The Value of Foramen Magnum Measurements in Sex Prediction Using Computed Tomography among Sudanese Population

Thesis

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دور قياسات الثقب الأعظم للجمجمة باستخدام الأشعة المقطعية في التنبؤ بالجنس بين السكان السودانيين

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وَأَنْزَلَ اللهُ عَلَيْكَ الْكِتَابَ وَالْحِكْمَةَ وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ وَكَانَ فَضْلُ اللهِ عَلَيْكَ عَظِيمًا

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ABSTRACT

Background: The Foramen Magnum is an important landmark of the skull base and is of particular interest in anthropology, anatomy, forensic medicine and other medical fields. Radiography can assist in giving accurate dimensions for which certain formulae can be applied to predict sex.

Objective: The present study aimed to detect the value of foramen magnum measurements using Computed Tomography scanning in sex prediction among Sudanese population.

Materials and Methods: The sample consisted of 400 Sudanese adults of known sex (200 males, 200 females) who were referred for head Computed Tomography scan due to different causes.

Results: Length of Right Condyle (LRC), Minimum Intercondylar Distance (MnID) and Width of Foramen Magnum (WFM) - were able to determine sex with an accuracy rate of 83 %. Our large sample enabled us to prove that all measurements were significantly higher in males than females.

Conclusion: Foramen Magnum measurements can be used for sexing when other methods are inconclusive in Sudanese population.

Key Words: Sex prediction, Foramen Magnum, Computed Tomography, Sudanese.

Introduction

The forensic pathologist has always had a central role in the identification of the dead in every day practice, in accidents, and in disasters involving hundreds or thousands of victims. This role has changed in recent years, as advances in forensic odontology, genetics and anthropology have improved the chances of identifying victims beyond recognition. According to the Interpol Disaster Victim Identification (DVI) Guide, fingerprints, dental examination and DNA are the primary identifiers, and this has given new emphasis to the role of the forensic pathologist as the leader of a multidisciplinary team of experts in a disaster situation, based on his or her qualifications and the experience gained from doing the same work in the everyday situation of an institute of forensic medicine *(Schuliar and Knudsen, 2012).*

Identification of human remains relies on various procedures, such as identification by direct facial recognition, fingerprint and dental analysis, identification of special features, recognition of clothing and belongings, autopsy findings, forensic anthropologist's findings, reconstruction of facial features from skulls, hair comparisons, and DNA analysis *(Andelinović et al., 2005).*

The examination of skeletal remains is a challenge to the forensic doctor conducting the investigation *(Krishan et al., 2012).*

Forensic anthropology has been one of the fastest growing medico-legal disciplines both in its contribution to the practical needs of the legal system and research accomplishments. New anthropological standards were developed to apply to a specific population of a region *(Işcan and Olivera, 2000).*

Skeletal identification has a long tradition in both physical and forensic anthropology. The process generally begins with formulation of a biological profile (osteobiography); specifically, estimation of sex, age, ethnicity and stature *(Franklin, 2010).*

Identification is an important work in forensic investigation included sex discrimination, age and stature estimation. Human identification depended on radiological image technique analysis is a practice and proper method in forensic science field *(Zhang et al., 2006).*

Determination of sex of an unknown individual is one of the critical questions addressed when human skeletal remains are found in both forensic investigations and in studies of past populations *(Albanese, 2003).*

From a forensic point of view it is important to determine sex of skeleton remains early, as this reduces the possible identification of missing person by a considerable degree. This varies with completeness of the skeleton and whether it is adult or child.The more bones available for examination, the greater the accuracy and thus every endeavor should be made to retrieve as much skeleton as possible *(Stavrianos et al., 2009).*

Metric and nonmetric differences between men and women as regards the size and proportions of skeletal components are available, and these differences can be used in the identification of sex. Correct sex identification of the human skeleton is important in bioarcheological and forensic practice *(Bruzek, 2002).*

Anthropological examination of defleshed bones is routinely used in medico-legal investigations to establish an individual's biological profile. However, when dealing with the recently deceased, the removal of soft tissue from bone can be an extremely time consuming procedure that requires the presence of a trained anthropologist. In addition, due to its invasive nature, in some disaster victim identification scenarios the maceration of bones is discouraged by religious practices and beliefs, or even prohibited by national laws and regulations *(Alison et al., 2012)*.

Populations differ with regard to both the extent of sexual dimorphism and the inter-correlation between features. Hence, a vital prerequisite of accurate sex identification in skeletal remains is information about their origin, so that the available examination methods can be adjusted accordingly. Previous studies reported important conclusions. There are significant size differences between populations and that therefore all discriminates formulae for determination of sex are population-specific *(Altayeb et al., 2011)*.

Physical anthropologists are often faced with the problem of developing a biological profile from incomplete human skeletal remains. Recent large scale investigations involving mass graves or mass disasters compound this challenge *(Elizabeth et al., 2009)*.

Aim of the Work

The aim of this work is to estimate the value of foramen magnum measurements in sex prediction using Computed Tomography (CT) among Sudanese population.

It thoroughly studies the value of radiological methods represented by CT in estimating sex as an important element in identification. Virtual anthropology can replace ordinary identification methods and limit deflishing of decomposed corpses in order to be used in identification of skeletal remains in case of mass disasters or victims of military conflicts.

Chapter One

IDENTIFICATION

The identification of human remains, especially if they have been mutilated or burnt, or occur in skeletal form, may pose a major problem for the forensic doctor . It may involve the co-operation of coroner, police officer, forensic pathologist and forensic laboratory. It is first necessary to demonstrate that the remains are human, and that the tissue in question represents one, or more than one, body. A meticulous postmortem examination by the forensic pathologist will reveal all anatomical peculiarities for study and record. Photographs, radiographs, dental charts, fingerprints and blood type all contribute materially to the solution of the problem *(William , 1964).*

The most common method used for identification is visual recognition by family. Although this is most often utilized , it must be recognized that it is not a scientific method and major mistakes have been known to occur. In a minority of cases positive identification will not be able to be made. This problem occurs when bodies are badly decomposed or skeletonized .Then , forensic pathologist will perform full range of investigations such as total body photographs , fingerprints , total body x-ray , dental charts and DNA samples (blood , bone , hair and teeth).Forensic pathologist will perform meticulous assessment of skeletonized bodies to provide useful estimates of the age , race , gender and stature *(Joseph and Roger , 2012)*.