



STUDY OF THE FACIAL ANGLE IN DRIED SKULLS OF SOUTH GUJARAT REGION

Anatomy

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ABSTRACT

Introduction: Measurements of the skull are important in certain neurological conditions, grossly misshapen cranium and abnormally large heads. A science which deals with study of the quantitative physical differences is called as "Anthropometry". Craniometry is concerned with the measurement on the cranium and skeleton of the face. The Facial angle measurement technique used to know evolutionary base of humans and primates. A Facial angle is the angle that is formed between a line passing from a base of nose the upper border of external acoustic meatus and another line passing from the most prominent part of the forehead to base of nose.

Aim: To study the facial angle in dried skull in south Gujarat region and to compare with facial angle of different races in world. To compare evolution of prefrontal cortex in association with increase in the facial angle from animals to humans.

Material and Method: A total 75 number dried skull collected from South Gujarat. We have measured this skulls for the Facial angle during the period of April 2015 to September 2016. The facial angle measured by skulls placed in Frankfurt's plane. The Facial angle is measured with two still protractor and two still scales by placing one scale in Frankfurt plane and another in vertical from nasion to prosthion and angle was measured with instrument called protractor.

Results: Out of 75 dried skull, minimum Facial angle measured is 84° and maximum is 90°. The average Facial angle measured is 87°. In view of type of skull 70 number of skull (94.66%) are Orthognathous type, 4 number of skull (4.0%) are Mesognathous type, 1 number of skull (1.33%) are Prognathous type.

Conclusion: The facial angle of an orthognathous skull is large (measured by whichever method), the term being more or less definitely employed as the opposite of prognathous where the angle is small, or as the mean between prognathous and hyperorthognathic or opisthognathous, where the angle is excessively large. As the increase in Facial angle also there is considerably increase in the size of prefrontal cortex in different races of humans and also from primate to humans.

If we compare the size of the human brain with primates, the human brain is 3 times larger. Also in comparing proportions of individual parts, they are also different. So logically to accommodate this enlarged prefrontal cortical area of the brain frontal bone of the skull must be enlarged and forehead become prominent and chin placed backwards to form flat splanchnocranium. So on this evolutionary basis due to enlargement of prefrontal cortex and frontal lobe we found increased facial angle in humans compared to other species.

KEYWORDS

Nasion, prosthion, Facial Angle, Anthropometry, South Gujarat Region

INTRODUCTION:

Importance of measurements of skull are in certain neurological conditions, grossly misshapen cranium and abnormally large heads seen. Psychological and physical of development of human being are affected by the genetic factors, environmental factors such as sunlight, temperature, humidity, climate, geographical condition, food and various other factors. Anthropologist classifies human being according to phenotypic variations into races. Most classification are based either on one or two phenotypic characters such as skull form and pigmentation. A science which deals with study of the quantitative physical differences is called as "Anthropometry". It may be divided into primatology (study of evolution and variation in nonhuman 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). Craniometry is concerned with the measurement on the cranium and skeleton of the face. Craniometry also includes measurement of different types like liner, angular, depth, volume, arc, etc. hence different types of instrument are needed to take different types of measurements. Some measurement istaken directly on the skull.

One anatomist from Dutch Professor Petrus Camper developed study of angular measurement study of human skull in 1792 for the first time.¹⁰ The size and shape of the skulls of Human being and the primates both living and extinct, can be measured by craniometry. And comparable study can be done. This comparative anatomy important to establish the phylogenic relationship among evolutionary trends in Human being and the primates. The correlations can be established through Craniometry between the different parts of the skull.⁵

The Facial angle measurement technique used to know evolutionary base of humans and primates. In past this technique was used to decide

racism in addition to evolution. It was also believed that contraction of mouth, nose, jaws are due to increased facial angle in humans and due to that facial angle increased to 90°.¹²

MATERIAL & METHOD:

In order to take more possibly accurate measurement, the skulls must be oriented on a specific fixed plane and 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 of the orbit of the skull are placed on the same horizontal plane, that is the Frankfurt horizontal plane. (**Figure No.1**) This plane is commonly used as a plane of measuring and describing a skull.³ In our study the Facial angle measurement is done with two steel scales and steel protractor by placing one scale in Frankfurt plane and one vertical from nasion to prosthion and angle was measured with protractor. Various types of angles on skull can be measured directly on dried skull or x-rays & some of them can be calculated from simple measurement performed on skull.⁷

Landmarks used during study are described in **Table No.1** These landmarks were well mentioned by Montagu 1960 in his study.⁶

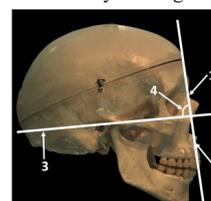


FIGURE NO.1: Showing method of Measurement of Facial angle = Line drawing from Nasion to Prosthion/ Frankfurt's horizontal line

RESULTS:

TABLE NO 1: For the present study above mentioned landmarks were used.

1	Nasion	Midpoint of nasofrontal suture. at this point intranasal sutures meets fronto nasal suture
2	Prosthion or (Alveolar point)	Most antero inferior point on the maxilla between the upper central incisor teeth
3	Frankfurt 's horizontal line	The line joining infraorbital margin to the upper margin of the external acoustic meatus (porion)

TABLE NO.2:Range of Facial Angle measured in our study.

Number of Skulls	Minimum Facial Angle	Maximum Facial Angle	Average
75	84°	90°	87°

TABLE NO.3: Showing classification of skulls of various Craniometric indices based on Montagu (1960).⁶

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

TABLE NO.4:Based on Table No.3 classification the number and percentage of skulls in our study fall in different types.

Type	Number of skulls	Percentage
Orthognathous	70	94.66
Mesognathous	4	4.0
Prognathous	1	1.33

DISCUSSION:

Facial angle is angle between line passing from nasion to the prosthion intersected by Frankfurt's horizontal line. The angle ranged from under 70° for Africans to about 100° for the Caucasians.¹² This measurement was used to prove an inferiority-superiority evolution and is till today used in racist literature.^{14,15} During the comparative study of animals with man it was observed that the structure of jaw was important in measuring the head and facial angle (Shown in Figure No.2 A&B) because Facial angle indicates position of chin also.⁴

FIGURE NO.2A: The Facial angle in different races of Human being¹⁶

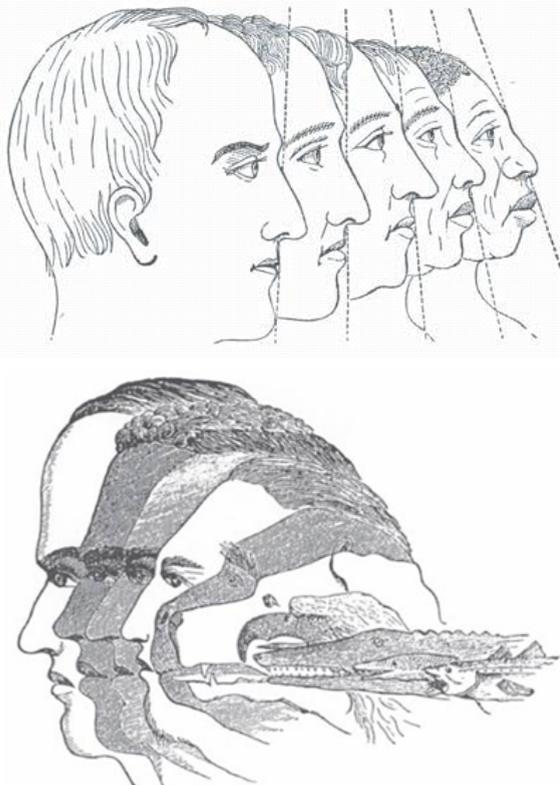


FIGURE NO.2B - The Facial angle description on evolutionary basis from lower species to Humans.¹⁵

Petrus Camper had compared the size and shapes of heads of different races.

He compared the heads of Negros with European and with ape by drawing a line from most prominent part of forehead to upper lip and find result that some similarities between head of negros and the ape.¹¹ Also classification of near and far species of animals to humans can be done by facial angle study.¹⁶ For racial craniology, the facial angle measurement was also the principle tool.¹⁰ As researched by Ransom Dexter that the facial angle measurement technique has drawn great attention of philosophers from beginning.¹⁵ Proposed theories by Camper, Dexter and many others conclude that the transition of nearly horizontal to vertical facial angle supports evolution of human to ape (Figure 3). Study of facial angle measurement frequently used to classify evolution of other animals (other than humans) from primary to advanced form of life.¹⁴

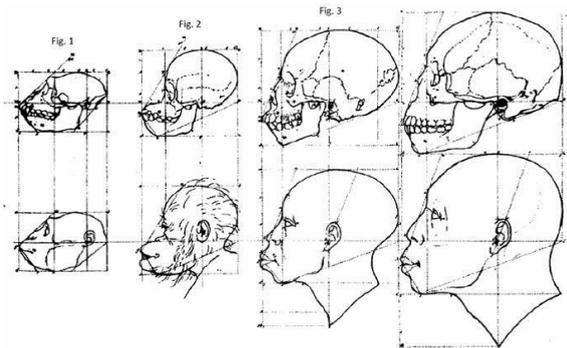


FIGURE NO 3: Diagram by Petrus Camper of Facial angle from ape to human¹⁰

The facial angle was not only used to compare from fish to humans but also used to kept human groups from inferior to superior.¹⁶ Initially it was an instrument of scientific racism.¹³ The study of human races was also done by facial angle measurement technique.¹⁷ Importance of more accurate and widely use of facial angle study for racial somatology concluded by John Haller.¹⁴ One anatomist from Dutch Professor Petrus Camper developed study of angular measurement study of human skull in 1792 for the first time, in his Dissertation on the Natural Varieties which characterize the Human Physiognomy.^{13,16} (Figure No.2 A&B). In a chimpanzee facial angle ranged from 40° to 50° due to jaw is bigger and occupies two-third of skull and one third occupied by brain. In Africans facial angle measured close to 70° and in Caucasians 75° to 80°. This is because the jaw was receding and brain encroaching as a sign of macroevolution as observed by Talbot.¹⁸ Talbot also agreed that along with facial angle study the changes in shape of pinna of ear also equal or more important for macroevolution.¹⁹ On the basis of various Facial angle measurement study concluded that Caucasian being the highest and black Africans or Australians being the lowest races of humans. In African forehead is slanting suggesting a smaller size of frontal cortex in brain like ape. (Figure No 3.) Considering this observation markedly important because the frontal cortex in brain is important centre for mental status like thinking, social behavior, calculation etc. Accordingly to accommodate larger frontal cortex facial angle evolved. So we can compare skulls of different races and nationalities by the facial angle measurement as widely accepted measuring tool.

In primates the evolution of the prefrontal cortex has got the attention to neuroscientists because of its known role in various human-like cognitive capacities like coordinated purposeful behavior towards reaching higher-level goals, high levels of social information processing, metacognitive introspective abilities and language.²² A disproportionate increase in the prefrontal cortex in human compared to other primates suggests that the prefrontal cortex is the neural basis of which makes humans unique among all species. Expansion of prefrontal area may be characterized by expansion in particular prefrontal regions e.g. Broca's area in humans rather than a general expansion of the prefrontal cortex as a whole Broca's area suggests prefrontal homologies linking human to ape and even monkey brains the uniqueness of the human brain is solely an important matter of the

evolution of new areas. Relatively increased in size of the prefrontal cortex are a significant factor in the evolution of primate brain and which aspects of human prefrontal size changes stand out.²³

If we compare the human brain and proportions of its different parts with other primates, human brain is around three times larger. Comparing the brain gradually from fish, amphibians, reptiles, mammals to humans, we can see considerable difference in development of neocortex and mainly prefrontal cortex of brain. (Figure No.4)

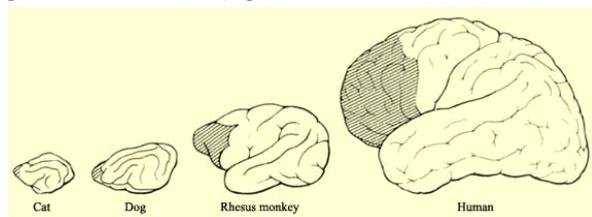


FIGURE NO.4. Showing the comparison of development of prefrontal cortex in different animals and Human.

Most rostral part of cerebral cortex is prefrontal cortex which is involved in chiefly to control motor function in other species but in primates is well developed for intelligence.

Due to well developed prefrontal cortex in human than other primates is solely responsible for cognition, planning, reasoning and all other abilities.

CONCLUSION:

Straight jawed species 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 (measured by whichever method), 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 considerably large. A more recent concept of facial angle is that it measured 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. Comparison of the baboon and an African Facial angle and that showed the baboon facial angle is about 58° the African 70° and the European 80° concluded by Professor John Kennedy.²⁰ Facial angles are useful in giving some clues to the shape of skulls & assessing orthognathous or prognathous.²¹ In our study the average value of facial angle is 87° (Table No.2). In Orthognathous facial angle index below 98° includes mixed races such as Europeans, ancient Egyptians etc. In humans prefrontal cortex is disproportionately enlarged when compared to other primates. The volume of human brain is around three times larger than in a primate of comparable size, and the proportions of its different parts to one another are different than in other primates. So it is unique feature of humans. And so logically to accommodate this enlarged prefrontal cortical area of the brain frontal bone of the skull has to be enlarged and forehead become prominent and chin placed backwards to form flat splanchnocranium. So on this evolutionary basis due to enlargement of prefrontal cortex and frontal lobe we found increased facial angle in humans compared to other species. Also we have concluded that in humans well developed prefrontal cortex lead to more facial angle and so that more intelligence.

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