CASE REPORT

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A Report on the Use of Fully's Anatomical Method to Estimate Stature in Military Skeletal Remains

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ABSTRACT: The present study applies two methods of estimating living stature from long limb bones to a sample of military remains. Preliminary results comparing the relative accuracy of the two methods are presented.

KEYWORDS: physical anthropology, musculoskeletal system, human identification, stature determination

In 1956, Fully [*1*] described a new method to estimate living stature from Caucasoid skeletal remains. He termed the new approach the "anatomical method." Although Fully's anatomical method has been advocated by Stewart [*2*] and Lundy [*3*], its use seems rare among forensic anthropologists. This may be due to the paucity of forensic science cases in which enough remains are present to employ the method, and it is more complicated and time-consuming than using Trotter and Gleser's [*4*] equations.

However, the author has used the anatomical method extensively in a South African Negro skeletal sample [*5-7*] as a step in deriving stature regression formulae. During the past year, the opportunity arose to apply Fully's anatomical method to three military cases where sufficient skeletal material was available. The results obtained using the anatomical method on these three cases are presented and compared with stature estimates obtained using the Trotter and Gleser [*4*] formulae.

Material and Methods

The sample consists of the skeletal remains of three white male U.S. servicemen who died in the Vietnam War, whose remains were returned by the Socialist Republic of Vietnam. In all three cases, the skeletons were virtually complete with the exception of some phalanges. In each case, identification was based upon dental comparisons, and antemortem stature data were available. Figures 1 through 6 illustrate the measurements discussed. Fully's [*1*] anatomical method prescribes the measurement of the basi-bregmatic height of the cra-

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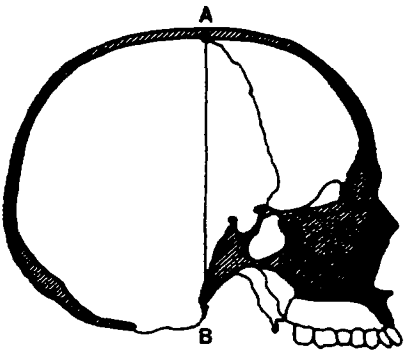

FIG. 1—*Basi-bregmatic height of the cranium.*

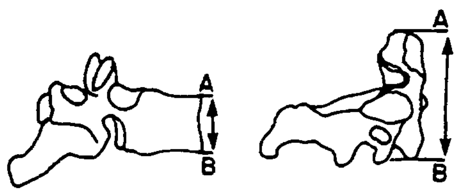

FIG. 2—*Maximum anterior heights of the presacral vertebrae.*

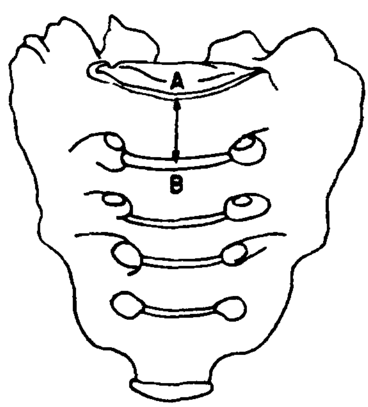

FIG. 3—*Maximum anterior height of sacral segment 1.*

nium, the height of each vertebra—C2 through S1, the bicondular (physiological) lengths of the femur and tibia [*8*], and the articulated height of the talus and calcaneus [*1,2,6*]. The maximum anterior height of each vertebra is taken with a sliding caliper.

In the case of C2, the measurement is taken from the most superior point on the odontoid process to the inferior margin of the anterior portion of the corpus, and thus includes the height of C1 in the measurement. The height of S1 is measured, using sliding calipers, in the midline, from the anterior margin of promontory to the transverse line separating the first and second sacral segments. The articulated talus and calcaneus are measured on a mandi-

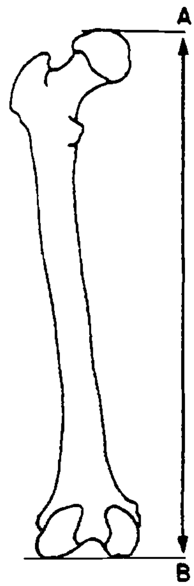

FIG. 4—*Bicondylar (physiological) length of the femur.*

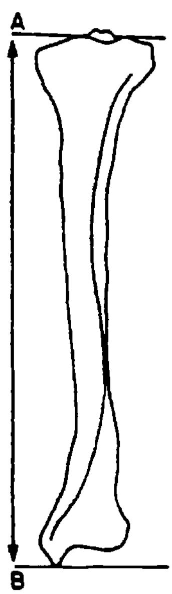

FIG. 5—*Bicondylar (physiological) length of the tibia without spines.*

ble board or an osteometric board. The sum of these measurements represents the "skeletal height." To this is added a correction factor for soft tissue—for skeletal heights of 153.5 cm or less, add 10.0 cm to obtain the estimated living stature, for skeletal heights from 153.6 to 165.4 cm, add 10.5 cm, and for skeletal heights of 165.5 cm and above, add 11.5 cm to obtain the estimated living stature [9].

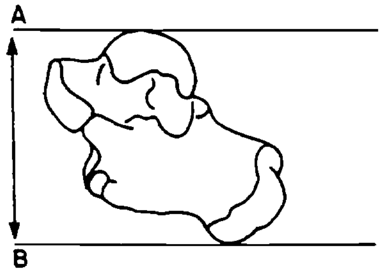

FIG. 6—*Articulated height of the talus and calcaneus.*

Results

Table 1 shows the antemortem recorded statures for the three cases, the estimated statures obtained using Fully's anatomical method, and the estimated living statures obtained using the Trotter and Gleser equations. The particular equation used is the femur plus tibia for white males [*4*]. In Case A, the recorded antemortem stature is 70.5 in. (179.07 cm). The estimated stature using the anatomical method is 70.6 in. (179.3 cm), a 0.1-in. (0.254-cm) difference. Using Trotter and Gleser's equations, the estimated stature for Case A is 68.4 in. (173.7 cm) with a standard error of 1.18 in. (2.99 cm), the resulting range being from 67.22 to 69.58 in. (170.73 to 176.73 cm). Thus, the actual stature lies outside the estimated range (± 1 standard error) using the Trotter and Gleser formula.

Case B presents an antemortem stature of 69.5 in. (176.5 cm), and an anatomical method estimate of 69.9 in. (177.5 cm), a difference of 0.4 in. (0.1016 cm). The Trotter and Gleser estimate of stature for Case B is 68.3 in. (173.4 cm), with a standard error of 1.18 in. (2.99 cm) and the range being 67.42 to 69.78 in. (171.24 to 177.24). In Case B, the antemortem stature does fall within the range of the Trotter and Gleser estimate, and the central tendency differs from living stature by 1.2 in. (3.048 cm).

In Case C, the living stature is 71.0 in. (180.3 cm) and the anatomical method estimate is 70.2 in. (178.3 cm), a difference of 0.8 in. (2.032 cm). The Trotter and Gleser formula provides an estimated stature of 71.3 in. (181.1 cm) and a standard error again of 1.18 in. (2.99 cm). The resulting range of the estimate is 70.12 to 72.48 in. (178.10 to 184.09 cm), and the antemortem stature falls within the range. The central tendency of the Trotter and Gleser equation differs from recorded height by 0.3 in. (0.762 cm).

Discussion

Before discussing the results, note that the reliability of recorded antemortem statures has been questioned by Snow and Williams [*10*] and by Willey and Falsetti [*11*]. The first study

TABLE 1—*Stature estimate comparisons using Fully's anatomical method and Trotter and Gleser's equations.*[a]

Case	Recorded Antemortem Stature	Fully's Anatomical Method [*1*]	Trotter and Gleser's Equations [*2*]
A	70.5	70.6	68.4 (1.18 S.E.)
B	69.5	69.9	68.6 (1.18 S.E.)
C	71.0	70.2	71.3 (1.18 S.E.)

[a]All statures in inches. 1 in. = 2.54 cm.

dealt with police records and the second with driver's license heights. However, in the cases addressed here, all three were naval aviators. During training, the Navy conducts detailed anthropometric studies of each aviation candidate which determine whether he or she falls within the minimum/maximum height and reach requirements, and to a degree, which types of aircraft the cadet will fly [12]. The measurements and completion of the anthropometric form are under the direct supervision of a physician and the form becomes part of the aviator's permanent record. Hence, the recorded statures for the sample discussed in the present study are far more reliable than those addressed by Snow and Williams [10] and by Willey and Falsetti [11].

As stated above, the estimates of stature based upon the anatomical method vary from the recorded heights by a margin of 0.1 to 0.8 in. (0.254 to 2.032 cm). The Trotter and Gleser formula provides one estimate, Case A, in which the recorded stature does not fall within the estimated range, and the other two central tendencies of estimate vary from the recorded data by margins of 0.9 and 0.3 in. (2.286 to 0.762 cm). The data indicate that in these three cases, the anatomical method is as accurate as the so-called mathematical method, and in Case A, more accurate.

One criticism of the mathematical method is that it does not always reflect body proportions accurately [3]. The anatomical method on the other hand, does, because one actually measures the height of the cranium, the length of the spine, the lengths of the leg components, and the height of the ankle.

Conclusion

Neither the mathematical nor the anatomical method should be expected to provide more than an estimate of living height, but obviously, the more accurate we can be the better.

While the application of the anatomical method is limited to those few cases where a nearly complete skeleton is available, preliminary indications are that it may be worth the time and effort to try Fully's anatomical method the next time such a case presents itself.

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