

A110 Mismeasurement of the Tibia and Femur Reconsidered: How Were Measurements Taken at the Central Identification Unit in Kokura, Japan?

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After attending this presentation, attendees will better understand historical changes in osteological measurement definitions and practices and how this impacts the reference samples used in the anthropological calculation of stature.

This presentation will impact the forensic science community by further illuminating change over time in measurement practices within the same forensic anthropological laboratory and how these may have affected reference standards.

In 1952, Trotter and Gleser published one of the baseline references for American forensic anthropology, using measurements from 1,200 World War II United States military casualties and 615 males from the Terry Collection to calculate a series of regression equations for the estimation of living stature from long bone lengths.¹ When Trotter and Gleser completed their 1952 study, the Central Identification Unit (CIU) in Kokura, Japan, conducted a test of how the new formulas compared to those of Krogman and Rollet (which the CIU had been using until that point) by applying both methods to 120 previously identified Korean War casualties. The average deviations between estimated and actual stature for the White males ($n=100$) were 1.24" (Krogman), 1.48" (Rollet), 1.14" (Trotter, averaging all bones), and 1.01" (Trotter, femur and tibia); for the limited sample of Black males ($n=20$), the parallel values were 1.61", 2.03", 1.19", and 1.19".¹⁻³ Based on these results, the CIU decided to adopt Trotter's formulas. Subsequently, Trotter and Gleser (1958) published a revised study using data from 5,517 United States casualties of the Korean War whose remains were processed at the CIU.⁴

In 1994, Jantz et al. analyzed the original data from Trotter and Gleser (1952) and demonstrated that the tibial lengths omitted the malleolus.⁵ In 1995, they compared the mean lengths of the tibia and fibula in Trotter and Gleser (1958) and concluded that the tibiae had not been measured properly in that study either.^{4,5} Although the Korean War data used by Trotter and Gleser has not been located, ongoing compilation of measurement data from Korean War casualties whose files are available to the DPAA has yielded a comparable reference set.

Between May and November 1953, the three anthropologists working at the CIU estimated stature in both ways to compare the results. In addition, they recognized that Trotter's measurement definitions differed from their previous ones, and on 35 measurement forms located to date, they recorded two distinct measurements of the femur and tibia. Because the forms only provided a single space for each long bone, whoever entered the data usually added a more specific designation. The first value entered is often unspecified, but several forms label it "KR," while others use "Bicondylar." The second, larger measurement is labeled "maximum" or "Trotter." Comparing the measurements recorded on these forms, the difference between the first and second measures of femoral length averages 4.5mm ($n=44$, Standard Deviation (SD) 2.40, range 1-11); for tibial length, the mean difference is 8.8mm ($n=51$, SD 5.62, range -1-21).

For a broader data set, measurements were compared from 316 skeletons that were analyzed at Kokura using both sets of stature formulas. The initial measurements were taken through May 1953, the second after September 1953. In 410 of 473 femoral length comparisons (87%) and 398 of 461 tibial length comparisons (87%), the later measurement was larger than the earlier one; the mean difference was 3.7mm for the femur (SD 3.17, range -6-15) and 4.5mm for the tibia (SD 3.91, range -6-16). By contrast, the fibula exhibited less change: the average increase in length was only 0.64mm ($n=390$, SD 2.13, range -8-11).

Tibia and fibula lengths were also compared. Until May 1953, the mean difference was 0.26mm ($n=379$, SD 5.09, range -15-14); after September 1953, the mean difference was 3.97mm ($n=437$, SD 5.12, range -13-23). While this increase does indicate that the post-1953 measurement standards were more comparable to those used by modern forensic anthropologists, they do not appear exactly the same.

It is clear that procedures for measuring the femur and tibia at Kokura changed over time. Before 1953, the (apparently unwritten) norm was to record the bicondylar length of the femur and anatomical length of the tibia; after the transition to Trotter and Gleser's formulas, the maximum lengths of both were standard; however, there is noticeable variation in measurements that leaves some uncertainty regarding how any particular bone was measured. In addition, the exact composition of the Korea data set provided to Trotter and Gleser is unknown, so we cannot be sure how many of the individuals within it were measured using each methodology. This introduces clear error into all of Trotter and Gleser's 1958 formulas using both femoral and tibial lengths.⁴

Reference(s):

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2. Krogman W.M., Isçan M.Y. (1986) *The Human Skeleton in Forensic Medicine*. C.C. Thomas, Springfield, IL.
3. Rollet E. (1888) On the measurement of the long bones of the limbs. *Thèses pour le doctorat en médecine, li're series*. Universit' de Lyon, 1 e 128.
4. Trotter M., Gleser G.C. (1958) A re-evaluation of estimation of stature based on measurements of stature taken during life and of long bones after death. *American Journal of Physical Anthropology*. 16 (1), 79 e 123.
5. Jantz R.L., Hunt D.R., and Meadows L. (1994) Maximum length of the tibia: How did Trotter measure it? *American Journal of Physical Anthropology*. 93:525-8.

Stature Determination, Skeletal Measurements, War Dead