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A Study of Estimation of Stature from Per-Cutaneous Length of Clavicle among Maharashtrian Population

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A B S T R A C T

***Introduction*:** Identification of an individual whether living or dead is one of the most crucial tasks in medico-legal practice. Determination of stature is quite easy when complete body is recovered, but it will become difficult task for forensic experts when there are only few body parts or fragments. Clavicle is one of the long bones of the body. Many studies have been done in estimation of age and sex from clavicle but only fewer studies have been conducted in relation to estimation of stature from clavicle from this population. ***Objective*:** To estimate the stature of individual from maximum length of clavicle. ***Methods*:** Cross sectional analytical study was conducted in Department of Forensic Medicine in Medical College during October 2023 to November 2023. Study population included 181 medical students in the age group of 22-25 years, from rural Government Medical College, Maharashtra. ***Results*:** Correlation co-efficient for both right and left clavicles in female for stature were 0.307 and 0.301 respectively and for males, 0.372 and 0.362 respectively. The differences observed in height and length of clavicle between males and females were statistically significant ($p<0.05$), mean values of length of both right and left clavicle and height being higher in males than in females. It was observed that, there was no significant difference between measured height and height estimated from length of clavicle by using regression equation in both male and female participants. ***Conclusion*:** There was a significant correlation between stature and length of clavicle in male and female study participants. Thus, clavicle can be used for estimation of stature.

Keywords: Percutaneouslength ofclavicle, Stature, Maharashtrian population, Identification, Regression formula.

INTRODUCTION

Identification of an individual whether living or dead is one of the most crucial tasks in medico-legal practice [1]. The services of forensic medicine experts are sought in establishing the identity of the dead, especially in mass disasters like fires, explosions, ship wrecks, air crash and railway accidents. They are often required to estimate age, gender and stature of a person from dismembered body parts and bones [2]. Stature is one of the biological characteristics often used in forensic anthropology, both to help build profiles for unidentified individuals and to support putative identification [3].

Determination of stature is quite easy when complete body is recovered, but it will become difficult task for forensic experts when there are only few body parts or fragments. At times forensic experts may come across cases like skeletal remains, bodily remains as in accidents, murders, natural disasters, for medicolegal examination and identification, from which they are expected to decode complete details of identity from the available remains [4].

Clavicle is one of the long bones of the body. Clavicle is the only horizontally lying long bone of the body. It differs from other long bones in the fact that it has no medullary cavity. It lies at the root of the neck acts as a connection between the acromion process of the scapula and the upper end of the sternum. Clavicle is directed laterally and somewhat backwards. The clavicle is subcutaneous throughout its whole length [5].

Clavicle is the first bone to ossify in the body. It has three ossification centres. There are 2 primary centres – medial and lateral. They appear on the 5^{th}-6^{th} week of intrauterine life and fusion takes place on the 45^{th} day of life. The shaft of the clavicle is ossified in condensed mesenchyme from these 2 centres. Then occurs the development of cartilaginous mass at the ends of the clavicle. The secondary centre at the medial end appears at about 18-19 years and fusion takes place at 20-22 yrs. There is no ossification at the lateral end of the clavicle or it is rudimentary and rapidly joins the shaft [6].

Many studies have been done in estimation of age and sex from clavicle but only fewer studies have been conducted in estimation of stature from clavicle. With this background present study was planned to with following objectives.

Objectives

1. To estimate the stature of individual from maximum percutaneous length of clavicle.
2. To find out correlation between length of right and left clavicle with stature of an individual.
3. To determine the variation of stature from length of clavicle in both sexes.
4. To obtain the regression formulae to estimate stature from adult clavicle for both sexes.

Material & Methods:

Cross sectional analytical study was conducted in Department of Forensic Medicine in Medical College and Hospital. After obtaining clearance from institutional ethical committee, data was collected from 181 MBBS students studying in 3^{rd} and 4^{th} year combined. Study was done during October 2023 to November 2023. Students with physical debilities, skeletal defects and past history of diseases affecting bones and joints and subjects who are on any form of hormonal medications, Non-Maharashtrians and less than 22 years were excluded from the study. All the subjects were briefed about the purpose of study and informed and written consent was obtained.

Parameter measured:

Length of clavicle:The maximal length of the clavicle was measured with a manual Vernier calliper (0-150 mm*0.05/6"*1/128, Gilson tools Japan), with a precision of 0.05mm. The palpable landmarks for measuring the clavicle were most medial point of the clavicle in the sternoclavicular joint and most lateral point of the clavicle in the acromioclavicular joint.

Stature/ height of the student was determined by stadiometer: It is measured as a distance from vertex to heel while standing in Anatomical position with bare foot on flat platform of stadiometer according to standard guideline.[7] All the measurements were taken to the nearest 0.1 cm. All the measurements were taken by principle author in order to minimize bias and error of identification of the landmarks involved in measurement. The measurements were taken twice and an average of the two readings was calculated. The data was entered in Epidata and analysed with Statistical Package for Social Sciences (SPSS) version 22. Kolmogorov-Smirnov test (Normality of distribution) showed normal distribution of both anthropometric variables (stature and clavicle length). Means and standard deviations (SD) were calculated. The relationship between body height and length of clavicle was determined using simple correlation coefficients. Then a linear regression analysis was performed to formulate an equation which predicts body height from length of clavicle. Estimated height of students was calculated implementing the derived regression equations and the former was compared with the observed height using paired 't' test. Statistical significance was set at $p<0.05$.

RESULT

Of the total 181 undergraduate students, 93 (51.38%) were males and 88 (48.62%) were females. Mean and standard deviation of observed height for males and females were 168.50±4.63 cm. and 157.31±5.58 cm. respectively. The length of right clavicle in males varied from 14 cm. to 18.2 cm. with mean and standard deviation of 16.32±1.36 cm.; whereas, that of left clavicle ranged from 14 cm. to 18.2 cm. with mean and standard deviation of 16.29±1.16 cm. On the other hand, the length of right clavicle in females fluctuated between 12.5 cm. and 16.5 cm. with mean and standard deviation of 14.64±0.96 cm.; whereas, that of left clavicle ranged from 12.5 cm. to 16.5 cm. with mean and standard deviation of 14.61±0.96 cm. An Independent 't'-Test confirmed that, the differences observed in height and length of clavicle between males and females were statistically significant ($p<0.05$), mean values of length of both right and left clavicle and height being higher in males than in females.

Table 1: Comparison of various regression parameters of stature and length of clavicle for male participants

Variable	Right Clavicle	Left Clavicle
Stature (cm.)	168.50±4.63	
Clavicle length (cm.)	16.32 ±1.14	16.29±1.16
Correlation (r)	0.381	0.365
Regression Coefficient (b)	1.55	1.46
Value of constant (a)	143.19	144.80
R^2	0.145	0.133
P value	<0.001	<0.001

R^2- Coefficient of determination

Correlation co-efficient for both right and left clavicles in male for stature were > 0.3, so there exists moderate correlation between right and left clavicles and stature of male participants. Correlation co-efficient for right clavicle (0.381) was higher than of left clavicle (0.365) for male sex.

Linear regression formula in male:

Body length = 143.19 + 1.55 (right clavicle length)

Body length = 144.80+ 1.46 (left clavicle length)

Table 2: Comparison of various regression parameters of stature and length ofclavicle for female participants

Variable	Right Clavicle	Left Clavicle
Stature (cm)	157.30±5.57	
Clavicle length (cm)	14.64±0.97	14.61±0.97
Correlation (r)	0.191	0.183
Regression Coefficient (b)	1.10	1.05
Value of constant (a)	141.13	141.88
R^2	0.0366	0.0335
P value	<0.001	<0.001

R^2- Coefficient of determination

Correlation co-efficient for both right and left clavicles in female for stature were > 0.1, so there was weak correlation between right and left clavicles and stature of female participants.

Linear regression formula in female:

Body length = 141.13 + 1.10 (right clavicle length)

Body length = 141.88+ 1.05 (left clavicle length)

Table 3: Actual height and estimated height from regression equation in male

Parameter	Actual Height	Calculated height from Right Clavicle	Calculated height from Left Clavicle
Mean	168.50	168.48	168.58
SD	4.63	1.76	1.69
SEM	0.48	0.18	0.17
P value		0.969	0.876
Significance		Not significant	Not significant

SD- Standard Deviation

SEM-Standard Error of Mean

It was observed that, there was no significant difference between measured height and height estimated from regression equation in male participants.

Table 4: Actual height and estimated height from regression equation in female

Parameter	Actual Height	Calculated height from Right Clavicle	Calculated height from Left Clavicle
Mean	157.31	157.23	157.22
SD	5.57	1.06	1.01
SEM	0.59	0.113	0.108
P value		0.895	0.882
Significance		Not significant	Not significant

It was observed that, there was no significant difference between measured height and height estimated from regression equation in female participants.

DISCUSSION

The length of clavicle has been used to estimate stature in several studies [8, 9] in different endogenous groups, where regression equation has been derived to reconstruct stature from clavicle length. In present study, positive correlation was observed between length of both right and left clavicles in male and female and stature of study participants.

Malik Anil Kumar *et al*., [10] revealed the positive correlation between the length of clavicle and the estimated stature. Ukoha U Ukoha *et al*., [11] who conducted study among Nigerian population revealed that, significant positive correlation between stature and lengths of the right and left clavicle ($p \leq 0.01$) across all the groups in both sexes.

In Singh *et al*., [12] study among Punjabi population, correlation co-efficient for right and left clavicle for stature was 0.68 and 0.72 respectively irrespective of sex. In Prakash et el6 study among Tamil population, correlation co-efficient for both right and left clavicle were higher in female as compared to male. While Balvir *et al*., [9] study among Maharashtrian population shows that, this correlation co-efficient were not statistically significant in both right and left clavicle in both sexes. In the present study, there was no significant difference between measured height and height estimated from regression equation in male and female participants.

CONCLUSION

From the present study it can concluded that, average stature & length of clavicle of males were higher than female counterpart. There was a significant correlation between stature and length of clavicle in male and female study participants. There was no significant difference between measured height and height estimated from regression equation in male and female participants. Thus, clavicle can be used for estimation of stature.

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