Simple Techniques for Managing Complicated Fractures in Camelids and Small Ruminants

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Abstract

In general, long bone fractures of New World camelids, sheep, and goats have a favorable prognosis for healing. Secondary complications associated with fracture location and severity, although uncommon, may affect outcome. Methods of fixation vary, but both internal fixation and different forms of external fixation, usually in the form of casting and transcortical pinning, have been successful. Fracture type, location, economic impact, and aftercare often dictate methodology. Existence of an open fracture will affect prognosis negatively, but my impression is osteomyelitis and sequestration, leading to fixation failure, is uncommon. When cases of non- or delayed union are presented, failure of fracture ossification often relates to inadequate stability or infection. Cancellous bone grafts in conjunction with other methods of fixation and management of infection have resolved these complicated cases.

Résumé

En général, la fracture d'un os long chez les camélidés du Nouveau Monde, les moutons et les chèvres a un pronostic de guérison favorable. Des complications secondaires associées à la localisation de la fracture et sa sévérité, bien que peu fréquentes, peuvent influencer la guérison. Les méthodes de fixation varient mais la fixation interne et différentes formes de fixation externe, habituellement sous la forme de plâtre et d'embrochage transcortical, ont eu du succès. Le type de fracture, sa localisation, l'impact économique et les soins post-opératoires vont souvent déterminer la méthodologie à suivre. La présence de fracture ouverte va influencer négativement le pronostic mais mon impression est que l'ostéomyélite et la séquestration, qui entraînent l'échec de la fixation, sont rares. Lorsque des cas d'union ratée ou retardée se présentent, l'échec de l'ossification de la fracture est souvent associé à des méthodes inadéquates de stabilité ou à l'infection. Des greffes d'os spongieux en combinaison avec d'autres méthodes de fixation et de gestion de l'infection ont résolu ces cas plus compliqués.

Introduction

Combined incidence of long bone fractures in camelids and small ruminants (sheep, goats, calves) far exceeds similar fractures presented in horses and mature cattle. At our facility the majority of fractures are comminuted and closed, with about 12% being open. Fractures were evenly distributed between sexes, and the majority of affected individuals were less than two years of age. When known, trauma accounted for most fractures. In camelids underlying factors, including nutritional or genetic predisposition, are speculative at this time. Mineral analyses of bone fragments were normal. Forelimb fractures were more common, with metacarpal fractures having the highest incidence. In the rear limb, phalangeal and tibial fractures were most common. Long bone fractures generally have a favorable prognosis for successful healing.

Clinical diagnosis of long bone fractures does not represent a diagnostic challenge. Typically, acute onset of non-weight-bearing lameness and palpable crepitation hallmark the condition. Soft tissue swelling is variable. Fractures of the phalanges and olecranon are most commonly misdiagnosed (missed). Differential diagnoses for severe lameness not related to a fracture include subsolar or nailbed abscessation.

Radiographic examination is necessary for proper diagnosis and case management. A minimum of cranial-caudal and lateral-medial views, and preferably both obliques should be taken pre- and post-fixation. The joints above and below the fracture must be included.

Fracture treatment may involve internal fixation, external fixation, or nonsurgical methods. We have utilized compression or buttress plating methods for fractures of the metacarpus/metatarsus, radius, ulna, humerus, and tibia. Surgical approaches are similar to those used in the horse. Despite smaller body size and muscle mass, some fractures, especially if fixation is delayed, can be inordinately difficult to reduce. Continuous intraoperative traction will greatly aid a seemingly impossible reduction. Soft tissues of the limbs are minimal, necessitating additional efforts to adequately cover implants. Intramedullary pins and tension band wires have been successfully used for treatment of comminuted olecranon and humeral fractures.

External cast fixation resulted in excellent healing of several phalangeal fractures. Cast fixation in conjunction with transverse cortical pins provides axial and rotational stability, and has been used to treat the majority of fractures involving the metacarpus, metatarsus, radius, and tibia. This methodology has not only proven successful, but represents an economically feasible treatment option for those owners unwilling or unable to afford more expensive internal fixation. Significant early callus formation and placid temperament of the patient accounted for fracture stability as early as 21 days in some cases.

Internal Fixation

For internal fixation, a few recommendations are appropriate to minimize complications. Pre-operative antibiotics are indicated before internal fixation. If possible, clipping of fiber is performed prior to induction of anesthesia. Success with this effort will save significant anesthetic time. Taking the time to pre-bend the plate using a radiograph of the long bone from the opposite limb always saves me 15 to 30 minutes during the application process, and likely reduces risk of contamination. Screw lengths and implant position can be determined during formulation of a pre-surgical plan from the obtained images. Because of minimal soft tissue coverage, I recommend utilization of curved or flap incisions for better exposure and coverage of the implants. Unless I intend to place a cancellous bone graft, I use antibiotic within the lavage solution. My preference is lincocin at 0.5 mg/ml (500 mg/liter) or potassium penicillin 5000 IU/ml (5 million IU/liter). Intraoperative radiographs are useful when reducing and stabilizing complicated fractures. Complications associated with internal fixation of long bone fractures in camelids over this case series were minimal. We feel use of perioperative antibiotics, pre-surgical clipping and scrubbing, pre-bent plates, and flap incisions minimize surgical time and infection rate. Fracture healing was delayed in two comminuted fractures involving the nutrient foramen. Implant failure occurred after plate fixation of one humeral fracture and one olecranon fracture, but for the most part llamas were tractable during recovery and postoperative confinement.

External Fixation

For external fixation, clip and surgically prepare discrete areas on the medial and lateral surfaces of the limbs for desired pin placement. The wool or fiber should not be clipped if only a cast is to be applied and it is a closed fracture. Skin staples placed in perpendicular planes to the limb can be utilized as radiographic markers. Make a stab incision, separate soft tissues, and drill a pilot hole with a bit size smaller than the pin. Radiograph the area, then drill the pin for maximal bone contact. (We initially used smooth intramedullary pins with a pointed end, but have transitioned to positive-profile threaded pins, which are stronger and provide more stable bone contact). Pins are placed above and below the fracture into healthy bone. Use lavage to cool the pins as they are advanced through bone. Pin size varies from 3 to 6 mm, depending on animal size. In metacarpal or metatarsal fractures, additional pins may be placed proximally in the radius or tibia to provide more rotational stability. The pins are cut to leave two inches of length from the skin surface. Cast padding and tape needs to be pushed over the pin ends.. Resin impregnated foam cast padding by 3M works well when the limb is in traction. Fetotomy wires placed within used intravenous tubing facilitate cast removal at a later date. In most cases, a complete full-limb cast, incorporating the foot positioned in a slight plantigrade position, is applied incorporating all pins. After the cast is placed, the pins can be cut to leave ½ inch exposed. Exposed pin ends should be covered with acrylic (technovit) to stabilize the pins and protect the patient. In the case of full-limb forelimb cast application, once the patient stands, it is often necessary to remove the proximal edge from the medial side to prevent trauma to the axillary region.

Phalangeal fractures are usually closed and readily heal with external stabilization. Bipedal nature of the small ruminant foot provides inherent support of the fracture by the adjacent claw. Fractures of the first or second phalanx are best supported in a splint with the digits extended, or preferably, I place the foot into a cast which extends to the proximal metacarpus or metatarsus. The angle of the foot is midway between being fully extended (flat) and fully flexed. The toes are contacting the ground at a 30 degree angle. The foot is completely enclosed in the cast material.

Fractures of the metacarpus or metatarsus are the most common type of long bone fracture we encounter in small ruminants. They can be repaired utilizing internal or external fixation. Internal fixation involves utilizing a single narrow DCP plate. External fixation can be in the form of a cast with transverse pins, or a cast alone. Sheep, goats, and calves have a high risk of developing a non-union fracture with cast application alone, so we recommend casting with transverse pins if external fixation is elected. Prognosis is favorable.

Radial fractures are the next most common type of long bone fractures we see at our facility. Again, internal fixation using a standard or narrow DCP plate provides excellent results. If internal fixation is contraindicated or is not cost-effective, use of a full-limb cast with transfixation pins usually provides a successful outcome. Traction is necessary to reduce the fracture. Usually we place the patient in dorsal recumbency, although they can be repaired in lateral recumbency with the affected leg up. Pins are placed proximal and distal to the fracture, and an additional pin is placed across the humeral epicondyles to provide more rotational stability. The cast is placed from the foot to the distal humeral region.

Usually, diaphyseal ulnar fractures are associated with radial fractures. Stabilization of radial fractures will allow healing of the ulna. Fractures of the olecranon are more difficult to diagnose as the patient is often weight-bearing but lame. Careful palpation to localize pain and radiographs are necessary to confirm these fractures. Olecranon fractures may heal with stall confinement, but my preference is to repair using a tubular plate in adults, or pins and a wire placed along the tension (caudal) surface in youngsters less than one year.

Humeral fractures pose the most difficulty when deciding whether to repair internally, or providing stall confinement. We have had equal success with either method, but we have also experienced failures. Size of the patient and type of fracture are important factors. External fixation is not an option. Internal fixation involves using either DCP plates or stacked intramedullary pins and cerclage wires. Extent of soft tissue coverage, and irregular bone contour make internal fixation challenging. Stall confinement alone has resulted in successful healing, but complications in some cases included ulceration of the sternal pad and contracture of the flexor tendons. Five humeral fractures in adult llamas were treated with only stall confinement. Two cases developed non-unions, excess callus production, severe distal limb contracture, and sternal pressure sores. The remaining fractures healed satisfactorily.

Tibial fractures are successfully repaired internally using a DCP plate as a preferred method, or by inserting intramedullary pins and placing cerclage wires. Risks of the latter method include wire breakage or pin migration. With internal fixation, the majority of effort may relate to reduction of the fracture ends. Despite smaller stature, muscle contracture at the upper hind limb is profound in camelids and small ruminants. Significant traction for prolonged time periods is necessary for reduction. Performance of the procedure with the patient in dorsal recumbency with the leg suspended works well. The tibia is also a long bone which can be stabilized with a full cast and transfixation pins, extending from the foot to just over the stifle. For economic reasons, clients often select this option.

Femoral fractures can be treated with internal fixation (plate or pins) or stall confinement. There is one report of a midshaft femoral fracture healing after stall rest. Amputation has also been reported as a treatment for an unsalvageable limb.[4]

Sequestration or non-union are not common complications of long bone healing in camelids. If they do occur, the abnormal fibrous tissue and bone is removed, often a cancellous bone graft is placed between the bone ends, and effort is made to optimally compress and stabilize the fracture. Complicated fractures respond well to this approach.

Long bone fractures affecting camelids are relatively common. Fortunately, successful healing is the usual outcome. Patients are typically lightweight, have a quiet demeanor, are tolerant of confinement, and are comfortable for prolonged time periods in sternal recumbency. Callus formation appears early and prognosis for most long bone fractures not involving articulations is good.

References

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