



## Physical Anthropology Section – 2008

### H98 Accuracy of Regression Formulae for Racing and Sexing the Cranial Base in a Forensic Collection

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The goal of this presentation is to share results of a study that tested two researcher's regression formulae for race and sex determination using the cranial base when applied to a modern forensic collection.

This presentation will impact the forensic community by presenting results of a study that tests the accuracy of formulae for determining race and sex of the cranial base on a modern forensic collection.

This presentation examines the applicability of Holland's race determination (1986) and Wescott's sex determination (1996) regression formulae when applied to a modern forensic collection that is housed at Louisiana State University's Forensic Anthropology and Computer Enhancement Service (FACES) Laboratory. Testing was conducted on 77 complete skulls that had been positively identified, or, if unidentified, skulls that clearly exhibited no admixture features. The 77 skulls consisted of 48 males and 29 females. Of the 77 skulls, 41 were identified as white and 36 were identified as black.

In 1986, Holland analyzed 100 black and white crania from the Terry Collection and created five regression equations for race determination based on eight measurements from the cranial base with an accuracy rate ranging from 70 to 86%. In a separate control test involving 20 different skulls from the Terry Collection, Holland had a 75 to 90% accuracy rate. The interpretation of certain landmark locations on the cranial base led us to exclude some formulae that included these landmarks. Therefore, for testing and determining race from the cranial base, we used Holland's regression formula #4 that involved the following four measurements: 1) the length of the occipital condyle defined as the maximum length of the left condyle as measured along its long axis from the ends of the articular surface; 2) the width of the occipital condyle defined as the maximum width of the left condyle as measured from the articular edges along a line perpendicular to the length; 3) the length of the foramen magnum defined as the maximum length of the foramen magnum as measured from basion to opisthion along the mid-sagittal plane, and 4) the width of the foramen magnum defined as the maximum width of the foramen magnum as measured perpendicular to the mid-sagittal plane. Holland's #4 regression formula had an overall 70 to 75% accuracy rate. The 77 modern forensic collection skulls were measured and Holland's #4 regression formula was applied. An accuracy of 57% was obtained.

In 1996, Wescott analyzed 308 combined crania from the Hamann-Todd and Terry Collections and created five regression equations for sex determination based on five measurements from the cranial base with an accuracy rate ranging from 72.1 to 80%. In a separate control test involving 83 different crania from the Hamann-Todd and Terry Collections, Wescott had a 63.6 to 90% accuracy rate. For testing and determining sex from the cranial base, we used Wescott's regression formula #5 that involved the following five measurements: (1) maximum condyle length defined as the maximum edge to edge length of the articular surface of the occipital condyle measured along its long axis, (2) maximum condyle breadth defined as the greatest edge to edge breadth of the articular surface of the occipital condyle measured perpendicular to the long axis, (3) basion to hornion length defined as the length of the basilar process measured from basion to hornion, (4) foramen magnum length defined as the length from endo-basion to opisthion, and (5) foramen magnum breadth defined as the maximum breadth of the foramen magnum measured perpendicular to the length. In Wescott's research, his #5 regression formula had an overall 73.2 to 90% accuracy rate. Of the 77 modern forensic collection skulls, 10 were eliminated due to anterior damage to the basilar process. Therefore, 67 skulls were measured and Wescott's #5 regression formula was applied. An accuracy of 68% was obtained.

As suggested by both Holland and Wescott, these formulae may be applied when a skull has been damaged and only certain portions of it remain. Additional testing on larger forensic collections may improve the accuracy rate of these formulae, further enhancing their applicability on forensic cases.

#### References:

- 1 Holland, Thomas Dean. Race Determination of Fragmentary Crania by Analysis of the Cranial Base. *Journal of Forensic Sciences* 1986: 31(2): 719-725.
- 2 Wescott, Daniel Jay. The Effect of Age on the Sexual Dimorphism in the Adult Cranial Base and Upper Cervical Region. Masters Thesis. Wichita State University 1996.

#### Race Determination, Sex Determination, Cranial Base