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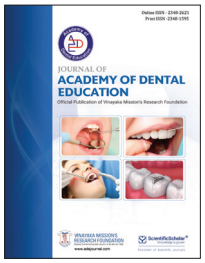

Original Article

Odontometric analysis as a potential parameter for height prediction

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ABSTRACT

Objectives: Actual determination of height and physical characteristics of an individual is very difficult from skeletal which remains and is a challenge in forensic science. In cases of environmental disasters, it is challenging to extract long bones for exact determination of stature and these situations demands aid for the identification of individuals. Teeth show high resiliency toward change and can present themselves as an excellent tool for stature determination. The bone standards for determination of height are generally population and race-specific.

Material and Methods: The present study investigated the potential of odontometric parameters as an indicator of stature. Total of 55 individuals aged 15–30 years of known height were selected and after taking impression, a cast was poured. Measurements on cast were done using standard digital Vernier calipers and height was measured using standard measuring tape.

Results: Results indicated that among the two parameters taken into consideration, the vertical crown length of the canine was significant for height determination and a regression equation was also derived for same.

Conclusion: Henceforth, it can be concluded that as population variation exists, further studies with large sample sizes and diverse population is required to validate these findings.

Keywords: Forensic odontology, Odontometric parameters, Stature determination

INTRODUCTION

Forensic odontology, being an important branch of forensic medicine, warrants the need for a through examination of the case scenario and presentation of the evidence in front of the law.[1] Forensic odontologists assist in identifying individuals by examining dental records, bite marks, and other odontometric parameters. Unidentified bodies in cases of bodies being burned, murdered or death from natural causes, most of the time, sufficient evidence is not available and will be based only on dental authentication. Every oral cavity is different and if examined properly an eye of a forensic odontologist will give a considerable amount of useful information. Even in this new era of advancements, assessment through odontometric parameters still seems to offer a rapid and cost-beneficial approach.[2] Identification can still be made by habitual and individual characterization of the oral cavity even in the absence of the presence of few teeth, which may match with antemortem records.[3]

In majority of the scenarios, criminal investigations are conducted by evaluating human which remains for establishing the identity of the deceased. This usually is determined by the "big

four:" Sex, age, ancestry, and stature. Among all "big fours" in forensics anthropological assessment, stature is of utmost importance. Estimation of stature or physical height is one of the aspects in anthropological records and is very essential for individual identification from skeletal remains.[4] Different tools used in anthropometry are somatometry, cephalometry, craniometry, osteometry, and odontometry since these tools are seemed to have an incredible role in human remains identification.[3]

Dental morphometrics can be described as a quantitative analysis of the form of a tooth inclusive of tooth morphology. Estimation of one's profile from this has been an area of great interest for forensic odontologist.[2]

Human identification becomes challenging in cases of mutilated bodies as in burns or environmental hazards. Teeth being highly consistent at raised temperatures and adverse conditions and, hence, can be withdrawn even in scenarios of complete decomposition of the body, thereby could be presented as invaluable tool in forensic science.[4] Among varied teeth present, canines are least likely to be extracted, least affected by endodontic and periodontal damage and are supposed to tolerate extreme situations.

Thus, the present study intends to investigate inter canine width (IC) of the maxilla and vertical crown length of maxillary canine and stature height and also to formulate a regression method for the same thereby signifying the relevance of odontometric parameters in stature determination.

MATERIAL AND METHODS

Study design

A prospective study was conducted from the outpatient department of the department of orthodontics. The ethical approval was obtained from the Institutional Ethical Committee (ITSCDSR/L/2023/012) and all the participants provided written informed consent.

Study size

A random of 55 subjects from the North Indian Population were selected that are were within age group of 15–30 years as this was a prospective study and the participants inclusive in the study were lying in the above-mentioned group only.

Participants

All study participants were with complete set of no carious and intact erupted teeth having healthy periodontium and were with satisfactorily aligned maxillary teeth. Patients with any restorations, abrasions, decayed tooth, malaligned teeth, fracture cases, or any congenital missing or tooth disorders are excluded from the study. Patients with poor periodontal health or with any gingival enlargements are also not included in this study.

Study settings

After obtaining informed consent from patient's maxillary intercanine width and vertical crown length of maxillary canine was measured and recorded. The reason for selecting only maxillary canine for the same is its eruption age (around 11–12 years), which is often late as compared to other teeth in oral cavity, also it is most durable and resistant to any external stimulus and hence suitable for age estimation. Along with that the closure of roots, apex is much later than other teeth, making it a beneficial indicator of age analysis in a younger population. The stature of patient was also assessed and registered. Digital Vernier calipers accurate up to 0.01 mm was taken to record the parameters (Themisto TH-M61). The pointed tines aided in accessing the coronal tip. The distance between the tines was seen and noted.

After an informed consent impression was made using alginate and perforated trays and cast is poured using dental stone. After the setting of dental stone, cast is obtained. IC width of maxilla is measured directly on cast using Vernier calipers [Figure 1]. Distance from cusp tip of 13–23 is measured and value on digital screen is recorded. The vertical crown length of canine is measured directly on cast from zenith until the cusp tip of canine and values on digital screen are recorded.

An anthropometer was used for the stature analysis of each subject. The assessment was done by asking the patient to be upright barefooted on some resting plane. The anthropometer was kept behind the patient keeping ala tragus line consistent with the dimension of the floor and back in contact with the

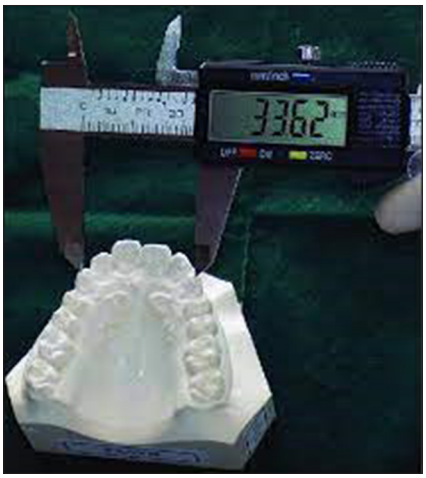

Figure 1: Pictorial representation of the inter-canine distance with the Vernier calliper.

instrument's vertical arm. The rotatory rod was brought in contact with head and values are noted. The entire analysis was made by individual examiner to eliminate any inter examiner errors.

RESULTS

The entire collected data were statistically analyzed, and then, results were tabulated [Table 1]. The mean inter-canine width among all the study groups is within the significant range. Regression analysis was done and regression equations were derived. The following regression equation can be used to calculate the height of an individual.

$Y = B + Ax$

Where Y = predicted stature of individual

B = constant for parameter

A = regression coefficient for each parameter

x = crown length of 23.

The given regression equation could be taken into consideration to assess the height of a subject.

$H = 136.514 + 0.545 \times \text{CL OF } 13 + 2.516 \times \text{CL OF } 23$

Coefficient of determination (R^2) = 13.4%.

DISCUSSION

Conceptualization of combined dental records with forensic invigilation has attained immense interest that it is also proposed as the only methodology for solving detailed aspects of complicated case scenarios. Renowned forensic expert in dentistry handles and compiles evidences and assists law imposing organizations in identifying and solving critical cases. As suggested by the literature, in lieu of physiological disparity of hard and soft dental tissues as they are specific for each individual, thus warrants the need of this branch in medical science.[5]

As per the forensic odontology literature, the inception of the same as the only branch should be accredited to Dr. Oscar Amoedo, who has laid down the foundation of Forensic Odontology. He is also known to have a role in recognizing the victims of Paris in 1898 fire accident. The first such case of dental identification was reported back in 1453.[5,6]

Varied researches in forensics in regard to gender and age determination include the use of mandibular canine index as sex determination, a study done by Kumawat *et al.*[7,8]

A review study done by Shebah *et al.*, concludes that bite marks being valuable but also contentious as along with proving the suspects as guilty, also aids in exonerate of the acquitted. Proper assessments prove that bite marks are an extremely reliable, easy, and cost-effective methodology for identification.[9]

Dentinal translucency has also proven to be the most effective morpho-histologic parameters in dental age estimation. It provides accuracy along with simplicity.[10]

A study done by Chandrappa *et al.* in 2017[2] shows a strong correlation between the two parameters among children and adults. The study depicted that canine length can be proved to be the predictor for adult height with a statistical significance.

In the present study, based on linear stepwise regression analysis done on permanent dentition, shows that the crown length of the left canine, that is, 23 can be significantly correlated with height with $P = 0.006$.

The results are consistent with the study done by Shalakizadeh *et al.*,[11] in 2020. They illustrated statistical variance in the mean canine dimensions among both the jaws and genders; however, a positive correlation was evident only in maxillary canine dimensions and the height of female subjects.

The results for inter canine width were in contrary to the study done by Dinakaran *et al.*, in 2022.[12] The results in there study depicted that males depicted a significant correlation of maxillary intercanine width with height whereas, in our study, the correlation was significant with that of females.

In various studies, it has been proved that canine and premolar width can be taken into consideration to depict

Table 1: Mean canine length and inter-canine width among study groups.

Height (cm)	Study participants (*n*=55)	C/L of 13 (mm) Mean±SD	C/L of 23 (mm) Mean±SD	ICW (mm) Mean±SD
130.1–140	1	6.4	6.4	39.7
140.1–150	4	8.25±0.49	8.25±0.66	34.25±1.82
150.1–160	27	7.4±1.12	7.46±1.05	30.68±4.67
160.1–170	14	7.43±1.03	7.47±0.97	31.86±4.3894
170.1–180	6	8.05±0.99	8.13±0.81	31.48±4.75
180.1–190	3	9.8±1.3	9.8±1.48	31.6±7.24
P-value		**0.009**	**0.005**	0.370

n: No. of, C/L: Canine length, SD: Standard deviation, ICW: Inter-canine width, Bold value: *P*-value is less than equal to 0.05

individual's height. Henceforth, both these dimensions could be significantly correlated with height.[13] The role of tooth dimensions in stature prediction is of paramount importance and can be considered as a significant tool in such aforementioned scenarios.[14]

As reported by Jeddy *et al*.,[15] the body usually gets decomposed in the majority of mass disasters but skulls prevails unaltered for millions of years and, thereby, could prove to be a distinctive means of determination. The cranial features seem to have a significant role in the gender determination of the individual.

CONCLUSION

Stature evaluation using odontometric parameters supplements but not replace traditional methods, thereby suggesting the potential limitation of our study that that single formula might not be suitable for all population groups. This also aids in hypothesizing that individual odontometric parameters along with combined parameters may have a significant role in the stature determination of human remains. Henceforth, future studies should aim to include larger and more diverse populations to generalize these findings.

Ethical approval: The research/study approved by the Institutional Ethical Committee at Institute of Technology and Sciences, Centre for Dental Studies and Research, number ITSCDSR/L/2023/012, dated 24th August 2023.

Declaration of patient consent The authors certify that they have obtained all appropriate patient consent.

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Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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