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Archaeological and palaeopathological study on the third/second century BC grave from Turfan, China: Individual health history and regional implications

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ABSTRACT

This paper presents an archaeological–palaeopathological case study from Turfan (western China). Although this area is located outside of the two focus regions of the special issue (Baikal and Hokkaido), it once belonged to the same cultural sphere and experienced intensive contacts and exchanges with the neighbouring regions. The case study presented here combines detailed palaeopathological analysis of human skeletal remains with precise age determination and archaeological and regional contexts, demonstrating the high potential of such studies in arid and semi-arid China. The current paper also presents an unusual early case of prosthetic leg use from western China. The skeleton of a 50–65-year-old man and his wooden leg prosthesis discovered in a tomb in Shengjindian graveyard (Turfan, China) have been examined. Macroscopic lesions observed on ribs two to eleven, between the fifth and sixth cervical vertebra, and on the left knee joint are probably due to tuberculosis infection. The inflammatory process led to osseous ankylosis of the knee, fixing it at 135° flexion and 11° internal rotation, making walking impossible. The lost mobility of the disabled shank was regained by using an externally fitted wooden prosthesis which consists of thigh stabilizer, peg, leather straps, sheep/goat horn reinforcement of the peg tip, and horse/Asiatic ass hoof as sink resistance. Heavy traces of wear and absence of muscle atrophy indicate long-term use of the prosthesis. Ten radiocarbon dates on the prosthesis, human bones and wood pieces from the same grave suggest the most probable age of the burial is about 300–200 BC (68% confidence interval), thus introducing the oldest functional leg prosthesis known to date. The results provide some support for a DNA-based hypothesis that the spread of tuberculosis in Asia was related to intensified inter-regional contacts and higher residential mobility during the first millennium BC.

1. Introduction

The Baikal–Hokkaido Archaeology Project (BHAP: http://bhap.arts.ualberta.ca/project description) aims to explore prehistoric hunter-gatherer lifeways in Northeast Asia, through an intensive comparative analysis of two long-term regional trajectories of Holocene cultural and environmental change in the Lake Baikal (Russia) and Hokkaido (Japan) regions. BHAP promotes the examination of human and environmental records with high temporal resolution and the implementation of the individual life history approach (Weber et al., 2010; 2013) to archaeological research. The latter approach has been defined as a suite of laboratory and macroscopic methods which (i) give detailed information about individuals through examination of their skeletal remains in conjunction with archaeological and environmental contexts; (ii) provide insights into the variation of past human behaviour at the individual and community level; and (iii) allow robust comparison with the high-resolution records of past environments and with regional climate model simulations (Weber et al., 2010). Furthermore, comprehensive dating and detailed comparative analyses of cemetery complexes allow tracing the cultural dynamics,

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interaction patterns, mobility and health of larger populations in a wider area (e.g. Weber et al., 2002). Infectious diseases like tuberculosis might be used as a proxy for human health and movement in the broader region (Roberts and Buikstra, 2003; Taylor et al., 2007; Suzuki et al., 2008).

Our paper presents an archaeological–palaeopathological case study from Turfan (western China). Although this area is located outside of the two focus regions of the special issue (Baikal and Hokkaido), it once belonged to the same cultural sphere and experienced intensive contacts and exchanges with the neighbouring regions (e.g. Di Cosmo, 2002; Parzinger, 2006). Following methodological principles of BHAP, the case study presented here combines detailed palaeopathological analysis of human skeletal remains with precise age determination and archaeological and regional contexts, demonstrating high potential of such studies in arid and semi-arid China. The current paper also presents an unusual early case of prosthetic leg use from western China. 'Standing on one's own feet' is synonymous for self-sufficiency. An individual whose foot or lower leg is disabled or lost due to accident or disease ultimately needs cultural intervention for survival. Walking sticks or crutches are the simplest supporting tools helping to regain mobility, but they keep the hand and arm occupied. The use of a functional artificial shank allows the person to lead a close-to-normal life. Therefore, the invention of a prosthesis – a device to replace a missing or disabled limb – was a great advance in medical engineering. Considerations about the earliest use of leg prosthetic devices commonly start with indirect textual evidence, e.g. the Hegesistratus story recorded by Herodotus (484–425 BC) about an artificial wooden foot (Bliquez, 1996; Knoche, 2006), suggesting that foot prostheses were already known in the Graeco-Roman world in the fifth century BC (Finch, 2011). The oldest prosthesis of a big toe was reported by Nerlich et al. (2000) in Thebes, Egypt, dated around 950–710 BC.

To date, the oldest case of prosthetic leg use was discovered in Capua, Italy, in 1885 (Bourguignon and Henzen, 1885; Sudhoff, 1917; von Brunn, 1926) and dated to about 300 BC based on the typology of accompanying vases (von Duhn, 1887). The 'Capua leg' assigned to a man's skeleton with right leg missing from the mid-calf had a wooden core and luxurious bronze sheeting, indicating the owner's wealthy status. The device once acquired by the Museum of the Royal College Surgeons London was lost during the Second World War and its functionality has remained uncertain.

In China, historical texts report foot or leg amputation as one of the "five punishments" from the late second millennium BC onwards and a bronze figurine of an invalid with an amputated lower limb attached to a vessel is dated to about 900 BC (Shaughnessy, 1999). However, no examples of prosthetic devices or skeletons with healed amputations have been reported to date.

Midway between the Graeco-Roman and Chinese worlds a wooden peg-leg next to a well preserved human skeleton was excavated near Turfan in the Uygur Autonomous Region Xinjiang, China (Fig. 1). The Shengjindian archaeological site is assigned to the Subeixi (Subeshi) culture, conventionally dated to the first millennium BC (Chen, 2002; Han, 2007; Xinjiang, 2011). The current study discusses the construction details, wear, and numerical age of the leg prosthesis discovered at the Shengjindian site and pathological changes in the skeletal remains of its user.

2. Materials and methods

2.1. Grave setting and archaeological context

The Shengjindian graveyard (Fig. 1) is situated about 35 km east of modern Turfan on the upper terrace, which belongs to the valley crossing the 'Flame Mountains' in the eastern part of Tian Shan. The mean temperatures in Turfan are −9.5 °C in January and 32.7 °C in July. The annual precipitation is about 16 mm, reflecting an extremely dry climate (Domrös and Peng, 1988).

In total, 31 tombs were excavated at Shengjindian in 2006–2008. The current study is focused on the tomb 2007TSM2 (further named M2), which contained the wooden peg-leg found near the well preserved skeleton of its user. Construction of the tomb (Fig. 2) and grave goods (Fig. 3) match the general features of the whole graveyard and do not indicate an unusual social status of the deceased. Organics including reed- and wheat-straw mats and wooden beams covering the tomb opening were well preserved. Wheat straw and sand filled a 110 cm deep vertical shaft where the skeleton of a woman was found (Fig. 2A). The remains of the male invalid buried in a supine flexed position were found in a side chamber (Fig. 2B). Signs of a secondary opening indicate that the tomb was constructed primarily for the man, and the woman was interred later. Partially displaced or missing small bones of the man's skeleton reported by the excavators likely resulted from this later opening.

The grave goods (Fig. 3) are limited in quantity and quality and include ceramic cups, a jar and a wooden plate placed next to the head, and fragments of two reflex bows and the peg-leg found right of the man's body (Fig. 2A). The nearly complete skeleton of the man was available for palaeopathological investigation.

The whole graveyard including tomb M2 belongs to the Subeixi culture, associated with the Cheshi (Chü-shih) state known from Chinese historical sources (Sinor, 1990). Archaeological and historical data attest it as society with a developed agro-pastoral economy, that existed in and north of the Turfan Basin (Fig. 1) during the first millennium BC. The Subeixi weaponry, horse gear and garments (Mallory and Mair, 2000; Lü, 2001) resemble those of the Pazyryk culture (Molodin and Polos'mak, 2007), suggesting contacts between Subeixi and the Scythians living in the Altai Mountains.

2.2. Dating

For reliable age determination three samples from the peg-leg and seven other samples representing tomb M2 were submitted to the Radiocarbon Dating Laboratory at Peking University. The accelerator mass spectrometry (AMS) radiocarbon dates are provided in Table 1. Resulting radiocarbon dates were calibrated against the IntCal09 calibration curve (Reimer et al., 2009) using the SEQUENCE deposition model in the Bayesian software, OxCal (v4.1.5; Bronk Ramsey, 2008, 2009; https://c14.arch.ox.ac.uk/oxcal/OxCal.html).

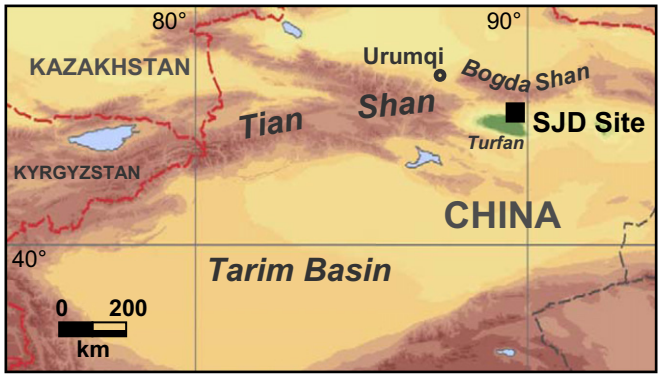

Fig. 1. Map showing the main physiographic features of the Uygur Autonomous Region Xinjiang in western China and the location of the Shengjindian (SJD) archaeological site (indicated by a black square).