



# Hypertrophic osteoarthropathy in a young adult male from Berber, Sudan (2nd–3rd century CE)



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## ABSTRACT

Hypertrophic osteoarthropathy (HOA) is a pathological condition characterised by extensive periosteal new bone formation (NBF) on the diaphyses of the long bones, metacarpal and metatarsal bones. In modern clinical contexts, the secondary form of the disease is common and most often occurs secondary to intra-thoracic cancer and other forms of chronic pulmonary disease. Paleopathological evidence for HOA on the other hand has only occasionally been reported.

Here we report a young adult male from the Meroitic cemetery at Berber in Sudan (2nd–3rd century CE) displaying widespread NBF on the diaphyses of the upper and lower limb bones, metacarpal and metatarsal bones, as well as the pelvis and scapulae. While several pathological conditions have to be considered as differential diagnostic options for NBF in the post-cranial skeleton, HOA is the most likely diagnosis, based on the distribution of the changes observed in this individual, as well as their macroscopic and radiographic characteristics. A chronic pulmonary condition as indicated by NBF on the visceral side of the ribs may represent the underlying cause for the HOA. This individual represents the first paleopathological case of HOA reported from an archaeological site in Africa.

## 1. Introduction

Proliferative periosteal new bone formation (NBF) represents a very common pathological finding in human skeletal remains from archaeological contexts worldwide (e.g. Ortner 2003; Larsen, 2015: 88–96). The periosteum is a thin membrane of connective tissue which surrounds all surfaces of bones except the joints of long bones. Any mechanical, trophic or infectious disruption to the periosteum, due to intrinsic or extrinsic factors, leads to stimulation of the osteoblasts in the inner cambium layer resulting in the formation of periosteal new bone (Freyschmidt, 2008: 512). Consequently, there is a wide range of pathological conditions which feature NBF, as primary and secondary symptoms, including trauma, vascular insufficiencies, and various infectious diseases (Resnick and Niwayama, 1995: 4435; Ortner, 2003: 206–207; Freyschmidt, 2008: 512). In clinical practice, differential diagnosis of NBF relies on the morphology and distribution of the periosteal changes on the bone and throughout the skeleton and, most importantly, on the involvement of neighbouring soft tissue structures or the presence of any other systemic disease processes (Freyschmidt, 2008: 512–513). In paleopathological studies the exact aetiology remains unknown in the vast majority of cases (Weston, 2008, 2009).

This paper presents the results of the skeletal analysis of an individual from the Meroitic (2nd–3rd century CE) cemetery at Berber, Sudan who displays extensive periosteal NBF and will further discuss differential diagnostic options in light of the historical and environmental background of the individual.

## 2. Materials & methods

### 2.1. The meroitic cemetery at Berber, Sudan

The Meroitic cemetery of Berber (BMC) is located on the east bank of the Nile, 300 km north of the Sudan's modern capital Khartoum (Fig. 1). Stretching from the Egyptian border, over 1500 km to the south along the Middle Nile Valley, the Meroitic Kingdom (350BCE–350CE) represented the most substantial political structure of sub-Saharan Africa until the 19th century (Edwards, 2004). Famed for iron production and metalworking (Rehren, 2001), the Meroites had wide-ranging contacts with the Romans, but also far into India and China. Despite extensive archaeological work, particularly surrounding the royal capital at Meroe, most of the current knowledge about the Meroitic Kingdom still draws from an elite milieu while little is known

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Fig. 1. Map of Sudan showing location of the site.

about life of the Meroitic people beyond the urban centres (Nowotnick *et al.*, 2014). Being largely confined to the small areas of arable land along the Nile, subsistence of the settlements would have likely been based on riverine agriculture and associated livestock herding (Edwards, 2004). The cemetery of Berber represents one of the few examples of a non-elite, rural cemetery in the Meroitic heartland, providing a unique opportunity to investigate life outside of the royal centre (Bashir 2010, 2013).

Excavations by the National Corporation for Antiquities and Museums of Sudan (NCAM) commenced in May 2009 after accidental discovery during construction work for a plastics factory. Since then, six seasons of salvage excavations have recovered 57 males, females and children buried in single and multiple graves. The skeleton presented in this study, BMC35, was buried in a small, oval-shaped, north-south orientated pit (125 × 40 cm, depth: 128 cm) which was accessed via a staircase 4 m in length (Fig. 2). The entrance to the burial pit was



Fig. 2. The burial of the young man BMC35 in situ (Photo: NCAM).

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