



## Case Study article

# A rare probable chondroblastoma of the calcaneus in a pre-Columbian subadult from Illinois



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## ABSTRACT

Discrete cystic or tumorous intraosseous lesions can arise from a variety of benign and malignant conditions as well as trauma and infection. They are clinically rarely observed in the calcaneus. A fourteen-to-seventeen-year-old subadult recovered from a Late Woodland (~AD 800–1100) period mortuary context in the Mississippi River Valley of central Illinois presents with a single lytic intraosseous lesion on the posterior right calcaneus that bilaterally perforates the cortex. The lesion, although primarily anterior to the epiphyseal plate, does breach it. There is also a small perforation of the outer cortex of the epiphysis above the insertion of the Achilles' tendon. The lesion is well-defined with a primarily spongy cancellous interior margin. On the body of the calcaneus, there is periostosis and a slightly expansive endosteal reaction. Comparative radiographic assessments undertaken to differentially diagnose the lesion indicate that it was likely not malignant. Based on the posterior location, the radiographic signature, the bilateral cortical perforation and the breach of the epiphysis, the lesion is best interpreted as a chondroblastoma.

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## 1. Introduction

The occurrence of tumors (any abnormal mass of tissue) or cysts (air, fluids, or semi-solid tissue enclosed in a sac) in the calcaneus is clinically rare (e.g. [Andermahr et al., 2004](#); [Foo and Raby, 2005](#); [Oommen et al., 2009](#); [Polat et al., 2009](#); [Weger et al., 2013](#)) and most often identified in adults (e.g. [Polat et al., 2009](#)). Tumors or cysts can be the result of any one of a number of malignant or benign pathological conditions as can intraosseous lesions formed by sequestered infections or mechanical injury ([Mascard et al., 2015](#); [Oommen et al., 2009](#); [Revinga Martínez et al., 2007](#)). Certain malignant conditions, such as chondrosarcoma and Ewing's sarcoma, have a predilection for the calcaneus ([Kilgore and Parrish, 2005](#)). But, even if a calcaneal intraosseous lesion is benign, there may be tangible life-affecting biomechanical consequences to locomotion or other physical activities ([Foo and Raby, 2005](#); [Hafner et al., 2011](#); [Hatori et al., 2001](#); [Murani et al., 1989](#)). Lesions of the calcaneus are very rarely described in the paleopathological literature ([Curto and Fernandes, 2016](#); [González-Reimers et al., 2015](#)). A cortex-perforating lesion of the calcaneus is macroscopically visible in the skeletal remains of a prehistoric subadult from

west-central Illinois. In addition to this case as the first reported calcaneal intraosseous lesion from pre-Columbian North America, the lesion enables a comparison of the radiographic signature to the reactive change on dry bone.

### 1.1. Site background

Schroeder Mounds (11He177) is a Late Woodland Period (~AD 800–1100) mortuary site located on a low bluff overlooking the eastern bank of the Mississippi River floodplain in Henderson County, Illinois ([Fig. 1](#)). The site was serendipitously discovered during the remodeling of a domestic structure and the impacted area was excavated in 1979 ([Kolb, 1982](#)). The site yielded 123 well-preserved adult and subadult burials ([Nicosia et al., 2016](#); [Mosher et al., 2015](#); [Smith et al., 2016](#)). Although there are no Late Woodland village or other domestic structures associated with the site, indirect archaeological evidence suggests a forager-farmer subsistence/settlement pattern ([Esarey, 2000](#); [Nansel and Green, 2000](#); [Stoltman, 2000](#)).

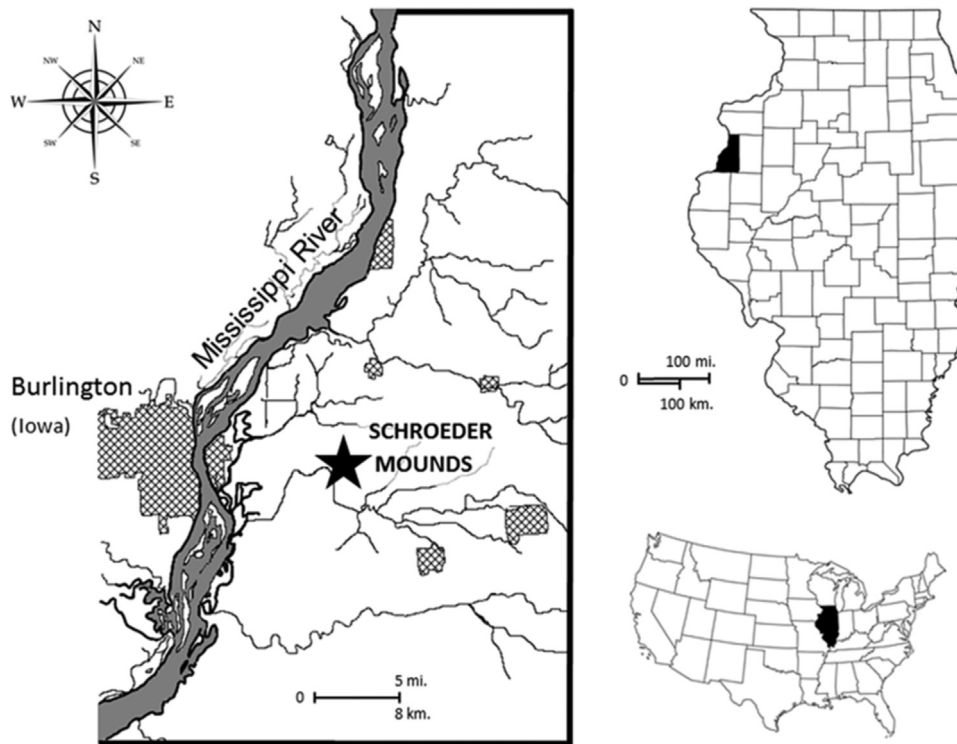
## 2. Case description

### 2.1. Age, sex, and preservation

The only long bone diaphyses of Burial 33 ([Fig. 2](#)) to exhibit epiphyseal fusion is the distal humerus which, preserving the

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**Fig. 1.** Map of the location of the Schroeder Mounds site (11He177) in Henderson County, Illinois. The site is approximately six miles east of the present-day city of Burlington, Iowa.

epiphyseal line, suggests an age-at-death (Buikstra and Ubelaker, 1994; Schaefer et al., 2009; White and Folkens, 2005:372) of between fourteen and seventeen years. The level of molar crown-root development (Ubelaker, 1989:64) of Burial 33 is also consistent with this age-at-death. Based on the preserved pelvic anatomy (i.e., wide subpubic angle, quadrangular pubic corpus) (Buikstra and Ubelaker, 1994), Burial 33 is likely a female.

This subadult preserves most of the long bone diaphyses and epiphyses, twenty vertebrae, bones of the mid face, three small fragments of temporal squama, and the mandible (Fig. 2). The only evidence of reactive change on the long bones is an area of periostosis on the anterior left tibia (Fig. 3a and b). There is no evidence of tuberculosis in the Schroeder Mounds sample (Mosher et al., 2015) or other chronic infection in Burial 33 that might account for a focal lesion. The hands and feet are fragmentary. There are six manual phalanges (two are certainly distal), three identifiable metacarpals (left and right fourth, right fifth), four right carpals (capitate, trapezoid, lunate, and scaphoid) and two left carpals (lunate, scaphoid) (Fig. 2). The right fifth metacarpal exhibits periosteal plaque on the dorsal surface (Fig. 3c). There are no pedal phalanges and the metatarsals consist of two non-diagnostic distal epiphyses and a fragmentary left proximal metatarsal. The only tarsals present are the left and right talus, the left and right calcaneus, and the left cuboid. Although the left calcaneus is very fragmentary, the body preserves an epiphyseal surface suggesting an unfused epiphysis. The complete right calcaneus exhibits epiphyseal fusion with the epiphyseal line beginning to obliterate along the lateral margin.

## 2.2. The right calcaneus

The posterior calcaneal body (maximum length 65 mm, maximum width 39 mm) exhibits a well-defined, bilaterally perforating, lytic lesion (circa 15 mm × 15 mm orifice) anterior to the epiphyseal margin (Fig. 4a and b). The lesion breaches the epiphyseal plate at the unfused medial margin and is anterior to the fusing lat-

eral margin (Fig. 4a). The lateral orifice is surrounded by expansile periostosis across the peroneal tubercle (Fig. 4b).

The medial and lateral orifices have a smooth cortical margin with a rounded rather than a sharp-edged perimeter. The defect has the appearance of a bore-hole with a slightly lobulated interior surface. The interior surface is macro-porotic on the anterior margin (Fig. 5a) and becomes smooth-walled at the posterior margin (Fig. 5b). The epiphysis has a small perforation at the area of the insertion of the Achilles tendon (Fig. 5c). These reactive changes on the lateral aspect of the calcaneus may have contributed to the fragmentation of the calcaneal epiphysis. That is, the lateral process, instead of being the area of initial epiphyseal fusion (Scheuer and Black, 2000:463) is a separate and unfused epiphysis (Fig. 5d). There is no evidence of any traumatic injury to the calcaneus. The only other preserved bone of the right foot is a fragmentary talus which exhibits no reactive change. The discrete area of periosteal plaque on the anterior left tibia and the right dorsal fifth metacarpal appear to have no relationship to the calcaneal lytic lesion.

## 2.3. Radiographic images

The radiographs of the calcaneus confirm the observations on the dry bone. In the lateral view (Fig. 6a), the lesion is visible as a well-defined radiolucent area anterior to the epiphyseal line. The contour is somewhat lobulated but not “soap-bubble” (i.e., Kuna and Gudena, 2011), and the margin is not sclerotic. The lesion does not alter the contour of the bone. The mottled appearance of the calcaneal body may reflect the periostosis evident on the dry bone. The radiograph also indicates the bilateral perforation of the cortex. In the coronal view (Fig. 6b), there is no radiolucent area indicating the presence of a lytic defect. However, despite the opacity generated by the articular facets, an area of diffuse (presumptive periostotic) mottling is evident.

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