

BASKETMAKERS REVEALED:

Physical, CT, and 3D Analyses of Mummified Human Remains from the Southwest

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INTRODUCTION

FIGURE 1. MAP OF BASKETMAKER REGION



Variation across the Four Corners area separates Western and Eastern Basketmaker regions. The Penn Museum's mummies are from the Western region. Map adapted from Reynolds (2012).

The Basketmakers were groups of sedentary agriculturists in the American Southwest dating from 1500 B.C. to A.D. 500¹. They were the basket-making antecedents to the Ancestral Puebloans (formally known as the Anasazi), who are well known for their pottery and cliff dwellings at places like Mesa Verde. Less is known about the Basketmaker populations, which occupied a large geographical area with varying climates and available resources² (Figure 1). Previous research has focused on their basketry, pottery, diet, and agriculture, but few studies have addressed their skeletal biology. In this regard, Harvard University's Peabody Museum of Archaeology and Ethnology and the University of Pennsylvania Museum of Archaeology and Anthropology (the Penn Museum) have been important due to the presence of mummified remains identified as "Basketmaker" in their collections (Figures 2-3).

FIGURE 3. DEMOGRAPHIC DISTRIBUTION BY AGE AND SEX

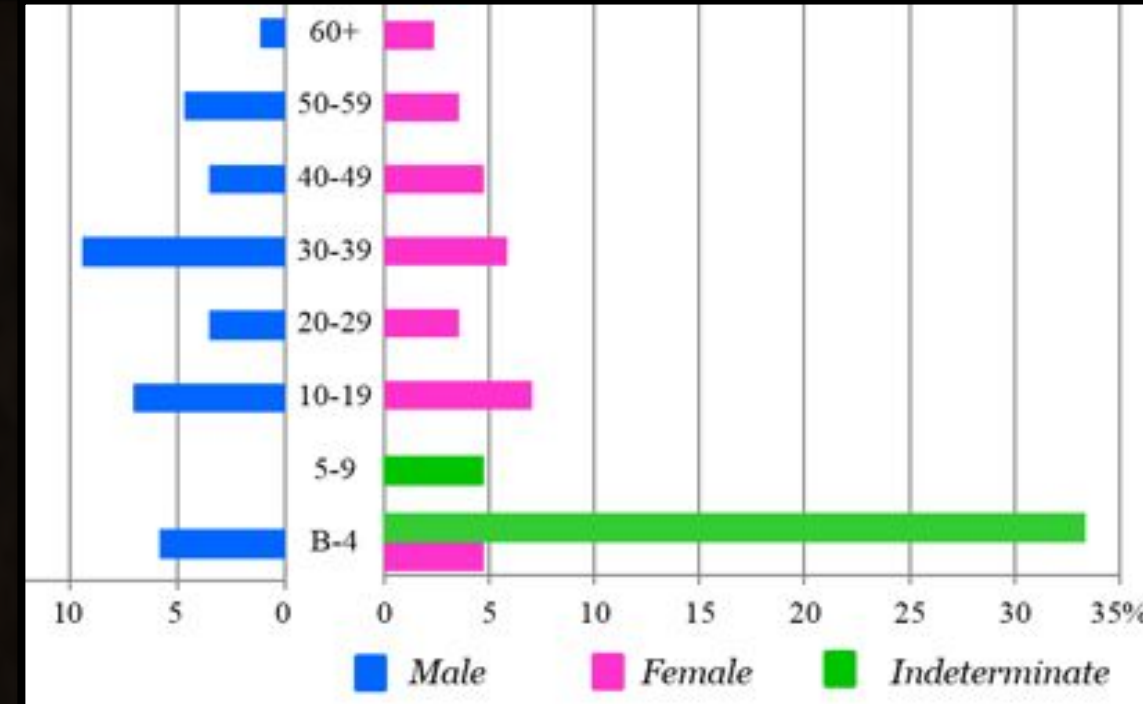


FIGURE 2. BASKETMAKER SITES AND BURIALS

Site	Region	State	No. of Skeletons	No. of Mummies	Total
Unknown	Red Canyon ¹	SE Utah	0	3	3
Unknown	Colorado River Canyon ¹	SE Utah	0	2	2
Unknown	Lake Canyon ¹	SE Utah	0	2	2
Unknown	Deep Canyon ¹	SE Utah	0	1	1
White Dog Cave	White Dog ²	NE Arizona	13	13	26
Cave 23	Durango ²	SW Colorado	15	0	15
North Cave	Durango ²	SW Colorado	20	13	33
South Cave	Durango ²	SW Colorado	20	0	2
Total Number of Individuals Examined:			68	34	85

Sites of the "Woman & Child" and "Probable Female" are indicated above.
¹ University of Pennsylvania Museum of Archaeology and Anthropology
² Peabody Museum of Archaeology and Ethnology at Harvard University

In July 2014, a team of Smithsonian scientists spent a week at the Penn Museum examining the remains of eight previously unstudied Basketmaker mummies from the Grant Gulch region of Utah through physical analysis, photo documentation, and archival research. The hot, dry environment of the southwest desiccated and naturally preserved the tissues of these mummies. Internal organs, bones, teeth, and anomalies that are used to develop a biological profile composed of (but not limited to) age, sex, health, pathology, and cause of death are concealed.

Computed Tomography (CT) technology allows non-invasive analysis of mummified remains and was critical for the collection of biological data. CT scans were obtained from the Open Research Scan Archive at Penn. 3D models of the remains were created using the Mimic Innovation Suite. Featured below are two case studies of three mummified individuals from the Penn Museum that were analyzed using gross observation, CT, and 3D modeling. These demonstrate how physical examination and CT scan data can be utilized to conduct initial examination, refine archival records, and guide more in-depth future analyses.

CASE STUDY #1: "WOMAN & CHILD"⁴

The Penn Museum archive records state that this "Woman & Child" were recovered from a cave in Red Canyon, Utah⁴ (Figures 1, 2, 4). This unusual double burial features a child resting on the adult's abdomen, cradled in its arms.

Artifacts include personal effects worn in life and objects of burial preparation. Animal hides were placed between the adult and child. Juniper shavings were present under the flexed legs of the child. Small, wooden sticks pierced the adult's ears and braided human hair bands were fashioned as an anklet on the adult and as a choker on the child (Figures 5-6). The adult has plant fiber nose plugs in both nostrils.



Figure 4. "Woman & Child" at the time of the physical examination.

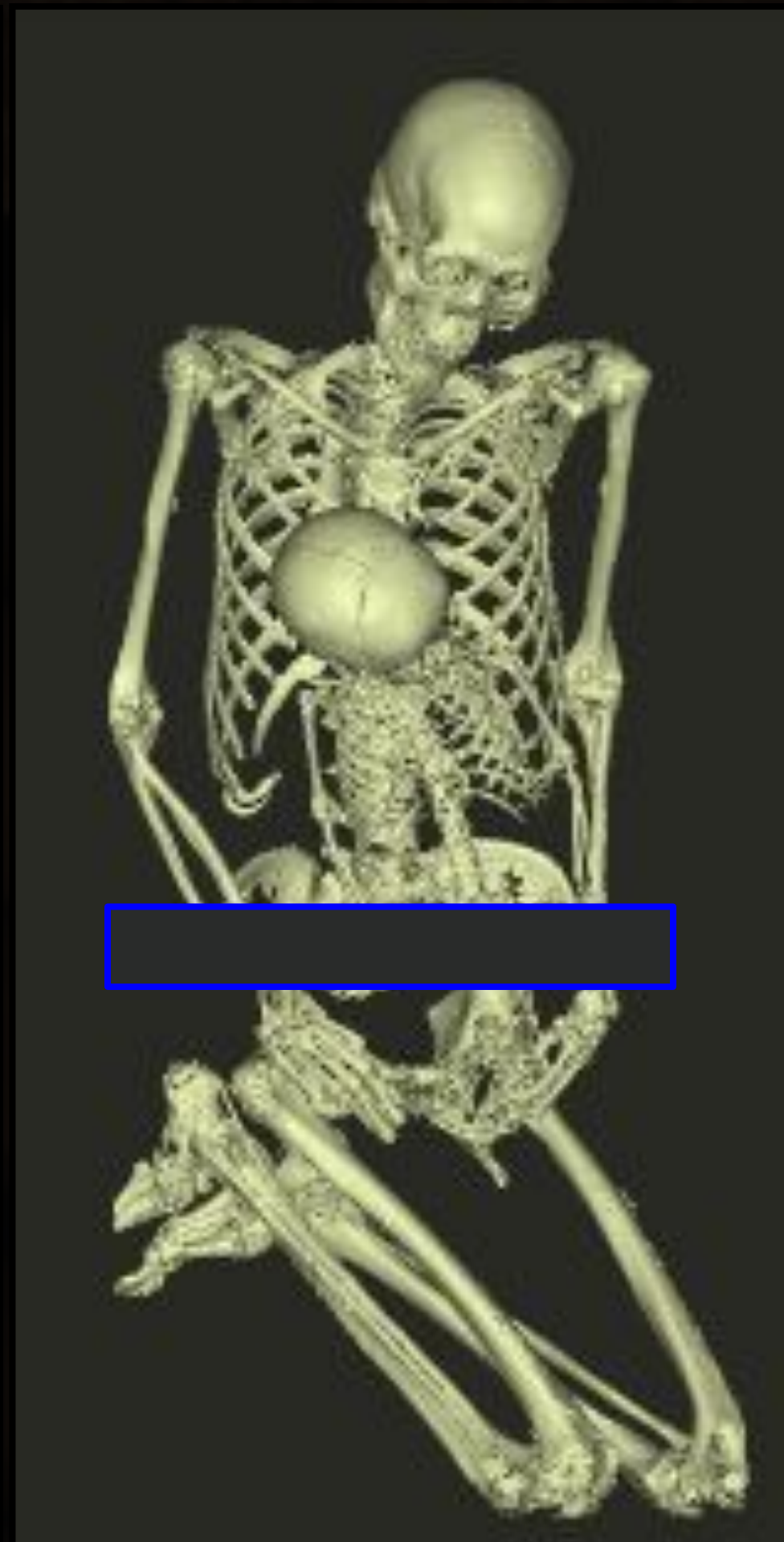


Figure 7. 3D model produced from CT scans. The missing section of the CT scan is indicated.

Both individuals have head hair, eyebrows, and eyelashes. The hair of the adult is dark brown in color and the hair of the child is reddish-brown (Figure 5). The unusual red shade likely indicates protein-calorie malnutrition, since this condition results in dyspigmentation and texture changes in hair⁵.



Figure 5. The unusual red hair of the child could be a sign of a nutritional deficiency. His human hair choker is also indicated.

Gross examination of the adult included removal of the child's body from the anterior torso, revealing well preserved male external genitalia. An exposed right rib exhibited shallow scalloping and slight cupping of the sternal end. Comparison of these metamorphic changes with standards for sternal rib extremity age phases⁶ suggests he was 25 to 34 years old at the time of his death. This is supported by CT scan data showing complete tooth root formation and moderate tooth wear.



Figure 6. Braided human hair bands fashioned as an anklet on the adult.

Gross examination of the child identified male genitalia. The CT scan is missing a section of data across the flexed legs and pelvis of the child (Figure 7) preventing a digital evaluation of sex. The child is about 18-24 months based on long bone growth standards⁷ as calculated from the length of his left humeral diaphysis, and CT scans and 3D modeling of the child's dentition (Figure 8).

Gross examination and CT analyses failed to identify evidence of disease or trauma in either the man or child.

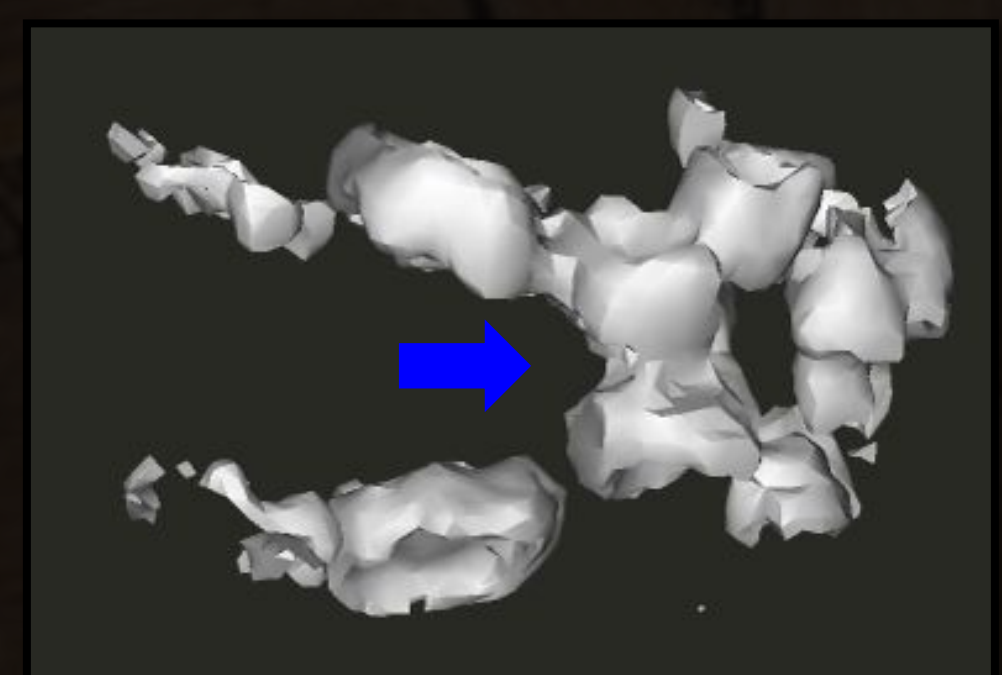


Figure 8. 3D model of the child's teeth showing the occlusion of the right deciduous 1st molars.

CASE STUDY #2: "PROBABLE FEMALE"⁴



Figure 9. "Probable Female" at the time of the physical examination.

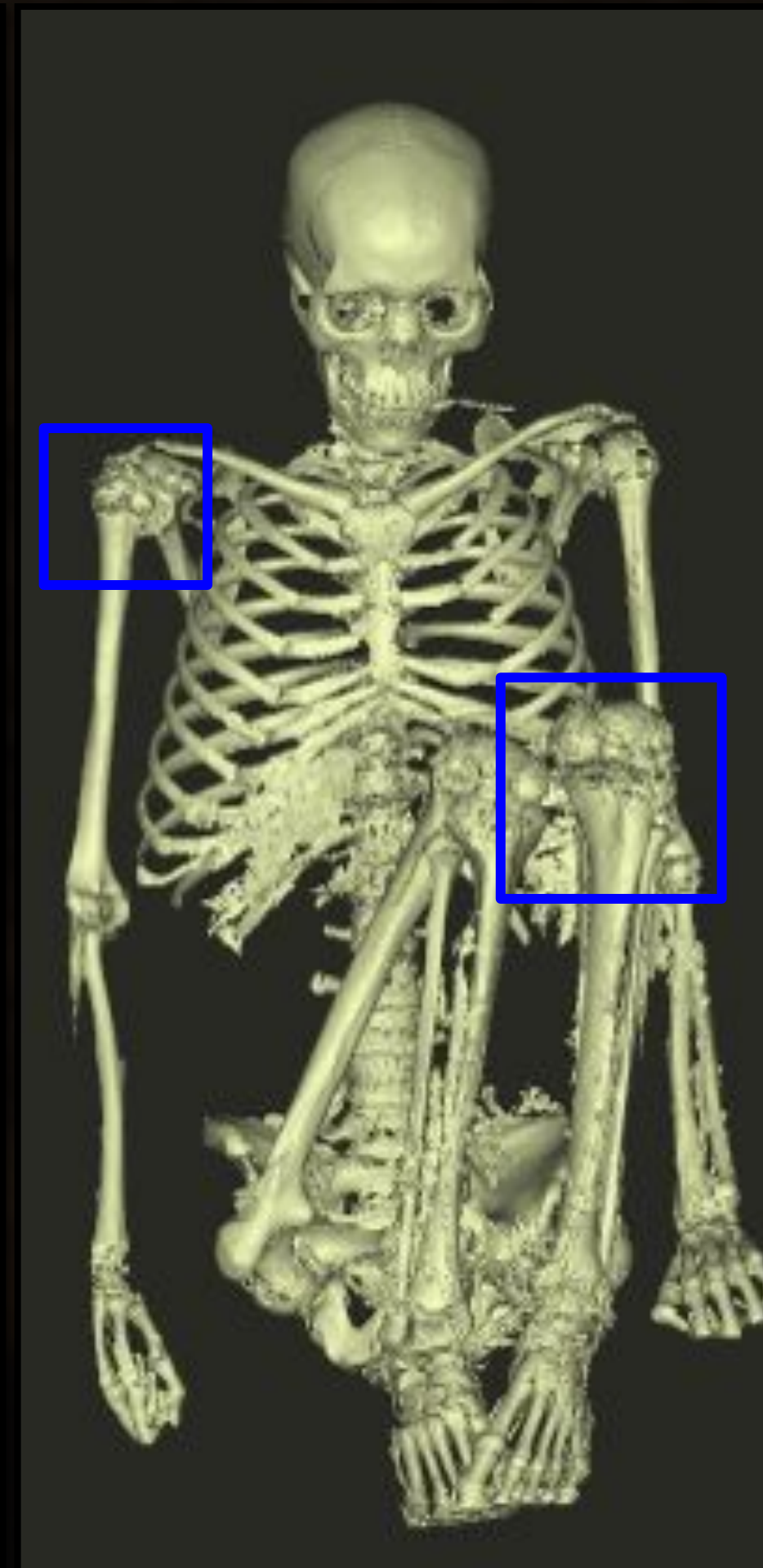


Figure 12. 3D model produced from CT scans. Unfused epiphyses are noted.

CT scan data and 3D modeling of her skeleton show developing dentition and unfused epiphyses, indicating an age of about 14 years (Figures 11-12). Gross examination noted abnormally enlarged breast tissue and distended abdominal tissue (Figure 13). Typically, mummified tissues of the abdomen recede inward during desiccation (Figure 14), but her abdominal tissues do not. 3D modeling also shows a markedly expanded ribcage (Compare Figures 12 and 7) and visual examination of preserved tissues confirmed an enlarged vaginal opening. These features suggest late stage pregnancy or recent birth.

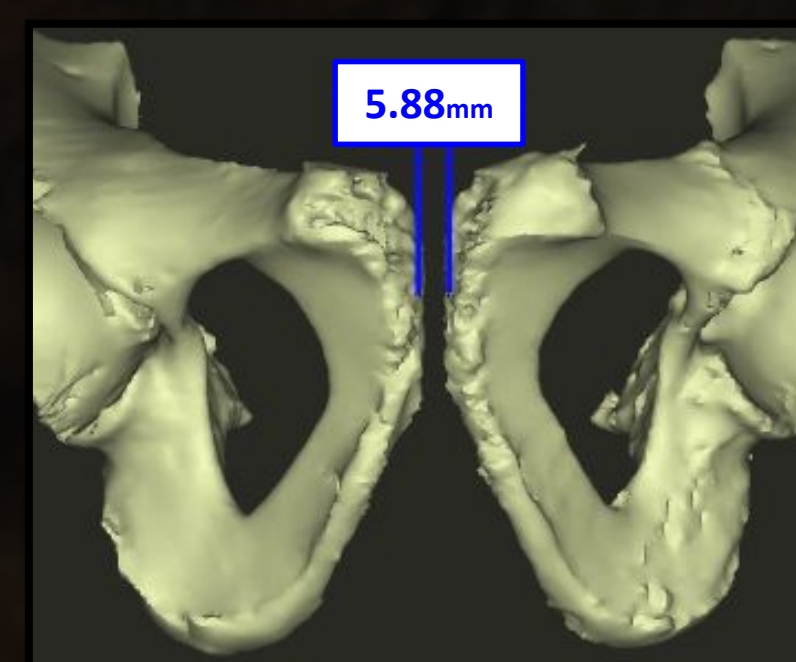


Figure 15. 3D model of her pelvis.

CT scans show no evidence of a fetus within her uterus. However, the distance between her pubic bones is 5.88 mm (Figure 15). The normal distance between the pubic bone is between 4 to 6 mm⁸. During pregnancy, the symphyseal ligaments relax, which can increase the distance to 6 to 8 mm in mature adults, and does not return to normal until 4 to 12 weeks after birth^{9,10}. The distance between her pubic bones, lack of fetal remains, and other physical evidence suggest that she is postpartum.

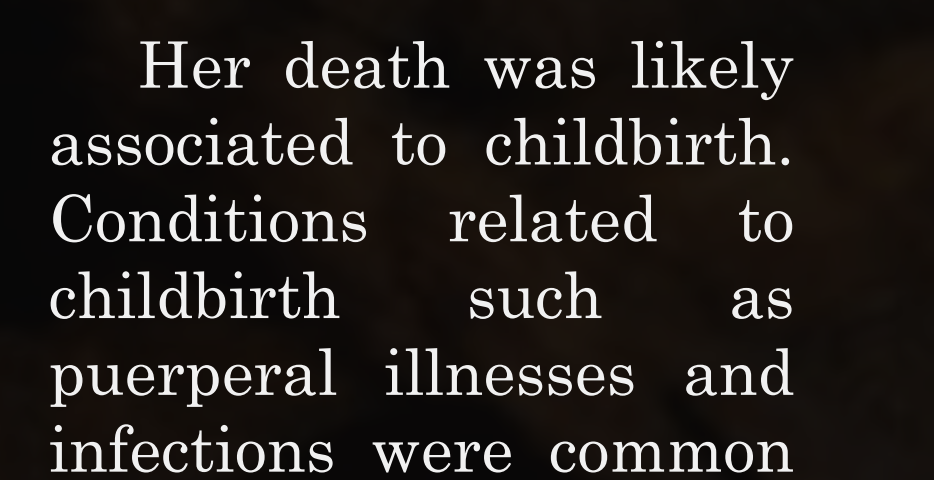


Figure 13. CT slice showing a cross-section of her distended abdomen.

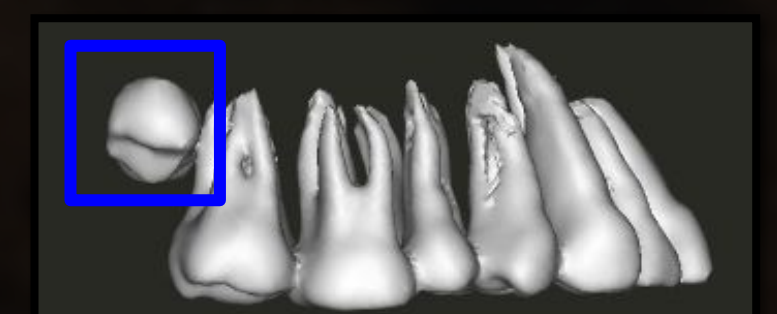


Figure 11. 3rd molars are in the process of developing.



Figure 10. Her hair has a reddish tint.

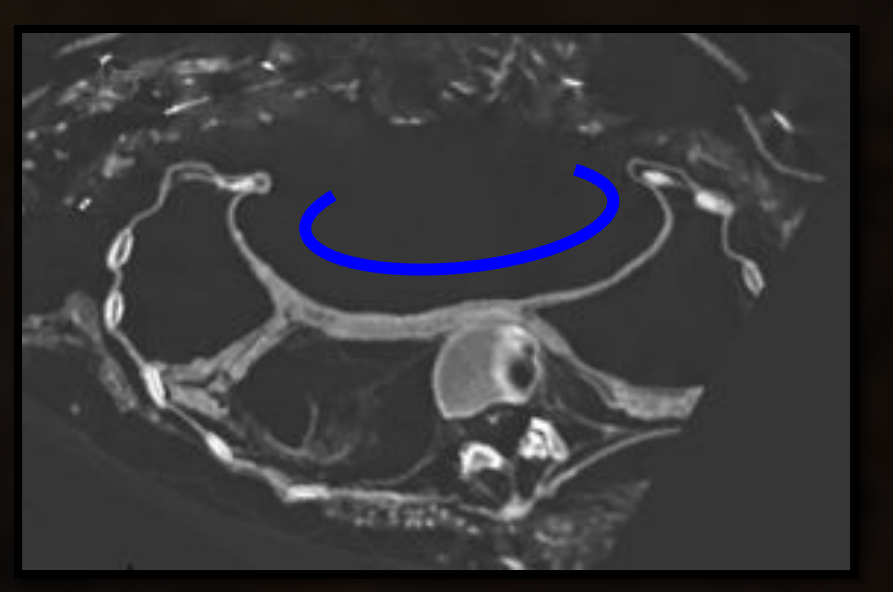
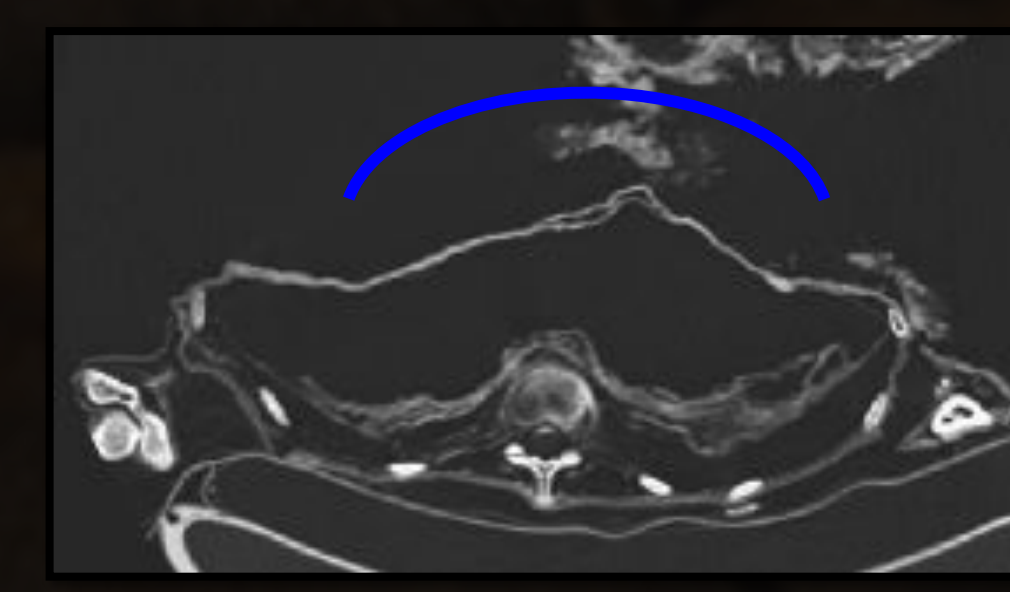


Figure 14. CT slice showing a more typical cross-section of another Basketmaker mummy's sunken abdomen.

Her death was likely associated to childbirth. Conditions related to childbirth such as puerperal illnesses and infections were common in prehistoric societies¹¹.

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CONCLUSIONS

Prior to this study, archival information provided vague and sometimes incorrect information of the human remains identified as Basketmaker mummies at the Penn Museum. Gross examination of these remains accompanied by CT analysis and 3D modeling has corrected and refined the biological data as demonstrated in the two case studies detailed above. The "Woman & Child" have now been correctly identified as an adult male and 18-24 month old boy. The "Probable Female" has been identified as a teenage female whose death was likely linked to childbirth. These added insights provide a guide for future analyses. Genetic relationships between the man and child may be pursued through genetic testing of tissues. Chemical analyses could provide dietary data to explore related issues of malnutrition and seasonal migration patterns. Skeletal variation could be identified to distinguish Western from Eastern Basketmakers. These two case studies have expanded the knowledge of the prehistoric Basketmakers of the American Southwest and provide a foundation for future studies of mummified remains.

ACKNOWLEDGEMENTS

Thank you to Katie Barca and Vicki Simon for their kindness and assistance, and the NHRE program coordinators, Virginia Power, Gene Hunt, and Liz Cottrell, for running a spectacular program.

We also thank the University of Pennsylvania Museum of Archaeology and Anthropology, the Open Research Scan Archive at Penn, Janet Monge, Alessandro Pezzati, and P. Thomas Schoenemann.

And finally, thanks to the Smithsonian Institution and the National Science Foundation for making the NHRE program possible.