Analysis of linear parameters measured from digitized landmarks reveal sexual dimorphism of clavicle in Malaysian population

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ABSTRACT

Introduction: The clavicle is amongst the postcranial bones that can be utilized for identification of unknown skeletal remains as it is sexually dimorphic. The accuracy and reliability of the identification process is population-specific, which leads to the need for the development of regional databases. To overcome the limited bone collections of the Malaysian population, virtual anthropology utilizes three-dimensional (3D) computed tomography (CT) models to visualize skeletal components. Previous morphometric studies on the clavicle analyse linear parameters measured directly on the bone. In this study, we aim to elicit sexual dimorphism of the clavicle bone by analysis of linear parameters obtained from landmarks applied on 3D clavicular models and to determine its classification accuracy. **Materials and Methods:** A total of 140 CT thorax of 70 males and 70 females, aged between 20 to 74 years were sampled from the Malaysian population. Nine landmarks were digitized on the clavicular models. Based on the landmarks, five linear parameters were measured which include clavicular length (CL), acromial end length (AL), acromial end height (AH), sternal end length (SL), and sternal end height (SH). Data were analysed using independent T-test and discriminant function analysis (DFA). **Results:** There were significant sex differences in all parameters of the clavicle ($p<0.05$), except for acromial end height ($p=0.08$). Subsequent univariate DFA of the significant parameters revealed classification accuracy between 60.7% (SL) to 90.7% (CL). Multivariate DFA revealed classification accuracy between 65.7% to 91.4%, while stepwise analysis showed 91.4% accuracy. **Conclusion:** Sexual dimorphism of the clavicle can be elicited from analysis of linear measurements obtained from landmarks applied on the clavicular surface. This novel approach provides an alternative method for obtaining linear parameters on skeletal bodies with high accuracy for sex classification.

Keywords: Virtual anthropology, sex estimation, clavicle