## Osseous sequestration in alpacas and llamas: 36 cases (1999–2010)

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**Objective**—To describe clinical findings, treatments, and outcome in camelids treated for osseous sequestration.

**Design**—Retrospective case series.

**Animals**—27 alpacas and 9 llamas with osseous sequestration.

**Procedures**—Medical records of 2 veterinary teaching hospitals were reviewed to identify camelids evaluated because of osseous sequestration between January 1, 1999, and December 31, 2010. Data on history, signalment, physical examination and medical imaging findings, treatment, and complications were collected.

**Results**—Records of 36 camelids were included, of which there were 22 sexually intact males, 11 females, and 2 castrated males with a median age of 7.5 months, 3.9 months, and 8.5 years, respectively (age and sex were not available for 1 camelid). The most common clinical signs were lameness, swelling over the affected bone, and associated draining sinus. Sequestra were associated with trauma in 7 (19%) camelids. Camelids with sequestra not associated with trauma (n = 29 [81%]) were significantly younger than those with sequestra attributed to trauma. Thirty-four camelids underwent sequestrectomy, and all survived to hospital discharge (median duration of hospitalization, 6.5 days). Recurrence of a sequestrum occurred twice in 1 (3%) camelid. Long-term follow-up (≥ 12 months) information was available on 24 camelids, of which 20 (83%) recovered without long-term complications.

**Conclusions and Clinical Relevance**—Unlike in other livestock, trauma was not a primary cause of osseous sequestration in camelids. Sequestra should be considered in the differential diagnostic process in camelids with lameness, a draining sinus, or a firm swelling over a bony prominence. Sequestrectomy is a successful treatment option. (J Am Vet Med Assoc 2013;243:430–436)

Osseous sequestration is an orthopedic disorder increasingly recognized in camelids (alpacas and llamas). Clinical data regarding sequestra in camelids have been limited to publication in conference proceedings or individual case reports. The clinical manifestation of sequestra in affected camelids contrasts with that in other large animal species, such as cattle and horses, because the condition has only been reported in camelids < 2 years of age and most often develops without evidence of trauma. Sequestration of bone in camelids is proposed to be a sequela of hematogenous osteomyelitis. To the authors' knowledge, no studies have been conducted to characterize the clinical signs, diagnosis, treatment, and long-term outcome in a large number of alpacas and llamas with bone sequestra.

The objectives of the study reported here were to characterize the history, clinical signs, treatment, complications, and outcome of sequestra in alpacas and llamas. On the basis of clinical experience, we hypothesized that sequestra in camelids would be most commonly associated with etiologies other than trauma and with juvenile (< 2 years old) alpacas and llamas. We also hypothesized that sequestrectomy would be a successful procedure with few complications when performed in affected alpacas and llamas.

**Materials and Methods**

Case selection—Medical records of 2 veterinary medical teaching hospitals were searched by computer and reviewed to identify alpacas and llamas with osseous sequestration that were treated between January 1, 1999, and December 31, 2010. Records of camelids with sequestra associated with osteomyelitis due to the extension of infection from soft to osseous tissues (eg, tooth root abscess and otitis interna or media) were excluded from the study because such sequestra are occasional consequences of those conditions.

Medical records review—Medical history, signalment, physical examination and radiographic findings, hematologic and serum biochemical findings, micro-
brial culture and antimicrobial susceptibility test results, concurrent diseases, treatments performed, surgery reports, and complications data were retrieved when present from all included medical records. Surgery reports were reviewed, and data concerning the type of closure and application of drains were noted.

When available, information from follow-up examinations at the teaching hospitals was also retrieved. Additional follow-up information was obtained through telephone communication with the owners. Owners were interviewed about whether the affected camelid had been retained in the herd, recovered after the procedure, or developed complications as well as their satisfaction with the outcome. Long-term follow-up was defined as an interval ≥ 12 months after hospital discharge. All data were entered into a spreadsheet for statistical analysis.

Statistical analysis—Descriptive statistics were generated from the retrieved data and are reported as medians and ranges or proportions. The Mann-Whitney U test was used to compare ages between affected camelids with and without a history of trauma, with a value of P < 0.05 considered significant.

Results

Signalment—The medical records search resulted in the identification of 36 camelids (27 alpacas and 9 llamas) with sequestration that met the inclusion criteria for the study. Of the 35 camelids for which data on age and sex were available, 22 (63%) were sexually intact males (median age, 3.9 months; range, 1.0 to 23.4 months), 11 (31%) were females (median age, 7.5 months; range, 0.8 months to 8 years), and 2 (6%) were castrated males (8 and 9 years of age). Thirty-one camelids originated from 31 farms, 3 from 1 farm, and 2 from 1 farm. Body weight was recorded for 24 alpacas (median, 29.1 kg [64 lb]; range, 8.6 to 83.6 kg [19 to 184 lb]) and for all llamas (median, 70.9 kg [156 lb]; range, 23.6 to 136.4 kg [52 to 300 lb]).

History—The 29 camelids for which the information was available had been admitted to the hospital a median of 28 days (range, 2 days to 20 months) after the onset of clinical signs. Nine alpacas were referred for treatment at the 2 teaching hospitals after a radiographic diagnosis of osseous sequestration was made by their referring veterinarians. Three of these 9 alpacas were initially examined by their veterinarians because of lameness alone (forelimb, n = 2; hind limb, 1), 2 because of forelimb lameness and concomitant swelling over the fused metacarpal bones or proximal phalanx, 1 because of a draining tract of the fused metatarsal bones, and 1 because of a swelling over the affected metatarsal bones. For 2 of these 9 alpacas, the reasons for initial examination by their veterinarian were unknown.

The most commonly recorded reason for initial examination in the other 27 camelids was lameness (n = 16 [59%]). Four camelids with lameness were also evaluated because of a swollen area (fused metacarpal bones, 2; humerus, 1; carpus, 1), 3 because of a draining tract (fused metatarsal bones, 1; medial aspect of tarsus, 1; distal aspect of tibia, 1), and 1 because of a decrease in feed intake. Presence of a draining tract over a bony structure of the appendicular skeleton (fused metatarsal bones, 1; scapula, 1; femur, 1) or the axial skeleton (rib, 1; zygomatic bone, 1) represented the main clinical sign reported by owners of 5 other camelids. One of the 5 camelids had been evaluated because of weight loss, 1 because of a decrease in feed intake, and 1 because of seizures. Two other alpacas were referred to the teaching hospitals after recurrence of the clinical signs following sequestrectomy performed by the referring veterinarian. The reasons for examination in 3 other camelids included infected skin lacerations over the fused metatarsal bones (2) and delayed healing of an open metatarsal fracture (1). Review of the medical records of 1 alpaca failed to identify the main reason for examination for that camelid. Only 1 male llama had a history of neonatal maladjustment when it was a cria. None of the other camelids had record of difficulties during their birth, neonatal maladjustment, previous systemic illness, or failure of passive transfer of immunoglobulins.

Previous treatments—Prior to initial evaluation at the teaching hospitals, various treatments had been administered by the owners or referring veterinarians to 23 camelids. Information about previous treatments was not recorded for 12 camelids, and 1 llama did not receive any treatment before hospital admission. Antimicrobials were the most common treatments mentioned (n = 14), including ceftiofur (sodium, hydrochloride, or crystallidine-free acid formulations), procaine penicillin G, trimethoprim-sulfadiazine, and florfenicol. Other treatments included administration of NSAIDs (11) such as flunixin meglumine or phenylbutazone, stall rest (4), antiseptic cleansing of the draining tracts (4), and IM administration of polysulfated glycosaminoglycan (3). Fourteen of the 23 (61%) camelids received various combinations of these treatments. Treatment doses and durations were not available. Only 2 camelids had an initial favorable response to treatment, but their clinical signs recurred following treatment discontinuation.

Physical examination findings—Median values of physiologic variables at the initial teaching hospital evaluation of the 36 camelids were as follows: rectal temperature, 38.4°C (101.2°F); range, 36.6°C to 39.6°C [97.9°F to 103.3°F]); heart rate, 72 beats/min (range, 48 to 148 beats/min); and respiratory rate, 32 breaths/min (range, 12 to 60 breaths/min). Clinical signs included lameness (n = 16 [44%]), swelling over the affected bone (16 [44%]), draining sinus (12 [33%]), signs of pain upon palpation of the affected area (4 [11%]), traumatic wounds (4 [11%]), and radiocarpal joint effusion, delayed union of a metatarsal fracture, or cardiac arrhythmia (1 [3%] camelid each). Of the 16 lame camelids, lameness intensity was recorded for 12 as weight-bearing (10) or non–weight bearing (2). Concurrent conditions identified at initial physical examination included loose feces in 4 (11%) llamas and 1 (3%) alpaca, angular limb deformity in 1 (3%) alpaca, simple umbilical hernia in 1 (3%) llama, epilepsy in 1 (3%) llama with a femoral sequestrum, and focal alopecia in 1 (3%) llama. Fecal examination showed the camelids with loose feces had intestinal parasitism.
Etiology—Only 7 of 36 (19%) camelids (5 sexually intact males, 1 castrated male, and 1 female) had a history of trauma reported by the owners and had signs of trauma. Causes of sequestra were not identified for the other 29 camelids, and no evidence of trauma was found at the time of initial evaluation. Camelids with no evidence of trauma (median age, 3.1 months [range, 25 days to 8.3 years]; n = 28) were significantly (P = 0.02) younger than those with a history of trauma (median age, 17.6 months [range, 6.6 months to 8.8 years]; 7).

Medical imaging—A radiographic diagnosis of osseous sequestration was made in 33 camelids. Identification of osseous sequestration was established by CT in the other 3 camelids after a presumptive diagnosis of sequestrum had been made via physical examination and radiography. These sequestra involved the mandible (n = 1), ulnar carpal bone (1), and rib (1; Figure 1). Computed tomography findings helped in selection of the appropriate surgical approach for sequestrectomy.

The most common radiographic findings in the 36 camelids included soft tissue swelling surrounding the affected area (n = 19 [53%]), osteomyelitis (18 [50%]), and periostitis (13 [36%]). Given these findings, extension of the pathological process to an adjacent joint was suspected in 4 camelids. In 3 camelids, soft tissue abscess was diagnosed on the basis of simultaneous increase in thickness of the soft tissue and presence of gas with demarcated lines of fluid. Radiographic images from the referring veterinarian showed the evolution of the radiographic abnormalities in the acute phase of the disease process in 1 alpaca cria (Figure 2).

Osseous sequestration affected a long bone in 26 camelids. In 11 of 26 (42%) camelids, sequestra were located only within the diaphysis, whereas lesions also extended to the metaphysis in 2 (8%) camelids or to the metaphysis, physis, and epiphysis in 3 (12%) camelids. In 1 alpaca, the lesions identified via radiography involved the metaphysis, physis, and epiphysis of the proximal aspect of the humerus. Upon review of radiology reports, accurate identification of the specific region of the affected long bone was not possible in 9 camelids with long bone sequestration.

All 7 camelids with a history of trauma had sequestra in the distal extremities of the appendicular skeleton (6 with metatarsal sequestra and 1 with a carpal sequestrum). Thirteen camelids with no history of trauma had sequestra of the distal extremities of the appendicular skeleton, which were distributed as follows: metacarpal bones, 5; metatarsal bones, 3; calcaneus, 2; proximal phalanx, 2; and carpal bones, 1. Three camelids with no history of trauma had sequestra of the axial skeleton (1 each for mandible, zygomatic bone, and rib), and the remaining 13 had sequestra of the proximal aspect of the appendicular skeleton (tibia, 4; radius, 2; humerus, 2; scapula, 2; femur, 2; and ilium, 1).

Clinicopathologic characteristics—A complete hematologic and serum biochemical analysis was performed before surgery in 7 camelids, whereas PCV and blood total solids concentration were measured in 21 camelids. The total leukocyte count was high in 2 camelids (2.40 × 10³ leukocytes/µL and 3.03 × 10³ leukocytes/µL; reference limits, 8.0 × 10³ leukocytes/µL to 21.4 × 10³ leukocytes/µL). The leukocytosis was due to mature neutrophilia in both situations (17.0 × 10³ neutrophils/µL and 19.0 × 10³ neutrophils/µL; reference limits, 4.0 × 10³ neutrophils/µL to 14.8 × 10³ neutrophils/µL). Hyperfibrinogenemia (0.6 g/dL; reference limits, 0.1 to 0.4 g/dL) was detected in a 3-month-old female llama. All other hematologic findings were within reference limits.

Hyperglycemia was identified in 2 camelids (serum glucose concentration, 158 and 172 mg/dL; reference limits, 74 to 154 mg/dL) and was attributed to stress. Hypoproteinemia (serum total protein concentration, 3.7 g/dL; reference limits, 5.1 to 7.8 g/dL) was associated with intestinal parasitism in a 3-month-old alpaca. Three camelids had a low PCV (22% and 23%; reference limits, 27% to 45%). All other measured values were within reference limits.

Bacterial culture—Bacterial culture and antimicrobial susceptibility testing were performed for 46 samples (24 aerobic and 22 anaerobic cultures) of sequestra or pyogenic membrane collected from 24 camelids during surgery. Anaerobic bacteria were isolated from 11 (50%) cultures, whereas aerobic bacteria were isolated from 7 (29%) cultures. More than 1 isolate was obtained from 5 (21%) cultures. All aerobic isolates were susceptible to >1 antimicrobial.

The following bacterial species were recovered from samples obtained from camelids with no history of trauma: Fusobacterium necrophorum, 5; Fusobacterium spp, 5; Staphylococcus aureus, 2; Staphylococcus intermedius, 1;
Enterococcus spp, 1; Pseudomonas spp, 1; Bacillus spp, 1; and Corynebacterium pseudotuberculosis, 1. From 3 camels with trauma-associated sequestra, 1 isolate was obtained for each of Fusobacterium necrophorum, S aureus, S intermedius, Enterococcus spp, Proteus spp, Escherichia coli, and Streptococcus zooepidemicus.

Treatments—Thirty-five camels underwent surgical treatment for osseous sequestration. Thirty-four (97%) underwent sequestrectomy with debridement and curettage of the involucrum. The remaining camel (3%) underwent incision and drainage of a subcutaneous abscess that was communicating with a humeral sequestrum. The 1 camelid that received only medical treatment was a 1.2-month-old llama with a humeral sequestrum.

Histologic analysis—Eight surgically removed sequestra were examined microscopically after decalcification. In 6 sequestra, the microscopic lesions were consistent with suppurrative osteomyelitis most likely caused by a bacterial infection. Aerobic and anaerobic bacterial cultures were performed for 5 of these 6 sequestra. The following bacterial species were recovered from 3 camels: Fusobacterium necrophorum, 1; Fusobacterium spp, 1; and Corynebacterium pseudotuberculosis, 1. Reactive fibrosis and inflammatory infiltration were identified in 1 sequestrum, whereas reactive bone formation, fibrosis, and osteolysis consistent with a response to a previous fracture were identified in another sequestrum.

Postoperative management—Systemic antimicrobial treatment was provided for 4 to 37 days after surgery (median, 10 days; n = 31 [duration unknown for 4 camels]). Twenty-three camels received 1 antimicrobial, whereas 10 camels received ≥ 2 antimicrobials. One male alpaca received no antimicrobial parenterally during the perioperative period; the information on the antimicrobial administered to another male alpaca was not available.

The most commonly administered antimicrobial was ceftiofur sodium (n = 22), followed by procaine penicillin G (11), ceftiofur hydrochloride (5), isoniazid (2), florfenicol (2), trimethoprim-sulfadiazine (1), and enrofloxacin (1). Bandages (n = 16), splint bandages (7), and cast bandages (3) were applied to protect the surgical site or support the limb for 2 to 28 days (median, 12 days) after surgery.

All camelids required at least 1 osteotomy of the involucrum to gain access to the sequestrum. Typically, the surgical approach and subsequent ostectomies were centered over the draining sinus. However, when a draining sinus was lacking, the surgical approach required careful planning. Immediately before or after closure of surgical sites, postoperative radiographs were obtained in 12 camels (10 with no trauma history and 2 with trauma) to assess complete excision of sequestra and integrity of the remaining cortices.

Twenty-eight sequestrectomy sites were primarily closed, whereas 3 others were left open to heal. The type of closure was not indicated for 1 camelid. Penrose drains were used in 13 camels and left in place for a median of 4 days (range, 1 to 9 days; n = 10 [duration of drain use unknown for 5 camels]). Multifenestrated flat silicone (Jackson-Pratt) drains were used to provide an active irrigation system after surgery in 6 camels. These drains were left in place for a median of 5 days (range, 2 to 9 days). Irrigation solutions consisted of sterile saline (0.9% NaCl) solution with 1 or more antimicrobials (eg, potassium penicillin, sodium ampicillin, amikacin, and gentamicin; 3 camels) or diluted iodine solution (2). The type of solution was not recorded for 1 camelid.

Figure 2—Radiographic images of the left forelimb of a 3-month-old male alpaca with osseous sequestration. A—Dorsopalmar view obtained by the referring veterinarian 7 days after the cria began to have signs of lameness in the affected limb. Notice the soft tissue swelling surrounding the proximal aspect of the left fused metacarpal bones without evidence of bony lesions. B—Dorsopalmar view of the same left forelimb (LF) 13 days later, revealing a cortical sequestrum of the dorsomedial aspect of the fused metacarpal bones. C—Lateromedial view obtained at the same time as the view in panel B. Physical examination of the cria failed to reveal signs of trauma.
Short-term complications in the surgically treated camelds prior to hospital discharge included surgical site infection (n = 2), postoperative lameness (2), and fever of unknown origin (1). Camelds were discharged 0 to 34 days after surgery (median, 7 days). Owners of 18 (53%) camelds were instructed to confine their cameld in a stall or small pen for 14 to 21 days, followed by a period of progressive return to usual activity. All owners of surgically treated camelds were instructed to monitor the healing of the surgical incision. Skin su-
tures were removed 14 to 21 days after surgery by the referring veterinarian or the owner.

Follow-up information and outcome—Long-term follow-up information was available for 24 (67%) camelds (19 alpacas and 5 llamas; 19 with no trauma and 5 with trauma). The median follow-up period after hospital discharge was 7.7 years (range, 1 to 10.7 years). Half of the camelds (9 with no trauma and 3 with trauma) had remained in their herds during the follow-up period. According to the owners, 21 (88%) camelds (16 with no trauma and 5 with trauma) had fully recovered. Owners of 22 (92%) camelds (17 with no trauma and 5 with trauma) were satisfied with the final outcome, but owners of 2 (8%) camelds with no trauma history were unsatisfied.

Four (17%) camelds (3 with no trauma and 1 with trauma) developed long-term complications. Two of them, both with no history of trauma, developed major complications, such as persistent infection of the surgical site (sequestrum of the fused metacarpal bones) and neurologic deficits of the affected forelimb (sequestrum of the scapula), leading to death. Two other llamas developed minor complications, such as abnormal appearance of the affected limb (trauma-associated se-
questrum of the fused metatarsal bones) and persistent lameness (femoral sequestrum with no trauma history) that did not affect their reproductive performance.

Recurrence of a femoral sequestrum occurred twice (10.5 and 3 months after surgery) at the same anatomic site in a 3-year-old male llama, despite complete re-
moval of the sequestrum during the first and second surgical procedures, as assessed intraoperatively and by radiographic surveys after surgery. Long-term follow-
up information after the last sequestrectomy was not

Discussion

The present study represents the largest retrospec-
tive case series of osseous sequestration in alpacas and llamas to date. A previous study2–4 involved 9 young camelds with 13 sequestra in the appendicular skeleton without evidence of trauma, whereas our study includ-
ed camelds with sequestrum of traumatic and nontrau-
matic origin in axial and appendicular skeletons. Short, irregular, and flat bones were included in addition to long bones because these types of bones have metaphy-
seal-like regions similar to that in long bones.18

A sequestrum is a nonviable and avascular segment of bone that has become detached during the process of necrosis from the surrounding sound bone. Most osseous sequestration in cattle and horses is caused by traumatic wounds with damage to the surface of the bone and associated periostal injury.11–14 Secondary bacterial colonization of the bone is considered a fundamental factor in sequestrum development.11–14 In the present study, only 7 of the 36 (19%) camelds had clinical signs of osseous disease or a history of injury. Although the lack of historical and physical evidence of trauma cannot exclude injury, such as blunt trauma without a noticeable skin defect, in the other 29 camelds, we believe that under the circumstances, trauma was unlikely.

Another possible cause of osseous sequestration is bacteria that reach bone by local extension of an adja-
cent soft tissue infection or blood circulation. Extens-
ion of infection to osseous tissues can occur following dental, sinus, inner ear, and foot infections in various species.8,17,18 Camelds with chronic infectious condi-
tions such as otitis interna, otitis media, or tooth ab-
scess were excluded from the present study because se-
questra are occasional consequences of those diseases. Hematogenous spread of bacteria to bone was the most likely cause of osteomyelitis or osteitis and further os-
seous sequestration in the 29 camelds with osseous sequestration not attributable to trauma.1,4 Osseous sequestration secondary to hematogenous osteomyeli-
tis has been identified in young and adult cattle11,16,19
and in foals.20 The study camelds were born without complication and had no history of systemic or local-
ized illness or failure of passive transfer of immuno-
globulins, with the exception of 1 llama with neonatal maladjustment. However, signs of bacteremia could have been undetected by owners and farm managers. In contrast, 5 of 9 camelds in another study2 had difficulties at birth or illnesses during the first 2 weeks of the neonatal period. Hematogenous emboli can re-
sult in polyostotic sequestration in the same animal.2

Although osseous sequestration in young camelds ap-
ppears to be a sequela of hematogenous osteomyelitis, additional investigations involving bacterial culture of blood or bone tissue, bone biopsy, and serial ultraso-
ographic and MRI evaluations as performed in chil-
dren10,21 during the early stage of osseous sequestration are needed to support this supposition.

Hematogenous osteomyelitis causing osseous sequestrat-
ation in children and adolescents20,22,23 resembles the condition in camelds. In humans, the disease is usually diagnosed and treated during the early stage, but without treatment, the condition becomes chronic and osseous sequestration develops.23 It develops following bacterial colonization of the metaphyseal region of long bones or similar regions of flat bones.10 Local vascular stasis within the terminal branches of the metaphyseal arteries and the presence of incomplete capillary endothelium are believed to favor local seeding of bacteria.24 Inflammatory exudate accumulates into the rigid vascular channels of the bone, marrow cavity, and endosteal and subperiosteal regions. Detachment of an avascular fragment of bone from the surrounding bone results in the formation of a seque-
strum.13,14,17 Vascularized periosteal new bone, also called involucrum, envelops the sequestrum. Finally, the inflam-
mmatory exudate exits the involucrum through a draining tract to the skin forming the cloaca.17

In large animals, hematogenous formation of se-
questra has not been thoroughly characterized. Given
but only 14 days in another study, with a much smaller evaluation at the hospitals. The median duration of elapsed between the onset of clinical signs and initial treatment for this difference in age distribution may be the time necessary for the formation of the involucrum, cloaca, and soft tissue abscesses. Computed tomography is excellent for detection of sequestra, involucrum, cloaca, and soft tissue abscesses. In most instances, infection is secondary to the local spread of bacteria from a contiguous infection. Anaerobic hematogenous osteomyelitis results from bacterial spread to bone from a primary extraskeletal focus of anaerobic infection.

Fusobacterium necrophorum can cause bacteremia without predisposing factors in previously healthy adolescents and young adults, in adults with predisposing internal jugular vein thrombosis (Lemierre syndrome), and in women with puerperal infections. To the authors' knowledge, there are only 2 reports of F necrophorum-associated hematogenous osteomyelitis with secondary sequestra in ruminants. Anaerobic bacteremia was not reported in a case series of 21 septic camels < 21 days old with positive culture results. Additional investigations are needed to determine the etiology and pathogenesis of idiopathic sequestration in camels.

In our study, only 36% of camelids with sequestra attributed to causes other than trauma were < 3 months of age at the time of initial evaluation, whereas most camelids in other studies were that age. The reason for this difference in age distribution may be the time elapsed between the onset of clinical signs and initial evaluation at the hospitals. The median duration of clinical signs before initial evaluation was 28 days in our study, with a wide range of 2 days to 20 months, but only 14 days in another study; with a much smaller range of 1 to 28 days.

Radiography was a useful imaging tool for establishment of a definitive diagnosis of osseous sequestration of the appendicular and axial skeleton and growth of bone from a primary extraskeletal focus of anaerobic infection. Persistent infection and drainage from the surgical site should alert owners and attending veterinarians of the possibility of sequestrum recurrence. One camelid developed neurologic signs of unknown origin following drainage from the hospital after scapular sequestrectomy; however, because it was not reevaluated, one cannot conclude whether the signs were attributable to complications related to the sequestrum or surgery. Other complications in other camelids included persistent lameness and abnormal appearance of the limb that did not affect the return to intended use. Pathological fracture of the affected bone has been reported and justifies taking precautions during the postoperative period, which may include the application of external coaptation. Owners should be informed of the possibility of complications prior to the beginning of treatment.

The results confirmed that osseous sequestration has a unique clinical manifestation in camels, compared with other large animal species. The condition should be suspected in juvenile camelids with lameness, a draining sinus, or a firm swelling over a bony protrusion of traumatic origin.

Infections with multiple aerobic species were detected in relatively few camelids with sequestra of either etiology. Bacterial pathogens of particular concern included Fusobacterium necrophorum and nonspecified fusobacteria, which appeared to cause singular microbial anaerobic infections. Such infections were believed to have been hematogenous in origin because specimens for bacterial culture were obtained during surgery in camelids with sequestra of nontraumatic origin.
prominence. When a sequestrum is suspected, radiography should be performed to confirm the diagnosis. Sequestrectomy offers the best treatment option and should be delayed until the sequestrum is well formed and detached from the surrounding sound bone.

References