ORIGINAL STUDY

Determination of Stature Using Tooth Length

Dhanesh Narayanan[1], Sudeendra Prabhu[2], Sherin Mathew[1], Soniya Adyanthaya[1], Maji Jose[1], Laxmikanth Chatra[3] Akhter Husain[4], Syed Miqdad[2]

Abstract

Background: Stature plays a major role in forensic identification. It is also considered to be one of the fundamental components of physical anthropology. When a full skeleton is not available, stature can be estimated from incomplete human remains. Teeth form an excellent material for anthropological, genetic, odontologic and forensic investigations. Various studies have ventured to ascertain the usefulness of tooth crown measurements in stature prediction.

Methodology: Tooth lengths of all 28 teeth except 3rd molars were measured on digital OPG using inbuilt software IMPAXH (Agfa, Belgium). Stature was measured from the vertical distance from the vertex of head to the floor. Correlation between the tooth length and height of an individual was done by Pearson correlation test and linear regression analysis for prediction of stature from tooth length.

Result & conclusion: Overall the results revealed that individual tooth variables have a good correlation with stature with r value ranging from 0.12-0.57 and p value less than 0.05. Among the tooth lengths, the length of the maxillary right molars showed the highest correlation with stature followed by maxillary right premolars and maxillary right canine than the other teeth. Regression equation was generated from tooth length, to predict height.

Key Words: Stature; Tooth length; Correlation.

Oral and Maxillofacial Pathology Journal (2022): ***https://www.ompj.org/archives***

Introduction

Height of a person in the upright posture is called Stature. Estimating stature, along with age, sex and race, is one of the four pillars of the anthropological protocol and may be helpful in preliminary screening and reconstructive identification of skeletal remains.[1] Estimation of stature is a necessary tool in forensic examination particularly in unknown, extremely decomposed, fragmentary and mutilated human remains. Mostly stature estimation is derived from the long bones.[2,3]

Many studies have been conducted on the estimation of stature from different body parts like hands, trunk, vertebral column, limbs, individual long and short bones, foot, face dimensions, sternum length, cephalo-facial dimensions and they found a very good correlation.[4,5,6,7]

Filipson R and Goldson L in early 1963 in their research had established as there was no correlation between tooth width and stature.[8] Further, researchers have tried to co-relate tooth dimensions such as intercanine width, inter premolar width, bucco-lingual width and found moderate correlation.[9,10] Prabhu S et al had done a study to determine the usefulness of tooth crown (both buccolingual and mesio-distal) measurements in stature prediction, where they could find a moderate correlation.[1]

However, there is no research work on correlation between stature and tooth length in English language literature and this study has been undertaken to see such correlation between the tooth length (radiographic) and the height of the individual.

Material and Methods

The participants of the study are patients who have undergone a radiographic (OPG) analysis for various dental requirements such as assessment of dentition prior to orthodontic treatment or to evaluate the positioning of 3rd molars etc. Inclusion criteria for selection were individuals with all erupted teeth except third molars and individuals with teeth having proper alignment. Where as individuals with caries or any other dental problems such mal-aligned teeth, missing teeth, restored teeth, attrited teeth, root canal treated teeth, crowned teeth or any procedure, which shall hamper the accurate tooth length were excluded. The sample was estimated as simple random sampling, which includes 30 males and 30 females between the age 18 and 24 years. Tooth length of all 28 teeth except 3rd molars was measured on digital OPG using inbuilt software IMPAXH (Agfa, Belgium).

[1] Department of Oral Pathology, [2] Centre for Forensic Odontology, [3] Department of Oral Medicine and Radiology, [4] Department of Orthodontics, Yenepoya Dental College, Mangalore, Karnataka, India

Corresponding author: Sudeendra Prabhu, Incharge head, Centre for Forensic Odontology, Yenepoya Dental College, Mangalore, Email id: drsudi2014@gmail.com

How to cite this article: How to cite the article: Narayanan D, Prabhu S, Mathew S, Adyanthaya S, Jose M, Chathra L et al Determination of Stature Using Tooth Length. Oral Maxillofac Pathol J 2022; 13(2): page no. 97-100

Source of Support: Nil

Conflict of Interest: None

Stature measurement

Stature was measured from the vertical distance from the vertex of head to the floor. The subjects back should be as straight as possible, which may be achieved by rounding or relaxing the shoulders and manipulating the posture The height was measured with the help of standard height chart, making the subject stand straight and barefooted with the heels in close contact with each other on a firm horizontal resting plane in front of a scale calibrated to 0.1 cm on a rigid vertical plane.[1] (Figure 1)

Tooth measurements

Conventional panoramic radiographs were formed with a 17.6 second time exposure on automatic settings with an Instrumentarium Orthopantomograph OP100 on Fuji Super HRT30 film and Kodak Lanex Regular Intensity screen. The films were developed in a Kodak M35A processor, scanned by an Epson Perfection 700 photo scanner (Epson, Long Beach, Calif) at 300 dpi and 24-bit colour, and optimized for contrast and brightness by means of the Epson scanning software. JPEG images (saved at lowest compression) were imported into Dicom Imaging for analysis. (Figure 2)

While taking the OPG, patients were asked to look at the apparatus and subsequently bite on the biting segment of the radiographic equipment with the anterior teeth. The Frankfort horizontal (FH) plane was positioned parallel to the horizontal plane. This helps in maintaining a consistent head position. On digital panoramic radiographs, length of the tooth were measured by the IMPAXH (Agfa, Belgium) system (Figure 2).There is a magnification error of 1.19% between the actual tooth length and estimated tooth length. The correction factor has been included in the statistics.

Statistical Tests

Statistical analysis was done using the SPSS software (Version 1.0.0.1406). Pearson correlation test for correlation between tooth length and height and linear regression analysis was done for the prediction of stature from tooth length.

Results

18 out of 28 (64.2%) variables had statistically significant correlation with height. Overall the results revealed that individual tooth variables have a good correlation with stature of r value ranging from 0.12-0.57 and p value less than 0.05. Among the tooth lengths, the length of the maxillary right second molars showed the highest correlation with stature followed by maxillary right first premolars and maxillary right canine. The summary of correlation, linear regression formula generated and standard error of estimate - SEE (variation in estimated age from actual age) has been depicted in Table 1 and Figure 3

Discussion

Recognition of human remains is the most important step in forensic practice. Anthropometric methods have been employed to estimate stature for more than 100 years. With the rising frequency of mass disasters, estimation of height from fragmented and dismembered human remains has created difficulty in the examination of the identity of some of the victims. Many studies in the earlier period have been carried out by different researchers to estimate the stature from various bones of different parts of the body[3]. However researches on stature estimation from teeth are seldom, available in English language literature. Therefore, this study was carried out to determine the relationship between tooth length and stature using digital radiograph.

In previous research involving correlating stature with hand length, tibial length, head length, cephalo-facial measurements, sternum length, coronal sutures and ulna length showed moderate correlation (r= 0.2-0.5) and SEE of 4.7 – 7 years[11-24]. However, in the present study stature has a good correlation with the tooth length with p-value less than 0.05 and r value ranging from 0.12 to 0.57 and SEE varying from 3.2-5.5 years.

Yadav AB et[8] al in their work had measured the mesio-distal crown width of six maxillary teeth and predicted stature. They found a higher value of SEE (8.907) which is higher to our results (5.529). The study showed that all odontometric parameters were positively and significantly correlated with stature independent of gender, where maxillary canine width showed highest correlation. In the present study, length of the maxillary right second molar had highest correlation among all the teeth.

The width of six maxillary anterior teeth were combined and has been used for assessment of stature by Kalia S et al[2] and only small statistically significant relationship was there between stat-

Fig. 1: Measuring the height of the individual from the vertex of the head and the toe

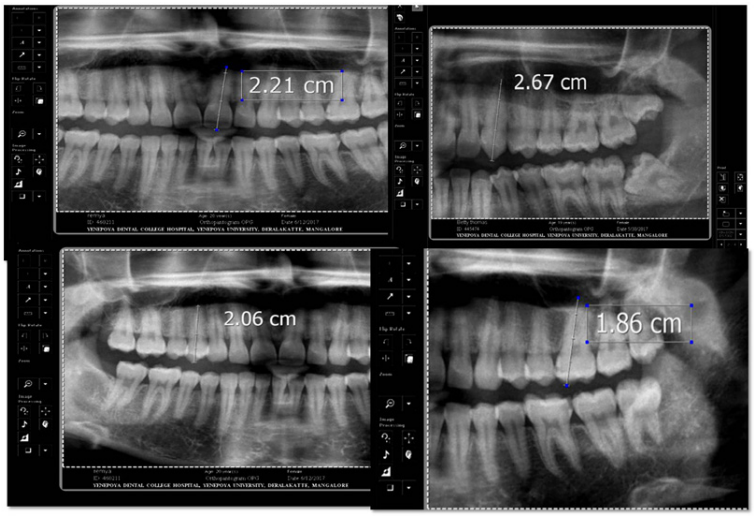

Fig. 2: Measuring the length of teeth (Incisors, canine, premolars and molars)

ure and combined mesiodistal width of six anterior maxillary teeth, contrasting to our finding.

Prabhu S et al[1] had done a research to determine the usefulness of tooth crown measurements in stature prediction. They had measured the buccolingual and mesiodistal dimensions of all teeth (except third molars) and stature measurements were taken from 95 living adults (47 females, 48 males). Out of 56 tooth variables, 21 (37.7%) had statistically significant correlation to stature. Ridge regression was conducted in which they found out a reasonable but statistically significant correlation to stature (R = 0.68; P < 0.0001).

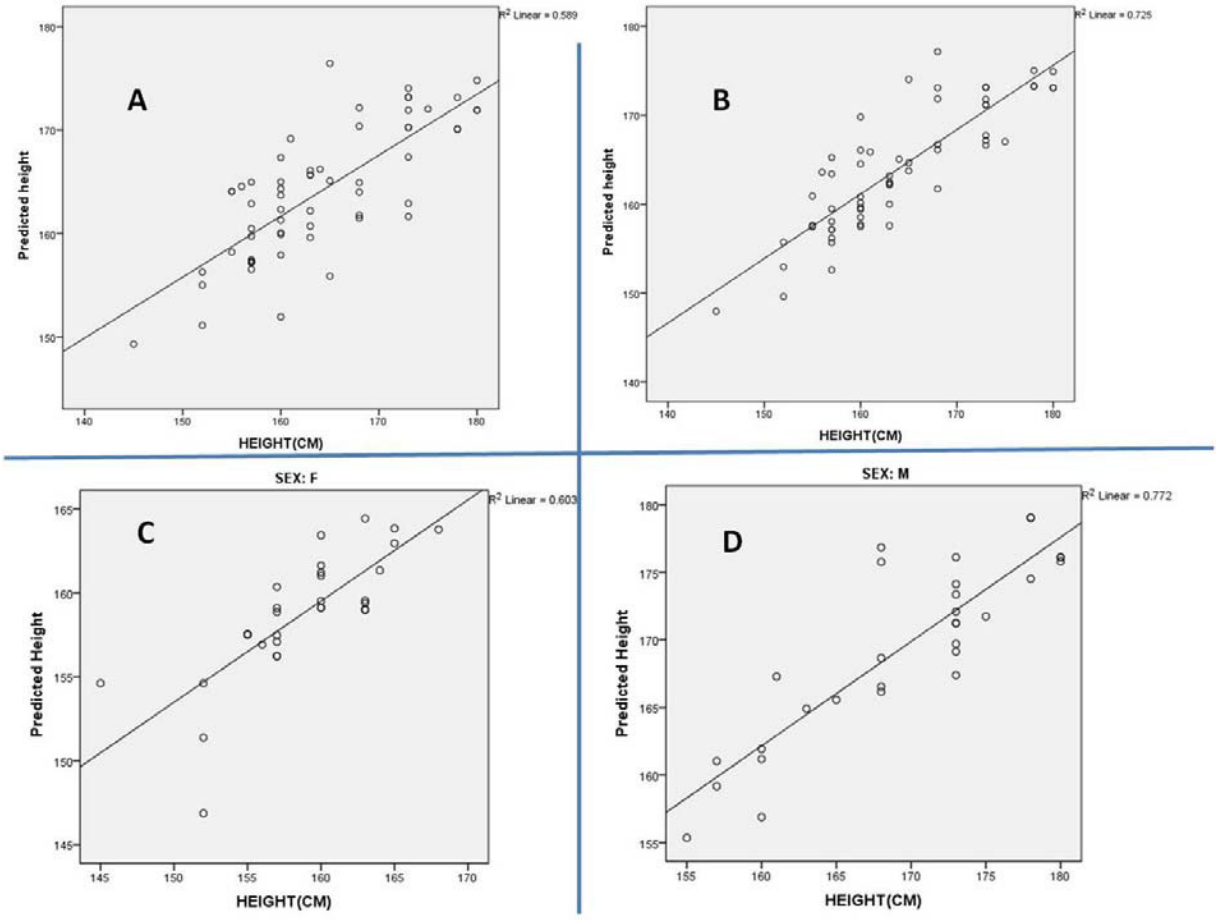

Fig. 3: Linear regression for A-combined data without gender as a parameter, B-combined data with gender as a parameter, C-females, D-males

Table 1: Linear regression analysis

	Linear regression formula generated	**Model significance**	**R^2**	**SEE (in years)**
Linear regression analysis without adding gender as a parameter.	Height =102.205+1.69 x (length of 27) +1.001 x (length of 13) -1.928 x (length of 34) +0.811x (length of 33) + 0.834 x (length of 15)	<0.05.	58.9%	5.529
Linear regression analysis involving gender as a parameter	Height =117.584 + 7.232 x (gender) + 1.446 x (length of 27) -1.421 x (length of 34) + 1.069 x (length of 13) + 1.314 x (length of 32) - 1.071 x (length of 31)	<0.05	72.5%	4.569
Linear regression analysis for females	Height =144.392 + 1.693 x (length of 14) -1.571 x (length of 14) -1.571 x (length of 34) + 0.533 x (length of 32)	< 0.05	60.3%	3.213
Linear regression analysis for males	Height = 140.258 +2.066 x (length of 27) -2.431 x (length of 41) + 2.443 x (length of 33) -1.506x (length of35) -2.846 x (length of16) + 1.417 x (length of15) + 1.252 x (length of21).	< 0.05	77.2%	4.11

In the present work, 18 out of 28 (64.2%) variables had statistically significant correlation with height. Overall the results revealed that individual tooth variables have a good correlation with stature of 'r' value ranging from 0.12-0.57 and p value less than 0.05. Among the tooth lengths, the length of the maxillary left second molars showed the highest correlation with stature followed by maxillary right premolars and maxillary right canine. This shows that length of the tooth is more useful in estimating stature than mesio distal or bucco lingual dimension.

In this study, regression formula was generated with mainly five teeth entering the formula, such as maxillary right canine, maxillary second premolar, maxillary second molar, mandibular left canine and mandibular first premolar. When the data was analysed separately for males and female sexes, a generated formula had maxillary right second premolar, maxillary right first molar, maxillary left central incisor, mandibular left canine, mandibular left second premolar and mandibular right canine for males and maxillary right first premolar, mandibular left first premolar and mandibular left lateral incisors for females, entering the equation.

Conclusion

Stature is a main factor in determining the partial identity of mutilated bodies and skeletal remains. In the present study, the length of the tooth was found to be well correlated to stature with correlation co-efficient 'r' value ranging from 0.12-0.57 and SEE ranging from 3.2-5.5 years, having prediction accuracy better in females than in males. These results also show that 18 out of 28 variables (64.2%) having significant correlation with stature, indicating all the available teeth has to be considered in predicting height from tooth length. With these findings we can conclude that the length of the tooth can be a useful tool in the estimation of stature, when no other skeletal components are available for anthropological or forensic identification. However, increasing the sample size and involving different population groups, may provide us more reliable information and regression formulae's.

References

1. Prabhu S, Acharya AB, Muddapur MV. Are teeth useful in estimating stature?. Journal of forensic and legal medicine. 2013; 20(5):460-464.
2. Kalia S, Shetty SK, Patil K, Mahima VG. Stature estimation using odontometry and skull anthropometry. Indian Journal of dental research. 2008; 19(2):150.
3. Menezes RG, Kanchan T, Kumar GP, Rao PJ, Lobo SW, Uysal S, Krishan K, Kalthur SG, Nagesh KR, Shettigar S. Stature estimation from the length of the sternum in South Indian males: a preliminary study. Journal of forensic and legal medicine. 2009; 16(8):441-443.
4. Krishan K. Estimation of stature from cephalo-facial anthropometry in north Indian population. Forensic Science International. 2008; 181(1):52.
5. Agnihotri AK, Kachhwaha S, Googoolye K, Allock A. Estimation of stature from cephalo-facial dimensions by regression analysis in Indo-Mauritian population. Journal of forensic and legal medicine. 2011; 18(4):167-172.
6. Waghmare VK, Gaikwad RB, Herekar NG. Estimation of the stature from the anthropometric measurement of hand length. The Internet Journal of Biological Anthropology. 2011; 4(2).
7. Shah T, Patel MN, Nath S, Bhise RS, Menon SK. Estimation of stature from cephalo-facial dimensions by regression analysis in Gujarati population. Journal of Indian Academy of Forensic Medicine. 2015; 37(3):253-257.
8. Fillipson R and Goldson L. Correlation between tooth width, width of the head, length of the head and stature. Acta Odontol Scand 1963;21:359-365
9. Yadav AB, Yadav SK, Kedia NB, Singh AK. An odontometric approach for estimation of stature in Indians: Cross-sectional analysis. Journal of clinical and diagnostic research JCDR. 2016; 10(3):24-26.
10. Khangura RK, Sircar K, Grewal DS. Four odontometric parameters as a forensic tool in stature estimation. Journal of forensic dental sciences. 2015; 7(2):132.
11. Mansur DI, Haque MK, Sharma K, Mehta DK, Shakya R. Use of head circumference as a predictor of height of individual. Kathmandu University Medical Journal 2015; 12(2):89-92.
12. Chiba M, Terazawa K. Estimation of stature from somatometry of skull. Forensic science international. 1998; 97(2):87-92.
13. Mohanty NK. Prediction of height from percutaneous tibial length amongst Oriya population. Forensic science international. 1998; 98(3):137-41.
14. Shahar S, Pooy NS. Predictive equations for estimation of stature in Malaysian elderly people. Asia Pacific journal of clinical nutrition. 2003; 12(1):80-84.
15. Jasuja OP, Singh G. Estimation of stature from hand and phalange length. Journal of Indian Academy of Forensic Medicine. 2004; 26(3): 100-106.
16. Gauld LM, Kappers J, Carlin JB, Robertson CF.Height prediction from ulna length. Developmental Medicine & Child Neurology.2004; 46: 475–480.
17. Duyar I, Pelin CA, Zagyapan R. A new method of stature estimation for forensic anthropological application. Anthropological Science. 2006; 114(1):23-27.
18. Cordeiro C, Muñoz-Barús JI, Wasterlain S, Cunha E, Vieira DN. Predicting adult stature from metatarsal length in a Portuguese population. Forensic science international. 2009 Dec 15; 193(1):131-132.
19. Ilayperuma I. On the prediction of personal stature from cranial dimensions. Int. J. Morphol. 2010; 28(4):1135-1140.
20. Jaiswal A: Prediction of Stature from lower extremity among the scanthal tribe of odisha, India. Inidan J Forensic Med and Toxicology 2013;7:10-15
21. Krishan K, Kanchan T, Passi N. Estimation of stature from the foot and its segments in a sub-adult female population of North India. Journal of Foot and Ankle Research. 2011; 4(1):24.
22. Pal A, De S, Sengupta P, Maity P, Dhara PC. Estimation of stature from hand dimensions in Bengalee population, West Bengal, India. Egyptian Journal of Forensic Sciences. 2016; 6(2):90-98.
23. Rao PJ, Sowmya J, Yoganarasimha K, Menezes RG, Kanchan T, Aswinidutt R. Estimation of stature from cranial sutures in a South Indian male population. International journal of legal medicine. 2009; 123(3):271-276.
24. Patel JP, Patel BG, Shah RK, Bhojak NR, Desai JN. Estimation of stature from hand length in Gujarat region. NHL Journal of Medical Sciences. 2014; 3(1):172-178.