## A62 The Implications of Thermal Alteration on Osteometry

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**Learning Overview:** After attending this presentation, attendees will understand how different thermal alterations and bone conditions affect the magnitude of changes observed on bone and how this affects an anthropologist's ability to accurately collect measurements.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by contributing to knowledge on the impact of thermal alteration on osteometric methods that are used in biological profile estimates.

Standard Operating Procedures (SOPs) in forensic anthropological analysis dictate that thermally altered remains should not be measured, which can hinder the creation of a biological profile. In South Africa, the majority of burned cases received at the Forensic Anthropology Research Centre (FARC) at the University of Pretoria, present with limited burning, which calls into question our ability to accurately measure this material and to develop biological profile parameters. Few studies have addressed estimating biological parameters from burnt remains, with the greatest focus of the existing research on cremated remains.[1,2] However, cremation is rarely seen in the South African forensic context compared to other burn characteristics, while limited calcination, less severe charring, and heat-altered borders are observed more commonly. The condition of the bone and the duration of the fire have been shown to have the greatest effect on the degree of thermal alteration, particularly on the degree of bone shrinkage.[3] Therefore, the degree of shrinkage needed to be tested on fresh and dry bone exposed to different fire durations to gauge the degree of shrinkage in the various conditions and the subsequent effect on standard anthropological measurements.

Ten standard femoral measurements were collected from 96 pig femora separated into fresh and dry categories. The fresh bones were void of flesh, but still greasy with the periosteum present, and the dry bones had some organic content lost, but had residual periosteum. Equal samples within each category were exposed to different durations of burning (5, 10, and 20 minutes). The measurements were repeated after exposure to fire. Technical Error of Measurement (TEM), Wilcoxon signed-rank, and Kruskal-Wallis tests were used to assess changes in the femoral dimensions before and after burning.

With the fresh bones, nearly all measurements collected after burning were significantly different, decreasing in size by up to 7.78% in the longest duration category. The greatest differences were observed with the maximum and bicondylar lengths as well as the lengths of the condyles. While the medial condyle length was not significantly different, the absolute TEM and relative TEM (%TEM) were 3.86mm and 5.70%, respectively. With the dry bones, all measurements collected after exposure were significantly different, decreasing in size by up to 3.98%. However, the maximum and bicondylar lengths and subtrochanteric diameters were noted to increase in size after exposure to fire. The biggest TEM and %TEM discrepancies with the dry bones were that of the medial condyle length with values of 1.70mm and 2.65%, respectively. With an increase in duration of fire exposure, there was an increase in bone fragility.

The magnitude of post-burning measurement changes was smaller for both burn conditions than has previously been reported for observer measurement errors of commonly used variables investigated for standard osteometric studies. Osteometrics on burned remains may be feasible to use in multivariate models to estimate parameters of the biological profile. Further research is needed on how the condition and duration will affect the pre- and post-burning measurements of bones other than the femur. While animal proxies are useful, there are differences in the bone compositions and, therefore, the effect of the condition of human bones and fire duration also needs to be tested.

**Reference(s):**

1. Gonçalves D. The reliability of osteometric techniques for the sex determination of burned human skeletal remains. *HOMO - J Comp Hum Biol*. 2011 Oct;62(5):351–8.
2. Gonçalves D, Thompson T.J.U., Cunha E. Osteometric sex determination of burned human skeletal remains. *J Forensic Leg Med*. 2013 Oct;20(7):906–11.
3. Symes S.A., Rainwater C.W., Chapman E.N., Gipson D.R., Piper A. Patterned Thermal Destruction of Human Remains in a Forensic Setting. In: Schmidt C.W., Symes S.A., editors. *The Analysis of Burned Human Remain*s. Second. United-Kingdom: Elsevier/Academic Press; 2015. p. 17–60.

**Fire, Osteometry, Technical Error of Measurement**

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