



# What Is Your Diagnosis?



Figure 1—Dorsopalmar radiographic view of both carpal joints, metacarpal bones III and IV, and metacarpophalangeal joints in a 7-month-old female Huacaya alpaca cria evaluated for decreased activity, poor growth, and a stiff gait of 3 weeks' duration.

## History

A 7-month-old female Huacaya alpaca cria was evaluated for decreased activity, poor growth, and a stiff gait of 3 weeks' duration. On physical examination, the cria was thin, reluctant to move, kyphotic, and had bilateral valgus angular limb deformities of the carpal and tarsal joints. The left metacarpophalangeal joint also appeared to have a valgus deformity. Palpation of the limbs and vertebral column elicited signs of pain. Results of a CBC were within reference ranges. Results of serum biochemical analyses indicated that the serum phosphorus concentration was low (1.1 mg/dL; reference range, 4.5 to 8.5 mg/dL) and serum activities of creatine kinase (345 U/L; reference range, 10 to 200 U/L), alkaline phosphatase (514 U/L; reference range, 10 to 100 U/L), and aspartate aminotransferase (417 U/L; reference range, 10 to 280 U/L) were high. Serum was submitted for determination of the 25-hydroxy vitamin D<sub>3</sub> concentration. A radiograph of both carpal joints, metacarpal bones III and IV, and metacarpophalangeal joints was obtained (Figure 1).

Determine whether additional imaging studies are required, or make your diagnosis from Figure 1—then turn the page ▶

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Figure 2—Same radiographic view as in Figure 1. Notice the markedly wide distal physes in the radius, ulna, and metacarpal bones III and IV bilaterally (arrows). The metaphyses are also cupped.



Figure 3—Dorsopalmar radiographic view of both carpal joints, metacarpal bones III and IV, and metacarpophalangeal joints in the cria in Figure 1 obtained 1 month after administration of a single dose of vitamin D<sub>3</sub> (2,000 U/kg [909 U/lb], SC). Notice that the widths of the physes of the radius, ulna, and metacarpal bones III and IV have decreased bilaterally (arrows) and that metaphyseal remodeling with dense bone formation is evident.

### Radiographic Findings and Interpretation

Marked widening of the distal physes of the radius, ulna, and metacarpal bones III and IV is evident bilaterally (Figure 2). Affected bones have widening and cupping of the metaphyseal bone. The cortical margins, particularly those of the distal portion of the radius, are not distinct. Lateral bowing of the distal portion of the antebrachium is evident bilaterally, but more severe in the right limb. Bilateral carpal valgus deformity centered on the distal radial and ulnar physes is also evident. Additionally, valgus deformity of the left metacarpophalangeal joint centered on the distal physes of metacarpal bones III and IV and mild varus deformity of the right metacarpophalangeal joint centered on the distal physes of metacarpal bones III and IV can be seen.

Radiographically, differential diagnoses included rickets attributable to a calcium, phosphorus, or vitamin D deficiency and metaphyseal chondroplasia. Dietary deficiencies of zinc, manganese, magnesium, and vitamin A were also considered as less likely differential diagnoses.

### Comments

Although not an optimal radiographic technique, both forelimbs were included in 1 radiograph to offer a skeletal survey, to address the owner's financial constraints.

On the basis of physical examination, radiographic findings, and a low serum phosphorus concentration, a diagnosis of hypophosphatemic rickets as a consequence of hypovitaminosis D was made. Serum con-

centrations of 25-hydroxy vitamin D<sub>3</sub> were 5 nmol/L (reference limit, > 50 nmol/L), which supported the diagnosis.

The cria was treated with a single dose of vitamin D<sub>3</sub> (2,000 U/kg [909 U/lb], SC). Three weeks after initial evaluation, the cria was ambulating well and had a serum phosphorus concentration within reference range. Radiography of both forelimbs from the carpus distally revealed that the previously widened physes were normal bilaterally, with sclerosis of the subjacent metaphyseal bone, indicating increased mineral deposition (Figure 3). Other findings were unchanged.

Rickets is a metabolic bone disease of young animals and has been attributed to either a single or combined deficiency of calcium, phosphorus, and vitamin D.<sup>1</sup> In camelids, hypophosphatemia may be associated with insufficient concentrations of vitamin D.<sup>2</sup> In addition, camelids living in regions of the country with prolonged inclement weather or reduced sunlight may be predisposed to vitamin D deficiency.<sup>3</sup>

Radiography of the limbs is important when evaluating crias with angular limb deformities. Typical radiographic findings in animals with rickets result from failure of the physal cartilaginous matrix to calcify, as well as widening, demineralization, and disorganization of metaphyseal bone.<sup>4,5</sup> Additionally, asymmetric musculotendinous forces on a weakened physis and weight-bearing effects can lead to limb deformities.<sup>5</sup> Typical radiographic findings in animals with rickets include widened, irregular physes; widening and cupping of metaphyses; poor metaphyseal mineralization; bowing of long bones; and failure of adequate mineralization of all bones.<sup>5,6</sup> The classic radiographic lesions reflecting hypophosphatemic rickets are important in achieving a correct diagnosis and initiating treatment.

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