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Scientific analysis of a calcified object from a post-medieval burial in Vienna, Austria

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ABSTRACT

Calcifications commonly occur in association with soft tissue inflammation. However, they are not often discussed in palaeopathological literature, frequently due to problems of identification and diagnosis. We present a calcified object (40 × 27 × 27 cm) found with a middle-aged male from a post-medieval cemetery in Vienna. It was not recognized during excavation, thus its anatomical location within the body remains unknown.

The object was subject to X-ray, SEM and CT scanning and compared to historic pathological objects held in the collection of the Natural History Museum Vienna. Two of closest resemblance, a thyroid adenoma and goitre were subject to similar analytical techniques for comparison. Despite similarities between all objects, the structure of the object most closely conforms to a thyroid tumor. Nevertheless, due to similar pathophysiological pathways and biochemical composition of calcified soft tissue, a secure identification outside of its anatomical context is not possible.

The research further highlights the fact that recognition of such objects during excavation is crucial for a more conclusive diagnosis. Historic medical records indicate that they were common and might therefore be expected to frequently occur in cemeteries. Consequently, an increasing the dataset of calcifications would also aid in extending the knowledge about diseases in past human populations.

1. Introduction

Despite the relatively common occurrence of pathological calcifications in modern clinical contexts (Black and Kanat, 1985), in the palaeopathological literature such objects are only occasionally reported for archaeological human skeletal remains. In addition, in most cases the identification of these structures remains tentative. Calcifications in the human body can result from a large number of different pathological conditions including vascular, infectious, inflammatory, metabolic, and neoplastic entities (see Table 1) and can occur in virtually all anatomical regions of the body (Banks et al., 2005; Bohndorf et al., 2006: 288). Patho-physiologically, they are classified into organic concretions and calcifications of pathological lesions in soft tissue. Soft tissue calcifications are further subdivided into dystrophic, accounting for 93–95% of all observed cases, and metastatic, which are generally rare (Banks et al., 2005; Kumar et al., 2013a). Metastatic forms occur in living tissue and are always related to an imbalance of the mineral metabolism, whereby dystrophic forms arise from necrotic tissue and do not involve any metabolic changes (Bohndorf et al., 2006: 288). While metastatic calcifications are usually associated with significant morbidity and mortality, dystrophic calcifications are often asymptomatic and relatively common. In a large-scale roentgenological study carried out in the central US in the 1940s, 63% of patients were found to have calcifications in the thoracic cavity resulting from atherosclerosis, silicosis or infectious diseases such as histoplasmosis, tuberculosis or other parasitic infections (Felson, 1969).

In the palaeopathological literature, several different types of calcified structures have been reported dating back as far as the Neolithic period, including parasite cysts (e.g. Perry et al., 2008; Waters-Rist et al., 2014), tumorous calcifications (e.g. Strouhal and Jungwirth, 1977; Komar and Buikstra, 2003; Quintelier, 2009), vascular calcifications (Binder and Roberts, 2014) as well as organic concretions (e.g. Özdemir et al., 2013). However, specific identifications are often impossible due to the wide range of potential

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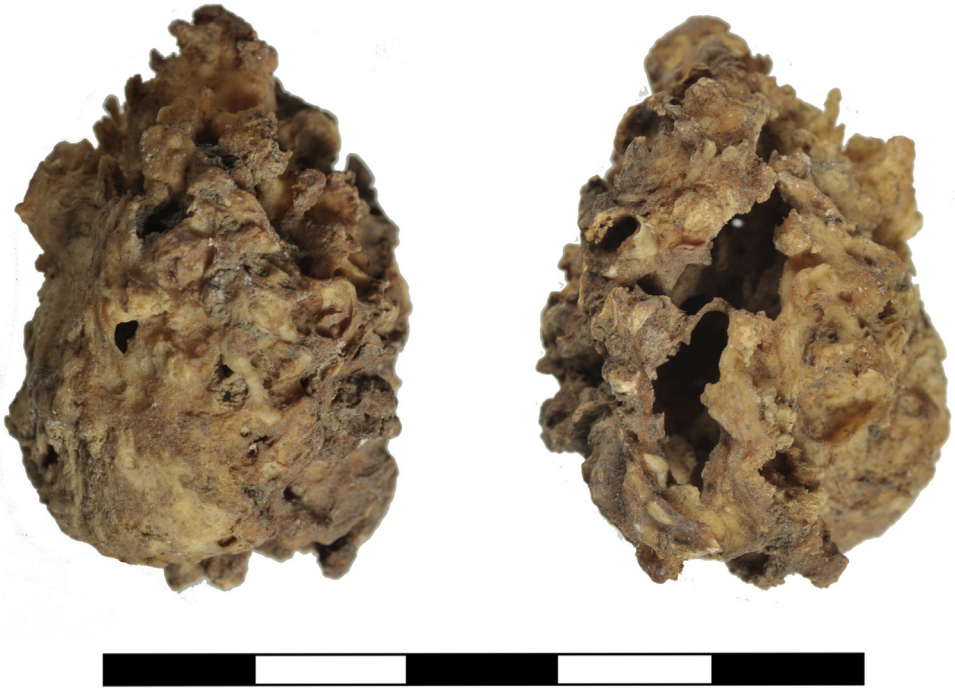

Fig. 1. Calcified object from grave 289 in the cemetery at St.-Bartholomäus-Platz, view from both sides (Image: W. Reichmann).

Table 1
Overview of common pathological calcifications and concretions (Steinbock, 1989; Bohndorf et al., 2006).

Concretions	Renal stones
	Gall stones
	Urinary stones
Soft tissue calcifications	
metastatic	Hypo-/Hyperparathyroidism
	Renal osteodystrophia
	Hypervitaminosis D
dystrophic	Trauma
	Tumors (eg. uterus, lymph nodes, pancreas, thyroid)
	Osteonecroses
	Atherosclerosis
	Tuberculosis
	Parasite cysts

underlying causes and unspecific morphology of the objects. Furthermore the lesions develop through similar underlying pathophysiological mechanisms and the biochemical composition of most soft tissue calcifications is indistinguishable from bone (Baud and Kramar, 1991). This paper reports the finding of an ovoid calcified object (40 × 27 × 27 mm, Fig. 1) of unknown origin in the burial of a middle adult male individual (Fig. 2) from the post-medieval cemetery of St.-Bartholomäus-Platz in Vienna, Austria.

2. Materials & methods

St. Bartholomäus church is located in the northern part of Vienna, which was once a small village until its integration into the municipality in the 19th century. The large cemetery surrounding the church was in use between the 15th and 18th centuries. Parish records indicate that the church belonged to an increasingly urbanised community living at the outskirts of the expanding city and comprised peasants, craftsmen, traders, servants and soldiers. Parts of the cemetery were excavated in 2007 by Stadtarchäologie Wien prior to the redevelopment of the square surrounding the church (Krause, 2011). Approximately 300 tightly spaced and often intercutting graves were uncovered. The skeletal remains recovered from the cemetery were subject to a detailed bioarchaeological analysis carried out by one of the authors (MB). The object presented in this study was associated with the fully skeletonized remains of a single individual (Fig. 2). Buried in a simple rectangular pit without coffin or other grave goods, it can be assumed the person was of lower social rank. The skeleton was complete and well preserved except for a small amount of post-mortem damage in the skull area. The calcified object was not recognized during excavation, thus its location within the body remains unknown.

The individual was determined to be of male sex, based on morphological examination of the pelvis and skull following recommendations by Buikstra and Ubelaker (1994). Age-at-death was calculated based on the degeneration of the pubic symphysis (Brooks and Suchey, 1990), auricular surface (Lovejoy et al., 1985) and dental attrition (Miles, 1963), and was estimated to be within the range designated as middle adult (36–50 years).

Analysis of the calcified object (BMP289) involved multiple components. In order to investigate its structure and internal morphology, the object was first examined radiographically using plain-film radiography and computerised tomography (Siemens Emotion 16). For a detailed characterisation of the external structure and chemical composition, the object was further analysed using a scanning electron microscope (SEM) and energy-dispersive X-ray spectroscopy (EDS, JEOL JSM 6610LV).

For comparison and to aid differential diagnosis of the calcified object, two pathological calcifications of known diagnosis from the collection of documented historic pathological specimens in the Narrenturm, Vienna (now part of the Natural History Museum, Vienna), a large goitre (MN17.747/331, Fig. 3) and a calcified thyroid adenoma (MN 272, Fig. 3), were chosen based on their morphological resemblance to the archaeological object and subject to similar analytical techniques.

3. Results

The ovoid calcified object is 40 × 27 × 27 mm in size and is composed of a very dense, hard, yellow substance (Fig. 1). Radiographic (Fig. 4a) and CT-examination (Fig. 4b) of the structure revealed a