EXTERNAL FIXATION FOR FRACTURE REPAIR IN SMALL EXOTIC MAMMALS

Vittorio Capello, DVM
Clinica Veterinaria S.Siro
Clinica Veterinaria Gran Sasso
Milano, Italy

Orthopedic lesions are common in small exotic mammals such as rabbits, rodents and mustelids (ferrets and skunks), which are increasing in popularity as household pets. Most lesions are traumatic in origin, typically the result of having been dropped by the owner, stepped on, or sat on. Falls from heights are common, and are often a result of improper handling and restraint. Injuries can also result from attacks from other animals.

Rabbits and chinchillas suffer injuries secondary to entrapment in cages. The inquisitive nature of the pet ferret can lead to "high rise syndrome" following falls from apartment terraces.

Most traumatic lesions are bone fractures, occurring most frequently to long bones.

THE VISIT OF THE ORTHOPAEDIC PATIENT

If the injury is recent, the animal must be considered a trauma patient; therefore shock, any thoracic and/or abdominal lesions and potential bleeding must be addressed and treated immediately before the orthopedic evaluation.

With the exceptions of orthopedic injuries directly impacting the central nervous system (spinal fractures), respiratory system (severe fractures of the ribs), and/or open fractures, bone and articular lesions are not a true emergency, and the owner must be advised that primary repair may be delayed until the patient is stabilized.

Fractures of the distal portions of the limbs are often open fractures due to the lack of significant soft tissue, especially in rabbits and rodents. Open fractures are often hidden by thick fur, which necessitates careful examination, especially in case of grade I and grade II open fractures. Grade III open fractures are prone to osteomyelitis, and the risk for nonunion or other complication post-fixation is higher.

Open fractures must be managed with strict aseptic technique, even in cases of highly contaminated wounds. Shaving of the fur before the evaluation is mandatory.

In unstable trauma patients, survey radiographs without anesthesia can be performed to rule out other lesions and confirm the presence of fractures. When the patient is stable, complete evaluation of the fracture is performed with a minimum of two basic projections (lateral and cranio-caudal). Due to smaller size of exotic patients, good to excellent quality radiographs are essential. For this reason, they should be accomplished with the patient under general anesthesia. Additional oblique projections are often helpful.

Due to species, body type and location, some open fractures cannot be aseptically bandaged until primary repair can be performed. In these cases, strict cage confinement is often the only reasonable option. Patients are best confined in wireless cages such as plastic containers to prevent climbing and further entrapment and damage to the fractured limb.

COMMON FRACTURES IN RABBITS

The most common fractures of pet rabbits are fractures of the hindlimb. Among these, fractures of the tibia and fibula are the most frequent. These usually occur when the foot becomes trapped in the cage, or while the animal is running on smooth surfaces such as indoor flooring. Diagnosis of complete fractures of the tibia is straightforward, because lameness and foot deviation are usually very obvious.

Comminuted fractures of the tibia are common, especially distal fractures. The short distal fragment makes fixation of these fractures challenging.

Femoral fractures in pet rabbits usually occur after a fall or when the rabbit is inadvertently stepped on. In case of distal fractures, A cranio-caudal projection is mandatory to diagnose or rule out condylar or bicondylar fractures, as articular fractures are particularly severe.

Fractures of the radius and ulna in pet rabbits usually occur after improper handling (when the rabbit is lifted or held by the forelimbs), after jumping down, or after a fall from height.

Humeral fractures in pet rabbits usually occur after a fall from height or other blunt trauma. Patients with this fracture type should always be checked for the presence of thoracic trauma.

Many other common fractures occur in pet rabbits, like fractures of the pubis and ischium, vertebral fractures and fractures of the phalanxes. Some are difficult, if not impossible to be repaired surgically.

Repair of fractures secondary to metabolic bone disease is particularly difficult as the bone cortices are unable to support insertion of pins. In most cases, fixation by splinting or simple cage rest are the only options.

COMMON FRACTURES IN RODENTS

The most common fractures in pet rodents are fractures of the tibia and fibula. Similar to rabbits, these usually occur when the foot is trapped in cage wires.

Clinical signs of lameness in pocket rodents are not easily detected by the owner. Therefore it is not uncommon to diagnose an old fracture long after the bone has healed.

COMMON FRACTURES IN MUSTELIDS

Events leading to fractures of the limbs in pet ferrets skunks are very similar to those occurring in dogs and cats and in most cases the patterns of fracture are similar as well. The most frequent are complete fractures of the femoral shaft, comminuted or non-comminuted.

Fractures of the forelimb are also very common in ferrets, especially following falls from height.

Fractures of the radius and ulna are more frequent than humeral fractures.
TREATMENT OF FRACTURES AND METHODS OF FIXATIONS

Among the methods of definitive stabilization, intramedullary pinning alone rarely provides enough rigidity. Bone plating is not frequently feasible due to the small size of the bones and the thin cortices when compared to the screws available (especially in rabbits and rodents), and the high costs.

The main indications for external fixation are comminuted or highly comminuted fractures where intramedullary pinning is not feasible, and open fractures, as this method of fixation allows stability without involving the fracture site. In general, external fixation allows proper stabilization against all the forces acting on the fragments in the three directions of the space: both latero-lateral and craniocaudal bending forces, and rotational forces.

These advantages are particularly important in small mammals, where postoperative control of excessive movement is much more difficult than in dogs and cats.

BASIC PRINCIPLES OF EXTERNAL FIXATION AND INSERTION OF PINS

The surgeon must have an excellent knowledge of surgical anatomy of the exotic species treated. The pins should be inserted into the bones in such a way to minimize negative impact on soft tissues such as vascular and nervous structures. Pins must also not interfere with the body wall.

Due to the normal physiologic hyperflexed position of the hindlimb in rabbits and chinchillas, a monolateral external fixator is better placed on the lateral aspect of the tibia rather than the medial side, where it can interfere with the lateral abdominal wall and the genitalia of male animals.

Strict aseptic technique is mandatory, despite the fact it is often more difficult in small exotic animals. Shaving of fur and surgical scrubbing must be performed very carefully in rabbits and rodents in order to avoid damage to the very thin and delicate skin in these species. Excessive scrubbing can lead to severe inflammation of the skin, which could result in postoperative complications.

The proper insertion of pins has to be performed according to accepted basic principles: Pins must be inserted through at least two cortices. The ideal angle of insertion should be 70 degrees to the longitudinal axis of the bone, toward the center of the bone fragment. This angle increases the resistance of the pin, when compared to pins inserted perpendicularly to the axis. This angulation is often not feasible in small exotic mammals, and parallel insertion of pins may be only option.

Pin size should not exceed the 30% of the bone diameter. This necessitates the use of pins often as small as 0.8 to 1.5 mm in small exotic mammals. Pins must be inserted along a single plane to allow connection with a single external rod.

A minimum of two pins is needed for each fragment, and three is even better. However, it is often impossible to insert more than two pins per fragment in small exotic mammals.

Maximal stability is accomplished by inserting the pins proximally and distally in each fragment. An insertion too close or too far to the fracture site is incorrect.

CONFIGURATIONS OF EXTERNAL FIXATORS

Pins can be inserted and connected with external rods forming a number of different configurations each providing different types and levels of stabilization. The basic configurations are: monolateral, bilateral on the same plane, biplanar, and tridimensional.

External fixation (EF) can be used in conjunction with other methods of fixation (pins, screws, cerclage wires). The most common combined technique is external fixation with intramedullary pinning. In this configuration the goal of the EF is to provide antirotational stability, therefore a single pin per fragment is adequate.

INSTRUMENTS AND MATERIALS

Kirschner wires, commonly called pins, can be smooth or threaded. Threaded pins are much more secure and are extremely unlikely to become loose during the postoperative period. The sizes commonly used in small exotic mammals ranges from 0.8 mm. to 1.5 mm. Pins used as a connection bar are usually 2.0 mm or larger.

A low-speed power drill (about 350 rpm/min) is the best option for insertion of pins. The risk of thermal injury to cortical bones is less than the risk of excessive mechanical forces applied using a hand chuck. The insertion hole is more oval using a hand chuck, therefore loosening of the pin is more likely. However, hand chucks can be useful in very small exotic mammals where the weight of the power drill alone can produce excessive, harmful movements to the whole limb, not to mention the whole patient, during the insertion of pins.

Many different types of clamps for connection of the pins to the bar are currently available. Each size clamp usually matches one rod size, and two or three different pin sizes.

Clamps weight differently according to its composition metal alloy, therefore the lightest should be chosen for exotic mammals.

A combination wrench and angled open socket wrench are needed to tighten the screw bolts of the clamps.

Shears are needed to cut Kirschner wires and rods to the proper length.

Polymethylmethacrylate is frequently used in exotic animal orthopedics to connect the pins to the bars. Avoiding the use of clamps significantly reduces the weight of the EF implant.

INSERTION OF PINS AND POSITIONING OF CLAMPS

According to the basic principles of external fixation, proper insertion of pins must follow certain guidelines.

The first pin is inserted through the lateral and medial bone cortices in the proximal end of the proximal fragment.
The fracture is then reduced, and the second pin is inserted at the distal end of the distal fragment. It is mandatory to insert these two pins on the same plane of the femoral shaft.

The two pins are connected to the rod with two clamps. This way, primary stabilization of the fracture can be accomplished, allowing the insertion of the other two pins.

The third pin is inserted at the distal end of the proximal fragment, not too close to the fracture site. The rod helps to insert the pin on the same plane as the other two pins.

The fourth pin is inserted at the proximal end of the distal fragment, not too close to the fracture site.

Another option is to pre-place two other clamps; this will allow the perfect insertion of the first two pins on the same plane.

COMPLICATIONS

The most common complications of external fixation are similar to those experienced in non-exotic mammals, like osteomyelitis, delayed union and nonunion. In small exotic mammals, other complications include injuries to soft tissues caused by the EF device, and fractures or other severe lesions due to the entrapment of the device itself with furniture. These usually happen when the EF is not bandaged properly, or when the padding is removed by the pet.

Loosening of the pins and/or the rod can occur with improper placement of the EF device, weak fixation with clamps or methacrylate, and/or improper post-operative management of the pet. Inadequate stabilization is usually a consequence of loosening of the pins and the rod, which can result in delayed union, nonunion, or break down of the healing fracture site.

Adequate post-surgical recheck examinations are extremely important.

CLINICAL CASES EXAMPLES

The osteosynthesis of the tibia and the fibula in a chinchilla is shown in Figure 1. Figure 2 illustrates external fixation of the femur in a ferret.

Figure 1

References