

# DETERMINATION OF CENTER OF MASS USING 3D ANTHROPOMETRY METHOD DURING STANDING POSTURE IN HUMANS

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## INTRODUCTION

Body segment volume has been measured by various methods such as immersion methods, mathematical model and photographic methods in order to estimate each segment mass in biomechanical studies. Using the three dimensional anthropometry has a possibility for the estimation of various body segment parameter. Purpose of this study was to estimate center of mass using three dimensional anthropometry.

## METHODS

The subjects were 6 males (Age : 22.3±1.1years, body height: 172.5±5.9cm, body mass: 67.2±2.5kg) participated in this study. Body line scanner (BLS:Hamamatsu Photonics KK) was used for 3D whole body anthropometry.

### Estimation of COM and %BH using BLS

Whole body volume was measured using BLS. Whole body scanning data was divided into 14 segments in the same manner as the study by C.E.Clauser [1] according to anatomical landmark points and each segmental volume was determined. Center of each segmental volume (COV) was calculated from each segmental volume. Segment mass (SM) was calculated using each segment density [1]. In standing posture, height of center of mass (COM) and relative height of COM to body height (%BH) was calculated.

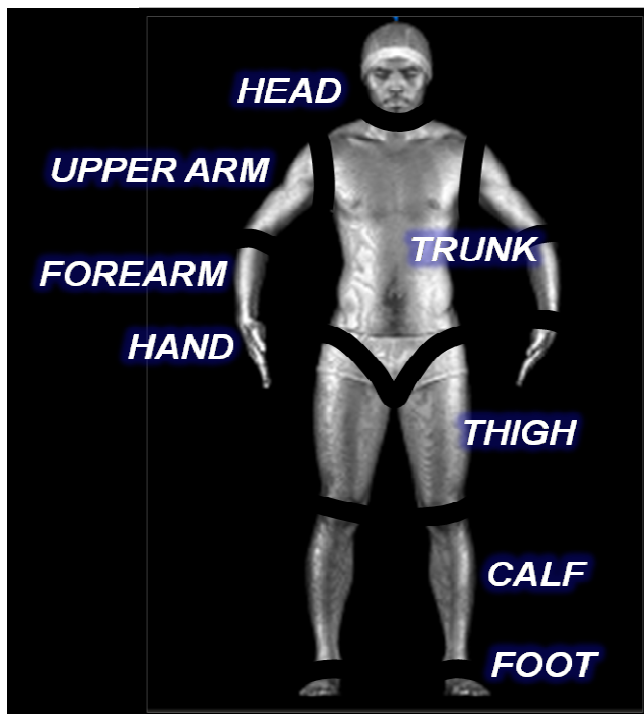


Figure 1 Definitions of each segment.

### Direct measurements of COM and %BH

Two points weighing methods were used for the direct measurements of COM and %BH. In two points weighing methods, reaction rigid board (180 × 91.5 × 2.5cm) mounted on two scales was used.

COM and %BH were compared between estimated and direct methods as well as the predicted value from C.E.Clauser, 1969.

## RESULTS AND DISCUSSION

Difference of body mass between estimated from BLS and measured directly was under 1.5%. %difference of COM and %BH (BLS and a measurement) were 2.9±0.9%. In COM and %BLS, values by estimation from BLS showed lower than the values by direct measurement (estimated : COM=94.4±3.0cm, %BH=54.9±0.5%, measured : COM =97.2±3.6cm, %BH=56.6±0.5%).

**Table 1 Heights of COMs (absolute and relative to body height) obtained from directly measured, present study and C.E. Clauser's anthropometric values[1].**

Sub.	Present Study		Measured		C.E. Clauser [1]	
	COM(cm)	%BH(%)	COM(cm)	%BH(%)	COM(cm)	%BH(%)
1	94.1	55.0	97.2	56.8	101.2	59.1
2	93.9	55.6	96.2	57.0	99.4	58.9
3	90.9	55.1	93.7	56.8	94.9	57.5
4	98.4	54.3	103.0	56.8	105.0	57.9
5	91.7	54.4	93.7	55.6	98.1	58.2
6	97.3	55.2	99.4	56.4	102.2	58.0
Mean	94.4	54.9	97.2	56.6	100.1	58.3
SD	3.0	0.5	3.6	0.5	3.5	0.6

## CONCLUSION

It is suggested that center of mass can be estimated from 3 dimensional whole body scanning with the accuracy of the error of estimateion within 2.9%.

## REFERENCES

1. Clauser C.E. , *AMRL technical report TR:69-70*,1969.