

Odontometric Approach for Stature Estimation in South Indian Population: A Cross Sectional Analysis

Nishat Ahmed Sheikh¹, Perugu Vanishri²

Abstract

Background: Forensic Odontology is the study of teeth, in the interest of justice, which deals with proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings. At times, skull or facial remains only are brought for examination as well as identification in medico legal practice. **Aims and Objectives:** To establish the relationship of the stature of person with odontometric parameters like Inter Canine width and Inter Premolar width of maxillary arch as well to obtain a linear regression formula for stature estimation. **Study Design:** Cross Sectional Study. **Place of Study:** Study was conducted in the department of Forensic Medicine, Government Medical College Mahbubnagar State Telangana. **Materials and Methods:** The present study consists of a cross-sectional sample of 192 subjects (96 males and 96 females) aged from 19 to 26 years. Stature was measured using the stadiometer, Maxillary Inter canine distance was measured as horizontal distance between the cusps tips of maxillary right canine to the cusp tip of left canine. Maxillary Inter premolar distance was measured as the horizontal distance between the buccal cusp tips of maxillary first premolar from right side to maxillary first premolar from left side. **Observation and Discussion:** Regression equation of Male stature on IC Length Stature = $100.758 + 1.8286 * IC \text{ Length}$, Regression equation of Male stature on IP Length. Stature = $128.2966 + 1.0063 * IP \text{ Length}$, Stature is dependent on IC Length & IP Length. Stature = $85.088 + 1.6186 * IC \text{ Length} + 0.5702 * IP \text{ Length}$ the Regression equation of Male stature on IC length and IP length is significant with p value of 0.000088. Regression equation of Female stature on IC Length, Stature = $37.4967 + 3.3692 * IC \text{ Length}$, Regression equation of Female stature on IP Length. Stature = $99.5668 + 1.4598 * IP \text{ Length}$, Regression equation of Female stature on IC Length and IP Length, Stature = $29.5967 + 3.1706 * IC \text{ Length} + 0.3847 * IP \text{ Length}$. **Conclusion:** It can be concluded that Inter canine and Inter premolar distance has a positive correlation and can be used successfully to estimate stature of the individual.

Keywords: Forensic Odontology; Stature estimation; Regression equation.

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Introduction

“Forensic Odontology” is the study of teeth, in the interest of justice, which deals with proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings.¹ Anthropometry is a specialized

branch which comprises a series of systematized measuring techniques that expresses quantitatively the dimensions of the human body which also includes skeleton remains. It is common, that mutilated bodies, dismembered body parts or just fragmentary remains are presented for medico legal examination. At times, skull or facial remains only are brought for examination as well as identification in medico legal practice. There are multiple scenarios like fire disaster, wild animals attack in deep forest, road traffic accidents, aircraft crash and terrorist attack where the question about identification is a major objective. In such scenario usual techniques of identification such as fingerprints, facial recognition methods do not give positive results or even it may be of no use, in such scenario help of Forensic Odontologist who makes a post-mortem record helps in identity of

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the victim, also such data can help to determine age, stature, ancestry, sex and socioeconomic class of the individual in question. Somatometry, cephalometry, craniometry, osteometry, and odontometry are the various specialized tools that is being used in anthropometry and such tools had proved to be valid in the identification of human remains. It is also seen that anthropometric difference had a great diversity and varies between races and has been influenced by national social and economic conditions.² Many researchers had done studies on various bones of the human skeleton for the determination of stature.³ It is very much evident that accurate biological correlation of stature is linked with some body parts which include extremities, head, trunk, vertebral column.⁴ Long bones have been used for estimation of stature with certain accuracy by forensic anthropologists in various situations, where the other evidence is incomplete and fragmented.⁵ In Archeological excavation, forensic investigation for mutilated body or the skeletal remains, all the bones of the individual is not retrieved or found, commonly long bones, head will be available for identification as well to determine stature based on the principle of positive correlation between various long bones and stature.⁶⁻⁹ Human teeth are extremely durable and withstand at high temperatures and may help in identification even when the rest of the body has undergone late decomposition stage. Hence, they are considered to be an invaluable tool in forensic medico legal investigation. Out of all the teeth in the human dentition, it is the canines which are least frequently extracted teeth, may be due to relatively decreased caries and periodontal diseases as well canines are reported to withstand extreme condition, recovered human remains in air disasters and hurricanes.¹⁰⁻¹¹ There is a paucity of literature which supports stature estimation from odontological parameters on south Indian population. Hence, in this present study was conducted to establish the relationship of the stature of person with odontometric parameters like Inter Canine width and Inter Premolar width of maxillary arch as well to obtain a linear regression formula for stature estimation based on each correlating odontometric parameter, as well to check the reliability of the derived regression equation on the same population.

Materials and Methods

Place of study

Study was conducted in the department of

Forensic Medicine, Government Medical College Mahbubnagar State Telangana.

Study design

Cross Sectional Study.

Procedure

The present study consists of a cross-sectional sample of 192 subjects (96 males and 96 females) aged from 19 to 26 years. Subjects were selected irrespective of their caste, religion, dietary habits and socioeconomic status. Sufficient permissions and informed consents were procured before the measurements of the subjects are taken and clearance from the Institutional Ethical Committee is obtained in advance.

Stature

Stature was measured using the stadiometer; the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Maxillary Inter canine width (IC)

Maxillary Inter canine distance was measured as horizontal distance between the cusps tips of maxillary right canine to the cusp tip of left canine.

Maxillary Inter premolar width (IP)

Maxillary Inter premolar distance was measured as the horizontal distance between the buccal cusp tips of maxillary first premolar from right side to maxillary first premolar from left side. Both the parameters were recorded with the help of a Digital Vernier Caliper accurate up to 0.01 mm (Insize Digital Caliper, China). Vernier Caliper was disinfected with antiseptic solution (Microsteril) after recording of each patient. The pointed tines of Vernier Caliper allowed accessing the inter proximal areas of teeth. The distance between the tines was read off from the display and then recorded. The measurement of height and Inter canine and Inter premolar breadth was carried out at a particular period of time 10 am to 1 pm to avoid diurnal variations.

Inclusion criteria

Age of the volunteers between 19–26 years, a complete set of fully erupted, periodontally healthy, noncarious, intact, satisfactorily aligned maxillary teeth subjects were included in the study.

Exclusion criteria

Subjects with History or clinical evidence of cleft palate, crown restoration, orthodontic treatment, trauma, or oral destructive habit, History or clinical features suggestive of endocrinal disorders, metabolic disorders, developmental disorders, or history of prolonged illness were excluded. Also Subject morphologically showing the congenital malformations, Dwarfism/Achondroplasia, features of nutritional deficiencies and injuries to extremities were not included in the present study. Subjects from other regions, NRI, those with deformities of vertebral column & limbs, and history of trauma were excluded from the study.

Data Analysis

Data arrange in tabular form after arranging data was represented graphically. Relationship between stature and CI is presented through scatter diagram. In this study samples were drawn randomly by using simple random sampling technique. Total

sample size in this study is 192 which are calculated by sample size determinant formula which is, where a critical value of normal distribution p is a sample proportion and ϵ is a margin of error. In Digital Vernier Caliper, Length = Reading of the main scale + Vernier coincidence \times Vernier constant + mechanical error. (Here Vernier constant = 0.01 and mechanical error = 0) Calculation of stature using regression equation: Stature = value of constant + regression coefficient \times Inter canine and Interpremolar breadth. Value of the constant and regression co-efficient was calculated using SPSS Version 19 program. Descriptive statistics like mean, sd min , max , CI etc. was done for all characteristics of variables. To analyze the data we used Pearson correlation to measure the relationship between statures with IC and IP. To predict the stature on the basis of IC and IP we used linear regression and multiple regression equations.

Results

Regression equation of Male Stature on different

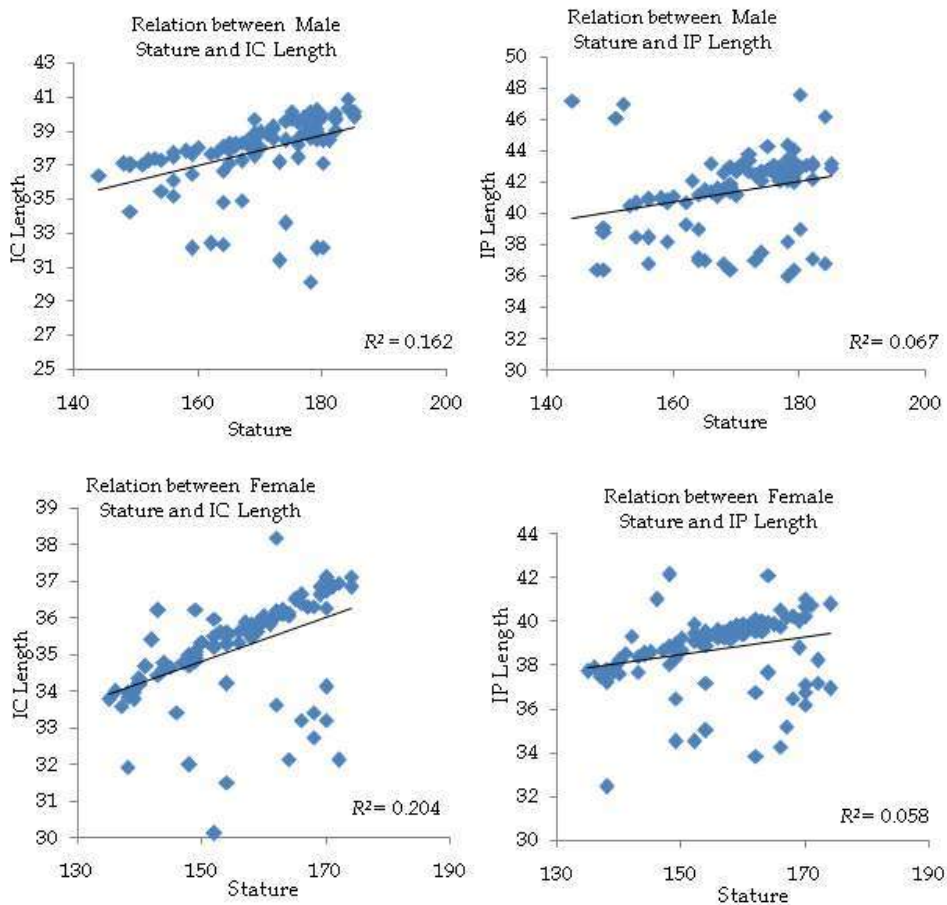


Fig. 1: Scatter diagram and regression line showing the relationship between stature and Inter canine [IC], Interpremolar [IP] distance in Males and Females.

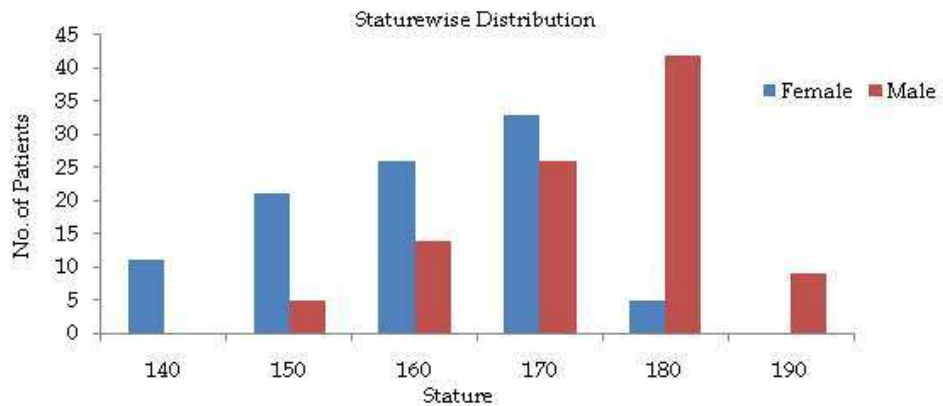


Fig 2: Stature wise distribution.

Table No 1: Gender wise various parameters.

Characteristics		Male	Female	Combine (M + F)
Age	Min	19	19	19
	Max	26	26	26
Stature	Min	144	135	134
	Max	185	174	185
IC	Min	30.15	30.1	30.1
	Max	40.86	38.2	40.86
IP	Min	36	32.45	32.45
	Max	47.6	42.15	47.6

Table 2: Gender wise comparison of parameters.

Variables	Mean		Standard Deviation		Confidence Interval		P-Value
	Male	Female	Male	Female	Male	Female	
Age	22	22.5	2.4	2.29	22 ± 0.5	22.5 ± 0.46	0.7856
Stature	169.98	156.07	9.96	10.46	169.98 ± 1.99	156.07 ± 2.09	0.0032
IC	37.86	35.19	2.1952	1.4042	37.86 ± 0.44	35.19 ± 0.28	0.00324
IP	41.42	38.71	2.5662	1.7326	41.42 ± 0.51	38.71 ± 0.35	0.00185

Table 3: Correlation between Inter canine and Interpremolar distance with stature.

Variables	Stature	P Value
IC	Male	0.4030
	Female	0.4524
IP	Male	0.2593
	Female	0.2419

Table 4: Regression equation Inter canine and Interpremolar distance with stature.

Variable	Regression equation	P - Value	Significance
IC Length	Stature = 100.758 + 1.8286 * IC Length	0.000047	All are significant
	Stature = 37.4967 + 3.3692 * IC Length	0.0000037	
IP Length	Stature = 128.2966 + 1.0063 * IP Length	0.01074	
	Stature = 99.56680 + 1.4598 * IP Length	0.01759	
IC + IP Length	Stature = 85.088 + 1.6186 * IC + 0.5702 * IP Length	0.000088	
	Stature = 29.5967 + 3.1706 * IC + 0.3847 * IP Length	0.0000492	

parameter, hence Regression equation of Male stature on IC Length Stature = $100.758 + 1.8286 * IC \text{ Length}$. The Regression equation of Male stature on IC length is significant with p value of 0.000047. Regression equation of Male stature on IP Length. Stature = $128.2966 + 1.0063 * IP \text{ Length}$. The regression equation of male stature on IP length is significant with p value of 0.01074. Also Stature is dependent on IC Length and IP Length. Stature = $85.088 + 1.6186 * IC \text{ Length} + 0.5702 * IP \text{ Length}$ the Regression equation of Male stature on IC length & IP length is significant with p value of 0.000088.

Similarly for Female Stature, Regression equation of Female stature on different parameters. Regression equation of Female stature on IC Length, Stature = $37.4967 + 3.3692 * IC \text{ Length}$. The regression equation of Female stature on IC length is significant with p value of 0.0000037. Regression equation of Female stature on IP Length. Stature = $99.5668 + 1.4598 * IP \text{ Length}$. The regression equation of Female stature on IP length is significant with p value of 0.01759. Also Regression equation of Female stature on IC Length and IP Length, Stature = $29.5967 + 3.1706 * IC \text{ Length} + 0.3847 * IP \text{ Length}$. The Regression equation of Female stature on IC length and IP length is significant with p value of 0.00004919.

Discussion

In skeletal remains, mutilated dismembered bodies the utmost importance is of determination of the individuality especially in Medico legal cases, as well sex, age and ancestry, stature of is a biological parameter and such parameters have a specific characteristics to the individual in his biological profile. Analysis of such specific parameters definitely accelerates the human remains analysis and surely it will narrow the pool of victims to match and will provide a definite markers for the final confirmation.¹²

Preliminary investigation in unknown human remains is stature estimation for the purpose to establish Identification of that individual. However, various methods are being used to establish the identity of unknown human remains, but a specific drawback to such techniques is that it had a limited applicability to fragmentary remains.¹³

Various researchers from all over the world had used different bones of human skeleton like femur to metacarpals to estimate the stature.¹⁴ There

may be scenario where unavailability of these bones recording of other body parts can be useful to determine body stature. Various odontometric dimensions are also genetically determined as other bones of the body.¹⁵ Such measurements are unique for each race and geographical area due to environmental variations.¹⁶

Research related to stature estimation from odontometric parameters are circumscribed in Indian population as well. However, the present research aim to provide the valuable data pertaining to correlation to stature with odontometric dimensions in south Indian population.

In a study performed by Prabhu *et al.*¹⁷ in year 2013 on 95 adult individual used buccolingual and mesiodistal measurement of all teeth, excluding third molars estimated stature. He suggested that the dentition may be used as a supplement to more valid predictor of statures as he observed a moderately significant correlation between two.

However, there was no correlation between tooth width and stature was recorded by Filipson and Goldson¹⁸ in early 1963 in Swedish population, smaller sample size or difference in ethnicity may be the reason to show such low correlation.

In a research conducted by Yadav *et al.* he concluded that regression equations generated from various odontometric parameters shall be used as a supplementary approach for the stature estimation in scenario where extremities are not available but with caution as these studies are population specific and shall not be used on other population of the world. It was concluded by him that canine width can aid in stature estimation as an adjunct when only teeth are available for identification, however he also suggested that it needs a further investigations with larger sample by considering ethnic and community background.¹⁹

In a study conducted by Hossain *et al.* some degree of positive correlations between stature and tooth crown dimensions like crown height, mesiodistal width, buccolingual width. In forensic situations, using this relationship as a tool shall not give accuracy in stature estimation. Tooth crown dimensions shall be used as a supplementary method for stature estimation in unknown human bodies in forensic identification together with other reliable body remains.²⁰ It was Kalia *et al.* in 2008 combined width of six maxillary anterior teeth for stature estimation with small statistically significant correlation.²¹

Conclusion

In forensic investigation human skeletal remains provides the vital clues to human identification, teeth and related odontometric feature also serves as a marker which has the capacity to narrow down the search for missing person in forensic investigation. It is a fact that common odontometric parameters have not been much evaluated as forensic tools in estimation of stature.

The present study was carried out to investigate the possibility of estimation of stature of a person from Inter canine and Inter premolar distance by application of regression analysis. It can be concluded that Inter canine and Inter premolar distance has a positive correlation and can be used successfully to estimate stature of the individual. Despite this positive correlation we propose that this is not an exhaustive study, it is an attempt to provide a statistically valid technique. It is advisable that the results may be viewed more as indicative of the feasibility of the technique as in providing regression equations applicable in forensic investigation.

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