

# Correlation of Stature of Adult Bangladeshis with the Length of Clavicle-A Radiographic Approach

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## Abstract

**Context:** Clavicle provides an opportunity for estimating stature of an unknown individual.

**Methods:** This study was a cross sectional study carried out in the Department of Anatomy, Dhaka Medical College, Dhaka from January, 2015 to December, 2015. Adult males and females attending the Radiology and Imaging Department of Dhaka Medical College and Hospital (DMCH), for the chest radiograph advised by their physicians were the subjects of the study. Height of the subject was taken using stadiometer. One hundred radiographs of left clavicle (posterior-anterior view) were taken of which fifty (50) were of males and fifty (50) were of females. The radiographs of clavicles were viewed on the x-ray view box and traced on the transparent sheets. Length of clavicles were measured in mm from the radiographs. Heights of adult males and females were calculated using the length of clavicle.

**Results:** No significant difference ( $P>0.05$ ) was found while comparing measured height of adult male with the calculated height of adult male using length of clavicle. No significant difference ( $P>0.05$ ) was found while comparing measured height of adult female with the calculated height of adult female using length of clavicle.

**Conclusions:** Present study showed that stature of adult male and female can be calculated using length of clavicle.

**Key words:** stature, length of clavicle

## Introduction

Estimation of stature is an essential part of biological identity of an unknown individual, especially in crime scenes and mass graves, requiring a careful examination for assessing the individual's identity.<sup>1</sup> It always remains a difficult task for any anthropological/ forensic examiner to estimate approximate stature of an unknown individual from any single bone. Every part of human

body is unique in itself as every part of the body is different in its own way from a similar part in another body. There is also a relationship between each part of body and whole body. In this regard, clavicle provides an opportunity for estimating stature of an unknown individual. The stature estimation from skeleton by anatomical method was introduced by Dwight in 1894.<sup>2</sup> Similar studies have been carried out by anatomists, forensic medicine experts and anthropologists. In their studies, researchers showed that significant positive correlation exists between stature and different parameters of clavicles of which length of the clavicle was the best parameter.<sup>3</sup>

Clavicle is the only long bone that lies horizontally across the neck from the manubrium sternum to acromion. It is subcutaneous through its whole length and accordingly can be palpated for its entire length.<sup>4</sup>

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Clavicles are well developed in prehensile limbs in man and primate but are absent from forelimbs in herbivorous and carnivores.<sup>5</sup> It is an important bone for human evolution and it permits all movements outside the parasagittal plane.<sup>6</sup> It also helps the anthropologists in their study of evolution of mankind and migration of races.<sup>7</sup>

Radiographic measurement of clavicle has several advantages over dry ossified clavicle or clavicle collected from the cadaver as it provides a large amount of information by noninvasive means.<sup>8</sup> The study will be helpful to the anatomists for a normative reference. In anthropology and forensic medicine, it will be helpful for identification of an individual. With the above perspective, this study was carried out to establish a baseline data of clavicle of our own for stature estimation for future studies.

#### Methods

This was a cross sectional analytical type of study. This study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka from January, 2015 to December, 2015. The study was carried out after approval of work by the Ethical Review Committee (ERC) of Dhaka Medical College. Adult males and females attending the Radiology and Imaging Department of Dhaka Medical College and Hospital (DMCH), Dhaka for the chest radiograph (posterior-anterior view) advised by their physicians were the subjects of the study. The subjects were requested to give permission for another exposure of posterior- anterior view of radiograph of left clavicle. Informed written consent was taken from each subject. The study was carried out on total one hundred (100) radiographs of left clavicle of which fifty (50) were of male and fifty (50) were of female. According to the International Agreement for the unification of anthropometric measures on the living adopted in the Fourteenth International Congress of Prehistoric Anthropology and Archeology held in Geneva, September 9-14, 1912, for paired measurements, it is recommended to operate on the left side.<sup>9</sup>

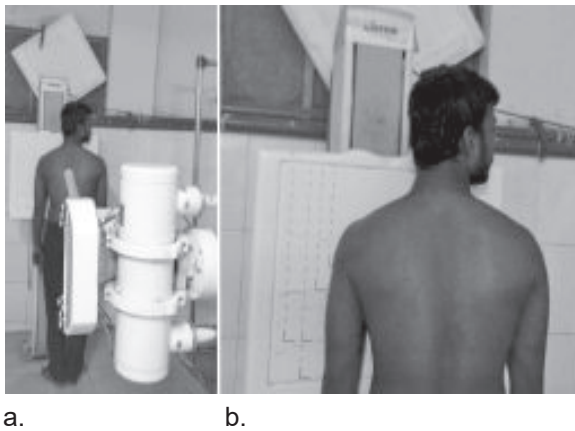
The age of the subjects was within the range of 25 to 50 years. The rationale behind selecting this age limit was that the process of ossification completes

at 25th years of age and early degenerative changes of clavicle occur from 50 years of life.<sup>10</sup> The height of the adult male and female subjects ranged from 5 feet 2 inches to 5 feet 9 inches and 4 feet 8 inches to 5 feet 3 inches respectively.<sup>11</sup> According to height-weight chart, the weight of study subject was ranged from 55 kg to 73 kg for male and 40 kg to 63 kg for female. At first, the stature of the subject was taken by using stadiometer.<sup>12</sup>



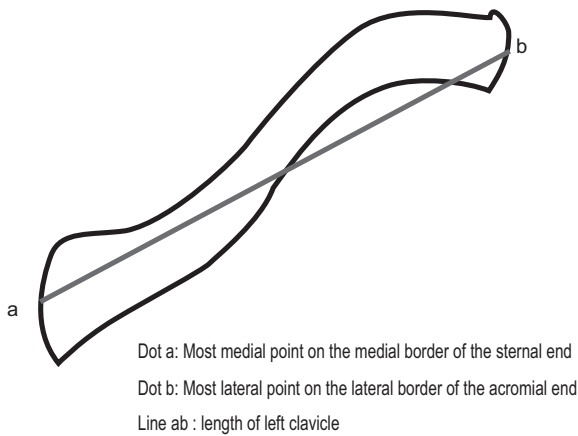
**Fig.-1:** Procedure of measuring height using stadiometer

After measuring stature, the subject was requested to stand erect facing cassette holder in the stand greed of X-ray machine. Subject's position was adjusted so that the middle of the left clavicle was in the center of the cassette and his/her head was turned away from the left side (i.e., from the side being examined). The left shoulder of the subject was rotated slightly forward to allow the left clavicle to be brought into close contact with the cassette. The subject was asked to hold the breath during exposure to reduce his/her movement. The horizontal central ray was directed to the center of the clavicle and the center of the image, with the beam collimated to the clavicle.<sup>13</sup> Radiation was projected on imaging plate and it was transformed in the monitor for editing and zooming of the radiograph at 100%.



**Fig.-2:** Position of patient in X-ray machine from two different distances.

The posterior-anterior view of radiographs of left clavicles were viewed on the x-ray view box and traced on the transparent sheet. Then, length of clavicle was measured as the distance between most medial point on medial border of the sternal end to the most lateral point on the lateral border of the acromial end <sup>14</sup>.

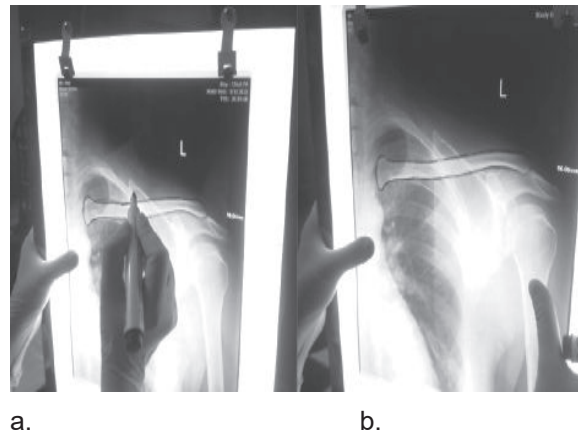


**Fig.-4:** Measurement of length of left clavicle.

**Calculation of Multiplication Factor:**

Multiplication factor was derived from following formula for calculating the height of a subject from the length of left clavicle. <sup>15</sup>

$$\text{Multiplication Factor} = \frac{\text{Height of a subject}}{\text{Radiographic length of left clavicle}}$$



**Fig.-3:** Tracing of posterior anterior view of radiograph of left clavicle on transparent sheet.

Two different means of the multiplication factors were finally derived for male and female subjects separately which were used for calculating the heights of male and female subjects individually.

Height of the Subject calculated from the length of the clavicle:

Height of a subject was calculated by multiplying length of clavicle with mean multiplication factor.

So, calculated height of a subject = radiographic length of left clavicle of a subject × mean multiplication factor. <sup>16</sup>

**Data processing and analysis:**

Statistical analysis of data were performed by using the statistical software SPSS software package (Statistical Package for Social Science, version 17). Unpaired Student's t test was done.

**Results**

No statistically significant difference was found between mean measured height of adult male and calculated height of those ( $p > 0.05$ ) (Table-I). Similarly, difference between mean measured height of adult female and calculated height of those was statistically non-significant ( $p > 0.05$ ) (Table-I).

**Table I**  
*Measured height and calculated height in adult male and female (N=100)*

Sex	Measured height (cm) Mean ± SD (Range)	Calculated height (cm) Mean ± SD (Range)	P value
Male (n = 40)	170.64±4.48 (162.56 to 175.26)	170.94±4.89 (161.25 to 177.16)	0.141 <sup>ns</sup>
Female (n = 40)	154.58±3.34 (149.86 to 160.02)	154.58±3.83 (148.85 to 161.3496)	0.141 <sup>ns</sup>

Figure in parenthesis indicate range. Comparison between measured height and calculated height of adult male and female were done by unpaired Student's 't' test, \* = Significant at P < 0.05, <sup>ns</sup> = not significant (2 tailed), N= Total sample size, n= Sample size in each group.

### Discussion

The present study was carried out to establish data for stature estimation of adult male and female Bangladeshis using length of clavicle. In the study, there was no significant difference between mean value of measured height of adult male and calculated height of those. Similarly, there was no significant difference between mean value of measured height of adult female and the calculated height of those.

The result of the present study was similar to that of Rajesh<sup>16</sup> who investigated on clavicles collected from cadaver of Indian population. She found that there was no significant difference between mean value of measured heights of adult male cadaver and the mean calculated cadaveric height from the length of left clavicle.

Balvir et al<sup>17</sup> carried out a study to establish a definite correlation between stature and length of clavicle. They found that it was possible to calculate stature of the subject from the length of clavicle in the population of Vidarbha region of Maharashtra, India.

### Conclusion

In the present study, it has been found that stature can be calculated using length of clavicle. Further studies with larger sample size are recommended to get more precise picture in order to produce a more comprehensive data for stature estimation using length of clavicle. In this regard, the more advanced CT scan and MRI could be used to get

more detailed and accurate information about clavicle for stature estimation.

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### References

1. Chavda HS, Khatri CR, Varlekar PD, Saiyad SS, Morphometric analysis and sex determination from clavicles in Gujrati Population. National Journal of Integrated Research in Medicine. 2013; 4(6): 18-22.
2. Dayal MR, Steyn M, Kuykendall KL, Stature Estimation from Bones of South African Whites. South African Journal of Science. 2008; 104:124-128.
3. Rani Y, Naik SK, Singh AK, Murari A, Correlation of Stature of Adult with the Length of Clavicle, Journal Indian Academy Forensic Medicine. 2011; 33 (3): 194-195.
4. Standring S. Gray's Anatomy. 40th ed. London:Churchill Livingstone ; 2008.
5. Bodi AKS, Sinha BN, Kumaran S, Some Observation on Human Clavicle. Journal of Nepal Medical Association. 2002; 41: 441-445.
6. Suryawanshi AK, Puranic MG, Mudiraj MG. Morphometric Analysis and Sex determination of Adult Human Clavicles in Maharastra

- Region. *International Journal of Recent Trends in Science and Technology*. 2015; 15(2) : 333-338.
7. Kamdi A, Gayatri, Sherke AR, Krishnaiah M, Chaitanya K, Morphometric Parameters and Sex Determination of Clavicle in Telangana Region. *Journal of Dental and Medical Science*. 2014; 13(10): 1-5.
  8. Merck Sharp & Dohme Corp, a subsidiary work of Merck & Co., Inc., Kenilworth, N.J., USA., 2009. *Radiography*. [Online] Available at: <https://www.merckvetmanual.com/mvm/clinical-pathology-and-procedures/diagnostic-imaging/radiography.html>. [Accessed 9 September 2015].
  9. Mac Curdy GG, *International Congress of Prehistoric Anthropology and Archeology*, Geneva. Wiley on behalf of the American Anthropological Association .1912, viewed 20 July 2015.
  10. Petersson CJ, Degeneration of the Acromioclavicular Joint: a morphological study, *Acta Orthopaedica Scandinavica*. 1983; 54:434-438.
  11. Miah MDFK, Rab Mollah MA, Begum M, Begum M, Begum Z, Samina R, Begum A, Mahal SF, Begum SM, Bose SR, Khan FA, Nasreen F, Jaha H, Haque A, Compilation of Anatomical, Physiological and Metabolic Characteristics of a Bangladeshi Man, Atomic Energy Centre, Dhaka. 2 .1988-1993;1-15.
  12. NHANES, Anthropometry procedure manual, Center for disease control. [Online] Available at: <http://cdc.gov/nchs/data/nhanes/nhanes-03-04/Bam/pdf>. 2007, [16 September, 2015].
  13. Whitley AS, Sloane C, Hoadley G, Moore AD, Alsop, CW. *Clark's positioning in Radiography*. 12<sup>th</sup> ed. London: Churchill Livingstone; 2008.
  14. Udoaka AI, Nwokediuko AU. Radiological Evaluation of Clavicular Morphology in Southern Nigerians. *Int. J. Morphol*. 2013; 31: 94-99.
  15. Waghmare V, Gaikward R, Herekar N. Estimation of the Stature from the Anthropometric Measurement of Hand Length. *The International Journal of Biological Anthropology*. 2010; 4(2): 111-112.
  16. Rajesh R, Determination of Stature and Sex from Human Clavicle, *International Journal of Recent Trends in Science and Technology*. 2014; 10: 111-12.
  17. Balvir TK, Deshpande JV, Badwaik P, Rahule AS, Kasote A. Estimation of Stature from the I of length of Clavicle in Vidarbharegion of Maharashtra. *The International Journal of Biological & Medical Research*. 2012; 3(3): 2254-2256.