Case Report

Evaluation of femoral head and neck new bone from a grey wolf (*Canis lupus lupus*): When is it pathology?

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Abstract

The ongoing debate about coxofemoral joint disease in domestic dogs indicates that new research is needed. Affected non-domestic canids are reported occasionally; we examined skeletal remains of a grey wolf and reported our observations.
Femurs of this specimen revealed articular margin new bone, mild new bone filling of the dorsal femoral neck, and a diagonal osteophyte line originating from the craniolateral aspect of the articular margin new bone. The latter extended in a cranioventral direction to the proximomedial femoral shaft, possibly representing new bone deposition along the margin of the joint capsule attachment. The features were inconclusive by radiography.

We suggest that some features of domestic dog coxofemoral joint disease may have ancestral origin, further underscoring the need for new research.

Keywords: Caudal curvilinear osteophyte (CCO), circumferential femoral head osteophyte (CFH), domestic dog, femur, grey wolf, new bone, osteoarthritis

Introduction

The ongoing debate about relationships between coxo-femoral osteoarthritis and the actual nature of hip dysplasia in the domestic dog (*Canis lupus familiaris*) might be summarized by observing that: Correct use of diagnostics is debated strenuously; interpretation of radiographic features is not agreed upon; the relationship of radiological features to actual morphology still needs levels of clarification; the biology of what does and does not constitute pathologic change is a continuing process of understanding. Further, since coxofemoral joint disease is recognized occasionally in non-domestic Canidae (Douglass, 1981; Lawler et al. 2012; Lawler et al. 2014), what interpretive diagnostic criteria exist independently or can be validly extrapolated from domestic dogs?

Ultimately, answering these questions with reasonable certainty will require more depth and breadth of radiographic and morphologic research. Indeed, even genomic questions are difficult to place in proper context without these basic but incomplete data. In this brief case report, we described observations of cleared proximal femora of an adult modern grey wolf (*Canis lupus lupus*), and we outlined our view of the implications of the findings.

Materials and Methods

The specimens that we evaluated are curated at the Illinois State Museum Research and Collections Center, Springfield, Illinois (USA), where they are part of zoological collections from North America. During a survey of modern skeletal remains, looking specifically at abnormalities of diarthrodial joints of Canidae, we observed the proximal extremity of the femurs of an adult modern grey wolf that was taken in the wild. The specimens are cataloged as ISM 693460. The specimens were examined visually and with magnification (3x), photographed, and radiographed. The observations were recorded and are presented herein.

Results and Discussion

Left femur Mild new bone production is present around the articular margin (Fig 1, 2). A line of new bone extends from the craniolateral aspect of the circumferential feature, first ventrally and then in a cranioventral direction, ending on the proximal femoral shaft. Mild new bone filling of the craniodorsal neck is visible. Radiological observations are indeterminate (Fig 3).

Right femur New bone production around the articular margin, the angular line of new bone, and filling of the dorsal femoral neck, are present as on the left proximal femur (Fig 4, 5). From the caudal aspect, articular margin new bone cannot be seen, but a linear density is visible at the location of the previously described CCO (Mayhew *et al.* 2002; Powers et al. 2004) (Fig 6). Radiological observations are indeterminate (Fig 3).

The terms circumferential femoral head osteophyte (CFHO) and caudocurvilinear osteophyte (CCO, Morgan's line) describe radiographic markers that have been associated with coxofemoral osteoarthritis and hip dysplasia in the domestic dog. The CFHO occurs at the articular margin of the femoral head (Szabo et al. 2007; Risler et al. 2009), and the CCO is found on the caudolateral femoral neck surface (both as recognized from the ventrodorsal, hips-extended radiographic projection (Riser, 1975; Morgan, 1987; Mayhew et al. 2002; Powers et al. 2004).

Our observations yield the information that mild or early stages of new bone proliferation, located similarly to those seen by radiography of domestic dogs, can be present in a non-domestic canid without being visible by radiography.

The angular line of new bone production is somewhat puzzling because of its distance from the articular surface. Differential diagnoses include enthesiophytes at the vastus medialis insertion, although the contour varies from descriptions of the domestic dog (Miller et al. 1979). Other differential diagnostic possibilities include pathological stretching of the joint capsule with secondary marginal osteophytes; periosteal reaction from focal trauma or muscle injury; or response to effects of abnormal stress vectors. These diagnostic differentials seem plausible because the grey wolf can run long distances at full speed in a prey chase.

Several new questions are raised, each indicating the need for new research, in our view.

(a) The grey wolf is the immediate ancestor of the domestic dog (Vila et al. 1997), and the dog is considered to be a grey wolf subspecies. However, we have used the term “new bone” to describe our direct observations, since our radiological examination was inconclusive. Degree of ossification, size, and stage of development are likely to be influential radiological factors, but stages of new bone progression that become evident by radiography are not yet defined.

b) Existing data show that the CFHO and CCO predict concurrent or future coxofemoral osteoarthritis in domestic dogs (Szabo et al. 2007; Risler et al. 2009). We are not aware of studies that precisely define the features and progression of degenerative coxo-femoral joint disease in non-domestic canids.

c) Histological studies of these features are needed in both dog and wolf. If histological observations are consistent across species, then using common terminology is appropriate. The femoral head changes do align observationally with anticipated location of osteophyte formation at and within the joint margin (Morgan, 1987).

d) Free-roaming and captive wild animals can hide pain convincingly. Wild animals, whether captive or free roaming, rarely are subjected to radiological study or necropsy evaluation that includes bone clearing and assessment for pathology.

Thus, it is difficult to develop clinical references for mild or early pathological states.

e) Finally, do unusual radiological and morphological features need to relate directly to some known problem in order to be considered as pathological changes? We submit that this question presently remains unanswered, certainly with respect to observations of cleared bone from wildlife.

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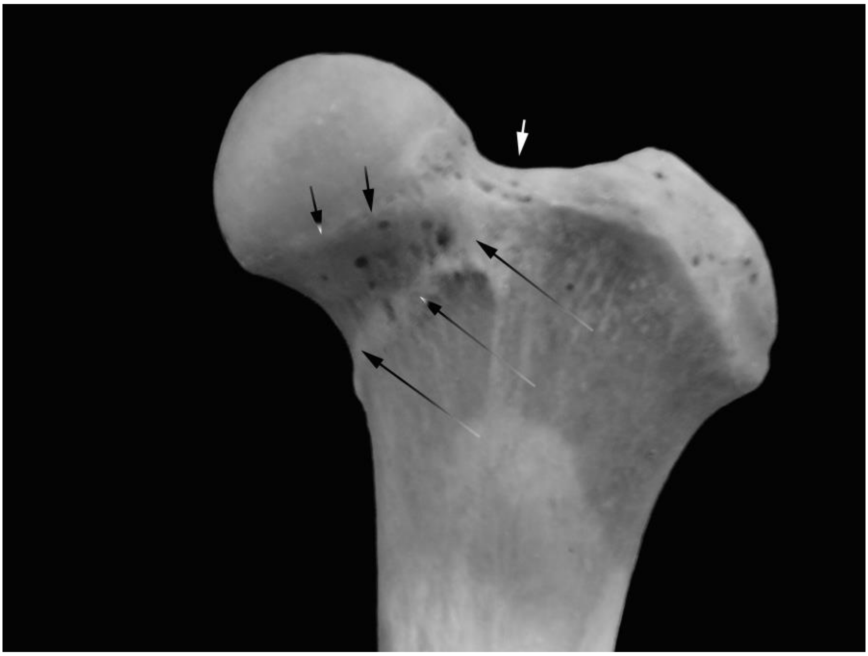

Fig (1): Left proximal femur, cranial view, showing periarticular new bone (short black arrows), diagonal osteophyte line (long black arrows) and mild filling at the dorsal femoral neck (short white arrow).

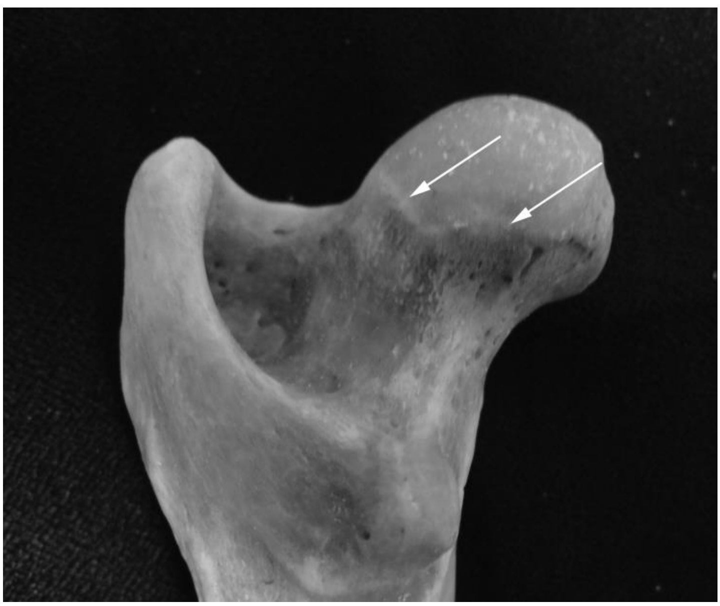

Fig (2): Left proximal femur, caudal view, showing periarticular new bone (long white arrows)

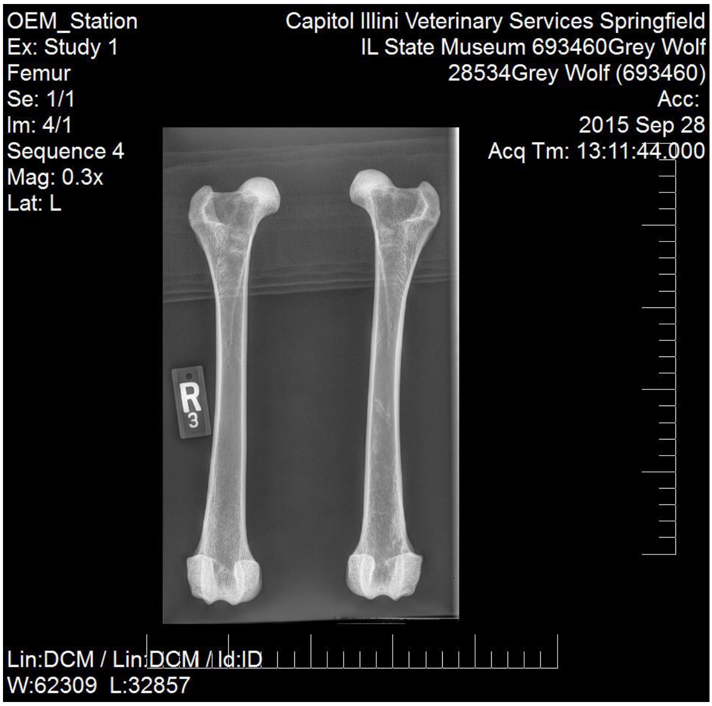

Fig (3): Radiograph of left and right femurs. The morphological features are not visible.

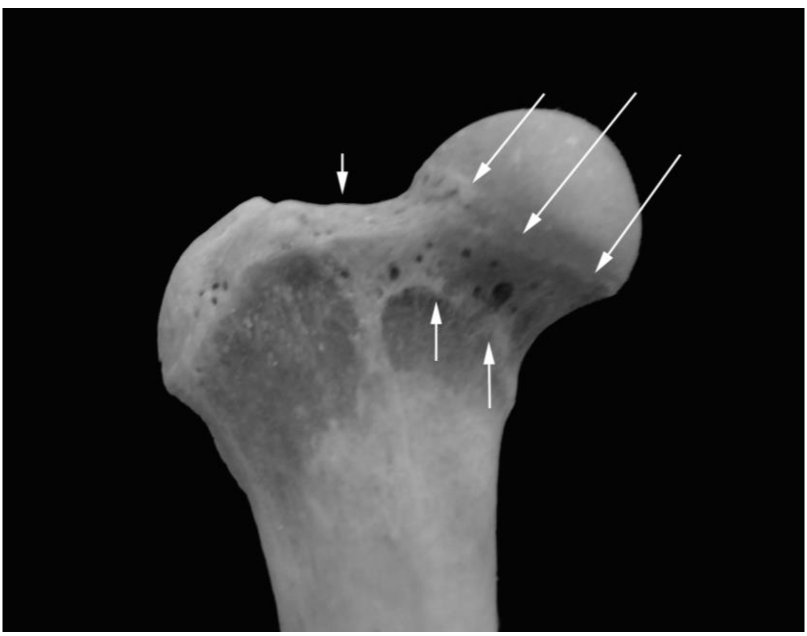

Fig (4): Right proximal femur, cranial view, showing periarticular new bone (long white arrows), diagonal osteophyte line (short white arrows), and filling the dorsal femoral neck

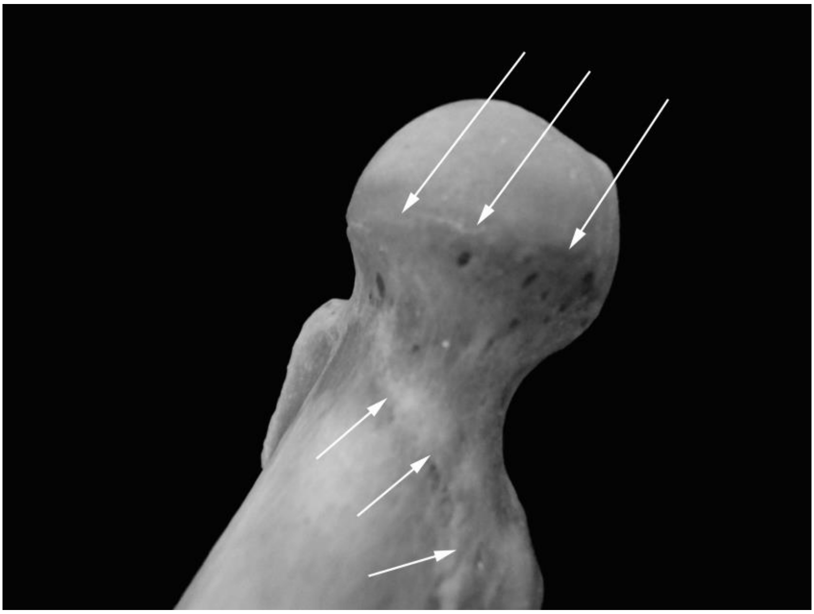

Fig (5): Right proximal femur, medial view, showing periarticular new bone (long white arrows) and diagonal osteophyte line (short white arrows)

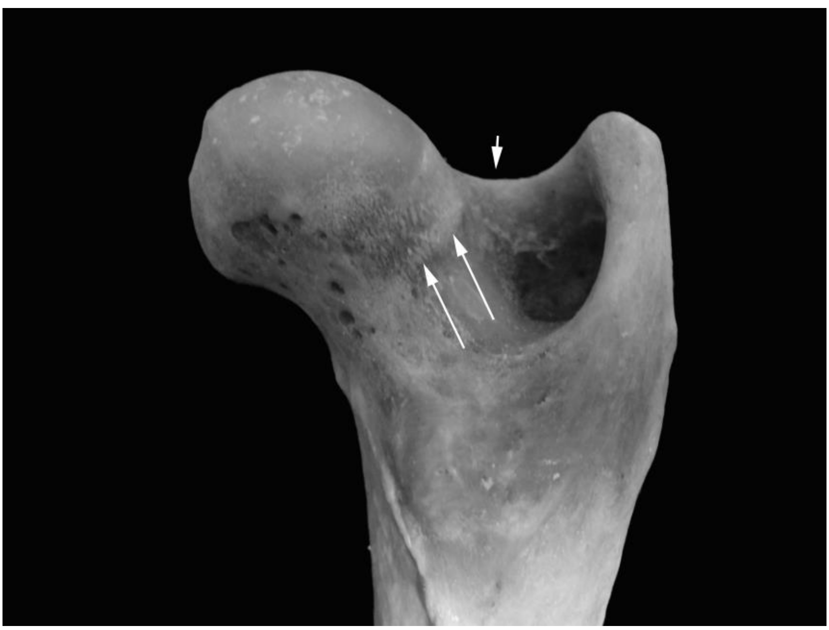

Fig (6): Right proximal femur, caudal view, showing new bone on the caudal femoral neck surface, and filling at the dorsal femoral neck