maharashtra were measured to determined the gnathic index & facial angle. Gnathic index were classified by the method of Montagu (1960).⁴ Average basion-nasion height were found to be 9.71 cm and maximum & minimum were observed to be 10.3 cm and 9.2 cm respectively. Average basion- prosthion height was found to be 9.01 cm and maximum & minimum were observed to be 10.0 cm and 8.2 cm respectively. Average gnathic index (mean \pm SD) was 92.67 ± 4.02 & S.E. 0.46. Average facial angle were found 87° . Maximum & minimum were observed to be 89° and 85° respectively. In our study most of the skulls were grouped under the Orthognathous (94.66%) when based on Montagu² & Comas³.

Key Words: gnathic index, facial angle, anthropometry, Maharashtra population

INTRODUCTION

Physical measurements of the skull are important clinical appraisal of certain neurological condition and of abnormally large heads or grossly misshapen cranium. Science has already proved that genetics is not the only factor which decides the physical features of an animal. Apart from genetic factors, environmental factors such as sunlight, temperature, humidity, climate, geographical condition, food and various other

factors affect the physical and psychological of development of human being. For two centuries biologist and anthropologist attempted to classify human being according to phenotypic variations into races. Most classification are based either on one or two phenotypic characters such as pigmentation or skull form. A science which studies the physical differences quantitative is called as "Anthropometry".⁶ Physical anthropology is the science of biology of man and his close

relatives. It may be divided into primatology (study of evolution and variation in non-human primates), human paleontology, (study of fossil human types), and genetics (study of inherited differences in the physical attributes of living man, and distribution and evolutionary values of such differences and human societies) ⁷. Craniometry is concerned with the technique of measurement on the cranium and face of the skeleton. Craniometry includes measurement of different types, for example linear, angular, depth, volume, arc, etc. and hence, different types of instrument are needed to take different types of measurements. Some measurement are taken directly taken on the skull. Craniometry is an important character which may be used to determine the racial differences as these characters have stabilized themselves through inheritance in the succeeding generations. The first angular measurement system devised for the comparative study of human crania was devised by the renowned Dutch anatomy professor Petrus Camper in his on the 1792 Dissertation *Natural Varieties Which Characterize the Human Physiognomy*.⁸ His system exerted such a profound influence on the development of the physical anthropology field that he is often called “the grandfather of scientific racism”.⁹ The shape and size of the skull of man and his near relatives, the primates – both living and extinct – can be obtained by craniometry. The values thus obtained can be fruitfully and meaningfully compared. This sort of study comparatively anatomy helps to establish the phylogenetic relationship among them and thereby to learn about the evolutionary trends in man and primates. The correlations among the different

parts of the skull can be established through Craniometry.¹

A measurement technique called facial angle has a history of being used to rank the position of animals and humans on the evolutionary hierarchy. The technique was exploited for several decades in order to prove evolution and justify racism. Extensive research on the correlation of brain shapes with mental traits and also the falsification of the whole field of phrenology, an area to which the facial angle theory was strongly linked, caused the theory’s demise. Ancients believed that an elevated facial line, produced by a great development of the instrument of knowledge and reflection and a corresponding contraction of the mouth, jaws, tongue, nose, indicated a noble and generous nature. Hence they have extended the facial angle to 90° in the representation of legislators, sages, poets, and others.¹⁰

MATERIAL & METHOD

In order to take measurement, more particular measurement, the skulls must be oriented on a fixed plane, which must be well defined and accepted by all workers. One of these planes is the Frankfurt horizontal plane. When the right and left porion (the deepest point on the upper margin of the external auditory meatus) & on the inferior margin if the orbit of the skull are on the same horizontal plane, it is said to be on the Frankfurt horizontal plane. This plane is used as a constant plane in measuring and describing a skull.¹Skull angles can be measured directly on skull or x-rays & some of them can be calculated from simple measurement performed on skull.⁵

Measurements were recorded with the subjects sitting in upright Frankfurt horizontal position. The measurements and other parameters were

the entered in the form head length is the maximum dimension of the sagittal axis of the skull Landmarks were used- Table No 1 well mentioned by Montagu 1960⁴.

1. Basion- Prosthion

The skull was placed in norma basalis with the help of spreading caliper. The distance between basion and prosthion was measured.

2. Basion-Nasion

The skulls was placed in norma basalis the left point of speeding caliper was placed on nasion and right point we adjusted to basion to record thre basion-nasion distance

1.The Gnathic index =

$$\frac{\text{Basion prosthion}}{\text{Basion nasion}} \times 100$$

2.Facial angle =

Nasion – Ogonion/ Frankfurt 's horizontal line

DISCUSSION

Gnathic index

The gnathic index is calculated as shown in Table no. 2 In the present series the average mean value is 92.67 and hence the skulls falling in orthognathous group. Out of the total 75 skulls studied the various skulls falls in different groups as shown in table No. 3 The mean value of gnathic index of present series is 92.67 Chaturvedi & Harneja (1961)¹¹ reported the mean value of gnathic index is of 94.40 on Indian skulls while values correlate with the present series out of 75 skulls almost skulls with 94.66% falls in Orthognathous group. Jaysingh et al (1979)¹² .also reported high incidence of orthognathous group of skulls in his study the gnathic indices by

various workers of different crania are compared with present study as shown in table No 4

The gnathic index is not useful as measure of jaw protrusion as it is independent of the height of the face. For the racial classification the jaw protrusion is not a very useful criterion because it is recessive & easily suppressed feature. The projection of the face, so characteristic of certain races like Negroes, may be estimated on the living by measuring the angle formed by two straight lines, the one passing from the middle of the external acoustic meatus to the lower margin of the septum of the nose; the other drawn from the most prominent part of the forehead above to touch the incisor teeth below. The angle formed by the intersection of these two lines is called the facial angle of 'Damper' and ranges from 62° to 85°. The smaller angle is characteristic of a muzzle-like projection of the lower part of the face. The larger angle is the concomitant of a more vertical profile. The degree of projection of the maxilla in the macerated cranium is most commonly expressed by employing the gnathic or alveolar index of Flower.¹

Ortho gnathons index below 98; including mixed Europeans,ancient Egyptians,etc

Mesognathons index from 98- 103; includesChinese,Japanese,Eskimo,Polynesians (mixed)

Prognathous index above 103; includes Tasmanians, Australians, Melanesians& various African Negroes,¹

Facial angle

Facial angle is distance between nasion to the ogonion intersected by horizontal line of Frankfurt. Facial angle indicates position of chin². The angle supposedly ranged from

under 70° for Africans to about 100° for the highest race, the Caucasians.¹⁰ This measurement was used by evolutionists for decades to prove an inferiority-superiority hierarchy and is still used in racist literature to day^{13,14}. The comparison to animals with man it was observed that the jaw structure was important in determining the head and face angle. Shown in figure 1. Camper concluded that, by comparing “heads of the Negro and the Calmuck to those of the European and the ape, a line could be drawn from the forehead to the upper lip that indicates a difference in the physiognomy of these peoples and makes apparent a marked analogy between the head of the Negro and that of the ape.”⁹ The facial angle system was widely considered valid for both documenting and demonstrating the evolution of all life from single cells. Even animals were classified as close to, or far away from, humans by their facial angle.¹⁵ Furthermore, the facial angle was “one of the main initiators of racial craniology, which emerged during the nineteenth century” to justify racism.⁸ The use of the facial angle, a method of measuring the forehead-to-jaw relationship, has a long history and was often used to make judgments of inferiority and superiority of certain human races. University of Chicago zoology professor Ransom Dexter wrote that the “subject of the facial angle has occupied the attention of philosophers from earliest antiquity.”¹⁴ The theory proposes that animal evolutionary history involves a progression from a nearly horizontal facial angle to a vertical one, a transition that was also used to support the evolution of ape-like creatures to humans. Facial angle was also commonly used in classifying other animals from primitive to highly evolved life-forms¹³

Shown in figure 2. Proponents of the facial angle theory hypothesized that facial angle was not only a trend from fish to humans, but could also be used to rank human groups from inferior to superior.¹⁶ It was a “primary instrument of scientific racism.”¹²

Thus facial angle science quantified not only the “very striking difference between man and all other animals”, but also the difference between the human “races”¹⁷ John Haller concluded that the “facial angle was the most extensively elaborated and artlessly abused criteria for racial somatology.”¹³

The first angular measurement system devised for the comparative study of human crania was devised by the renowned Dutch anatomy professor Petrus Camper in his 1792 Dissertation on the Natural Varieties Which Characterize the Human Physiognomy.^{12,15} Figure No1. His system exerted such a profound influence on the development of the physical anthropology field that he is often called “the grandfather of scientific racism”.

By 1898 the facial angle was used to measure human “degeneracy”. Talbot noted that a chimpanzee has a facial angle of 40° to 50° because the jaw occupies two-thirds of the skull and the brain only one third. Africans had angles of close to 70° compared to 75° to 80° for Caucasians because the brain was encroaching and the jaw receding.¹⁸ Although Talbot agrees that the general facial angle is solid evidence for macroevolution, he concluded it is “not an ideal from whence to study face degeneracy” such as the shape of the ear pinna may be more important.¹⁹ Black African or Australian Aborigine as being the lowest type of human and a Caucasian as the highest racial type. The slanting African

forehead shown in the pictures indicates a smaller frontal cortex, such as is typical of an ape, demonstrating to naïve observers their inferiority. Figure No 2. This observation was important because the frontal cortex is the location of higher mental faculties, such as reasoning ability. It was thus assumed that it became larger as humans evolved by changing the facial angle. Facial angle, the first widely accepted measurement for comparing the skulls of different races and nationalities. Camper's facial angle is the traditional beginning of craniometry, or the science of measuring human skulls, a major sub-discipline of physical anthropology.⁸

CONCLUSION

Straight-jawed; having the profile of the face vertical or nearly so, in consequence of the shortness of the jaws which constitutes orthognathism. The facial angle of an orthognathous skull is large (by whichever method it is measured), the term being more or less definitely employed as the opposite of prognathous or prosognathous where the angle is small, or as the mean between prognathous and hyperorthognathic or opisthognathous, where the angle is excessively large.. A more recent facial angle is that included between the nasio-alveolar (prosthion) and a line drawn through the supra-auricular point and the inferior margin of the orbit; when this is between 83° and 90° , the skull is said to be orthognathous. The same character is also defined by means of the gnathic or alveolar index, those skulls with a gnathic index below 98 being orthognathous; between 98 and 103, mesognathous; and above 103, prognathous.⁸ Another researcher, Professor John Kennedy, compared the

baboon and an African, finding that the baboon facial angle is about 58° , the African 70° , and the European 80° .²⁰

Facial angles are useful in giving some clues to the shape of skulls & assessing orthognathous or prognathous²¹

i) Gnathic index falls in orthognathous group 92.67

ii) The average value of facial angle is 87°
Orthognathous index below 98; including mixed Europeans, ancient Egyptians, etc
Few authors say Gnathic index commonly known as facial angle²²

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OBSERVATION

For the present study following landmarks were used-

Table No 1

1	Basion	Median point on the anterior margin of the foramen magnum.
2	Nasion	Midpoint of nasofrontal suture. at this point intranasal sutures meets pronto nasal suture.
3	Oposthion	Median point on the posterior margin of foramen magnum
4	Prosthion or (Alveolar point)	Most antero inferior point on the maxilla between the upper central incisor teeth.
5	Gonion	The point at the angle of the lower jaw
6	Frankfurt 's horizontal line	The line joining infraorbital margin to the upper margin of the external acoustic meatus (porion)

Table No 2: Showing classification of skulls of various craniometric indices based on Montagu (1960).²

Type	Range
Orthognathous	0-97.9
Mesognathous	98-102.9
Prognathous	103-over

Table No 3: The number and percentage of skulls fall in different types are

Type	Number of skulls	Percentage
Orthognathous	71	94.66
Mesognathous	3	4.0
Prognathous	1	1.33

Table No 4: Showing comparison of the mean values of gnathic index.

Name of worker	Crania studied	Gnathic index
Adam (1943)	Australian, Tasmanian Kelior skulls ,	104.5 101.4 99.1
Chaturvedi & Harneja (1963)	Indian	94.40
Jay Singh et al (1979)	U.P. India	94.35
Dr. N.G.Herekar (1981)	Maharashtra	94.27
Present study	Maharashtra	92.67

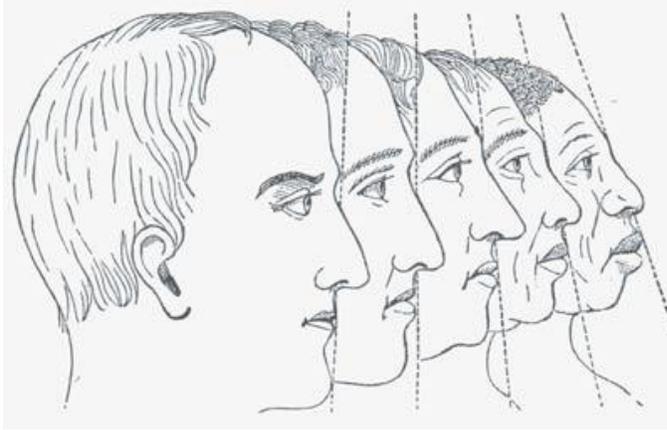


Figure No 1: A different example of facial angle ¹⁶

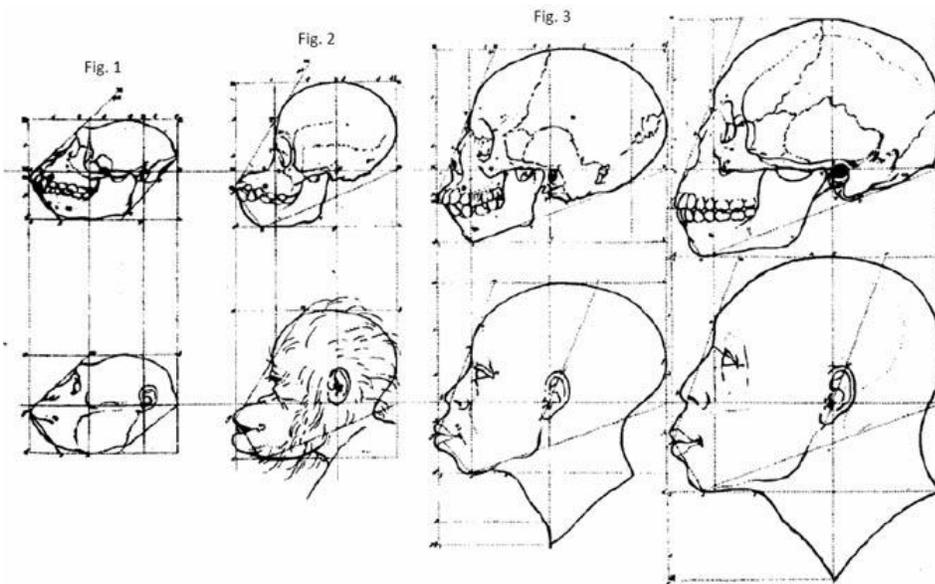
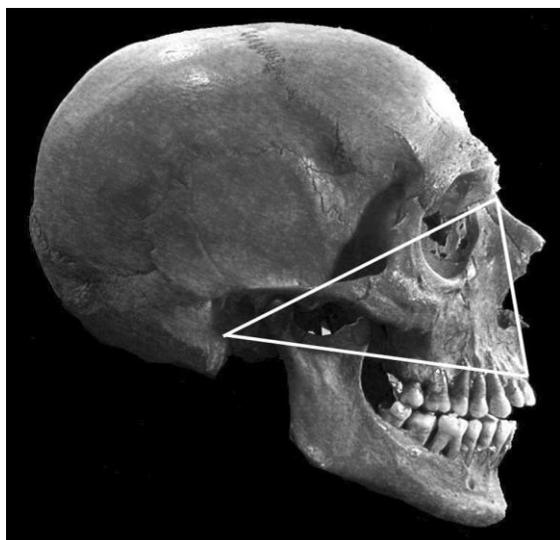
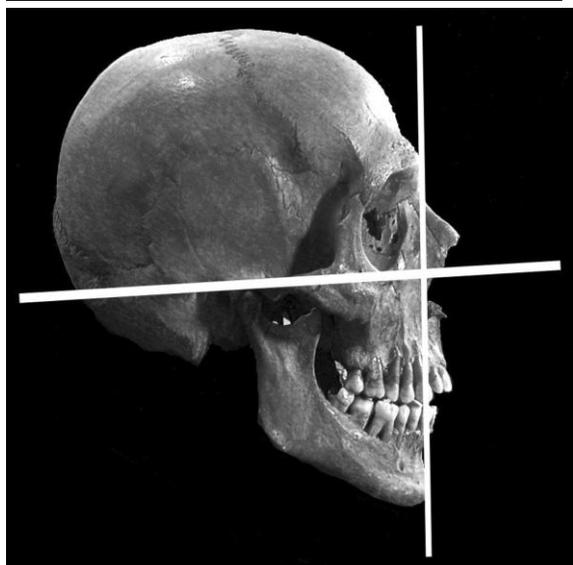


Figure No 2: Camper's facial angle diagram ⁸



The gnathic index.



The facial angle

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