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A case of enchondroma from Carolingian necropolis of St. Pere De Terrassa (Spain): An insight into the archaeological record

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ABSTRACT

Enchondromas occur with an estimated modern incidence rate of 27.7% of benign bone tumors (Hauben and Hogendoorn, 2010), but few are represented in the paleopathological record. The medieval site of St. Pere in Spain has produced a convincing case. The diagnosis was confirmed by X-Ray, CT-scan and μ-CT scan. Therefore UF 755 from St. Pere – a male of more than 60 years old – can be confirmed as a femoral case of enchondroma, supported by evidence, in the paleopathological record.

1. Introduction

Enchondromas are benign cartilaginous tumors located in the medullary cavity, most often in tubular bones. They are proliferative remnants of anachronistic growth plate chondrocytes that escape endochondral replacement by bone and so are most frequently located in the metaphysis of the phalanges of the hands, and secondary, in the long tubular bones of the arms and legs −namely that of the humerus and femur (Dahlin, 1981; Mirra, 1989; Schajowicz, 1982). The small bones of the hands often present enlargement of the affected bone accompanied by possible pain. These small bones occasionally will present a fracture causing a limiting or cessation of function of the affected phalanges. However, when the long tubular bones are affected they remain largely asymptomatic. Enchondromas account for approximately 10–25% of all benign bone tumors though it is hypothesized that this figure may be higher. Commonly enchondromas measure less than 3 cm and are rarely larger than 5 cm (Lucas and Bridge, 2013). The peak of prevalence occurs in the second to fourth decades of life but age profile for this neoplasm varies widely. There is no sexual predilection with regards to prevalence (Waldron, 2009; Dahlin, 1981; Fechner and Mills, 1993).

The structure of the tumor in dry bone takes the form of rather dense, irregular masses, except in phalanges where they would be round. Due to endochondral ossification they are rigid. This rigidity in the form and structure of the tumor in dry bone would lead to an expectation that they would be preserved readily within the archaeological record. As shall be discussed later, this is however not the case. Nevertheless, the sparsity within the archaeological record may be a result of the lack of external indications of enchondromas in long bones which masks their presence. They therefore go unobserved in osteological visual analysis, only to be detected if radiological tests are undertaken. Furthermore, the poor conservation of the small tubular bones of the hands likely results in enchondromas being lost from research. Regardless of the reasoning as to the infrequency of enchondromas in the archaeological and palaeopathological records, some cases have been described (Carter and Anderson, 1996; Charlier et al., 2012; Ciranni et al., 2006; Polo-Cerda and López-Flores, 2009) or cited (eg. some cases from Canarias Islands (Martín-Oval et al., 2008), Egypt (Baxarias, 2007), Nubia (Armelagos, 1969), or Russia [cit, at Ciranni et al., 2006]). There are also several cases that include enchondromas or related syndromes in the differential diagnosis (e.g. Kramar et al., 1995; Phillips and Verano, 2011) without a concluding etiology.

This work presents an endomedullary mass compatible with enchondroma within the femoral diaphysis of an individual from the medieval necropolis of St. Pere de Terrassa. It will provide radiological information pertaining to this type of lesion, and discuss this diagnosis in the context of other cases published in the archaeological record.

2. Material and methods

The site of St. Pere is a monumental archaeological complex, located in the city of Terrassa, 20 km North-West of Barcelona, Spain. It is comprised of three Romanic churches: Sta. Maria, St. Miquel and St.

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Pere. The subject of this report is one of more than one hundred Carolingian (9th- 10thCenturies) burials that have been excavated in the Necropolis of the St. Pere Church intermittently from 1982 to 2007. These burials are typically *decubito supine*, in a Southwest-Northeast orientation and are simple graves with anthropomorphic form. In specific cases they are covered with slabs or wood (Garcia et al., 2009; Jordana et al., 2010).

The case we present here corresponds to the skeleton UF 755 dated by C^{14} between 770AD and 1020AD (95.4%; LTL16803ACeDaD Code, Centro di Datazione e Diagnostica (CEDAD), Università de Salento).The entire individual presents an index of preservation of 73% (Armentano et al., 2012) with some taphonomic alterations of the cortical. The taphonomic damage of the right femur resulted in the loss of the cortical bone in the anterior distal diaphysis. Consequently, the internal region of the diaphysis was exposed displaying the presence of a rounded mass bound to the internal wall.

The sex and age at death of the individual were determined by studying the auricular surface of the ilium using methods compiled by Ferembach et al. (1980) and Ubelaker (1989) concluding that the individual was a male more than 60 years old.

UF 755 has a firm mass in the endomedullary cavity of the distal right femur (Fig. 1). An X-ray and CT scan were taken at the Hospital Universitari Sagrat Cor (Barcelona, Spain) (Fig. 2). X-ray of long bones and small bones of the hand were obtained. Later an additional μ-CT Scan of the damaged femur was acquired at CIRTEBEC (Università degli Studi di Sassari, Italy). In order to visualize the tangible aspects of the 3D structure of the tumour and cortical bone, μ-CT data were collected using a Bruker Skyscan 1172 high-resolution MicroCT system with a 5 μm focal spot size.

3. Results

The individual UF 755 presented several common pathological conditions seen in aged individuals. Indicators of axial degeneration were documented by way of osteophyte activity on all lumbar vertebrae (L1-L5), Schmorl's nodes on L3 and L4, and calcified flavum ligaments on most of the dorsal vertebrae. There were osteophytes and enthesophytes of the left radial tuberosity and also osteochondritis of the head of the left radius. The most intriguing pathological alteration is an endomedullary lesion in the right femur (Fig. 1).

Macroscopically, the internal mass is distinct from normal surrounding cancellous bone. The sharp, rather circumscribed mass is partially exposed due to taphonomic damage in the distal diaphysis. Additionally, there is no observed cortical thickening or periosteal reaction.

Fig. 1. Image of calcified lesion located inside the medullar diaphysis of the distal right femur belonging to UF 755 individual from St. Pere de Terrassa medieval site.

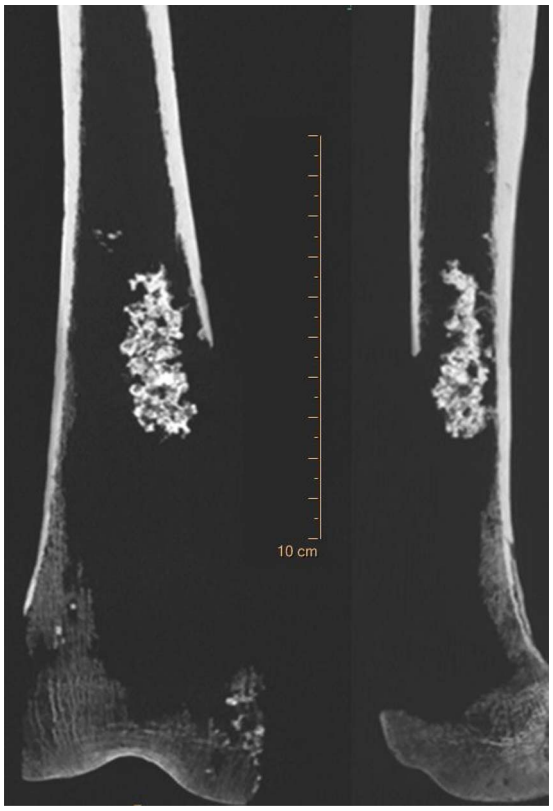

Fig. 2. Frontal and lateral view of CT images of distal femur of UF 755 individual. Image B indicates the way in which the calcification is attached to the posterior wall.

By X-ray, the image shows a flocculent and arc-and-ring pattern (Ragsdale, 1993; Greenspan and Borys, 2016). The CT image (Fig. 2) showed a disordered and dense mass approximately 7 × 2.8 cm, fused to the posterior internal diaphysis wall featuring sharp edges. The abnormal mass structurally differs from normal bone as is also seen in the μ-CT scan 3D images (Fig. 3). The location, ossification and appearance of the identified mass in the results of the X-ray and μ-CT scan support the diagnosis of enchondroma.

4. Discussion

The differential diagnosis includes various osteoblastic bone lesions. A bone infarction (a pseudotumoral lesion) should be located within the medullary cavity as outlined by a peripheral shell of amorphous mineralization (Inagaki et al., 2015). These lesions are difficult to differentiate morphologically from other endotumoral cases; in UF 755 there is slight endosteal scalloping (less than 2/3 of the cortical thickness), but no sclerotic rim (Fig. 4). Intramedullary osteomas or enostomas are solid laminations of bone without cancellous structure (Campillo, 2001), which are certainly not present in this case.

The differential diagnosis also includes other endomedullary tumors. Of these, the most frequent types are benign (osteoblastoma) and malignant (osteosarcoma, chondrosarcoma). A benign osteoblastoma could display spotted intralesional mineralizations, often associated with a cortical reaction. Bone fibroma conditions have a predilection for the distal femur and have sclerotic type IA border (Mehta et al., 2017). Loss of all unmineralized tumor tissue precludes differentiation of UF 755 from low grade chondrosarcoma by histological analysis. The area most commonly affected by low grade chondrosarcoma is the proximal femur (Schajowicz, 1982).The matrix of the enchondroma