A 3-year-old castrated male llama weighing 155 kg (342 lb) was referred to the large animal hospital at the Oregon State University, College of Veterinary Medicine, with a history of left hind limb lameness and suspected rupture of the cranial cruciate ligament. The llama had been found to be non–weight-bearing lame in its paddock approximately 1 month previously.

On physical examination, the llama had a grade 4 of 5 lameness of the left hind limb with obvious inward rotation and abduction of the limb at the walk. Palpation and visual assessment of the limb revealed effusion of the stifle joint and soft tissue swelling on the medial aspect of the stifle region. Cranial tibial thrust was elicited during a tibial compression test performed while the llama was standing. Cranial drawer could also be elicited, and widening of the medial aspect of the stifle joint could be palpated with abduction of the distal portion of the limb.

Marked widening of the medial aspect of the stifle joint was evident on a caudocranial radiographic projection obtained during application of stress (Figure 1). On the lateromedial radiographic projection, the femoral condyles were more caudal than expected, relative to the intercondylar tubercles. Radiographic changes were consistent with rupture of the medial collateral ligament and cranial cruciate ligament.

Tibial plateau leveling osteotomy was scheduled. A catheter was placed in the right jugular vein, and the llama was sedated with butorphanol (2 mg, IM) and xylazine hydrochloride (20 mg, IM). Anesthesia was induced with ketamine hydrochloride (2.26 mg/kg [1 mg/lb], IV), an endotracheal tube was placed, and anesthesia was maintained with isoflurane. Additional analgesia was obtained by epidural administration of morphine (30 mg) diluted in 5 mL of sterile saline (0.9% NaCl) solution. Ceftiofur (4 mg/kg [1.8 mg/lb], IV) was administered prophylactically.

The llama was positioned in dorsal recumbency, and the left stifle region was prepared for aseptic surgery. A cranialmedial skin incision was made from the proximal aspect of the patella to the proximal third of the tibia, and a medial approach to the stifle joint was performed. The medial collateral ligament was located and determined to be completely ruptured. A medial parapatellar arthrotomy was performed to allow exploration of the stifle joint and confirmation of the preoperative diagnosis. Complete rupture of the cranial cruciate ligament and partial tearing of the medial meniscus were identified. The caudal ligament of the meniscus was released with a No. 11 scalp blade.

A tibial plateau leveling osteotomy was performed essentially as described for dogs. The caudal belly of the sartorius muscle was incised, and the insertions of the gracilis and semitendinosus muscles were elevated to expose the proximomedial aspect of the tibia. The popliteal muscle and popliteal artery and vein were then elevated from the caudomedial aspect of the tibia to prevent iatrogenic damage. A commercial tibial jig and biradial curved saw blade were used to create a cylindrical proximal tibial osteotomy. The tibial
plateau was then rotated from a preoperative measurement of 18° to approximately 3°.

Two (1 left and 1 right) 3.5 tibial plateau leveling plates were used to stabilize the tibial osteotomy (Figure 2). The right plate was reversed and placed on the caudal aspect of the tibia to provide additional support. Lateral and caudocranial radiographic projections of the stifle joint were obtained intraoperatively to verify positioning of the tibial plateau. On the caudocranial projection, a screw could be seen to have entered the lateral aspect of the stifle joint. This screw was removed and replaced with a shorter screw. However, while this screw was being replaced, a second screw was broken. This screw was left in place.

The arthrotomy was closed in a routine fashion. The joint capsule was imbricated with size-2 polypropylene, and the medial collateral ligament was sutured with size-0 polypropylene in a modified Bunnell pattern. The medial collateral ligament was then reinforced with 2 strands of size-2 polypropylene placed in a figure-8 pattern between two 4.0 cancellous bone screws with spiked washers. Remaining layers were closed routinely. No external coaptation was applied to the limb after surgery.

The llama was hospitalized for 9 days after surgery. A single dose of flunixin meglumine (150 mg, IV) was administered the day after surgery, and ceftiofur (4 mg/kg, IV, q 12 h) was administered for 2 days after surgery. The llama spent most of the first day after surgery in a cuffed (sternal) position but was observed to spend most of its time on the following days standing. At the time of discharge, the owner was instructed to strictly confine the llama to a stall with firm bedding. Sutures were removed 2 weeks after surgery. Stall confinement and slow hand walking for 2 to 3 minutes at a time were continued for another 3 weeks.

Physical and radiographic evaluations were performed at 2-month intervals for the next 6 months. The severity of lameness while walking on hard surfaces steadily improved, with most of the improvement evident within the first 4 months after surgery. Six months after surgery, the lameness was much less apparent than it had been prior to surgery and was classified as grade 2 of 5.

Four days after surgery, failure of the medial collateral ligament repair was evident radiographically and during physical examination as an increase in instability. Conservative management of the ligament rupture, rather than a second attempt at surgical repair, was recommended to the owners. The degree of joint instability steadily improved while the llama was confined to a stall. This was evidenced by a decrease in the degree of abduction of the limb while the llama was

Figure 2—Lateral (A) and caudocranial (B) radiographic projections of the left stifle joint of the llama in Figure 1 obtained following tibial plateau leveling osteotomy. Two orthopedic plates were applied to increase the stability of fixation. Polypropylene suture was placed in a figure-8 fashion around cancellous bone screws and spiked washers placed in the medial femoral condyle and the proximomedial aspect of the tibia to support the repair of the medial collateral ligament.
standing or ambulating and by a decrease in the amount of distraction evident on radiographic projections obtained while stress was applied to the limb.

The tibial plateau leveling osteotomy healed without complications, and 4 months after surgery, the osteotomy appeared radiographically to be healed. The llama was brought to the teaching hospital 2 years after surgery for unrelated reasons, and at this time, results of a tibial compression test were negative. Radiographic evaluation of the limb indicated that the osteotomy had healed and that the plates and screws were stable.

Approximately 3.5 years after surgery, the llama was reexamined at the teaching hospital. The owners reported that the llama’s activity level was comparable to that of other llamas on their property. The llama appeared to have full use of its left hind limb and routinely stood on both hind limbs to eat leaves off trees. On physical examination, there was mild effusion of the left stifle joint with soft tissue swelling over the medial aspect of the stifle region in the area of the medial collateral ligament. A firm nodule of bone consistency was palpable over the proximal leg bone in the area of the olecranon fossa on the craniolateral aspect of the femur. In particular, the extensor carpi ulnaris, longus and brevis muscles, which originate from the extensor carpi ulnaris bone, are the primary muscles that provide stability to the palmar aspect of the stifle joint. The plantaris muscle, which is the lateral collateral ligament, is attached to the lateral aspect of the tibia. Finally, we decided not to use techniques that involved a fascia lata patellar ligament autograft because of the size of the llama.

In the llama described in the present report, we elected to use 2 orthopedic plates to stabilize the tibial osteotomy. In dogs, a single plate is usually sufficient. However, some surgeons use an additional plate in large or heavy dogs.

The lack of a fibula in camels may reduce the stability of the buttress at the trans-cortex following tibial plateau leveling osteotomy. However, the trans-cortex is relatively thicker in camels than in dogs, allowing for greater bone contact after rotation of the tibial plateau. In addition, we did not believe that any valgus, varus, or rotational deformity existed and opted to maintain a congruent osteotomy to maximize osteosynthesis. The distal aspect of the cis-cortex was shaved to provide maximal trans-cortical bone-to-bone contact after plate application.

Normal values for tibial plateau angles in camels are not reported. The original angle of the tibial plateau in this llama was 18°. In comparison, the tibial plateau angle in healthy dogs is approximately 25°.6

Rupture of the cranial cruciate and medial collateral ligaments in this llama was thought to be a result of a traumatic injury. An attempt was made to repair the medial collateral ligament; however, instability was evident within 4 days after surgery. It may be that the...
screw and suture material were too small for an animal of this size. Nevertheless, conservative management of the medial instability appeared to have resulted in adequate stability for this llama.

References