Examining Temporal Bones for Evidence of Pearl Diving in Prehistoric Arabia

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Introduction

Pearl diving has a long history in the Arabian Peninsula (**Figure 1**). During the Bronze Age (3200-1300 BCE), groups from coastal areas traded pearls with neighboring states like Mesopotamia and the Indus Valley (Carter, 2005; Charpentier et al., 2012; al-Naboodah, 1992; Potts, 2012).

We examined individuals from two tombs—Unar 1 (**Figure 2**) and 2 (**Figure 3**)—which date to the Umm an-Nar period (2700-2000 BCE) and are located at the Shimal Necropolis in the Emirate of Ras al-Khaimah (UAE). In particular, we surveyed the temporal bones for signs of external auditory exostosis (EAE), a benign tumor in the ear canal, and otitis media (OM), commonly known as an ear infection, in order to investigate whether individuals from this area engaged in maritime activities such as pearl diving. EAE forms when an individual is habitually submerged in cold water (Kennedy, 1986), and OM can result from many environmental factors such as occupation and diet, but is also associated with water exposure (Krenz-Niedbala & Lukasik, 2017).

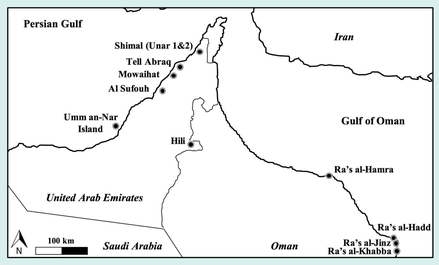


Figure 1: Map of Neolithic and Bronze Age sites across the Oman Peninsula (Gregoricka et al., 2021)

Figure 2: Tomb Unar 1 (2400-2200 BCE)

Figure 3: Tomb Unar 2 (2300-2100 BCE)

Methods

We scored temporal bones with 50% or more of the external auditory meatus (EAM) present for presence of EAE and its severity using the scale (1-3) described by Standen et al. (1998) (see also Crowe et al., 2010; **Figure 4**). Additionally, we included a category of 0 for severity of EAE to distinguish individuals exhibiting minor EAE from those with no signs of EAE. Using Buikstra & Ubelaker (1994), we scored the mastoid process from 1-5 to estimate sex (**Figure 5**).

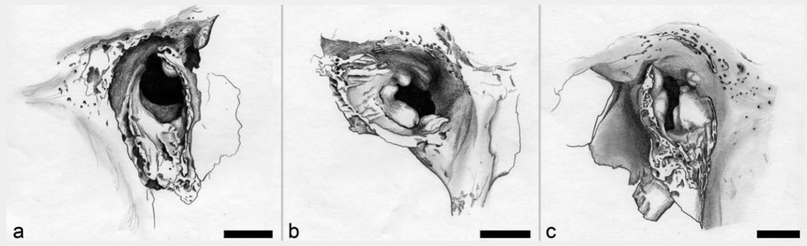


Figure 4: Examples of severity of EAE expression: (a) Grade 1 exostosis, (b) Grade 2 exostosis, (c) Grade 3 exostosis. Scale bars 5mm. Drawings by Mieke Khöler (Crowe et al., 2010).

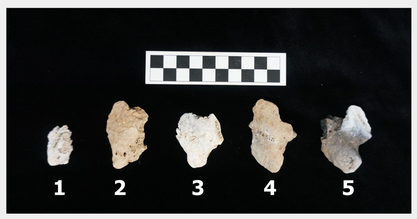


Figure 5: Fragmentary mastoid processes from tombs Unar 1 & 2 scored left to right in order from 1-5 according to Buikstra & Ubelaker (1994).

Using a stereo microscope (Nikon SMZ660; 8x-50x), we examined the surface of the cochlear promontory for signs of remodeling and resorption, which are indicative of otitis media, following the method described by Floreanova and colleagues (2020; **Figure 6**). Photos were taken with a DinoLite (AM4111T; 10x-50x). Statistical analysis included Fisher's Exact (FE) tests and Odds Ratios (OR).

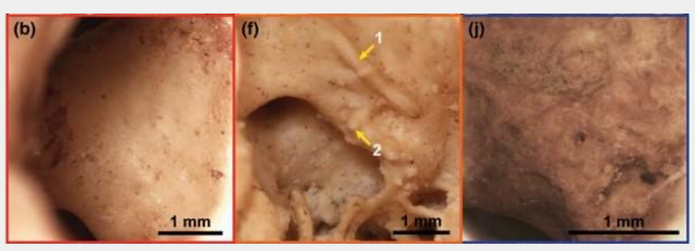


Figure 6: The three stages of remodeling on the promontory surface due to OM shown through a microscope: (b) No remodeling, (f) Remodeling, (j) Resorption (Floreanova et al., 2020).

Results

Out of the 46 individuals examined from Unar 1, 9% (n=4) had EAE, while 2% (n=3) of the 145 individuals examined from Unar 2 had EAE (**Figure 7, 8a**). However, this difference was not significant (FE: p =0.059).

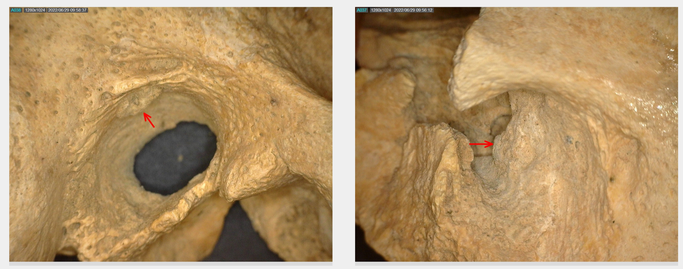
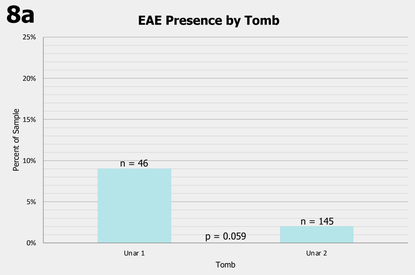
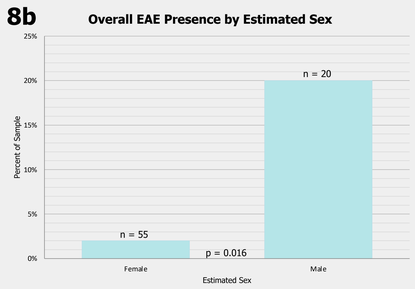


Figure 7: Exostoses from two individuals interred in tombs Unar 1 (U1.4.472) and Unar 2 (U2.4.40).

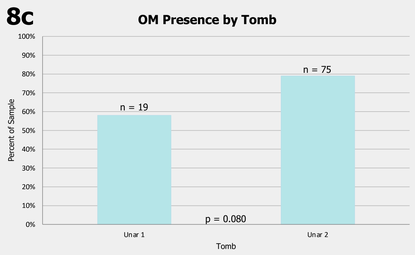
8a



8b



8c



Sex Estimation & EAE. Of the scorable fragments from the two tombs, we estimated 55 individuals to be female and 20 to be male. Four males and one female had EAE (**Figure 8b**). This difference was statistically significant (FE: p=0.016).

OM & EAE. Of the 94 scorable cochlear promontories found in temporal bones from both tombs, 74% had evidence of OM. However, there was no association between EAE and OM (OR=0.50, 95% CI [0.078 - 3.190]). Although 58% of bones scored from Unar 1 (n=19) and 79% of bones scored from Unar 2 (n=75) showed signs of OM, the difference was not statistically significant (FE: p=0.080; **Figure 8c, 9**).

Figure 8a: Rate of EAE in Unar 1 and Unar 2.

Figure 8b: Rate of EAE by estimated sex in Unar 1 and Unar 2.

Figure 8c: Rate of OM in Unar 1 and Unar 2.

Figure 9: Promontory surfaces from three individuals (U2.4.638, U2.4.186, U2.4.285). Remodeling scored according to Floreanova et al. (2020): (a) No remodeling, (b) Remodeling, (c) Resorption.

Discussion & Conclusion

Our results suggest that a small portion of individuals from this sample may have been spending a significant amount of time in the water—perhaps in order to dive for pearls (**Figure 10**). They also indicate that males were more likely to participate in these maritime activities, consistent with literature on sex-based differences in diving practices (Agius et al., 2016; Charpentier et al., 2012).

There is no correlation between EAE and OM within either tomb, which means that being submerged in water did not necessarily lead to more ear infections. There is also no statistically significant difference in EAE and OM between the two tombs, which indicates that neither group was participating in activities that put them at a greater risk of developing either condition.

Figure 10: Two individuals practicing traditional methods of pearl diving (Arab Times, 2018)

Acknowledgements

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