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Saudi Journal of Biological Sciences

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ORIGINAL ARTICLE

Sex determination using discriminant function analysis in Indigenous (Kurubas) children and adolescents of Coorg, Karnataka, India: A lateral cephalometric study



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Received 14 March 2016; revised 21 April 2016; accepted 8 May 2016

Available online 14 May 2016

KEYWORDS

Discriminant function analysis;
Forensic investigation;
Indigenous;
Lateral cephalograms;
Sex determination

Abstract *Aim:* To test the validity of sex discrimination using lateral cephalometric radiograph and discriminant function analysis in Indigenous (Kuruba) children and adolescents of Coorg, Karnataka, India. *Methods and materials:* Six hundred and sixteen lateral cephalograms of 380 male and 236 females of age ranging from 6.5 to 18 years of Indigenous population of Coorg, Karnataka, India called Kurubas having a normal occlusion were included in the study. Lateral cephalograms were obtained in a standard position with teeth in centric occlusion and lips relaxed. Each radiograph was traced and cephalometric landmarks were measured using digital calliper. Calculations of 24 cephalometric measurements were performed. *Results:* Males exhibited significantly greater mean angular and linear cephalometric measurements as compared to females ($p < 0.05$) (Table 5).

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Peer review under responsibility of King Saud University.



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<http://dx.doi.org/10.1016/j.sjbs.2016.05.008>

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Also, significant differences ($p < 0.05$) were observed in all the variables according to age (Table 6). Out of 24 variables, only ULTc predicts the gender. The reliability of the derived discriminant function was assessed among study subjects; 100% of males and females were recognized correctly. *Conclusion:* The final outcome of this study validates the existence of sexual dimorphism in the skeleton as early as 6.5 years of age. There is a need for further research to determine other landmarks that can help in sex determination and norms for Indigenous (Kuruba) population and also other Indigenous population of Coorg, Karnataka, India.

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1. Introduction

In forensic and physical anthropological discipline, skeletal elements play an important role in sex determination. Although pelvis is commonly used for sex determination, skull serves as second best option. However, morphological characteristics and morphometry methods have been used with certainty; cephalometric radiographs are an asset of being more explicit when correlated to morphologic methods.

Humans have come a long way from primitive to modern life. The enthusiasm to achieve new heights has brought an ambience of scientific advancement and technology. On the other hand, the zeal to invent new ideas also coerced to a rolling swell in crime rate, terrorism, disasters and other atrocious conditions (Chandra Shekar and Reddy, 2009). In all such incidents, establishing an identity of an individual is an essential aspect in any investigating procedure. Ascertainment of sex from skeletal carcasses is one of the most critical aspects of osteological analysis which is crucial to medicolegal investigations (Mahesh Kumar et al., 2013; Patil and Mody, 2005) and physical anthropological research. It also plays an imperative role in establishing the biological profile of deceased, while facial reconstruction is unfeasible if sex is not correctly identified (Mathur et al., 2014). The precise and conscientious estimation of biological sex, age and ancestry is a necessity for the recognition of anonymous human remains in forensic investigations (Kranioti et al., 2014). Consequently, segregating, annotating and appraising the manifestations of sex form an indispensable part of all skeletal examination (Mathur et al., 2014).

Varieties of techniques are used in the establishment of sex by utilizing various guidelines. While dealing with skeletal remains, age, sex and racial affinity are the major fundamental determinations that must be sought. Although, the pelvis is thought to be the most definitive sex indicator, the skull also offers numerous excellent sex indicators which can be effectively preserved (Mahesh Kumar et al., 2013). Skull is possessed of hard structures, due to which it is the foremost maintained part of a skeleton. Therefore, in many situations it is the only accessible component for forensic investigations (Patil and Mody, 2005).

Despite the morphometric and anthropometric methods used in determining the identity of sex from an excarnated skull, radiographs offer an accurate, simpler, perfect and emulative method of sex determination by linear and angular measurements (Naikmasur et al., 2010). Many researchers have asserted that the estimation of sex by skull radiographs is a consistent technique which bestows exactness up to 80–100%. This precision can be further amplified by lateral and

postero-anterior cephalometric radiographs as they reveal supplementary features and additional points for analogizing (Naikmasur et al., 2010). Lateral cephalogram is exemplary for the analysis of skull as it provides information of a variety of anatomical points in a single radiograph and also it supplies details of architectural and morphological architectures and intra-cranial niceties for evaluation (Patil and Mody, 2005).

Analysis of the human skull by means of discriminant function has turned out to be an imperative method in legal medicine and forensic anthropology. The assessment of morphological character makes it feasible to use them as metrical variables for consequent discriminant function analysis (Franceschini et al., 2007). The main goal of this study was, therefore, to test the legitimacy of sex determination using lateral cephalometric radiography with discriminant function analysis on the Indigenous (Kuruba) population of Coorg, Karnataka, India.

Indigenous groups such as Eravas, Kurubas, Poleyas, and Kudiyas were the original inhabitants of Kodagu in the Western Ghats in India. They reside in the forests of Coorg and depend on it for their livelihood. We had included one such group i.e. Kurubas in our study for better understanding of them.

2. Materials and methods

This study is based on the metric data collected from lateral cephalometric radiographs to identify sexually dimorphic dissimilarities in craniofacial growth. Subjects with skeletal malocclusion, history of craniofacial trauma, developmental disorders of jaws, orthodontic or surgical orthognathic treatment were not included in this study. With teeth in centric occlusion and lips relaxed, lateral cephalograms were acquired in a standard position. Only acceptable quality radiographs were included for the study. The sample included 380 males and 236 females divided into age groups with increments of

Table 1 Distribution of study subjects according to age and gender.

Age (Years)	Male n (%)	Female n (%)	Total n (%)
≤8.5	35 (68.6)	16 (31.4)	51 (8.3)
8.6–10.5	75 (58.6)	53 (41.4)	128 (20.8)
10.6–12.5	117 (55.5)	94 (44.5)	211 (34.3)
12.6–14.5	81 (61.4)	51 (38.6)	132 (21.4)
≥14.6	72 (76.6)	22 (23.4)	94 (15.3)
Total	380 (61.7)	236 (38.3)	616 (100)

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