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Commingled Tombs and ArcGIS: Analyzing the Mortuary Context and Taphonomy at Bronze Age Tell Abraq

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COMMINGLED TOMBS AND ARCGIS: ANALYZING THE MORTUARY CONTEXT AND TAPHONOMY AT BRONZE AGE TELL ABRAQ

By

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Abstract

The use of global positioning systems (GPS) and mapping software are commonplace in today's archaeology. Artifacts and human remains can be plotted on maps and digitized immediately on sites allowing for instant analysis. Yet, the use of GPS in some locations may not be feasible due to natural or human-made terrain features such as canopy cover, densely built urban environments, caves, or other environments where satellite access may be limited. Additionally, prior to the widespread use of GPS, field archaeologists had to rely solely upon systematic, detailed notes and sketches. Such was the case at the Bronze Age tomb at Tell Abraq in the United Arab Emirates (UAE). Excavation of the tomb from 1993 to 1998 yielded more than 27,000 commingled human bone fragments constituting the remains of more than 400 individuals, each provenience handwritten in notebooks. While this method is still a large part of today's archaeology, there has been a shift towards implementing time-saving, precision technological methods when possible. Geographic information systems (GIS) is but one method of storing, manipulating, and analyzing spatial data. When combined with bioarchaeological data, it can be used as a tool to aid in analysis. Although a great number of current archaeological studies may utilize GIS, this study combines the current technology of GIS with old handwritten data; transforming it into a format compatible with GIS. Applying GIS techniques enhances the ability to perform spatial analyses on the tomb, thus enabling a more thorough examination of mortuary practices and taphonomy at Tell Abraq. The bioarchaeological analysis of the tomb, the human remains, and the mortuary component then provides invaluable insight into past biological and cultural conditions.

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Background

The Bronze Age site of Tell Abraq is located in the United Arab Emirates (UAE) on the Oman Peninsula (Figure 1). It is situated on the border between Sharjah and Um Al-Quwain approximately 50 kilometers northeast of Dubai. While the site is currently located approximately 4 kilometers inland, at the time of occupation it was very likely a coastal town (Potts, 1989; Uerpmann, 2001). Occupation at Tell Abraq spanned a continuous period of nearly than 2000 years, from 2200 BC to 300 BC, spanning the Bronze and Iron Ages. During this time, the people of Tell Abraq had multiple changes in subsistence strategies – nomadic, semi-nomadic, traders, date palm agriculturalist, and miners (Parker et al., 2006; Cleuziou, 2009; Potts, 1993). The singular tomb associated with the site was only used for a 100-year period towards the end of the Bronze Age (2150-2050 B.C.) during the Umm an-Nar period. The tomb was quickly covered by new construction during the Wadi Suq period (2000-1300 B.C.), as well as in subsequent periods. A team led by Dr. Dan Potts initiated excavation of the site in 1989 (Potts, 1989). Once the tomb was discovered, excavation of the tomb was led by Dr. Debra Martin from 1993 to 1998.

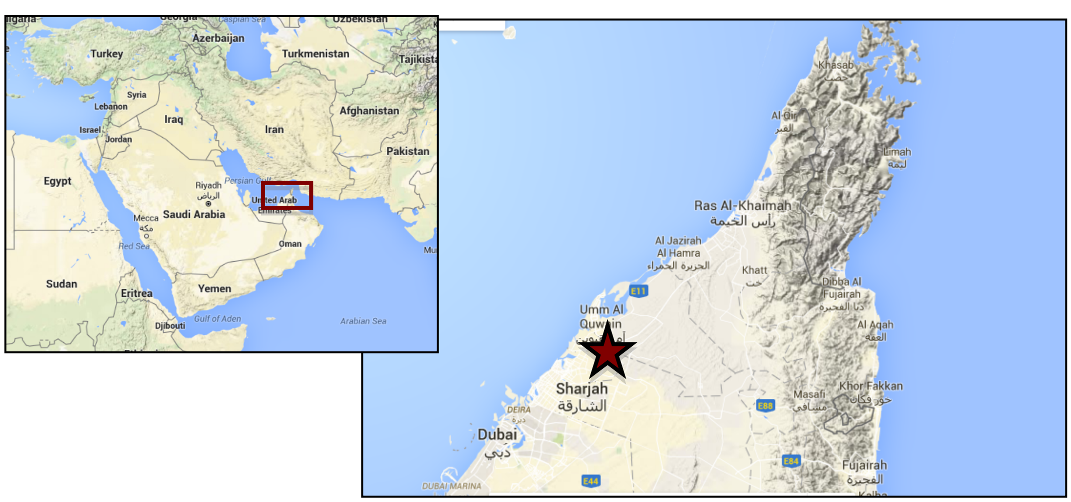


Figure 1. Geographic location of Tell Abraq, UAE.

Throughout the excavation of the tomb, Martin's team recovered the commingled and disarticulated remains of at least 403 adults and children (Osterholtz, 2013). These remains included more than 27,000 individual bone fragments suffering from varying stages of damage and decay. The fragments were altered significantly since their time of death through taphonomic processes. The *taphonomy,* a term coined by Efremov (1940) derived from the Greek *taphos* meaning burial and *nomos* meaning laws, includes everything that happened to the bodies from their time of death until the time they were analyzed (Martin, 2013). It can alter the appearance of bone due to multiple contributing factors, both natural and human. Generally speaking, mortuary practices shortly after death can add cut marks, punctures, or breakage to otherwise untouched remains. Other examples of taphonomy may include decapitation, defleshing, trophy-taking, and secondary burials that may all significantly alter the disposition of remains. Additionally, the natural processes of decay can be affected by temperature, soil composition, soil compaction, weather, carnivores, scavenger activity, and root growth creating cuts, marks, breaks and discolorations that can influence osteological interpretations (Tibbett & Connor, 2008; Duday et al., 2009; DiGangi & Moore, 2012). Furthermore, bones are often damaged during excavation or transport to labs. Even handling during analysis can alter the appearance of remains.

Umm an-Nar tombs, like that of Tell Abraq, are often found in disturbed states. Many of these tombs have been found looted, emptied, or otherwise damaged. The century of use at Tell Abraq may have contributed to numerous instances of repositioning remains within the tomb, either by those interring new individuals or by the forces of nature over time. The extreme dry heat and extensive period of time spent under layers of compacted soil enacted great force upon the aging bones. The use of the Tell Abraq collection as a learning tool regularly handled by students at the University of Nevada, Las Vegas also contributed to substantial taphonomic change. During excavation at Tell Abraq, each identifiable fragment was individually labeled and its location written in a field book by the excavator. Fragments that were far too small to yield significant information or lacking identifiable features were either bagged in bulk or left on site. Additional visual analyses were done on site by Martin and her team to estimate age and sex when possible. They noted any signs of pathological conditions, or changes to the bone caused by illness or disease. They also described any apparent abnormalities, whether due to physical use or heredity, in these field notebooks.

During the Umm an-Nar period, the grave structures were often multi-chambered tombs with one or more walls dividing the internal area into multiple chambers (Figure 2). Most of these tombs are above-ground structures that are circular in shape. They have been found with anywhere between one and twelve chambers (Blau, 2001), yet the purpose of this partitioning is still undetermined. The circular tomb at Tell Abraq had one wall running from the north-northeast to the south-southeastern wall just stopping short of the entrance. The wall effectively split the tomb into two distinct chambers. Both the eastern and western chambers were filled with primarily disarticulated remains at the time of excavation. The densely compacted fragments filled both chambers throughout each level of excavation, with little noticeable difference existing between the east and west. Whether the chambers were for ritual purposes, architectural purposes, merely aesthetics, or some combination thereof has still not been ascertained.

Figure 2. The Tomb at Tell Abraq from the North-Northwest.

Despite the lack of information regarding mortuary ritual for the people of Tell Abraq, a great deal of knowledge has been accumulated. Previous analyses of the commingled assemblage at Tell Abraq have provided valuable information regarding pathologies, activity patterns, and overall health of the Bronze Age population (Blau, 1996; Baustian, 2010; Cope et al., 2005; Potts et al., 2013; Gregoricka, 2013). These studies have primarily involved the analysis of entheses on singular skeletal elements such as humeri (Toussaint, 2015) and scapulae (Osterholt, 2015), or teeth (Gregoricka and Singhvi, 2002). Others have examined a subset of the population, such as subadults (Baustian, 2010), or pathological changes on the only fully articulated member of the tomb (Schrenk et al., 2016). These studies have presented important insights to the lived experiences, trade relations, and migration at Tell Abraq as well as advanced the methodological approaches in working on commingled, disarticulated skeletal remains (Osterholtz et al., 2013).

Attempting to acquire a thorough understanding of a population can be difficult to accomplish when one bone is separated from the rest of the body. Even when an entire, fully-articulated individual is available, the tendency to separate the body from the other aspects of daily life can still be problematic. The *Three Bodies* approach - introduced by Scheper-Hughes and Locke (1987) – suggests we look at each person as three separate, but overlapping entities. The *individual body* or *body-self* dismantles the Cartesian concept of mind and body. It does so by recognizing that one continuously influences and relies upon the other. In archaeological contexts, it looks at the individual's concept of self and how identity manifests on bone. The *social body* refers to how each individual interacted with others within the group. This includes everything from kinship systems and socially acquired diseases to the relationships between bones in a collective tomb (Martin et al., 2013). The *body politic* highlights how each person physically reflects their political environment. It can reveal inequality and structural violence - whereby the social structure impedes fair treatment and reinforces disadvantages (Galtung, 1969) - or equity in physical health across the population. Any insights into the ritualistic beliefs can elucidate the individual body and social body.

The tomb at Tell Abraq holds great importance, not only because it is one of the few Umm an-Nar tombs found in a nearly undisturbed state, but it yielded a large number of skeletal remains and grave goods (Potts, 1989; Potts, 2000). Unlike other tombs that were completely devoid of remains, Tell Abraq's remains were mostly intact with only a small portion of the tomb's northwestern stones removed in antiquity. The site was in use during a well-documented change in climate that resulted in changes to the local inhabitants in terms of subsistence and trade (Cleziou, 2009; Glennie, 2002). While some groups maintained their subsistence patterns, the Umm an-Nar period is associated with a general shift from semi-nomadic herding across the peninsula in the Hafit period to sedentary oasis farming (Rouse and Weeks, 2011). At Tell Abraq, date palms became a primary crop at the settlement site while copper was mined in the mountains (Potts, 1993; Uerpmann, 2001). Bronze production was accomplished on a small scale, but bronze and gold crafted objects were a major item for trade out of Tell Abraq. The change in physical demands could have an affect on overall health. Similarly, different patterns in social contact with outside groups and harsh working environments could contribute to a widespread decline in health. The bioarchaeological analysis of the tomb, the human remains, and the mortuary component can provide invaluable insights into past biological and cultural conditions.

Amongst the commingled remains were vast quantities of grave goods of varying origins. Ivory combs, bronze daggers with handles of Pakistani rosewood, and Mesopotamian pottery are just a few items indicative of widespread contact outside the Arabian Peninsula (Potts 2000). Traces of regular trade with the Harappan civilization, Dilmun, Elam, Mesopotamia, and Bactria – spanning geographical regions that cover today's Iraq, Bahrain, Iran, Afghanistan, Pakistan, and India – were evident in the ivory, ostrich shell beads, bronze ingots, semi-precious stones, linen textiles, and tin jewelry recovered from the tomb. Additional artifacts include bronze spearheads, grinding stones, hammers, gold and bronze jewelry, soft-stone vessels, and shell beads that suggest a prosperous existence at Tell Abraq (Potts, 2000). In fact, Tell Abraq - known to the ancient world as Magan or Makkan - is mentioned in ancient texts as a key point of trade (Potts, 2000). Its positioning at the opening of the Persian Gulf made it an ideal stopping point between India and Mesopotamia to exchange goods, rest, or resupply.

Umm an-Nar tombs, such as the one located at Tell Abraq, present multiple analytical challenges. Of the more than 65 Umm an-Nar tombs located across the Oman Peninsula, no completely intact tombs have been discovered by archaeologists; many had been previously looted or damaged (Blau, 2001). Creating an even greater challenge is the commingled nature of the remains in many of these tombs. The inherent difficulties of the commingled tomb at Tell

Abraq make it nearly impossible to differentiate one individual from another, thus obscuring mortuary context. It is necessary to identify cultural and natural modifications made to the remains after the time of death, differentiating between the two to accurately assess mortuary context.

The use of GIS modeling facilitates archaeologists in multiple ways (Wheatley and Gillings, 2003). It helps investigate mortuary behavior regarding the placement of the dead within the tomb (Renfrew and Bahn, 1991), as well as the taphonomic processes acting upon the bones (Allen et al., 1990). The spatial distribution of skeletal remains from Tell Abraq provide much needed information regarding possible hierarchical burial patterns, differential treatment of groups or individuals, and the mortuary rituals that may have been guiding the placement of burials within the tomb. Bioarchaeological context is crucial to understanding the individuals, their social roles, and how their bodies may reflect the political principals of the community at Tell Abraq.

Materials and Methods

I used the eight original handwritten excavation notebooks from Martin's tomb excavation and the skeletal remains recovered from site to create a database. Using the field notes and provenience records, the photos and drawings of the tomb, and ArcGIS, a digital representation of the data was created. The original provenience information was recorded in the field books utilizing a simple grid with one-meter by one-meter squares (Figure 3). Traditional naming conventions were followed so that the southwest corner – labeled with *x* and *y* coordinates - identified each square meter. Each square meter was further divided into quadrants A, B, C, and D. The coordinate system and point-of-origin were determined by previous excavations at Tell Abraq, predating the widespread use of global positioning systems.

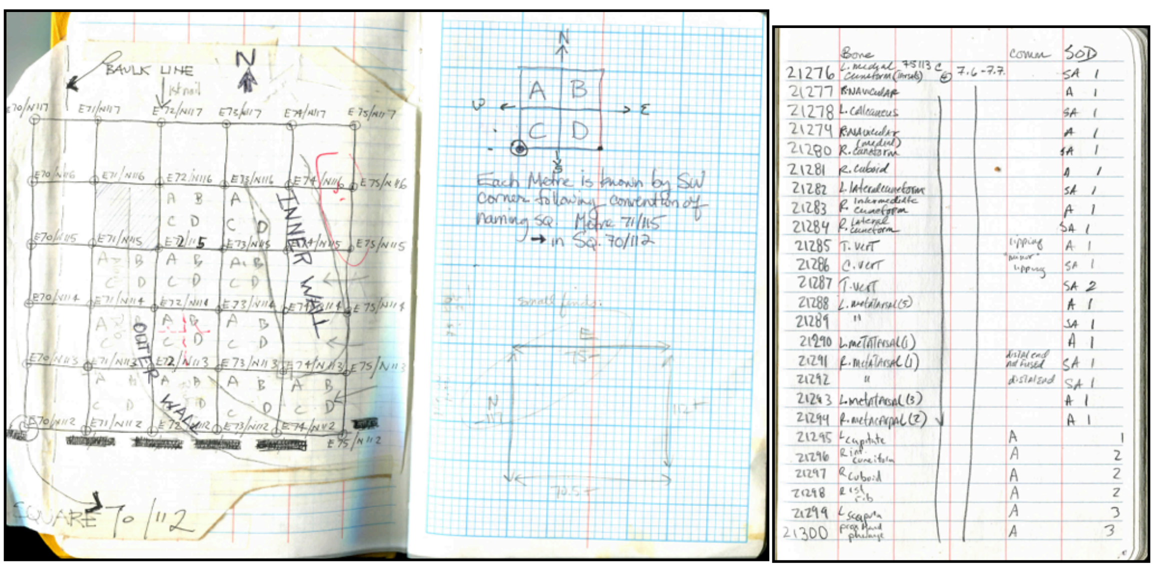
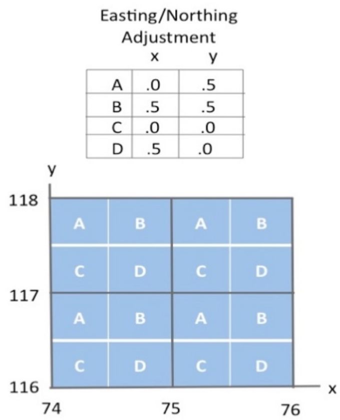


Figure 3. Handwritten excavation notes from tomb.

The excavation involved the removal of stratigraphic layers in increments ranging from 5 to 25 centimeters deep - depending upon the density of artifacts encountered – and .5 meters by .5 meters in width and length. The depth of each layer was annotated with each find. The position of each item has been converted into a digital format using Microsoft Excel, a format compatible with ArcGIS software. All proveniences have been converted into digital coordinates, consistent with the handwritten records (Figure 4).



Level	Range (cm)	Adjusted Depth (m) for *z*
1	720-740	-7.4
2	740-750	-7.5
3	750-760	-7.6
4	760-770	-7.7
5	770-780	-7.8
6	780-790	-7.9
7	790-820	-8.2

Figure 4. Digital conversion chart.

All point data was imported into ArcGIS 10.2.1 and analyzed using ArcScene and ArcMap. Original information collected on site regarding indicators of health and age were included in the database, as were relevant data from recent studies and personal examinations of the remains from the Tell Abraq collection housed at the University of Nevada Las Vegas Department of Anthropology Tell Abraq Laboratory. Where possible, new or revised data from these recent studies regarding age, sex, activity, and health were included to supplement field notes. Due to the extensive size and fragmentary nature of the collection, the study was aimed at a representative number of elements and features to include the supraorbital ridge, C2 vertebrae, sacrum, left patella, right patella, left talus, right talus, left humerus, and right humerus (Figure 5). Fragments that were unidentifiable, or that were too small to provide relevant data on sex, age, or health were omitted from the study. Likewise, for each skeletal element, only those clearly discernible as a separate, individual elements were included; probable fragments of an already counted element – such as the dens of a C2 - were reconstituted and counted as one complete element when possible, or omitted.

The skeletal elements were each selected for their distinct features and their representative position in the body. The disarticulated and commingled nature of the tomb does not currently allow for reconstruction of each individual, therefore multiple skeletal elements were examined. The overall selection of elements represents regions of the human body from head to foot. Although analysis of all fragments would be ideal, this representative sample provides greater depth in the analysis of overall health and demographics than the analysis of individual fragments of a singular type.

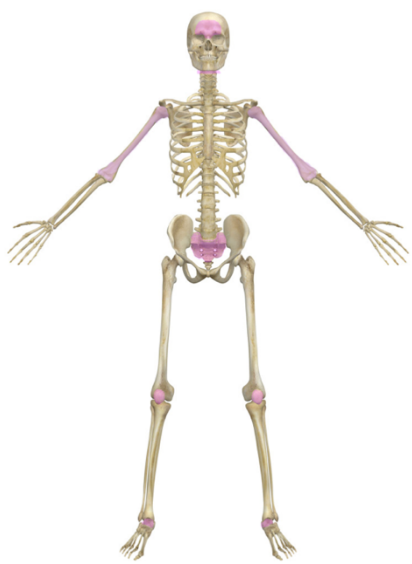


Figure 5. Skeletal elements included. The subraorbital ridge, C2, humerus, sacrum, patella, and talus are highlighted.

The Supraorbital ridge was selected as it is relatively simple to estimate sex when it is present. It is also a relatively dense, sturdy area likely to survive the adverse environmental conditions. The Supraorbital ridge can provide useful information regarding the positioning of male versus female remains in addition to accounting for the presence of cranial elements, which may or may not have been buried with the rest of the body.

The second cervical vertebrae (C2), also provides additional information regarding the placement of bodies. A C2 that is found a relatively great distance away from other cranial elements may provide insights into taphonomic processes at the site. It could indicate culturally induced repositioning of the body, the effects of soil weight, gravity, or erosion. Its atypical morphology as a cervical vertebra makes it easily identifiable, making it a better diagnostic element than other cervical vertebrae. Noted osteoarthritic changes and other pathological conditions will also be indicative of general health conditions.

Indicators of activity, health, age, and sex can often be observed on the humerus (Buikstra and Ubelaker, 1994). Through the evaluation of muscular attachment sites and overall robusticity, relevant assumptions can be made regarding use of these extremities. A recent study on the humeri from Tell Abraq (Toussaint, 2015) provides information on levels of activity as well as additional demographic information regarding sex ratios within the tomb.

The sacrum is a sexually dimorphic bone, making highly accurate in determining sex of an individual (Buikstra and Ubelaker, 1994; Stewart, 1979). Furthermore, this bone is very dense and often preserves better than the easily sexable features of the os coxa - sciatic notch, pubic symphysis, arcuate line. Therefore, analysis of the sacrum can aid in the overall characterization of the tomb's demography. It can also provide a better understanding of general health and activity patterns through the evaluation of abnormalities (Buikstra and Ubelaker; 1994). The centralized placement of the sacrum within the body makes it important in understanding the taphonomic shifting of individuals in the tomb; it can provide an expected midpoint for undisturbed remains.

To represent the lower extremities, the left and right patellae were selected. They have been well preserved in this collection, making them an excellent candidate for analysis (Osterholtz et al., 2011). They also provided supplemental information regarding activity patterns - such as heavy use - through the presence of osteoarthritis.

The extensive availability of the talus made it an excellent instrument in the establishment of a minimum number of individuals (Osterholtz et al., 2013). For this reason, it has also been included in this study. The talus, like most other bones in the body, can also provide information regarding health and activity patterns (Steele, 1976; Gualdi-Russo, 2007). They also serve as the necessary representation of the feet, ensuring that each individual has skeletal elements constituting the major sections of the body from head to foot.

Analysis was conducted on 1,908 of the more than 27,590 recorded fragments (approximately 7 percent) that were recovered at the tomb at Tell Abraq and housed in the University of Nevada, Las Vegas collection. Initial two-dimensional representations were made of the tomb, followed by 3-dimensional point mapping (Figure 6).

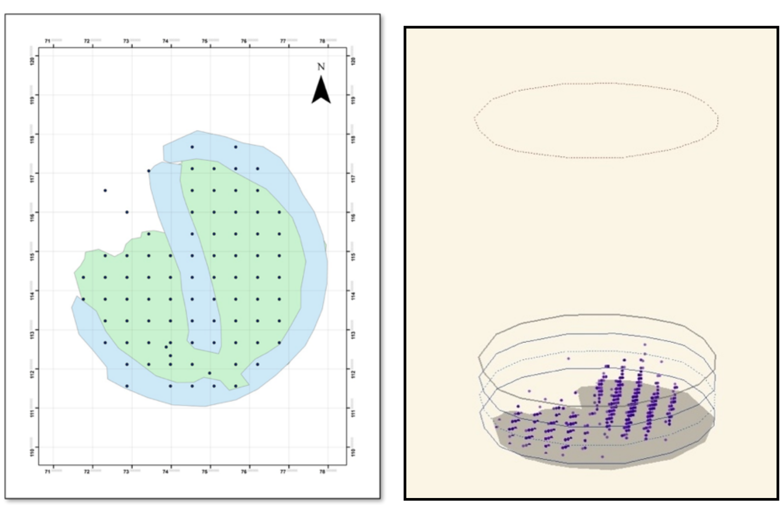


Figure 6. Point mapping of tomb with ArcMap (left) and 3-D point map (right).

The 3-dimensional maps were adjusted from points to volumetric blocks, representative of the grid space and level at which each element was found during excavation. Once the individual components were mapped, a comprehensive evaluation was conducted using ArcGIS and Excel. The software-provided visual representation allowed for a qualitative spatial analysis of individual elements in relation to one-another based upon the information uploaded. The model created was then used as a tool for further investigation. The model was examined for clusters by type, sex, age, and pathology where data was available. Patterns, to include the absence of patterns, were investigated in an effort to elucidate the mortuary or taphonomic forces that have affected those placed within the tomb.

Results

By creating an editable database, I rendered the data easy to manipulate. Demographic information indicates that individuals spanning a wide spectrum of age, sex, and health status were interred within the tomb (Table 1). Of those elements analyzed, 12.26% show indications of pathological conditions.

	N=	*Side (n)*		*Sex (N)*		*Age (N)*		*Path (N)*	
Brow	39	L	10	M	5	A	37	Y	5
		R	6	F	5	SA	1	N	34
		O	23	U	29	U	1		
Axis	138					A	121	Y	35
						SA	16	N	103
						U	1		
Sacrum	200			M	24	A	80	Y	24
				F	17	SA	54	N	176
				U	159	U	66		
Humerus	461	L	249	M	117			Y	16
		R	211	F	77			N	445
		U	1	U	267				
Talus	595	L	273			A	510	Y	30
		R	303			SA	78	N	565
		U	19			U	7		
Patella	475	L	232			A	453	Y	124
		R	217			SA	15	N	351
		U	26			U	7		
Totals	**1908**							Y	**234**
								N	**1674**

Left (L); Right (R); Other (O) - May include whole bone, left and right, or indeterminate; Yes (Y); No (N); Adult (A); Subadult (SA); Undetermined (U); Male (M); Female (F).

Table 1. Demographics of analyzed elements.

Qualitative analysis of the model indicates a significant difference in frequency of elements in the eastern chamber when compared to the western chamber (Figure 7). There also appears to be a pronounced abundance of elements with noted pathologies in the eastern chamber when compared to the western chamber. When analyzing for sex and age, there appears to be a relatively even deposition throughout both chambers and each level. A noticeable difference in excavation methodology also became apparent whereby the eastern chamber was excavated more often in 10 cm levels due to a high concentration of fragments as opposed to the western chamber where 20 cm increments were used and fewer fragments were found.

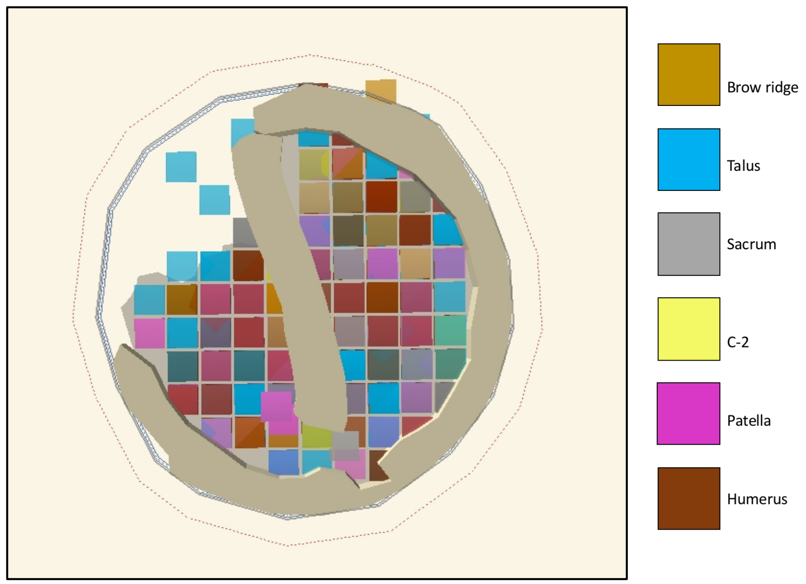


Figure 7. All mapped elements.

The lack of true origin - or datum point - grid coordinates and exact measurements of the tomb prevent quantitative analysis of the elements in the context of the east chamber versus the west chamber. Without more precise information for the tomb structure in relation to the mapped elements, estimates regarding which elements lie in which chamber would lack the level of accuracy required for meaningful statistical analyses.

Discussion

The use of 3-dimensional modeling has not been previously used on Umm an-Nar tombs, nor has it been used to recreate a tomb excavation solely off of handwritten notes predating GPS use. The 3-dimensional modeling allowed for the manipulation of the tomb so that it could be viewed from multiple angles. Different elements were selected and analyzed for patterns in location or quantity. This visual interpretation of the data elucidated patterns in placement for this particular tomb. While it was already suspected that there was a higher density of remains in the eastern chamber, mapping clarified that the cause was likely related to displacement or removal of remains from the previously exposed northwestern quadrant.

The only noted differential treatment of remains is that of bones with evidence of pathological conditions. For instance, annotated signs of remodeling, osteoarthritis, osteochondritis dissecans - or other conditions not usually found on human bone - were clustered primarily in the eastern chamber (Figure 8). This could possibly indicate that the ill or ailing were treated as an identifiable group that was relegated to one chamber. It can also imply that these people suffered such pathologies in life due to structural violence contributing to degraded living conditions. The fact that the clustering is primarily located towards the northern/back, lower portion of the eastern chamber indicates a possible temporal relationship to the burials (Figure 9). If it is assumed that one chamber was used until filled, then the other chamber was filled, then the proximity of the pathological fragments could indicate that there was a time period towards the beginning of the eastern chamber's use where health was severely effected by natural or cultural conditions. This change could be related to the significant shift in patterns of work, mobility, and subsistence subsistence during this period.

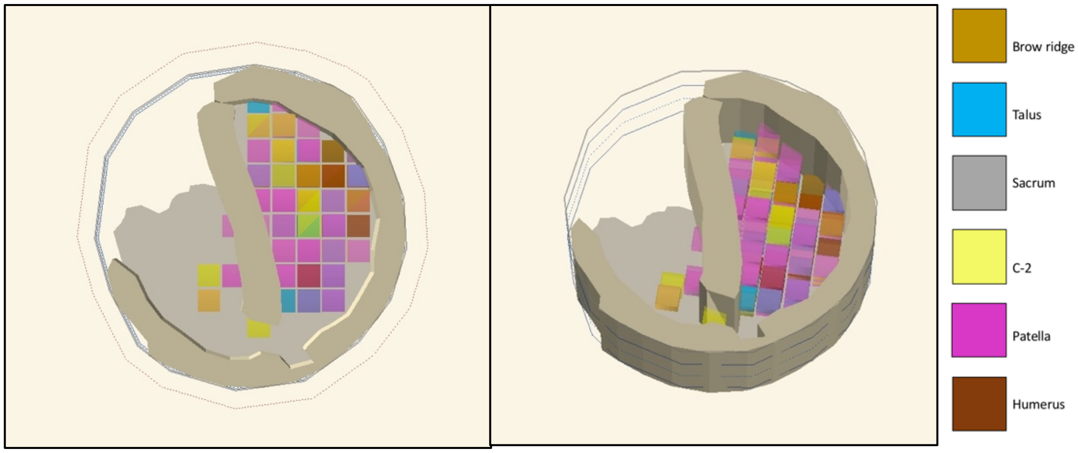


Figure 8. All noted pathologies from above (left) and from southern end (right).

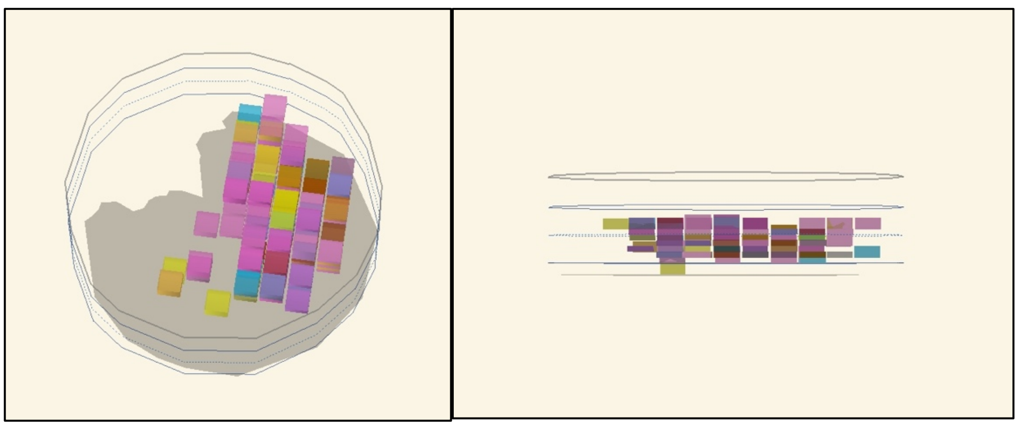


Figure 9. All pathologies clustered (left) and viewed from east at ground-level (right).

It must also be taken into consideration that the overall condition of the remains, while in excellent condition, still have limitations. The quality of preservation has been affected by several taphonomic processes. The continuous occupation not only increased the pressure within the tomb when built upon, likely crushing and fracturing many of the remains within, but it also affected the tomb's structural integrity in other ways. The missing northwestern corner of the tomb is expected to be the result of the reuse of construction materials in antiquity (Potts, 1993). Although it appears that the tomb was not disturbed by looting, given that an abundance of valuable artifacts were recovered, there is no way of knowing for certain what was removed or destroyed from that portion of the tomb. Documentation regarding remains initially found within the tomb prior to the bioarchaeological excavation is incomplete since human remains were not always examined as artifacts at this time. This missing data could have an impact on the overall analysis of the tomb demographics.

Tomb demographics may also be skewed by only examining a select number of skeletal features. While an in-depth analysis of all elements exceeds the scope of this study, it is evident that a larger selection – or all elements - should be consulted to provide the most accurate representation of the tomb. Future studies should address the entire collection, examining for additional information regarding sex, activity, and health indicators where possible.

Conclusions

Much as viewing the tomb through multiple dimensions has given a richer impression of the data, the *Three Bodies* framework allowed the examination of the multiple overlapping facets that comprised each lived experience. The commingled nature of the remains implies a concept of equality at Tell Abraq in death as in life. Such concepts are what we try to extract when interpreting the political body. It does not necessarily dismiss notions of a hierarchical structure, but it may strongly suggest that the greater part of the population held a similar status within the community. At the very least, it indicates that all remains were treated equally in death. Remains of the old and infirm were located within the same tomb as the remains of infants and young adults with no noticeable pathologies.

It has been suggested that the mortuary context can hint at the social body, revealing information regarding group ideology (Martin et al., 2013). By examining the overlapping features of mortuary context, health, subsistence change, and taphonomy at Tell Abraq we may better fathom their relationships and how they affected the population at Tell Abraq. Visualization of the tomb through GIS mapping may have indicated a previously unnoticed pattern of intentional interment that may help us to understand the social and political bodies. While neither age nor sex appear to have played a role in determining which chamber an individual would have been placed, pathology, age, or physical activity may have been a factor. This may relate to the individual and political bodies, where poor health may have been related to class structure. Lower classes may have been required to perform daily tasks that regularly put their health at risk. These classes may have been denied basic rights, such as the right to adequate living conditions, nutritious foods, or care when sick or injured. Those individuals that suffered from some pathology, such as osteoarthritis, may have been distinguished as a class or group based upon that common trait.

Spatial analysis has been used to further aid in the exploration of social and cultural roles at Tell Abraq. Through the use of GIS modeling, it has been possible to extrapolate a more nuanced representation of the tomb by dimensionally reconstructing the location of bones that had been removed from the tomb. The virtual reconstruction has made it easier to determine whether or not intentional burial patterns exist based on age, sex, pathology, or other discriminating factors. The apparent categorical distinctions made at death may reflect similar ideals held in life. These patterns would have been difficult to distinguish during excavation.

The destructive nature of archaeology often surrenders the content and context of a site to the detail of the archaeologists' notes. Prior to the common use of GIS, computers, or even photography, handwritten notebooks and sketches were the sole source of information regarding sites long since excavated. Many of these notes may lay dormant on library shelves, museums, collection rooms, or archaeologists' offices collecting dust. However, this study demonstrates how combining GIS technology with the continued use of previously existing data can bring about new, useful information that can be used to address current questions in archaeology.

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Curriculum Vitae

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Research/Presentations:

Calleja M, Martin D (*Western Bioarchaeology Group 2015) Poster.* Analysis of the Sacra from a Commingled Bronze Age Tomb: From Microstructure to the Population Level. (Second Place)

Calleja M, Schrenk A, Martin D (*Western Bioarchaeology Group 2014*) *Poster.* GIS and Commingled Tombs: Revisiting Tell Abraq. (Honorable Mention)

Calleja M (*University of Nevada, Las Vegas Anthropological Research Forum 2014*) *Poster.* Facial Expressions: Why We Make Faces. (Honorable Mention)

Bioarcheaology of Nubia Expedition 2015 Field Season. January 6 to March 15, 2015– PI: Brenda Baker, Arizona State University

Related Employment:

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- Research assistant
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Skills and Certifications:

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