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AGE RELATED CHANGES IN THE POST-CRANIAL HUMAN SKELETON AND ITS IMPLICATION FOR THE DETERMINATION OF SEX

by

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Declaration

I declare that the dissertation that I am hereby submitting to the University of Pretoria for the PhD degree in Anatomy degree is my own work and that I have never before submitted it to any other tertiary institution for any degree.

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Abstract

The study of skeletal differences between males and females has rarely taken into account the physical change in hard tissue characteristics with the onset of advanced age. Anatomical change through degenerative modification may pose a challenge when diagnosing the sex of an unknown individual, especially if age is unknown. The aim of this study was to establish whether sexual dimorphism changes with age. This issue was addressed by using three types of procedural analyses. Firstly, standard measuring techniques were utilized to determine sex from 593 individuals. Visual (morphological) assessment was then performed on 608 individuals using sexually dimorphic traits in the distal humerus and pelvis. Lastly, over 300 individuals were analyzed with geometric morphometrics using four locations on the postcranial skeleton. Younger females and males (50 years of age and younger) were then compared to older individuals (over 50 years of age) to determine if sexual dimorphism was increasing or decreasing with the onset of age. Long bone measurements of the postcranial skeleton increased with the onset of age in the most osteoporotic sample (South African white females). Males exhibited an increase in size, mainly in the knee and elbow joints, and black females remained static in their measurements with age. Older white females especially can sometimes incorrectly be misclassified as males. Visual techniques indicated that all populations have similar non-metric morphology in the distal humerus and pelvis. Classification accuracies in females decreased when viewing the distal humerus, indicating a decrease in sexual dimorphism at this location. Females appeared static in their pelvic morphology with the onset of age. Males remained sexually dimorphic throughout life in the humerus and pelvis. Geometric morphometrics showed that the morphology of the distal humerus is sexually dimorphic, and does not change with age. Morphometrics also confirmed the marked sexual

dimorphism in the pelvis, and showed virtually no change in sexual dimorphism when comparing young to old groups.

Abstrak

Studies van skeletale verskille tussen mans en vrouens neem selde die fisiese veranderinge in been met toenemende ouderdom in ag. Anatomiese veranderinge as gevolg van degeneratiewe modifikasie kan problematies wees met die bepaling van geslag van 'n onbekende persoon, veral as die ouderdom nie bekend is nie. Die doel van hierdie studie was om te bepaal of seksuele dimorfisme verander met ouderdom. Hierdie probleem is aangespreek deur gebruik te maak van drie metodes van ontleding. Standaard metriese tegnieke is eerstens gebruik om die geslag van 593 individue te bepaal. Visuele (morfologiese) evaluering van seksueel dimorfiese kenmerke van die distale humerus en pelvis is daarna op 608 individue gedoen. Laastens is vier areas op die postkraniale skelet van meer as 300 individue met behulp van geometriese morfometrie ontleed. Jonger mans en vrouens (50 jaar en jonger) is vergelyk met ouer individue (ouer as 50 jaar) om te bepaal of seksuele dimorfisme toeneem of afneem met toename in ouderdom. Langbeenafmetings van die postkraniale skelet neem toe met ouderdom by die mees osteoporotiese groep (wit Suid-Afrikaanse vrouens). Mans toon 'n toename in grootte, hoofsaaklik in die knie en elmboog, en afmetings van swart vrouens was bestendig met toenemende ouderdom. Ouer wit vrouens veral kan soms verkeerdelik geklassifiseer word as mans. Visuele tegnieke dui aan dat alle groepe 'n soortgelyke nie-metriese morfologie in die distale humerus en bekken vertoon. Klassifikasie akkuraatheid in vrouens neem af in die distale humerus, wat dui op 'n afname in seksuele dimorfisme in hierdie gebied. Bekkenmorfologie van vrouens toon geen veranderinge met ouderdom nie. Die humerus en bekken van mans bly seksueel dimorfies deur hul lewe. Geometriese morfometrie wys dat die bou van die distale humerus seksueel dimorfies is, en dat dit nie verander met toename in ouderdom nie. Geometriese morfometrie bevestig ook die kenmerkende seksuele dimorfisme van die

bekken, en wys feitlik geen veranderinge wanneer jong en ouer groepe vergelyk word nie.

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