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Determination of gender by analysis of lateral cephalogram using linear cephalometric variables

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Abstract

Introduction: Gender determination of skeleton represents an important stage in the execution of forensic anthropological examination. The lateral cephalogram reveals architectural and morphological details of the skull on a single radiograph, thereby providing additional characteristics and multiple points for comparison. With this background, the present study was undertaken to evaluate the role of lateral cephalograms in the identification of gender using six cephalometric variables.

Aim: Aim of this study was to determine gender by discriminant function analysis using linear cephalometric variables on lateral cephalogram.

Materials and methods: A total of 60 lateral cephalograms of 30 male and 30 female subjects between 11 and 30 years of age visiting the government dental college and hospital, ahmedabad were studied. The six linear cephalometric variables were derived using a range of cephalometric bony landmarks. The variables were transcribed onto the acetate sheets by tracing with the help of an X-ray film viewer using 0.5 mm pencil.

Statistical Analysis: Discriminant function equation was derived with centroid point which divides the score into male and female groups. The statistics were calculated using the Statistical Package for Social Sciences version 20.0.

Results: The discriminant function was highly significant and therefore all the six variables were useful in determination of gender. A discriminant function equation was derived using the coefficient of cephalometric variables. Functions at group centroids were 0 to ± 2.093, with 0 to 2.093 being males and 0 to – 2.093 being females.

Conclusion: The derived discriminant function equation can be useful in the identification of gender of human remains pertaining to population of gujarat. Further studies should be conducted to different populations of the world.

Key words: Gender determination, lateral cephalogram, linear cephalometric variables.

Introduction

When human bones are discovered, the first question asked is “Are they of male or female?’’ This is of interest in two fields: anthropology and forensic science.

There are several gender determination metods such as Dental index, Tooth shape, Orthometric method, Cheiloscopy, Rugoscopy, Molecular analysis, Barr Bodies, F bodies and Enamel protein.[1–7]

Among the bones of the human skeleton, the pelvis is the most determinant, but, because of its complex shape, it is delicate and often found in a very poor condition. The skull, on the other hand, is usually better preserved and more readily exploitable.[8]

Recognition of gender is an important aspect in identification of an individual. Apart from pelvis, skull exhibits highest genderual dimorphism in the human body.[9]

Gender determination of skeleton represents an important stage in the execution of forensic anthropological examination. If the entire skeleton is available, gender can be assessed with 100% accuracy, 92% when using the skull alone and 98% when using the pelvis and skull.[10]

The lateral cephalogram reveals architectural and morphological details of the skull on a single radiograph, thereby providing additional characteristics and multiple points for comparison.

The equipment required for lateral cephalometry is readily available and the technique is cost effective, easy to perform, offers quick results, reproducible and easily implemented in any special training for the forensic examiner.[9]

The lateral cephalograms are simple and reliable tools which can be routinely used for the forensic and anthropological purposes.

With this background, the present study was undertaken to evaluate the role of lateral cephalograms in the identification of gender using six cephalometric variables and to derive a discriminant function equation to determine gender of individuals.[9]

Materials and methods

A total of 60 lateral cephalograms of 30 male and 30 female subjects between 11 and 30 years of age visiting the government dental college and hospital, ahmedabad were studied. All lateral cephalographs taken for the diagnosis or treatment purpose were included. Individuals with the history of orthodontic and orthognathic treatment, trauma and surgery of the skull, any prolonged illness, clinical features suggestive of endocrinal, hereditary, developmental, nutritional disturbances and facial asymmetry were not included in the study.

The cephalometric variables were transcribed onto the acetate sheets by tracing with the help of an X-ray film viewer using 0.5 mm pencil. (**Fig. 1**)

The following six linear cephalometric variables were derived using a range of cephalometric bony landmarks as (**Fig. 2**): Basion to anterior nasal spine (Ba-ANS), Upper facial height (N-ANS), Length of cranial base (Ba-N), Total face height (N-M), Mastoidale to sella-nasion plane (Ma-SN), Mastoidale to porion-orbitale plane (Ma-FH).

The data were entered in Microsoft excel data sheet. The data were subjected to statistical analysis using SPSS software. Discriminant function equation was derived with centroid point which divides the score into male and female groups with minimum overlap.

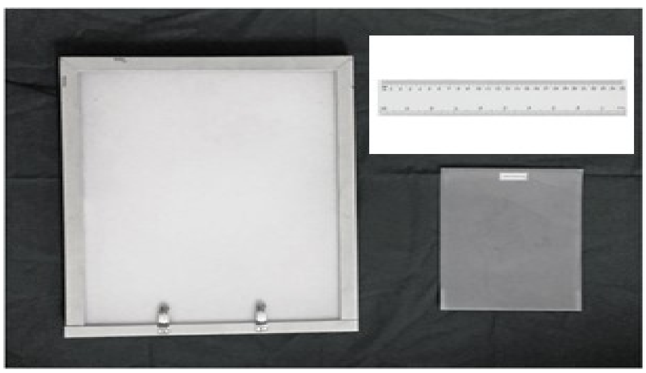

Figure 1: Armamentarium: X-ray film viewer; Plastic ruler; acetate sheets

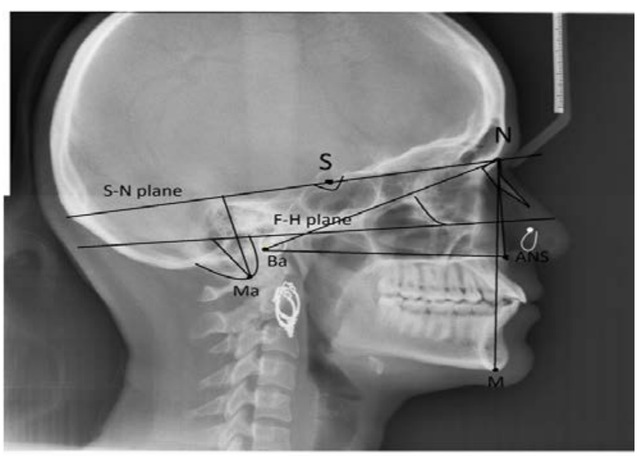

Figure 2: cephalometric variables: A) Basion to anterior nasal spine (Ba-ANS), B) Upper facial height (N-ANS), C) Length of cranial base (Ba-N), D) Total face height (N-M), E) Mastoidale to sella-nasion plane (Ma-SN), F) Mastoidale to porion-orbitale plane (Ma-FH).

Results

The age-wise distribution of the male and female study subjects into 11-20 and 21-30 years was not statistically significant. Hence, further analysis was carried out by the union of all the three age groups. The average measurements and standard deviation (SD) among males and females are presented in Table 1.

The six cephalometric variables were subjected to discriminant function analysis to test their efficacy to differentiate between the genders.

Table 1: Average measurements and standard deviation (SD) among males and females

Gender	Cephalometric Parameter	Mean	Std. Deviation
Female	Ba-ANS	9.1333	0.48447
	N-ANS	4.9600	0.38381
	Ba-N	9.6600	0.47605
	N-M	10.4800	0.83476
	Ma-SN	3.3300	0.30530
	Ma-FH	1.8400	0.33795
Male	Ba-ANS	10.0933	0.33624
	N-ANS	5.5100	0.31222
	Ba-N	10.6833	0.50725
	N-M	11.7383	0.75814
	Ma-SN	4.2367	0.37553
	Ma-FH	2.3400	0.20443
Total	Ba-ANS	9.6133	0.63659
	N-ANS	5.2350	0.44410
	Ba-N	10.1717	0.71000
	N-M	11.1092	1.01370
Total	Ma-SN	3.7833	0.56932
	Ma-FH	2.0900	0.37448

It was noted that Ma-SN, Ba-ANS and Ma-FH emerged as major variables in the determination of gender. All six variables were useful in the discrimination of gender ($p < 0.05$).

Since, the discriminant function was highly significant and therefore all the six variables were useful in determination of gender. A discriminant function equation was derived using the coefficient of cephalometric variables (Table 2).

Discriminant function equation (D)= - 26.628 + 1.631(Ba-ANS) - 0.742(N-ANS) + 0.318(Ba-N) + 0.055(N-M) + 1.903 (Ma-SN) + 1.817(Ma-FH).

Functions at group centroids were 0 to ± 2.093, with 0 to 2.093 being males and 0 to – 2.093 being females (Table 3).

Table 2: Canonical Discriminant Function Coefficients

	Function
	1
Ba-ANS	1.631
N-ANS	-.742
Ba-N	.318
N-M	.055
Ma-SN	1.903
Ma-FH	1.817
(Constant)	-26.628

Table 3: Functions at group Centroids

Gender	Function
	1
FEMALE	-2.093
MALE	2.093

Unstandardized canonical discriminant functions evaluated at group means

Table 4: Classification Results[a]

Gender			Predicted Group Membership		
			Female	male	Total
original	Count	Female	29	1	30
		Male	1	29	30
	%	Female	96.7	3.3	100.0
		Male	3.3	96.7	100.0

a - 96.7% of original grouped cases correctly classified.

The reliability of the derived discriminant function was assessed among the study subjects; 96.7% of the males were recognized as males and 96.7% of the females were recognized as females, with centroids score being 96.7% (Table 4)

Discussion

Identification of gender of an individual is one of the most important aspects of medico-legal cases and anthropological research. Availability of simple, economical, quick and accurate modalities can drastically reduce the time taken in the identification of individuals, thus shortening the legalities associated with the same. [9]

Cephalograms are favored for craniofacial assessment as they are more objective, standardized and reproducible.[8]

The cephalometric variables used in the present study were considered based on the evidences of previous studies that have reported high accuracy in determination of gender using a discrete number of morphological features of the cranium.[11]

In the present study, it was noted that Ma-SN, Ba-ANS and Ma-FH were the major variables in determination of gender. These results are accordance with the findings of Almas binnal et al. (2012) and Patil et al. (2005). [9,11]

Ma-SN and Ma-FH were the major contributors for gender determination in the present study, which is in accordance with the conclusions of Almas binnal et al. (2012) and

Kemkes et al. (2006) who studied the dimorphism of the mastoid process between gender.[9,12]

They concluded that the mastoid process is the most protected and resistant structure to damage, even in the cases of burning, due to its anatomical position at the base of skull and its compact nature. Thus, this anatomical region is favorable for gender determination especially when multiple measurements are carried out.[12]

The derived discriminant functional equation in the present study was 96.7% accurate in differentiating the male and female subjects.

Franklin et al (2005) and Almas binnal et al. (2012) reported an accuracy of 77 to 80% and 86% respectively.[9,13] Naikmasur et al (2010) claimed accuracy of 81.5 and 88.2% respectively by comparing South Indian and Indian immigrant of Tibetan populations. They found lower accuracy than our study.[9]

Hsiao et al (1996) and Patil (2005) found 100% and 99% accuracy in gender determination which is slightly higher than our study.[11,14]

The disparity in the findings of different studies may be explained by the use of varying number of parameters in the determination of gender.

Conclusion

As the skeletal structure of the human being is influenced by a number of environmental factors, specific standards of assessment must be drawn and applied to a particular population under consideration.

The derived discriminant function equation can be useful in the identification of gender of human remains pertaining to the population of gujarat. The findings of the present study confirm the role of lateral cephalograms and the six cephalometric parameters in the identification of gender.

Further studies should be conducted to evaluate the role of lateral cephalogram and the six cephalometric parameters among different populations of the world.

References

1. S. Kalistu, D.N. Doggalli, Gender Determination by Forensic Odontologist: A Review of various methods, 15 (2016) 78–85. https://doi.org/10.9790/0853-1511017885.
2. B. Sivapathasundharam, Shafer • Hine • Levy Shafer ' s Textbook of Oral Pathology, 7th edition; Elsevier, a division of Reed Elsevier India Private Limited Registered; chapter 21 : Forensic odontology; ISBN: 978-81-312-3097-8 (Indian adaptation).
3. M.Y. Işcan, P.S. Kedici, Sexual variation in bucco-lingual dimensions in Turkish dentition., Forensic Sci. Int. 137 (2003) 160–164. https://doi.org/10.1016/s0379-0738(03)00349-9.
4. K.S. Khanna, Efficacy of Sex Determination from Human Dental Pulp Tissue and its Reliability as a Tool in Forensic Dentistry., J. Int. Oral Heal. JIOH. 7 (2015) 10–6.
5. M.L. BARR, E.G. BERTRAM, A Morphological Distinction between Neurones of the Male and Female, and the Behaviour of the Nucleolar Satellite during Accelerated Nucleoprotein Synthesis, Nature. 163 (1949) 676–677. https://doi.org/10.1038/163676a0.
6. N. Das, R. Gorea, J. Gargi, J. Singh, Sex determination from pulpal tissue, J. Indian Acad. Forensic Med. 26 (2004) 50–54.
7. C. Urbani, R.D. Lastrucci, B. Kramer, The effect of temperature on sex determination using DNA-PCR analysis of dental pulp., J. Forensic Odontostomatol. 17 (1999) 35–39.
8. S.A. Veyre-goulet, M. Sc, C. Mercier, D. Ph, O. Robin, D. Ph, Recent Human Sexual Dimorphism

Study Using Cephalometric Plots on Lateral Teleradiography and Discriminant Function Analysis, 53 (2008) 786–789. https://doi.org/10.1111/j.1556-4029.2008.00759.x.

9. A. Binnal, B.K.Y. Devi, Identification of Sex using Lateral Cephalogram : Role of Cephalofacial Parameters, (n.d.) 280–283.
10. A. Mathur, A. Sande, M. Risbud, P. Ramdurg, A. Sr, Determination of sex by discriminant function analysis of lateral radiographic cephalometry using angular , linear and proportional cephalometric variables in Western Maharashtrian population, 3 (2017) 153–157. https://doi.org/10.18231/2395-6194.2017.0037.
11. K.R. Patil, R.N. Mody, Determination of sex by discriminant function analysis and stature by regression analysis : a lateral cephalometric study, 147 (2005) 175–180. https://doi.org/10.1016/j.forsciint.2004.09.071.
12. Kemkes A, Gobel T. Metric assessment of the Mastoid Triangle for gender determination : A Validation Study. J Forensic Sci 2006 , 51 (5):985-89.https://doi.org/10.1111/j.15564029.2006.00232.x
13. D.Ã. Franklin, L. Freedman, N. Milne, Sexual dimorphism and discriminant function sexing in indigenous South African crania, 55 (2005) 213–228. https://doi.org/10.1016/j.jchb.2004.08.001.
14. T.H. Hsiao, H.P. Chang, K.M. Liu, Sex determination by discriminant function analysis of lateral radiographic cephalometry., J. Forensic Sci. 41 (1996) 792–795.