



Suspected hypertrophic osteopathy in an ancient canid: Differential diagnosis of possible etiologies



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ARTICLE INFO

Article history:

Received 28 April 2014

Received in revised form 7 February 2015

Accepted 9 February 2015

Keywords:

Archaic period

Differential diagnosis

Domestic dog

Great Plains hypertrophic osteopathy

Iowa

ABSTRACT

Hypertrophic osteopathy (HO) has been reported in numerous mammalian species, but no reports address the range of conditions that can lead to HO, or the implications of those conditions, for archaeological diagnosis.

We describe suspected HO from skeletal remains of an ancient large domestic dog recovered in Iowa, USA, at the Cherokee Sewer site. Canid remains from this site date 7430–7020 cal BP. The site is believed to have been a temporary, low-intensity campsite where bison were procured.

Over 100 specimens from two small dogs, two large dogs, and a coyote, are present in the archaeofaunal assemblage. We document five pathological metapodials; an affected left ulna, radius, tuber calcaneus, accessory carpal, radial carpal; and an affected right central, second, and third tarsal within a proliferative mass. HO was suspected based on gross morphology, radiography, and computed tomography.

HO is a paraneoplastic syndrome with undetermined underlying pathogenesis; neuroendocrine complication of a number of neoplastic and non-neoplastic diseases is suspected. We review known disease associations of HO to provide a balanced field for considering differential diagnosis of suspect archaeological specimens, and suggest that definitive diagnosis of HO, or suspected HO, may be impossible in many instances where only skeletal remains are available for study.

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1. Introduction

1.1. Terminology

Hypertrophic osteopathy (HO) is the most biologically appropriate identifier for a disorder that has been termed variously as Marie's disease (Rumney and Schofield, 1950), hypertrophic pulmonary osteoarthropathy (HPOA) (Rumney and Schofield, 1950; Hancey and Pass, 1972), hypertrophic osteopathy (HPO) (Seiler, 1979), hypertrophic osteoarthropathy (HOA) (Carcassi, 1992), and secondary hypertrophic osteopathy (Johnson and Watson, 2000), each describing the same condition.

1.2. Species affected

HO has been reported in numerous mammalian species that include horse (Goodbary and Hage, 1960; Holmes, 1961; Godber et al., 1993; van der Kolk et al., 1998; Mair and Tucker, 2004), mink (Wilton and Graesser, 1967), cow (Martin et al., 1971), lion (Bush et al., 1974), chimpanzee (Marzke and Merbs, 1984), raccoon dog (Masegi et al., 1994), alpaca (Curtis et al., 1997), domestic cat (Becker et al., 1999; Grierson et al., 2003; Johnson and Lenz, 2011), and elk (Ferguson et al., 2008). However, HO is reported most frequently in humans and dogs (Brodey, 1971; Carcassi, 1992). It is not possible to extrapolate from existing literature to actual species-related incidence and prevalence, for any of the recognized species.

1.3. Characteristics

HO is characterized initially by firm enlargement of distal limbs with irregular periosteal new bone oriented approximately perpendicular to the long axis of the affected bone, or by smoother new

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bone with parallel orientation relative to the long axis (Johnson and Watson, 2000). As the condition progresses, upper limb bones, pelvis, and spine may become affected. Histologically, observed enlargements around bones are dense vascular connective tissue, periosteal osteogenic hyperplasia, and trabecular bone (Johnson and Watson, 2000).

1.4. Archaeology

North American archaeological reports of domestic dogs that describe apparent HO include a pre-contact Late Woodland burial (AD 500–1000) from the Hickory Bend site, Alabama USA (Chase, 1972) and a skeleton found at a 16th-century Neutral Iroquoian site in Ontario, Canada (Bathurst and Barta, 2004). No reports have discussed the range of conditions that can lead to HO as it is identified in archaeological specimens, or the implications for archaeological diagnosis. Here we present a description of an ancient canid with suspected HO, and review known precipitating pathologies in living domestic dogs.

2. Materials and methods

2.1. Archaeology

The remains of an ancient large domestic dog were recovered in Iowa (USA), at the Cherokee Sewer site (13CK405) (Fig. 1). This site is one of the best-documented examples of Early Plains Archaic lifeways in the eastern Great Plains (Shutler and Anderson, 1974; Anderson and Shutler, 1978; Anderson and Semken, 1980). Interdisciplinary investigations of this locality by the University of Iowa and Sanford Museum (1970s) included materials from the two middle Holocene components of the site. Horizon I dates 7430–7020 cal BP, and Horizon II 8170–7930 cal BP, based on charcoal 14C ages. Researchers suggest that cold-season bison processing activities (Anderson and Semken, 1980; Pyle, 1980;

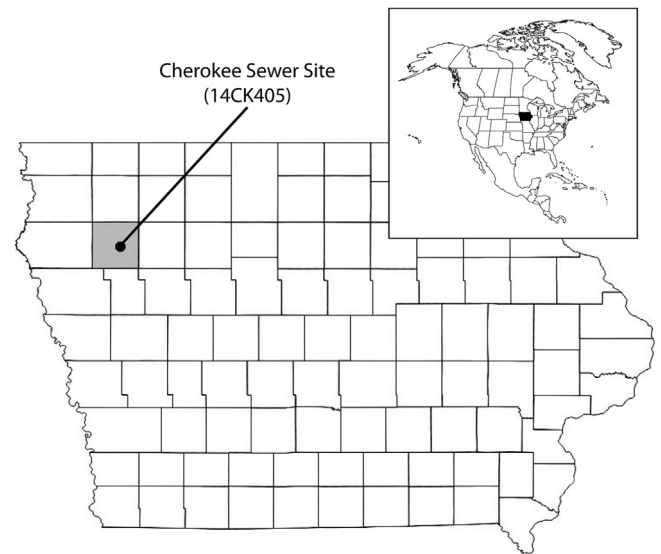


Fig. 1. Map indicating the location at which the HO-affected remains of a large domestic dog were recovered. Inset is USA map showing State of Iowa. Main figure shows the location of the recovery within the State of Iowa.

Whittaker, 1998) were undertaken because bison remains are prevalent and characteristics of the stone tool assemblage are compatible with animal processing.

2.2. Osteology

One hundred forty-three bone specimens attributed to genus *Canis* were documented from Horizon I. The positions of the bones show that the site was not used for deliberate burial, but rather the dogs appear to have been disposed of conveniently (Fig. 2). The *Canis* bone specimens were identified to element, portion, and side

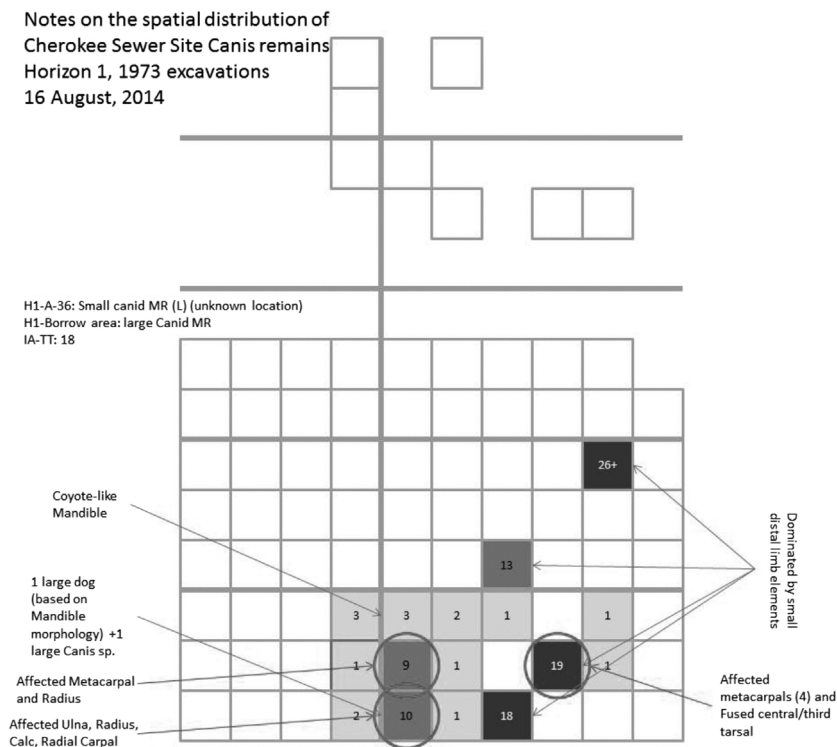


Fig. 2. Site map showing spatial distribution of remains recovered at the Cherokee Sewer Site.

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