A Tali of Two Tombs: Calculating MNI and Bone Calcination in Commingled Remains from Two Bronze Age Tombs in the UAE

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HYPOTHESES

1. Using the talus, the minimum number of individuals (MNI) of tomb Unar 2 will be greater than the MNI of tomb Unar 1 because of the greater diameter of Unar 2 at 14.5 m (Blau and Beech, 1999) compared to the diameter of Unar 1 at 11.5 m (Sahm, 1988), with overall tomb size reflective of a greater expected number of interments.
2. The MNI generated by the zonation method (Knüsel and Outram, 2004) will be lower than the landmark system (Mack et al., 2016) because the landmarks on the talus are smaller than the zones and therefore more likely to be 50% complete, which is a requirement to be included in MNI calculations.
3. Calcined bone is more susceptible to fragmentation and therefore will result in poorer preservation (Stiner et al., 1995) and fewer landmarks/zones present.
4. Unar 2 will have a greater amount of calcined bone than Unar 1, reflecting changing mortuary practices in the Umm an-Nar period.

BACKGROUND

Tombs Unar 1 (**Figure 1**) and Unar 2 (**Figure 2**), located in the present day Emirate of Ras al-Khaimah in the United Arab Emirates, date to the Umm an-Nar period (2700-2000 BCE). The Umm an-Nar period is characterized by the development of monumental towers and tombs, interregional trade, and oasis agriculture (Potts, 2012). Some degree of social stratification was present, as these towers would have required an organized labor force and only had room for a few people to reside (Potts, 2012). However, the Umm an-Nar tombs that have been studied bioarchaeologically thus far do not show evidence of exclusivity - all community members, including non-locals, were allowed to be interred there, and the remains are commingled (Gregoricka, 2013). There is also evidence of cremation in both Unar 1 and Unar 2, although the significance of this practice is unknown.

Figure 1: Tomb Unar 1 (2400-2200 BCE), Ras al-Khaimah, UAE

Figure 2: Tomb Unar 2 (2300-2100 BCE), Ras al-Khaimah, UAE

MATERIALS & METHODS

The talus bone from Unar 1 (n=206) and Unar 2 (n=516) was utilized in this study. Tali were sided as left, right, or indeterminate. MNI was calculated using both the landmark system (Mack et al., 2016) and the zonation method (Knüsel & Outram, 2004) (**Figure 3**). The landmark system uses four distinct features of the talus: the head (1), neck (2), trochlea (3), and posterior calcaneal surface (4). The zonation method uses four zones of the talus: the medial (1) and lateral (2) halves of the trochlea and the medial (3) and lateral (4) halves of the proximal portion. Each landmark and zone was assigned a score of 1 if it was > 50% present, 2 if it was < 50% present, and 0 if it was absent. Tali that could not be sided, and landmarks and zones that were scored as "2" or "0," were not included in the final analysis.

To assess the extent of cremation, which causes bone to predictably change color as temperatures rise, each landmark of the talus was scored using the Munsell Soil Color Book. Landmarks were scored for color instead of the entire bone to give a more nuanced view of the different colors present on each talus. Munsell scores were placed into six broad color categories: pale brown/yellow (unburned), brown, black, grey, blue-grey, and white/calcined (Ullinger & Sheridan, 2015) (**Figure 4**). If a landmark lacked cortical bone, it was recorded as not scorable (NS).

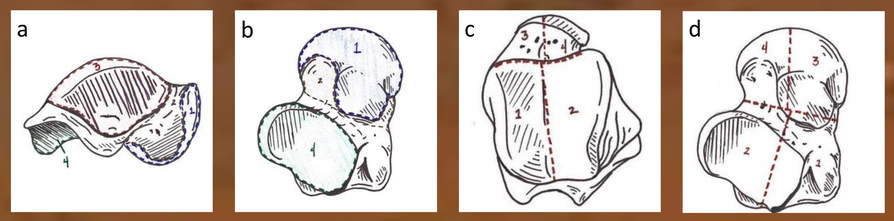

Figure 3: a: Lateral view of Landmarks 1-4, b: inferior view of Landmarks 1,2, & 4, c: superior view of Zones 1-4, d: inferior view of Zones 1-4 (adapted from Knüsel & Outram, 2004; Mack et al., 2016)

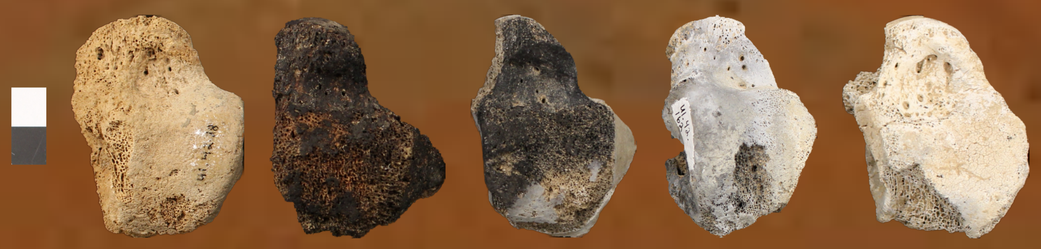

Figure 4: Range of colors on tali from Unar 1 resulting from cremation

RESULTS

- Landmark and zonation methods produced comparable results for MNI in both Unar 1 and Unar 2 (**Figures 5 & 6**)
  - Unar 1 MNI: Landmark: n=87 Zonation: n=88
  - Unar 2 MNI: Landmark: n=227 Zonation: n=228
- There was a statistically significant difference in degree of calcination between tombs Unar 1 and Unar 2 (χ^2 = 200.738, df= 2, p< 0.0001) (**Figure 7**)
- There was a statistically significant difference between preservation and extent of burning on the talus (χ^2= 22.132, df = 2, p< 0.0001) (**Figure 8**)

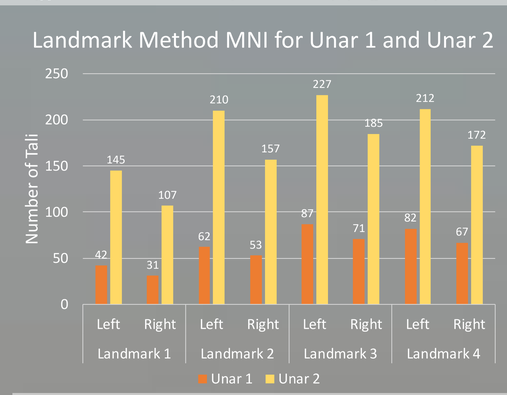

Figure 5: Comparison of MNI counts from the landmark method for Unar 1 and Unar 2

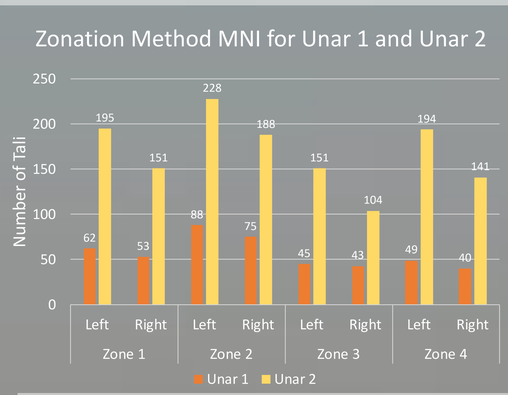

Figure 6: Comparison of MNI counts from the zonation method for Unar 1 and Unar 2

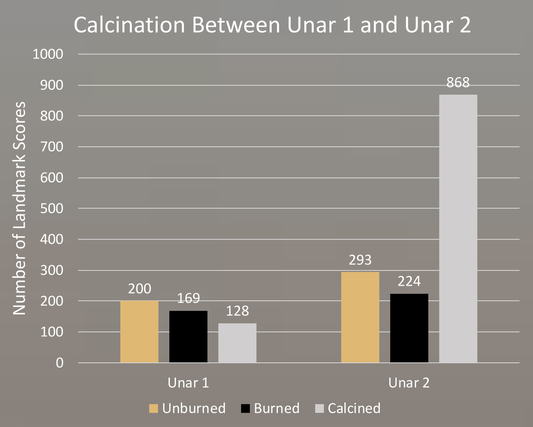

Figure 7: Comparison of unburned, burned, and calcined landmarks from Unar 1 and Unar 2

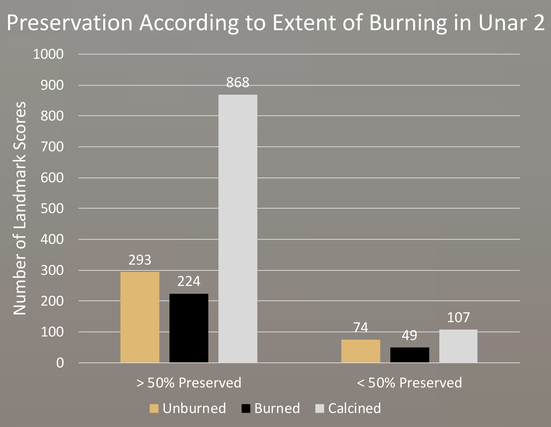

Figure 8: Comparison of unburned, burned, and calcined landmarks to preservation in Unar 2

DISCUSSION & CONCLUSION

The MNI for Unar 2 (n=228) was higher than that of Unar 1 (n=88), confirming our first hypothesis that tomb size (Unar 1: 11.5 m vs. Unar 2: 14.5 m) likely played a role in the number of individuals interred. This suggests that the population may have grown over time, and that later residents of the site needed a larger tomb to house more of their dead. However, other possible factors such as the length of tomb use should be studied.

Although both methods use different parts of the bone to give an MNI count, the final counts for Unar 1 (Landmark: n=87, Zonation: n=88) and Unar 2 (Landmark: n=227, Zonation: n=228) were nearly identical, likely due to the compact and blocky shape of the talus. Landmark 3 (trochlea) and Zone 2 (lateral half of the trochlea) gave the highest MNI counts, due to the posterior half of the trochlea preserving better.

In both tombs, the amount of unburned (pale brown), burned (brown, black, grey, grey-blue), and calcined (white) bone was different when compared to whether the landmark was greater than or less than 50% present. It would be expected that the landmarks that were less than 50% present would be calcined, as calcined bone is more susceptible to fragmentation (Stiner et al., 1995). However, there is actually a greater percentage of calcined landmarks that were over 50% preserved in both tombs (Unar 1: 26%, Unar 2: 63%). This suggests that calcination may actually aid in the preservation of bone.

Unar 2 showed a much higher percentage of calcined bone (63%) than Unar 1 (26%). Increasing amounts of calcined bone between the tombs could point to changing mortuary practices between the time when Unar 1 was used (2400-2000 BCE) and the time when Unar 2 was used (2300-2100 BCE), and indicates that cremation became an increasingly important means by which to dispose of the dead.

Future directions should include assessing (a) the color of bones other than the talus to learn more about cremation practices and (b) heat-induced fracture patterns on the tali.

ACKNOWLEDGEMENTS

We would like to thank the following people and organizations for their help and guidance during our project: the National Science Foundation (Award #1852426), the Government of Ras al-Khaimah's Department of Antiquities and Museums, the University of South Alabama, Quinnipiac University, California State University Fullerton, the University of Notre Dame, Dr. Susan G. Sheridan, Dr. Amelia Hubbard, Dr. Alexis Boutin, TAs Natalie Smith and August Ellis, and Erika Danella.