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A preliminary analysis of Late Bronze Age human skeletal remains from Gonur-depe, Turkmenistan

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Abstract: *The results of a palaeopathological investigation of human skeletal remains from the excavations of one of the largest Bactria-Margiana archaeological complex (BMAC) sites Gonur-depe (3rd–2nd mill. BC, southeast Turkmenistan) are discussed. Inhumation burials from Gonur-depe derive from a large necropolis (mainly dated to 2300–1800 BC) which was completely excavated and a sample of later burials placed in ruins of the palace-temple complex (mainly burials of the middle of the 2nd mill. BC). Preliminary results of the analysis of 920 individuals (582 subadults, 142 males, 196 females) from the latter sample are discussed here. The frequency of some dental pathologies (e.g., abscesses and AMTL) is relatively low (compared to similar data from the Gonur necropolis). This fact can be connected with some dietary change in the later Gonur population. A high percentage of* cribra orbitalia *in the children's subgroup suggests some negative biosocial factors (in conjunction with an increase in childhood mortality in comparison with the sample from the necropolis). Trauma, with the exception of a few cases, was most likely of accidental origin. However, cranial trauma was more often present in males. The prevalence of various joint diseases that are more often observed in agricultural populations is relatively high.*

Key words: adaptation; palaeoecology; dental disease; *cribra orbitalia*; trauma; joint disease; infectious disease; Central Asia

Introduction

Gonur-depe is situated 100km to the north of the city of Bayramaly in Southeastern Turkmenistan (38°12′50″N 62°02′15″E; mean 190masl). It is a unique Bronze Age archaeological site in Central Asia, discovered 35 years ago by the Margiana archaeological expedition of the Academy of Sciences of the USSR and Institute of History of Turkmenistan under the direction of V.I. Sarianidi (**Figure 1**). The site is under excavation by the expedition of the Institute of Ethnology and Anthropol-

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Figure 1. Map of Turkmenistan showing location of Gonur-depe (adapted from www.imondonauti.it)

ogy of the Russian Academy of Science (Moscow, Russia) directed by V. Sarianidi in collaboration with the National Department of Turkmenistan for Protection, Research and Restoration of Historical and Cultural Sites (Ashgabat). Gonur is one of the largest Bactria-Margiana archaeological complex (BMAC) settlements (the central part is about 25ha; the necropolis about 12ha) and is probably the capital city of the ancient state of Margush where more than 200 sites have been found (**Figure 2**).

Results of studies on archaeological material from the Gonur-depe excavation can be found in a number of special publications (Sarianidi 2001, 2002, 2005, 2007,

2008). Sixty C14 dates from different parts of Gonur reveal that this site was inhabited between 2300–1500 cal BC (Zaytseva et al. 2008). It is possible that the settlement was deserted when the Murghab River changed its course.

Figure 2. General view of Gonur-depe (photo by N. Dubova, 2004).

Human skeletal remains were unearthed at the main Gonur necropolis where 2843 tombs dating mainly from 2300–1800 cal BC were excavated. Additional skeletal material was recovered in the complex of Gonur temples and in the palace (about 1600 tombs dating to the middle of the 2nd mill. BC; referred to as 'ruins').

The human remains from Gonur were studied by Italian (Sperduti et al. 2002), Turkmen (Babakov 2002, 2004) and Russian biological anthropologists (Babakov et al. 2001; Vassiliev et al. 2001; Dubova & Rykushina 2004, 2007; Dubova 2005). A specific focus in these works was allocated to research of pathological changes seen in the skeletal system of the inhabitants of ancient Margiana. However, publications on palaeopathology of Gonur-depe are currently not numerous (Dubova & Kufterin 2008; Kufterin & Dubova 2008; Kufterin 2009, 2012). Unlike previous publications, the present study for the first time provides a summary of the data on the palaeopathology of the population buried in the Gonur 'ruins'.

Material and methods

The frequency of pathological markers in the Gonur-depe 'ruins' sample dating to the middle of the 2nd mill. BC were examined. Burials in the 'ruins' were constructed by people who lived in the settlement during the last period of its existence. In contrast to the burials in the Gonur necropolis, 'ruins' burials are often placed directly in the walls of architectural constructions (especially the burials of subadult individuals). In total, the analysis included skeletal remains of 920 individuals (582 subadults, 142 males and 196 females) (**Table 1**). Skeletons with poor preservation, and uncertain sex and age determination were excluded from the analysis. The Gonur necropolis sample used to compare the frequency of dental pathology included 470 individuals (see Dubova & Rykushina 2007). Multifactorial sex and age estimations were made using standard morphological features of the skeleton (Bass 1987; Buikstra & Ubelaker 1994; White & Folkens 2005): dental development and eruption (Ubelaker 1989), dental attrition (Lovejoy 1985), obliteration of cranial sutures (Meindl & Lovejoy 1985), and age-related changes in the pubic symphysis (Brooks & Suchey 1990).

Table 1. Sex and age structure of skeletal sample from Gonur-Depe ruins.

	Age categories													
Sex	**0–6**		**7–13**		**14–18**		**19–35**		**36–55**		**56+**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male							43	4.7	77	8.4	22	2.4	142	15.4
Female							63	6.9	94	10.2	39	4.2	196	21.3
Undet.	405	44.0	132	14.4	45	4.9							582	63.3
Total	405	44.0	132	14.4	45	4.9	106	11.5	171	18.6	61	6.6	920	100.0

In the present paper, we discuss the following common palaeopathological conditions: dental abscesses and antemortem tooth loss (AMTL), *cribra orbitalia*, traumatic injuries, degenerative joint diseases and infectious processes. Palaeopathological analysis and diagnosis was carried out on the basis of macroscopic studies of the material. In general, standard methodological recommendations were used (Ortner 2003; Roberts & Manchester 2005; Waldron 2009).

Frequencies of dental pathologies were calculated using the number of individuals with dental disease in relation to the number of preserved skulls. Thus, the present study takes only the frequency (crude prevalence) but not the intensity (true prevalence) of dental pathologies into account. We used the Lukacs (1989) grading system for recording dental caries and abscesses. Four possible degrees of expression for caries (no lesion, less than half the tooth crown destroyed, more than half the tooth crown destroyed and all the crown destroyed) and three for dental abscesses (1 = slight, less than 3mm in diameter, 2 = moderate, 3-7mm, 3 = severe, more than 7mm) were considered. For comparison with the data from the necropolis at Gonur (where no

grading system has been used) all grades of pathologies were included in the total count. AMTL was assessed if the tooth socket was partially (more than 2mm) or completely filled in with new bone.

Types of *cribra orbitalia* were recorded according to the Nathan and Haas (1966) scheme: a = porotic changes (or its traces), b = cribrous changes, c = cribrous and trabecular changes. In the final count all degrees of *cribra orbitalia* were included.

In the trauma analysis only antemortem injuries with traces of healing were considered. Fatal (perimortem) injuries were not included in the total count. Trauma was scored according to Lovell's (1997) recommendations and categorization.

Development of degenerative lesions was evaluated according to Sager (1969), Merbs (1983), and Walker and Hollimon's (1989) definitions and classifications and scored using five stages. In the final count all degrees of pathology were included. Cases where articular surface lesions were not caused by neuromechanical stress but by endocrine disorders or infections were excluded from the calculations.

For infections, description of lesion localization, size and degree of healing were recorded. Differentiations between periostitis (inflammation of the periosteum) osteitis and osteomyelitis (inflammation of bone and bone marrow) were made (Resnick & Niwayama 1995a, 1995b). However, in the final calculation all infection markers were taken into account together. Specific infections, if observed, were excluded from the analysis.

Results and discussion

Dental diseases

Previous studies of dental diseases in the Gonur population have produced contradictory results. O. Babakov (2008), for example, noted a low level of carious lesions (3.5%) in a small odontological sample. G.V. Rykushina, who has given special attention to the distribution of dental pathologies in this site, found carious lesions in 33% of individuals (males 28%, females 37.1%) (Dubova & Rykushina 2007). The development of caries frequently leads to the formation of alveolar abscesses and to AMTL. In the present study, the frequency of occurrence of alveolar abscess in the analyzed series is very high (**Table 2**). It is possible to assume that some cases of AMTL were connected with carious lesions, which is common in agricultural populations (Larsen 1983; Walker & Erlandson 1986). It should be noted that in general, the frequency of dental pathologies in the series from the ruins of Gonur is lower than in the series from Gonur's necropolis (Dubova & Rykushina 2004, 2007). This fact can be connected with a decrease in the intake of fermentable carbohydrates in the later Gonur population (cf. Hillson 2008).

Cribra orbitalia and porotic hyperostosis

Porotic hyperostosis and *cribra orbitalia* affect mainly subadult individuals and in adults the lesions may remain as the result of incomplete healing after an episode of anaemia or scurvy in childhood or as the sign of the chronic anaemia which has developed in childhood (Walker et al. 2009; Buzhilova 2001). The frequency of this condition in the late Gonur series is low (**Table 3**). No significant differences in *cribra orbitalia* were observed between males and females. In infants *cribra orbitalia*, as expected, was more common than in adults, and was the most widespread pathology (Dubova & Kufterin 2008) (**Figure 3**). The low frequency of *cribra orbitalia* may be a result of sufficient levels of vitamins B_{12} and C in food (cf. Walker et al. 2009).

Trauma

The frequency of trauma in the Gonur series is low (**Table 4**). Traumatic injures of the upper limbs are most common and trauma is more frequent in males than in females. The latter observation is valid especially for distributions of cranial injuries (from small injuries of the nasal bone to serious complex traumatic injuries encompassing several bones) (cf. **Figure 4**). The prevalence of cranial trauma is usually interpreted as a marker of the level of inter-personal violence in a population (Walker 1989; Jankauskas 1993). In this case, higher population densities may explain some increase in the frequency of the occurrence of traumatic injuries to the skull. Overpopulation may have led to an increase in inter-group competition and as a result in inter-personal violence (Buzhilova 1998). Traumatic injuries to the postcranial skeleton in most cases may be explained as the result of accidents during household activities, which is suggested by the significant similarity of parameters of postcra-

Table 2. The frequency of dental disease at Gonur-depe.

Pathology	**Males**			**Females**			**Total**		
	N	n	%	N	n	%	N	n	%
Dental caries	142	45	31.7	196	81	41.3	338	126	37.3
Dental abscess	142	8	5.6	196	10	5.1	338	18	5.3
AMTL	142	22	15.5	196	23	11.7	338	45	13.3

Table 3. The frequency of *cribra orbitalia* at Gonur-depe.

Age/Sex	**N**	**n**	**%**
Sub-adults	582	64	11.0
Males	142	3	2.1
Females	196	3	1.5
Total	920	70	7.6

Figure 3. *Cribra orbitalia*. Tomb 3615 (7–8 years old child).

nial trauma distribution among males and females. The highest occurrence of cranial traumas was noted in old or mature males and in mature females. Postcranial trauma prevails in mature males and old females.

Table 4. The frequency of traumatic injuries at Gonur-depe.

Feature	**Sub-adults**			**Males**			**Females**			**Total**		
position	N	n	%	N	n	%	N	n	%	N	n	%
Skull	582	0	0	142	11	7.8	196	4	2.0	920	15	1.6
Upper limbs	582	2	0.3	142	9	6.3	196	12	6.1	920	23	2.5
Lower limbs	582	0	0	142	7	4.9	196	8	4.1	920	15	1.6
Spine and thorax	582	0	0	142	4	2.8	196	3	1.5	920	7	0.8

Figure 4. Healed comminuted fracture of the mandible. Tomb 3243 (40-45 years old male).

Degenerative joint diseases (DJD)

In total, in the adult population buried in Gonur ruins, the frequency of joint diseases was high. It is worth noticing that in females this condition was observed slightly more often than in males—although the difference is not statistically significant (χ^2=0.89, df=3, p=0.83) (**Table 5**, **Figure 5**)—except in younger adults (18-35 years). As expected, the occurrence of joint disease progressed with age.

Table 5. The frequency of degenerative joint disease at Gonur-depe.

Sex	Age categories								
		18–35		36–55		56+		Total	
	N	n	%	n	%	n	%	n	%
Males	142	6	14.0	26	33.8	12	54.6	44	31.0
Females	196	8	12.7	35	37.2	24	61.5	67	34.2

Infectious diseases

In general, the frequency of infections is low (**Table 6**). In subadults and females infections were more often localized on the skull (**Figure 6**), whereas in males signs of infection were usually found on long bones. This difference may be related to a higher degree of physical activity in males, which may lead to more common periosteal infection (Borutskaya 2004:102). However, due to the relatively low frequency of infection, this difference is not statistically significant. In infants, several cases of in-

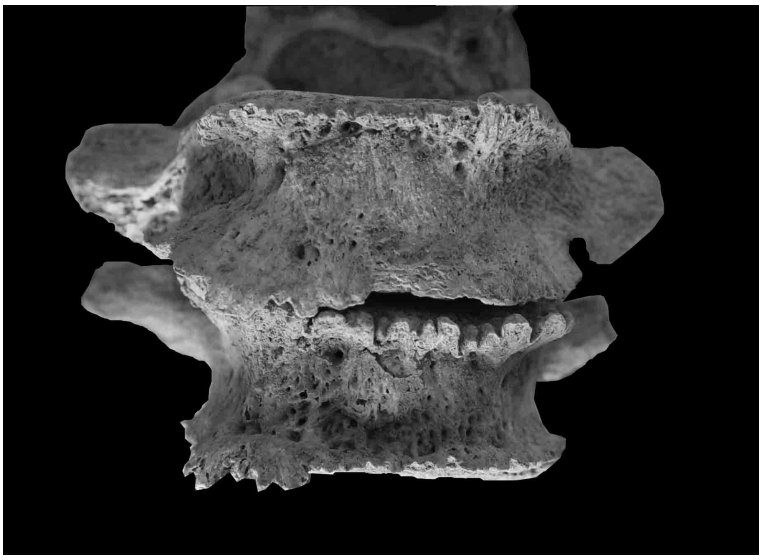

Figure 5. Osteoarthritis of the spine. Tomb 3640 (45-55 years old female).

fection in some skull bones (e.g., mastoiditis and otitis) may be cautiously interpreted as possible causes of death.

Table 6. The frequency of periosteal new bone formation at Gonur-depe.

Feature	Sub-adults			Males			Females			Total		
position	N	n	%	N	n	%	N	n	%	N	n	%
Skull	582	17	2.9	142	2	1.4	196	6	3.1	920	25	2.7
Postcranial	582	3	0.5	142	3	2.1	196	3	1.5	920	9	1.0

Conclusion

In general, low frequencies of most pathological conditions suggest that the later population from Gonur-depe was well-adapted to their environmental conditions. Neuromechanical stress (leading to a higher frequency of DJD), and also significant population density (despite of gradual 'desolation' of Gonur-depe) are the main factors possibly influencing the health status at the site. In children, the urban status of the site may have influenced the frequency of *cribra orbitalia* (Stuart-Macadam 1991; Buzhilova 2001; Walker et al. 2009) although genetic factors could also be important (Angel 1966). In adults, city-life brought on a higher risk of inter-personal violence, especially in males. The analysis of dental pathologies allows for an estimate of dietary

Figure 6. Infectious disease in the right mandibular fossa. Tomb 3787 (35-45 years old female).

stress and especially the amount of fermentable sugars, as indicated by the prevalence of dental caries. The present paper is a part of ongoing research project and a more comprehensive comparison of earlier and later samples from Gonur-depe is planned in the future.

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