

Determination of Stature from Mesio-distal and Bucco-Lingual Dimensions of Teeth in North Indian Population

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Abstracts

Teeth are in excellent material in living and non-living populations for anthropological, genetic, odontologic and forensic investigations. Some times, only teeth are brought for forensic examination. So determination of stature from the teeth is an important aspect in establishing identity in such cases. The aim of the present study was to estimate the stature from Mesiodistal, bucco-lingual dimension's of maxillary and mandibular teeth in a sample of 407 adolescents from North India. As a part of Indian cast system, mostly North Indian are an endogamous group. Along with stature, Mesio-distal and buccolingual diameter's of maxillary or mandibular teeth were taken on each subject.

The finding suggest that all the cephalo-facial measurements are significantly correlated with stature ($P < 0.01$, $p < 0.001$); the measurements of Mesiodistal Diameter of total maxillary have strong correlation with stature than other teeth dimension's. This was also supported by the regression analysis, which shows that Mesio-distal Diameter of all teeth of maxillary arch measurements give better prediction of stature. Reliability of the regression formulae was checked by comparing the estimated and actual stature within the same sample and in another sample taken from a mixed population of North India.

Key words

Forensic odontology, stature estimation, teeth dimension, bucco-lingual, mesio-distal.

Introduction

Determination of stature is an important aspect in establishing in the identity of the deceased in unknown fragmentary and dismembered remains. The estimation of stature

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from body parts involves specialized anthropometric techniques applied with great precision. For such estimation, regression analysis is the best method as far as the accuracy or reliability of the estimate is concerned. 1-3 Studies have been conducted on the determination of stature from isolated bones and different body parts including arms, legs, hands, feet, intact vertebral column, cephalo facial dimensions 4-17. In certain medico-legal cases, where only teeth are available for examination it becomes difficult for a forensic specialist to identify the deceased. No study have been conducted in past which focus on determination of stature from the teeth dimension. Keeping in the view the no literature in this regard, the present study provides.

1. The anthropometric correlation of Mesio-distal or bucco-lingual dimension of Maxillary and mandibular anterior, posterior or both with stature.
2. The regression equations for prediction of stature from teeth dimensions in North Indian adolescents.
3. To test the reliability and accuracy of regression formulae in the same population which was originally used to make these formulae and in another sample taken from mixed population of North India.

Material and Methods

Samples

A randomly selected sample of 407 (M : F 204 : 203) adolescents ranging in age from 13-20 years taken for the present study. The adolescent of North India are an endogamous caste group (Marrying within the same caste).

Methodology

Besides stature, maxillary and mandibular teeth dimensions measurement (study cast) were taken on each subjects. The measurements include bucco-lingual and mesio-distal diameter

of maxillary and mandibular teeth. Alginate impressions of the teeth were made and later casts were prepared with dental stone and teeth, Buccolingual and Mesio-distal diamensions were measured on the study casts.

The inclusion criteria for were as follows :

1. Healthy state of gingival and periodontium.
2. Caries free teeth.
3. Normal overjet and overbite.
4. Absence or minimum of spacing in any teeth.
5. Full erupted dentition.
6. Normal molar and canine relationship.
7. All subjects were healthy and free from any symptomatic Cephalo-facial and other physical deformity.

All measurements were taken on an study casts basis using a vernier caliper with a resolution 0.02 milli meters. The subjects included in the present study were living under more or less similar environmental conditions. Although no attempt was made to separate the age groups, but to avoid the age-biased sample was collected keeping in mind more or less equal distribution of subjects in each group. The data were subjected to statistical analysis like mean, standard deviation, karl pearson's correlation coefficient (r), regression analysis and standard error of estimate using SPSS version 11.0.

Result

Descriptive mesio-distal, bucco-lingual, maxillary and mandibular (anterior or posterior, total anterior or posterior arches both) in genders.

Table 1 : Presents the mean values, standard deviations of mesio-distal, buccolingual diameter of maxillary or mandibular teeth of both genders. The mandibular canines showed significant mean differences in all investigated variables. There were no statistically significant difference between any measures of the left and right side of either maxilla, or the mandible except mandibular canine i.e. right canine mesio-distal diameter (7.63 mm) as compared left canine (6.31mm) and also greater significant sexual diamorphism in mesio-distal diameter canine as compared to other teeth.

Table - II. Presents the mean value, standard

deviations, range of values of stature. It is evident that North Indian have average stature, the average being (M : F :: 158.641, 154.569 cm).

Table III. Lists the correlation coefficients between stature and Mesodostal, bucco-lingual diameter teeth in North India. All the teeth measurement exhibit significant correlation with stature (P <0.01, P (0.001). The highest correlation coefficient is exhibited by Mesio-distal diameter of maxillary arch (r = 0.513) and lowest by mesio-distal diameter of lateral incisor (r = 0.218).

Table IV. Shows the regression equations for estimation of stature (in mm) from teeth dimensions in North India. These are separate equations for each measurement which help in estimation of stature from individual, combined teeth or anterior, posterior, complete arch strongly attributed to homogeneous nature of the sample. These regression equations have been computed by computerized regression analysis of the data and the regression coefficients 'a' and 'b' are calculated; where 'a' is the regression coefficient of dependent variable i.e. stature and 'b' is the regression coefficient of the independent variable i.e. a teeth dimensions measurements. A hypothetical regression equation is depicted follows.

$$S = a + b X$$

Where, X = a teeth dimensions.

The table also presents the standard error of estimate (SEE) calculated for each and every regression equation for estimation of stature. The SEE tends to predict the deviation of estimated stature from the actual stature it ranges between ± 2.02 and ± 7.02 . A low value is indicative of greater reliability of the estimated stature and the higher value of SEE denotes less reliability of prediction. Mesiodistal diameter of maxillary arch dimensions of exhibits lowest value (SEE = ± 2.02) indicating that the prediction of stature from this measurements higher than any other dimension's of teeth. Similarly, the highest value of SEE is exhibited by Meso-distal dimension of mandibular lateral incisor (SEE= ± 7.02) indicating that the nasal depth is the least reliable measure for estimation of stature.

Discussion

The results indicate that teeth dimensions can

successfully be used for estimation of stature in situations where teeth remains are brought for postmortem examination.

Stature is generally a straight forward parameter to establish in the adult while the determination of stature in adolescent becomes difficult because of on going physical growth of the long bones which contribute substantially to stature of an individual 18. In present study, the physical growth of teeth has a no effect on the determination of stature because the no growth of occurs. The study will be very significant in determination of stature from teeth dimensions, where other body parts are not available for forensic analysis. Further, to test the reliability of the calculated regression equations, a sample of 102 subjects (30 each from four groups 12 - 14, 14 - 16 and 16 - 18) was taken from a mixed population of North India (Table 5). Two measurement's i.e. maxillary (arch's) mesiodistal and bucco-lingual diameter was taken for this test. The stature was estimated using the already computed regression equations for these two measurements for each subject in each age group. The mean estimated stature was compared with the mean actual stature of these subjects. The difference between actual and mean estimated stature ranges from 0.906 to 2.002 cm. which is considered as negligible and statistically insignificant.

The calculated regression equations show good reliability in estimation of stature not only in the sample which was originally used in the calculation of regression equations but also in another sample taken from the mixed population of North India. The teeth dimensions measurements are significantly correlated with stature and the measurements of maxillary arch mesio-distal show stronger correlation with stature than that of other dimension's. The regression equations calculated for the determination of stature for the north Indian endogamous group show high degree of reliability. Measurements of Mesio-distal

dimensions are found to be more reliable than bucco-lingual dimension of teeth. While conducting any forensic study based on anthropometry or odontometry, one must take into consideration the accuracy and reproducibility of the measurement. The result of the studies conducted without calculating personal error/technical error, are thus subject to major error. In the present study, utmost care was taken to ensure the precision in tooth dimension measurements. During data collection, the instruments like anthropometer, sliding caliper, spreading caliper, vernier caliper etc were regularly checked for their accuracy. Before actually beginning the data collection, these measurements were taken on 50 subjects for four times and the technical error was calculated following Schell et al¹⁹. The results indicate that the technical error contributes negligible to the measurement and the measurements are reproducible without significant technical error.

The study has substantial practical significant in the sense that the current sample of north India comprises endogamous group i.e. the members of this group marry within their own caste, thus making it anthropologically, genetically and forensically an important population. In case of the present study, the greater reliability of the estimate.

Conclusion

It is concluded that the study is quite useful for forensic odontologist and forensic scientists when unknown remains pertaining to only tooth, teeth are brought forensic examination. The mesio-distal dimension's give better reliability of estimate than that of bucco-lingual dimension's measurements. Mesio-distal and bucco-lingual dimension of maxillary (arch) are the best parameters for determination of stature. It is also observed that the calculated formulae hold true not only for the population upon which these formulae are based but also for a sample of mixed population from north India.

TABLE - 1

Tooth	M - D (Mean ± S.D.)		B - 2 (Mean ± S.D.)	
	Males	Females	Male	Females
UI 1	8.76 ± 0.72*	8.34 ± 0.72*	7.32 ± 0.84	7.21 ± 0.61
UI 2	6.83 ± 0.62	6.64 ± 0.57	6.32 ± 0.89	6.24 ± 0.86
UP 1	7.55 ± 0.86	7.23 ± 0.93	7.64 ± 0.68*	6.78 ± 0.71*
UP 2	6.78 ± 0.93	6.68 ± 0.72	9.21 ± 0.41	9.12 ± 0.89
UM 1	6.56 ± 0.53	6.23 ± 0.53	9.72 ± 0.53	9.19 ± 0.79*
UM 2	11.57 ± 0.92	11.42 ± 0.51	11.14 ± 0.59	10.84 ± 0.51
UM 3	11.01 ± 0.63	10.56 ± 0.73	11.13 ± 0.71	10.76 ± 0.78
LI 1	6.43 ± 0.52	6.32 ± 0.52	6.29 ± 0.74	6.13 ± 0.83
LI 2	6.32 ± 0.53	6.30 ± 0.43	6.52 ± 0.71	6.41 ± 0.92
LP 1	7.63 ± 0.22**	6.31 ± 0.32**	7.55 ± 0.83	7.33 ± 0.81
LP 2	7.12 ± 0.42	6.92 ± 0.41	7.72 ± 0.84	7.51 ± 0.80
LM 1	7.72 ± 0.62	7.73 ± 0.62	8.73 ± 0.51	8.12 ± 0.61
LM 2	11.51 ± 0.63	10.71 ± 0.62	10.46 ± 0.83	10.18 ± 0.67
LM 3	10.54 ± 0.61	10.21 ± 0.78	10.31 ± 0.72	9.96 ± 0.72
Upper anterior T#	46.12 ± 0.82	44.24 ± 0.71	41.28 ± 0.52	39.82 ± 0.51
Lower anterior T	41.57 ± 0.81	38.08 ± 0.62	39.41 ± 0.53	37.42 ± 0.51
Upper posterior T	70.81 ± 0.62	69.63 ± 0.54	82.40 ± 0.64	79.82 ± 0.67
Lower posterior T	70.71 ± 0.61	69.72 ± 0.60	76.42 ± 0.62	74.41 ± 0.62
Maxillary arch	116.93 ± 0.72	113.87 ± 0.53	123.68 ± 0.59	119.64 ± 0.59
Mandibular arch	112.28 ± 0.53	107.80 ± 0.52	115.84 ± 0.58	111.83 ± 0.65
Both archs	229.21 ± 0.65	221.67 ± 0.56	239.52 ± 0.57	231.47 ± 0.63

* P < 0.01

** P < 0.001

Teeth

Table : 2 DESCRIPTIVE STATISTICS FOR STATURE IN GENDER.

Variable (in nm)	Sex	Mean ± S.D x 10mm	minimum (x 10 mm)	Maximum (x 10 mm)
Stature	Male	158.641 ± 6.104	143.8	166.8
	Female	154.569 ± 6.163	141.7	162.4

TABLE - 3 : Correlation Coefficients between stature and various of Mesio-distal (MD), bucco-lingual (BL) Dimensions of Maxillary and Mandibular teeth.

Variable (in mm)	Variable	Correlation coefficient (r)	Standard error
UI 1	MD, BL	0.263*, 0.261 *	0.062, 0.042
UI 2	MD, BL	0.252*, 0.252*	0.051, 0.041
UP 1	MD, BL	0.341*, 0.321*	0.049, 0.047
UP 2	MD, BL	0.421**,0.401**	0.071, 0.067
UM 1	MD, BL	0.272*, 0.271*	0.083, 0.052
UM 2	MD, BL	0.413**, 0.241**	0.073, 0.051
UM 3	MD, BL	0.261*, 0.251*	0.071, 0.053
LI 1	MD, BL	0.262*, 0.261*	0.082, 0.057
LI 2	MD, BL	0.218*, 0.220*	0.081, 0.051
LP 1	MD, BL	0.322*, 0.301*	0.067, 0.043
LP 2	MD, BL	0.438**, 0.432**	0.063, 0.048
LM 1	MD, BL	0.431**, 0.421 **	0.058, 0.061
LM 2	MD, BL	0.351*, 0.252*	0.053, 0.067
LM 3	MD, BL	0.321*, 0.261*	0.043, 0.071
Upper anterior	MD, BL	0.491**, 0.235*	0.041, 0.073
Lower anterior	MD, BL	0.422**, 0.432**	0.051, 0.041
Upper posterior	MD, BL	0.438**, 0.434**	0.063, 0.048
Lower posterior	MD, BL	0.441**, 0.437**	0.047, 0.054
Maxillary arch	MD, BL	0.513**, 0.512**	0.051, 0.05a
Mandibular arch	MD, BL	0.428**, 0.427**	0.041, 0.063
Both archs		0.505**, 0.512**	0.043, 0.042

* P < 0.01

** P < 0.001

TABLE - 4 : Regression equations for estimation of stature (in cm) from Mesio-distal, Bucco - linged diameter of teeth in gender.

Variable (in mm)	Regression equation	± SEE
UI 1 (MD, BL)	621.531 + 20.321 U1M, 640.621 + 125.431 U1B	± 4.66, ± 4.72
UI 2 (MD, BL)	628.534 + 120.342 U2M, 627.632 + 121.432 U2B	± 4.77 ± 4.92
UP 1 (MD, BL)	641.632 + 123.421 UP1M, 642.637 + 137.421 UP1B	± 3.82, ± 3.91
UP 2 (MD, BL)	631.732 + 121.673 UP2M, 630.739 + 123.632 UP2B	± 3.81, ± 4.92
UM 1 (MD, BL)	637.931 + 123.683 UM1M, 619.732 + 132.173 UM1B	±3.82, ± 4.93
UM 2 (MD, BL)	593.987 + 132.673 UM2M, 592.983 + 123.674 UM2B	± 4.73, ± 4.79
UM 3 (MD, BL)	611.873 + 132.643 UM3M, 609.938 + 123.684 UM3B	± 3.82, ± 3.62
LI 1 (MD, BL)	592.983 + 143.432 LI1M, 691.981 + 142.421 LI1B	± 6.41, ± 6.01
LI 2 (MD, BL)	693.732 + 183.431 LI2M, 691.832 + 181.420 LI2B	± 7.02, ± 7.13
LP 1 (MD, BL)	613.742 + 162.328 LP1M, 610.643 + 1473.431 LP1B	± 7.01, ± 3.41
LP 2 (MD, BL)	617.663 + 161.438 LP2M, 608.738 + 164.801 LP2B	± 2.43, ± 3.42
LM 1 (MD, BL)	599.832 + 163.421 LM1M, 579.982 + 164.321 LM1B	±4.42, ± 6.01
LM 2(MD, BL)	513.732 + 183.403 LM2M, 511.839 + 184.408 LM2B	± 3.82, ± 2.93
LM 3 (MD, BL)	590.674 + 192.412 LM3M, 582.432 + 161.432 LM3B	± 4.93, ± 3.92
UA (MD, BL)	43.13 + 1.38 UAM, 434.143 + 20.81 UAB	± 281, ± 2.03
LA (MD,BL)	543.49 + 10.932 LAM, 592.432 + 22.432 LAB	±4.83, ± 4.81
UP (MD,BL)	421.132 + 10.321 UPM, 431.192 + 10.732 UPB	± 3.12, ± 3.22
LP (MD,BL)	422.321 + 10.461 LPM, 431.173 + 10.837 UPB	± 2.21, ± 2.81
Maxillary arch	493.494 + 7.321 Max.M, 693/.471 + 5.995 Max.B	±2.03 , ± 2.03
Mandibular arch	491.932 + 7.931 Man.M, 691.932 + 7.632 Man.B	± 4.82 , ± 4.93
Both archs (A)	641.693 + 5.342 AM, 691.932 + 7.572 AB	± 2.41, ± 2.32

TABLE - 5

Comparison of mean actual stature and mean estimated stature in subjects (n=102) from mixed population of North India.

Estimated stature using regression equations for (in cm)	Mean estimated stature			
	12-14 yrs.	14-16 yrs	16-18 yrs	18-20 yrs
Maxillary arch (Mesio-distal Dimension)	156.632	158.982	161.521	162.489
Maxillary arch (bucco-lingual dimension)	157.321	159.385	161.932	162.983
Mean actual stature (x10)	158.634	160.381	162.823	164.023
Difference between mean in case as (Maxillary full arch) mesio distal dimension	2.002	1.399	1.302	1.534
Difference between mean in case of maxillary full arch Bucco lingual dimension	1.313	0.996	1.091	1.840

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