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Estimation of Stature in Local Beed (Maharashtra) Population: An Odontometric Approach

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Abstract: *As stated by Federation Dentaire Internationale, "Forensic Odontology" is the branch of dentistry which, in the interest of justice, deals with proper handling & examination of dental evidence & with the proper evaluation & presentation of dental findings. Forensic dentistry is important for human identification, especially when conventional methods cannot be applied, usually due to advanced decomposition, carbonization or fragmentation of the body. However, the method of using teeth has several advantages as it is easy to locate & measure them. Teeth form an excellent material for anthropological, genetic, odontologic & forensic investigations. To investigate the possibility of predicting the height of an individual using selected odontometric parameters as a forensic tool. The study sample consisted of 70 subjects (35 females & 35 males). Measurements of the height, Combined Mesiodistal Width of permanent maxillary anterior teeth (CW), maxillary Intercanine Width (ICW), maxillary Interpremolar Width (IPW) were made directly on the subject. The data collected was subjected to statistical analysis & a linear regression formula was obtained against each odontometric parameter. As there are differences in odontometric features in specific populations, even within the same population in the historical & evolutional context, it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements. Thus the study evaluated all odontometric parameters of the Beed population. The statistical analysis showed that the three odontometric parameters, combined mesiodistal width, intercanine width & interpremolar width were found to show significant correlation with height.*

Keywords: *Arch length, arch width, intercanine width, interpremolar width, odontometric parameters, stature estimation.*

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I. Introduction

Identification of the unknown is the main aim of anthropometry. Routine methods have some limitations, especially in highly mutilated bodies which increases the difficulty of identification. In forensic investigations of such cases, estimation of stature becomes equally important along with other identification parameters like age, sex, race, etc. Stature is the height of a person in the upright posture & an important anthropometric parameter that can be used to determine physical identity as it is one of the distinct visible factors of an individual. In cases where identification has to be performed based on skeletal remains the most common stature estimates are derived from long bones. The use of long bones was used based on the principle that their length would positively correlate with stature. A proportional biologic relationship exists with every part of the human body including head, face, trunk, extremities and even long bones, foot and shoe print [1-5]. Consequently, teeth being relatively resistant to damage and odontometric parameters remaining constant over time, the methods using teeth are standard, well-defined and easy to locate [6].

1.1 Aim

Looking at the paucity of studies pertaining to stature estimation from odontometry in Beed and usefulness of these studies in forensic and legal medicine, the present study was designed to elucidate the anthropometric correlation of tooth dimensions with stature.

II. Materials And Methods

The study sample consisted of 70 subjects (35 females & 35 males) selected from the Out Patient Department (OPD) of Department of Orthodontics & Dentofacial Orthopaedics, Aditya Dental College, Beed, Maharashtra.

Criteria for selection
Inclusion Criteria [7]
Age 20-30 years

A complete set of fully erupted, periodontally healthy, noncarious, intact, satisfactorily aligned maxillary teeth Exclusion Criteria [7] History or clinical evidence of dental deformity, cleft palate, crown restoration, orthodontic treatment, developmental disorders & trauma After obtaining informed consent from the subjects selected, the height, the mesiodistal width of the six maxillary permanent anterior teeth, the intercanine width (ICW) and the interpremolar width (IPW) were measured and recorded.The height was measured as the vertical distance from the vertex to the floor using a standard anthropometer. Measurements were taken by making the subject stand erect on a horizontal resting plane barefooted. Anthropometer was placed in straight vertical position behind the subject with the head oriented in the Frankfurt Horizontal Plane & shoulders & hips touching the vertical limb of the instrument. The movable rod of the anthropometer was brought in contact with the vertex in the midsagittal plane Combined Width (CW) is the maximum mesiodistal width of each tooth and was measured at the level of anatomic contact points directly on the subject, with the help of a digital vernier caliper accurate to 0.01 mm (Aerospace). The combined mesiodistal width of the maxillary anterior permanent teeth (CW) in each case was obtained by summation of the individual mesiodistal width of each tooth (Fig. 1). If it was difficult to place the vernier caliper, a manual divider with very fine tips was used to measure the dimension; later we measured the divider distance with the same digital vernier caliper.

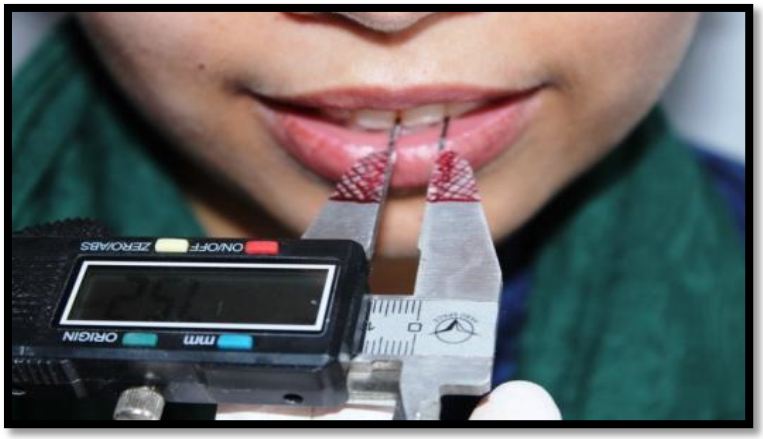

Figure 1 measuring the mesiodistal dimension of maxillary anterior teeth clinically on a patient with an electronic vernier caliper

Intercanine Width (ICW) was measured as the horizontal distance between the cusp tip of maxillary right side canine to the cusp tip of maxillary left side canine (Fig. 2).

Figure 2 measuring the intercanine width with an electronic vernier caliper

Interpremolar Width (IPW) was measured as the horizontal distance between the buccal cusp tip of maxillary right 1st premolar to the buccal cusp tip of maxillary left 1st premolar (Fig. 3).

Figure 3 measuring the interpremolar width with an electronic vernier caliper

The data collected was subjected to statistical analysis and the SPSS software package version 19.0 (SPSS Inc. IBM Corporation, Chicago, IL, USA) was used.

III. Results

Table 1 shows a detailed description of each parameter taken up for the study such as maximum value, minimum value, mean value, standard deviation and *P* value. Table 2 shows the correlation coefficient of all the parameters with the height of individuals along with their respective *P* value. The statistical analysis showed that out of the three selected odontometric parameters, combined mesiodistal width, intercanine width & interpremolar width were found to show significant correlation with height. The regression equations were derived using all the three parameters separately and also in combination. The following regression equation was used to calculate the height of an individual, i.e.

$y = c + mx$

where y = predicted height of the individual, c = constant for that parameter , m = regression coefficient and x = value of parameter used for calculation of stature. Table 3 shows the value (c) and regression coefficient (m) for each parameter along with regression formula for estimating the stature of an individual [7] With application of Z test, no statistically significant difference was seen between the predicted height and actual height in males when the odontometric parameters were used whereas significant correlation was seen between the predicted height and actual height in females when intercanine width and interpremolar width and intercanine width + interpremolar width were used [Table 4].

Table 1: Minimum, maximum and mean values of each odontometric parameter

Parameter	N	Minimum	Maximum	Mean	SD
Age	70	17.00	28.00	22.7429	2.04433
Height	70	145.00	169.50	159.4043	5.63363
CW	70	37.00	50.00	41.9786	3.34104
IC	70	29.00	42.50	36.3714	2.59694
IP	70	36.50	49.00	43.0500	2.69883
CW+IP	70	75.00	97.50	85.0286	5.12092
CW+IC	70	66.00	92.50	78.3500	5.37058
IC+IP	70	67.00	90.00	79.4214	5.01276
CW+IC+IP	70	104.00	140.00	121.4000	7.41649

Table 2: Correlation coefficient between height and odontometric parameters

Parameter	Correlation coefficient *(r)*	*p*-Value
CW	0.579	0.000
IC	0.493	0.000
IP	0.338	0.004
CW+IP	0.556	0.000
CW+IC	0.598	0.000
IC+IP	0.437	0.000
CW+IC+IP	0.556	0.000

Parameter	Constant (c)	Regression coefficient (m)	*t* value	*p* value	Regression formula Y=c+mx	Significance
CW	118.437	0.976	5.852	0.000	118.437+0.976x	S
IC	120.532	1.069	4.669	0.000	120.532+1.069x	S
IP	129.057	0.705	2.959	0.004	129.057+0.705x	S
CW+IP	107.434	0.611	5.510	0.000	107.434+0.611x	S
CW+IC	110.233	0.628	6.157	0.000	110.233+0.628x	S
IC+IP	120.394	0.491	4.007	0.000	120.394+0.491x	S
CW+IC+IP	108.120	0.422	5.518	0.000	108.120+0.422x	S

Table 3: Value of constant (c) and regression coefficient (m) for each parameters and regression formula

Table 4: Application of *Z* test to test for difference in actual and predicted height among Males and Females

Predicted Height with	Male	p-Value (z test)	Sig.	Female	p-Value (z test)	Sig.
CW	161.341	0.955187	NS	157.389	0.094806	NS
IC	160.630	0.99938	NS	158.118	0.018232	S
IP	160.006	0.999906	NS	158.765	0.002553	S
CW+IP	161.099	0.991713	NS	157.571	0.065699	NS
CW+IC	161.379	0.971315	NS	157.378	0.122652	NS
IC+IP	160.366	0.99989	NS	158.348	0.009407	S
CW+IC+IP	161.013	0.994588	NS	157.586	0.063649	NS

IV. Discussion

With an increasing occurrence of mass disasters, the identification of an unknown person from the fragmentary remains has become a prime aspect of forensic investigation.Age, sex and stature are significant parameters in establishing the identity of an unknown individual because whenever it is possible to predict the stature, identification is simplified because then the missing persons of only that stature needs to be considered [8]. Estimation of stature has been done by using various anthropometric parameters such as length of long bones, sternum, foot length, hands, knee height and vertebral column [9-14]. The use of long bones was used based on the principle that their length with positively correlate with stature hence, other parameters such as foot length and cranial sutures [15,16].Doris *et. al.* have indicated that the early permanent dentitions provide the best sample for tooth size measurements because early adulthood dentition has less mutilation & less attrition in most individuals. Consequently, the effect of these factors on the actual dimension tooth parameters would be minimum. Thus, only subjects in the 20-30 years' age group were included in the study sample [17].Three odontometric parameters namely the combined mesiodistal width of 6 maxillary anterior teeth, intercanine width, interpremolar width were evaluated to determine if there is a significant correlation between these parameters & the height of an individual.Out of the three odontometric parameters selected for the study, only the combined mesodistal width of six maxillary anterior teeth has been used for estimation of stature by Kalia *et. al.* & only small statistically significant correlation between height & combined mesiodistal width of six anterior maxillary teeth had been reported [16]. However, in this study it has been found that there is significant between height & all the three odontometric parameters.Prabhu *et. al.* Have done a study in 2013 to ascertain the usefulness of tooth crown measurements in stature prediction. They used buccolingual & mesiodistal dimensions of all teeth (except third molars) & stature measurements were obtained from 95 living adults (47 females, 48 males). Regression analysis was performed which revealed a statistically significant correlation to stature [18].

When each odontometric parameter was correlated with the height of an individual, all were found to be significant. When combinations of 2 parameters (CW+IC, CW+IP, IC+IP) were correlated with height, then statistically significant correlation was obtained. When all the 3 parameters (CW+IC+IP) were correlated with height, they too were found to be statistically significant. The selected parameters can be used singly or in combination successfully in the estimation of the stature of an individual. Thus the study proposes the importance of various odontometric parameters as a forensic tool for stature estimation from fragmentary remains.

V. Conclusion

From the present study, it can be concluded that regression equations generated from odontometric parameters can be used as a supplementary approach for the estimation of stature when extremities are not available but with caution as these are population specific & cannot be used on other populations.
Thus, the reliability of using odontometric parameters in combination improves the predictability of estimating stature rather than when a single parameter is used alone in fragmentary remains.

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