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Influence of metric and non metric osteogenetic traits on the cranial architecture of population of Haryana

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INTRODUCTION

Much attention has been paid to the variations of the shape and size of the human skull and efforts have been made to associate these variations with certain differences, which characterize different races. It is a matter of common experience that in dealing with crania of different racial types, an impression of racial affinity and differences may often be introduced. Skeletal metric and non-metric variables are widely used for such studies.

Measurements play an important role in skeletal morphology. Cranial and postcranial measurements have typically been used to describe individuals and to correlate various ethnic and racial groups. Prior to the year 1960, comparisons were based on single measurements. These measurements have shown the shape and size variations of different racial groups. Then came the era of multivariate analysis. The modern methods based on the computed software's focused on various statistical programs backed by multivariate analytical methods. Alternatively, the craniometrical methods have extensive use in forensic anatomy by reconstructing the most probable human faces and physiques from dry skeletal remains1. Besides rebuilding the actual morphology of "most probable" figures, one can also rebuild the ancestry of the individual by using the genetically transmitted traits. Biometrics also performs a vital role in bioarchaelogy and bioanthropology to study the modern and prehistoric populations particularly about the selection pressures, functional morphology, gene transmissions, influence by climatic fluctuations, and altitudes and how they influence the structural morphology of various populations4.

Non-metric traits are also known as discontinuous or quasi continuous variables2. Such variables are generally discrete in nature (present / absent). The percentage of frequency of expressions is generally judged by three changeable variables ranging from slight, medium and high or prominent. There are internationally accepted comparative standardized casts formulated by Larnach and Freeman, and Larnach and Macintosh available for this purpose. Among the earlier workers, there are some of them who worked on non-metric traits to study human cranial morphology. Later the genetic factors and the usefulness of non-metric traits in population studies were conducted by other workers3. Manzi et al suggested that these non-metric traits play a significant role in origins and diversification of the anatomically modern human populations (Homo sapiens).

Raghavan of Australian National University (ANU) is conducting his investigations on "Contributions of South Asia to the peopling of Australasia" by studying multiple ethnic groups in India using the most accepted metric methods proposed by Howells and Pietrusewsky 6. The non-metric analytical methods formulated by Larnach8 and Freeman, and Larnach and Macintosh. At present these methods play very crucial roles in many branches of science including human anatomy, forensic anatomy, panthropology, bioanthropology, bioarchaeology and other human population and evolutionary studies.

Inspite of the similarities exhibited on superficial morphological or physical characteristics on various ethnic groups in India, there are considerable numbers of variations observed among the Indians. The current investigations on the human crania that were recovered from various geographical zones of Haryana State will focus on the craniological details.

A recent important finding by Raghavan on the preliminary analysis of his non-metric data of Haryanvi and Punjabis suggests that northwest Indians stand in between the Caucasoid and Australoids6. His recent findings, on non-metric models of sex determination among the majority of Punjabis and Haryanvi show their similarities of Caucasoid traits. On the other hand they also exhibit some of the Australoids features. A population affinity model by Raghavan based on 20 traits of North West Indians shows highly variable ratios. In general they show 6-8 characteristics of Caucasoid and also express 6-8 cranial features of Australoids. Surprisingly they also show 4-6 intermediate or transitional traits including :

Overall Raghavan's preliminary observations of the non metric data of the people of Uttar Pradesh shows more Australoid expression than the North West Indians. Similarly, the Central Indian population also shows more Australoid characteristics are more closely related to the geographical zones than the ethnicities.

Anthropological research in relation to forensic sciences includes assessments of variation in sex, age, stature, race, reconstruction of face and body from skeletal remains5. The skull has over 90 percent success rate in sexing post-pubertal skeletal material. Sex can also be identified from small pieces of bone, Sarangi and Sharma studied sex determination from mastoid process of skulls from Delhi and reported that it can give invaluable conclusive proof of sex. This requires population and that each, therefore, needs its own specific standards of assessment7. Not only that, even accuracies of results varies between populations. For example in a study on humerus, it was reported that the accuracy of sex determination was 87 percent in Chinese, 91 percent in Japanese and 97 percent in Thais. In spite of the fact that all of them were Asian Mongoloids, it was concluded that these regionally diverse populations exhibited significant metric differences, which affect sex determination from skeleton. Nearly 80 percent of the bones which contribute to the frame of the human skeleton exhibit typical male / female traits related to metric and non-metric data. These traits do show some astonishing details within one particular ethnic/racial group. The skeletal morphology including texture, hardness and prominence in expression of certain structures are also generally influenced by genetic factors, nutritional status, and other environmental agencies.

Several studies related to population specific osteological standards are available for various populations of the world. No detail systematic study seems to have been conducted or interpreted by any one on a particular ethnic group from India. The present investigation which is the first of its kind in any Indian university will provide an important database of population of Haryana. This will help the forensic experts in resolving the cases from crime related episodes such as genocides, war crime and murders. Till now identification is done on the basis of race. Indian skulls are generally described as Caucasoid with a few Negroid characters. Because of racial mixing, all the skulls may not be correctly differentiated into the major races. In the absence of population standards for this region (Haryana), standards calculated for other groups are usually used which may not be correct. Over the past 30 years, this department has collected skeletons from unclaimed autopsies by maceration. The primary objective of the study is to investigate the historical-biological relationship of population of Haryana in terms of their cranial architectures regard to their nearness to Caucasoid and Australoids and also to establish if any genetic link exists between Australian Aborigines and population of Haryana. Additionally this study will help to create forensic osteometric standards for the population of Haryana which will help for identification of population of Haryana from bones.

Curiosity created among many scientists on "Noah's Ark hypothesis" about the origin of anatomically underdeveloped or non advanced archaic Homo sapiens from a lone stem ancestor during the Last Glacial Maxima. This has been tested by two opposing hypotheses known as "Out of Africa" or "Eve vs Multiregional continuity". So far the "Out of Africa" hypothesis is well supported by many productive research outcomes based on paleontological and molecular biological studies. Throne's hypothesis of "dihybrid theory" strongly supports the origins of Australian Aborigines directly from the Javanese Homo erectus.

MATERIAL AND METHODS

For the study of various metric and non metric traits 150 complete skulls (115 males and 50 females) and equal no. of mandibles were used. These bones were retrieved and available in the department of Anatomy, Pt. B.D.Sharma,UHS, Rohtak. Skulls showing obvious pathological deformities were excluded from the study. The age to which these skulls belonged was also noted from the records, whenever possible and all the skulls were around 40- 50 years age at the time of death.

METRIC ANALYSIS RESULTS

1. FORDISC 2.0 analysis of sex estimation were surprising. Sex could be classified in only 54.78 percent of male crania and 64.1 percent of male mandibles while in female crania and mandibles results were better (88.57 percent and 89.47 percent respectively). Failure of estimation of sex particularly in males was because FORDISC 2.0 database did not have measurements from South Asia except few crania from Andaman. So, the present study will provide database which can be added to FORDISC 2.0 from this part of the world so that result of sex estimation can be improved.

   FORDISC 2.0 analysis in which individual Haryana skull was compared with Howell's 28 populations showed varying affinity with all the 28 populations of the world. By and large, the population affinity of Haryanvi ethnic group consisting both males and females has yielded the following results : Aina 0 percent, Andaman 3.33 percent, Anyang 1.33 percent, Antalya 10.66 percent, Arikara 1.33 percent, Australian aborigines 2.0 percent, Buriat 0 percent, Berg 0 percent, Bushman 3.33 percent, Dogon 0 percent, Easter Island 10.66 percent, Egypt 8.0 percent, Eskimo 6.0 percent, Guam 0.66 percent, Hainan 1.33 percent, Mokpo 0.66 percent, Marjorie 1.33 percent, North Japan 0.66 percent, Norse 13.33 percent, South Japan 2.66 percent, Peru 4 percent, Philippines 0.66 percent, Santa Cruz 1.33 percent, South Japan 2.66 percent, Tasmania 1.3 percent, Tiete 15.33 percent, Tolai 1.33 percent, Zavala 8 percent and Zulu 0.66 percent. Thus, the result showed a maximum affinity of 15.33 percent with Tiete population.
   The same FORDISC 2.0 software calculations have pronounced that Haryana crania have significant affinities and American White (34.66 percent), followed by Blacks (25.33 percent) and Hispanic 22.09 percent (Mediterranean group / Spanish speaking people)
   On the racial basis Haryana Population showed Caucasoid affinity 56.66 percent, Negroid 31.33 percent and Mongoloid 11.66 percent. Till now it has been described that Indians are Caucasoid with few Negroid characters. Present study has added a new dimension that in addition to Caucasoid and Negroid features Haryana crania have some resemblance with Mongoloid too on the basis of FORDISC 2.0 analysis.

2. One Way ANOVA was applied using SPSS-10 programmed to compare present data with Howell's 28 populations, the results showed that Haryana crania's were significantly different from all the 28 populations of the world being endogenous ethnic group. The present data from Haryana will form an additional data, if added to the FORDISC 2.0, to help the Forensic Scientists.

3. Haryanvi day when compared with three neighboring ethnic groups (U.P. M.P. Punjab) by use of One Way ANOVA showed that, in most of the measurements Haryana Crania do resemble with their neighboring ethnic groups but are significantly different in six measurements as compared to other three ethnic groups. GOL, NOL, AUB and NDS cranial measurements were maximum in Haryana population and WCB was minimum while SOS did not show any specific pattern. GOL and NOL suggest cranial length, AUB is width of crania above ear and WCB minimum width of crania at base of skull. Indirectly, we can say that length of Haryana crania is also more in supramastoid region as compared to their neighboring ethnic groups while cranial width near base of skull which is not visible apparently was found to be minimum in Haryanvi crania. Prominence of nose is also found to be maximum in Haryanvi's. However, in most of the measurements Haryanvi crania do resemble with their neighboring ethnic groups. These six measurements will help in identification of Haryana skulls from neighboring ethnic groups.

4. Stepwise discriminate function analysis reflected that five measurements (WCB, ASB, GLS, NLB, NAS) were important to estimate sex of Haryanvi crania. With the help of these measurements sectioning point (Z 0) was obtained as 101.71 and sex could be estimated in 90 percent crania. Since each population has its own measurements and sectioning point to estimate sex. Present study is the first of its kind to provide such data for Haryana populations. This data will help the Forensic experts in identification of sex from isolated skulls more accurately.

NON-METRIC ANALYSIS RESULTS

1. Eighty-seven non-metric traits were analyzed using percentage frequency of each trait in present study and 26 of these non-metric traits were found to be similar to those of Australian aborigine.

2. Non-metric data was further analyzed by a scoring system to see affinity of Haryana crania with Australian aborigine and three neighboring ethnic groups from India (UP, MP, Punjab).

Affinities of Haryana population with Australian European of East Asian analysis showed appreciable amount of affinity with above population. However, Haryana males showed lesser affinity (58.33 percent) with European cf. East Asia males as compared to males from Punjab (68.33 percent), UP (63.33 percent) and MP (70.00 percent). As far as females are concerned Haryanvi and Punjabi females showed only 51.66 percent and 56.66 percent affinity respectively with European cf. East Asian population as compared to UP and MP (61.66) percent each).

Haryana males and females showed appreciable amount of affinity with Australian aborigine cf. New Guinean. However, Haryana males showed lesser affinity (58.33 percent) with Australian aborigines cf. Guinean males as compared to males from Punjab (63.88 percent), UP (63.88 percent) and MP (66.66 percent). As far as females are concerned Haryanvi and Punjabi females showed only 50 percent and 47.22 percent affinity respectively with Australian cf. Guinea population as compared to UP (58.31 percent) and MP (55.50 percent) suggesting UP females showing maximum affinity with Australian aborigines.

Non metric-for sex determination in different ethnic groups of india

	Haryana		Punjab		Uttar Pradesh		Madhya Pradesh	
	Males	Females	Males	Females	Males	Females	Males	Females
Glabella development	1.10	1.02	1	1	1.02	1	1.03	1
Supercillialy ridge	2.39	1.50	2.64	1.39	2.52	1.84	2.84	1.38
Zygomatic trigone dev.	2.96	1.29	2.47	1.68	1.89	1.89	2.83	1.50
Malar tuberosity	1.65	1.03	2.61	1.58	2.54	2.00	2.69	1.50
Mastoid process size	2.45	1.79	1.55	1.33	1.12	1.00	1.41	1.07
Occipital marketing	2.04	1.61	2.27	1.47	2.36	1.57	1.53	1.61
Palate size	1.10	1.00	1.24	1.08	1.04	1.22	1.32	1.01
Total Score	13.69 =14	9.24 =9	13.78 =14	9.53 =10	12.42 =12	10.52 =11	13.65 =11	8.07 =8

Maximum Score = 21
> 12 = M
12 or <12 = F

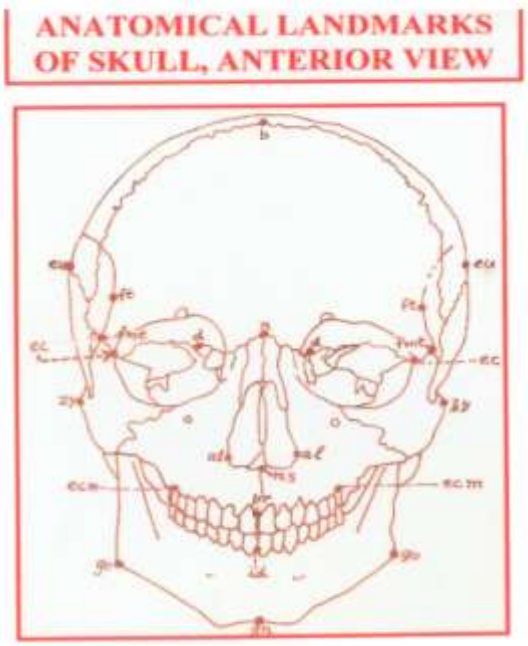
SUMMARY AND CONCLUSION

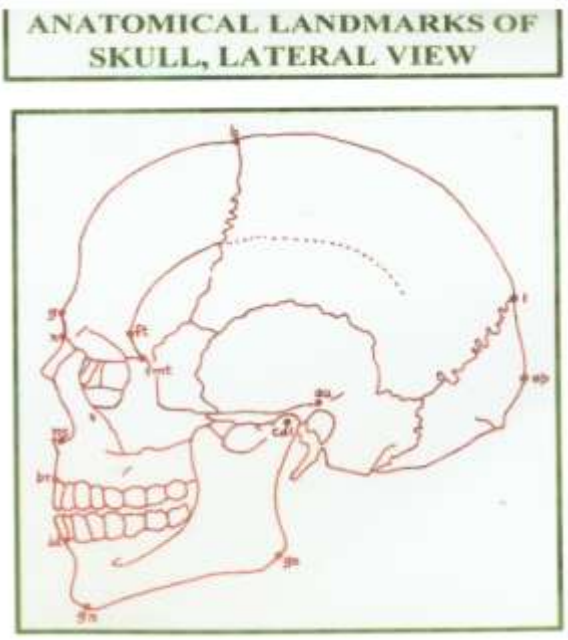
Present study reflects that Haryana crania have maximum affinity with Caucasoid followed by Negroids and Mongoloids. Additionally Haryanvi crania do have affinity with Australoids.

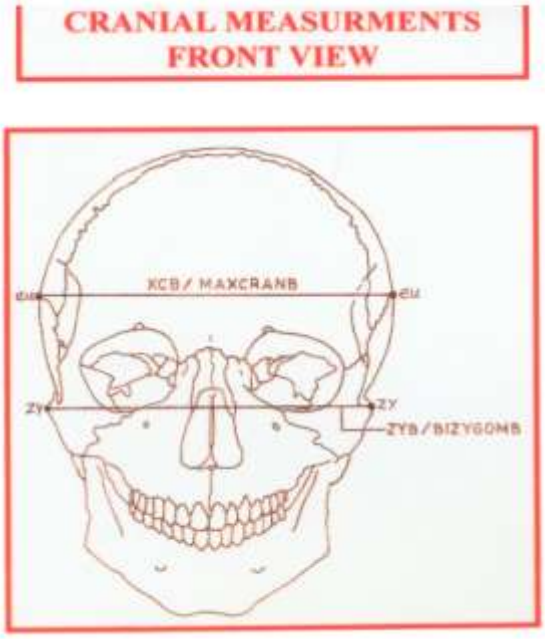
Some of the important non-metric traits reflecting cranial architecture of the Haryanvi crania are:

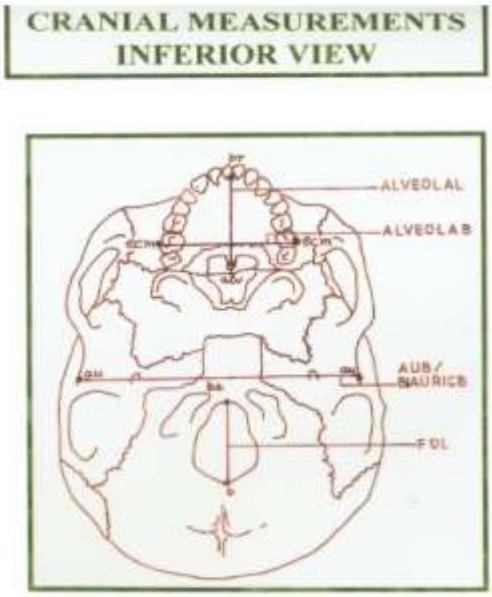
- Dolichocranic palate was seen in 98.63 percent cases.
- Sphenoparietal wide articulation was present in 97.08 percent cases.
- Less developed Zygomatic trigone of frontal bone (slight-medium) was present in 96.61 percent cases.
- Short vaginal process of temporal bone was seen in 95.89 percent cases.
- Anterior nasal spine was found pointed in 95.30 percent cases.
- Some degree of development of external occipital protuberance was seen in 94.70 percent cases.
- Narrow constricted middle part of nose was seen in 94.66 percent cases.
- Size of supra mastoid ridge was large in 94.3 percent cases.
- Medium - Large digastric fossa was seen in 93.83 percent of cases.
- Posterior nasal spine was light to medium in 92.69 percent cases.
- Pre condylar tubercle was absent in 92 percent cases.
- Prominence of Glabellas less prominent (1,2 grade) was seen in 91.0 percent cases.

- Juxta mastoid process was seen in 91.65 percent cases.
- Ossicles in frontonasal articulation were seen in 90.54 percent cases.
- Unequal type foramen ovale was observed 89.6 percent cases.
- Complete type of foreman ovale was seen in 85.71 percent cases.
- Rounding of orbital margin of malar was present in 85.33 percent.
- Shape of external auditory meatus was found to be Martine type 3 in 83.21 percent cases.
- Complete infraorbital (facial and orbital part) suture was seen in 82.85 percent cases.
- Slight to medium prognathism was seen in 82.59 percent cases.
- Long ovoid crania were seen 75.96 percent cases.
- Medium Keeling was less frequently seen (12.84 percent).
- Marked parietal prominence was seen in 6.83 percent cases.

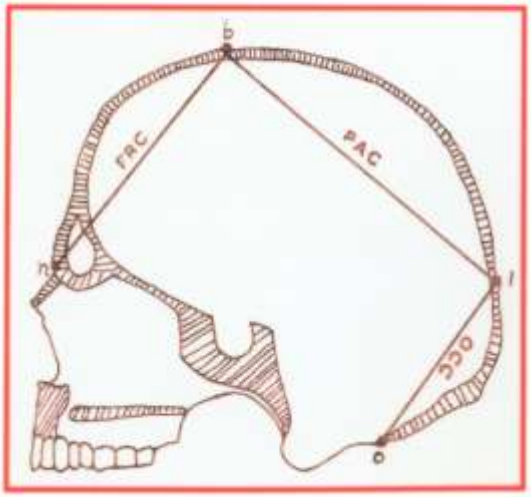




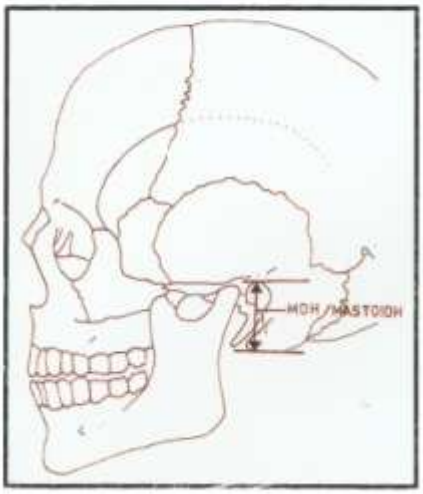




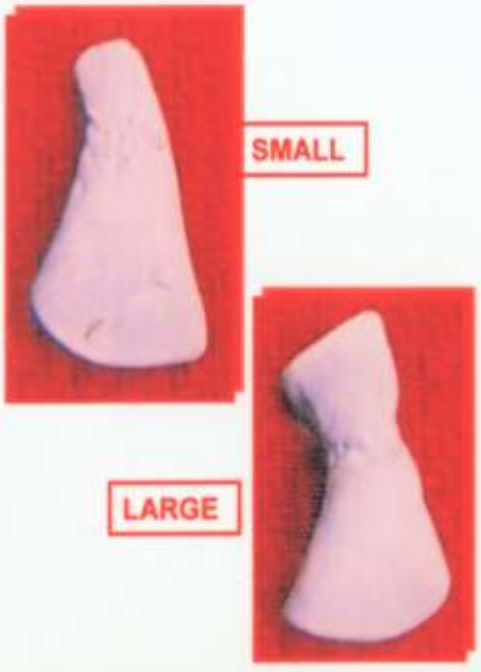
FRONTAL, PARIETAL, OCCIPITAL CHORD MEASUREMENTS



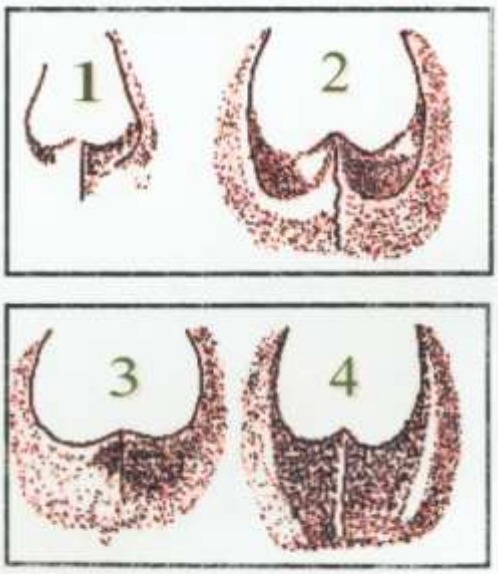
LATERAL VIEW OF CRANIUM SHOWING MASTOID HEIGHT (MDH)



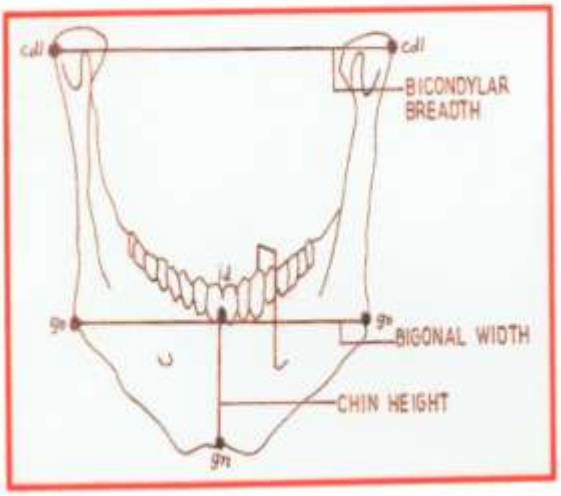
GRADING OF ZYGOMATIC TRIGONE



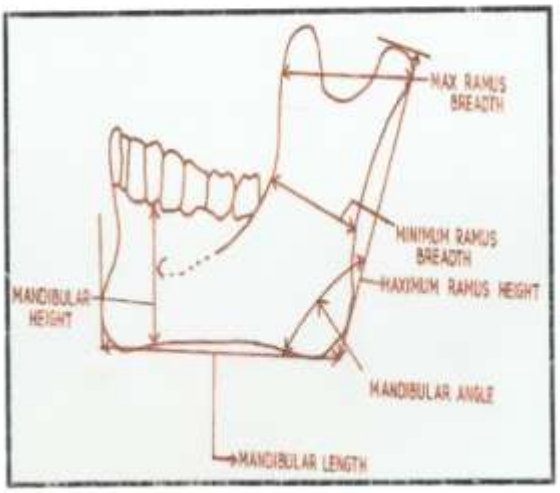
INFERIOR BORDER OF ANTERIOR NASAL APERTURE (GRADES 1-4)



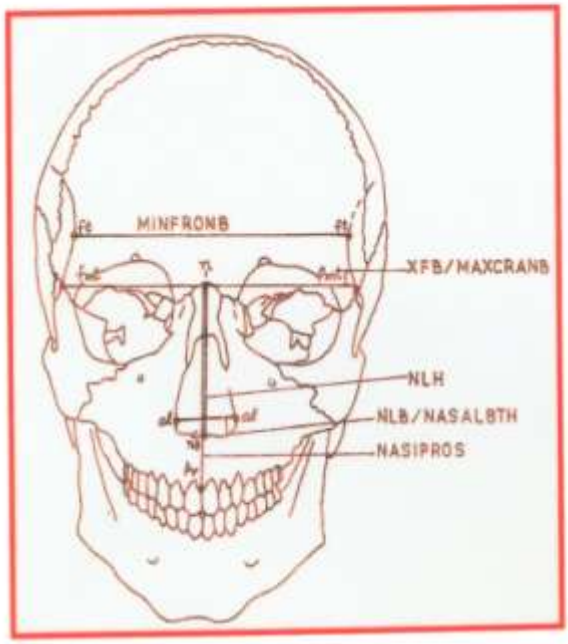
MANDIBLE SHOWING DIFFERENT MEASUREMENTS



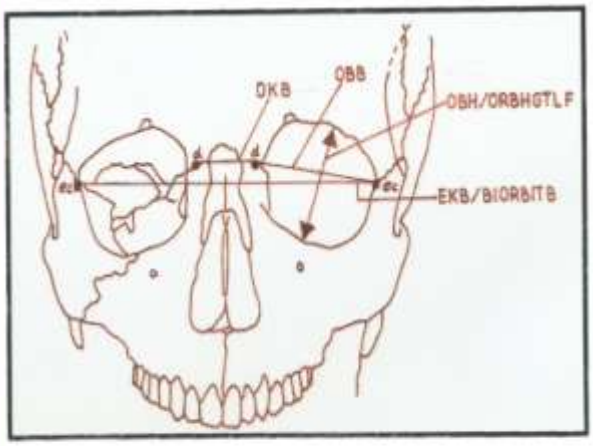
LATERAL VIEW OF MANDIBLE SHOWING DIFFERENT MEASUREMENTS



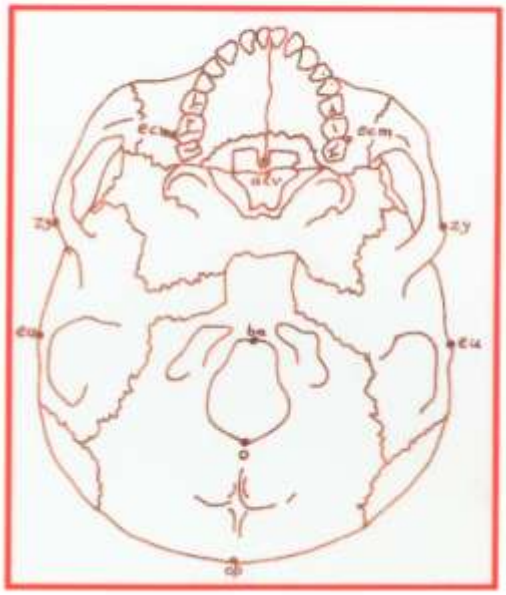
CRANIAL MEASUREMENTS, ANTERIOR VIEW



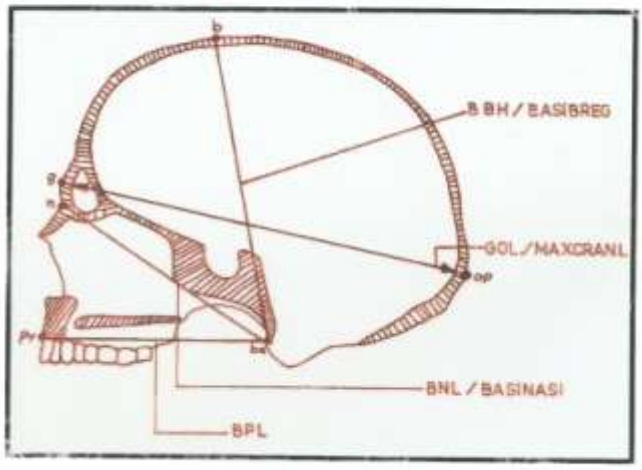
CRANIAL MEASUREMENTS, ANTERIOR VIEW



ANATOMICAL LANDMARKS OF SKULL, INFERIOR VIEW



CRANIAL MEASUREMENTS IN SAGITTAL PLANE



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