How to Stabilize Equine Fractures in the Field

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Appropriate emergency care of horses with unstable fractures is a challenging and life-saving veterinary procedure. Effective treatment requires a thorough understanding of the biomechanical loads imposed on the fracture site and creation of an external support system that neutralizes these forces and protects both bone and soft tissues at the fracture site. Author's address: New Jersey Equine Clinic, 279 Millstone Road, Millstone Township, NJ 08535; e-mail: spalmer@njequine.com.

1. Introduction

Emergency stabilization of fractures is an extremely important procedure for veterinarians to perform in the field. In some cases, external stabilization of the fracture may be the definitive treatment. In other cases, appropriate field stabilization of the fracture enables safe transportation to a facility for a surgical procedure that will achieve anatomic reduction and compression of the fracture, or, in other cases, ensure survival of the patient. Improper emergency care may limit treatment options and even endanger the life of the patient. The objective of this presentation is to present clinically accepted techniques to stabilize common fractures of the horse.

2. Materials and Methods

Evaluation of the Fracture Patient

Successful management of unstable fractures in the field involves a combination of clinical assessment, appropriate medical treatment, stabilization of the fracture, and careful and prompt transportation to a facility equipped for fracture repair. Most equine fractures cannot be definitively treated in the field and benefit from transportation to a clinic or referral facility. A horse with an unstable fracture is usually anxious and painful as it attempts to bear weight on the injured limb.

Clinical Assessment

Clinical assessment begins with evaluation of the general condition of the horse, the location and degree of injury, and an initial determination whether repair of the fracture is feasible. Specifically, this examination should address the following concerns: What is the overall assessment of the horse's condition and temperament? If the horse is painful or anxious, sedation and analgesic medication should be administered promptly. Is the patient able to bear weight on the injured limb? Is the skin intact? What is the level of the injury? Is the limb unstable? If the limb is unstable, a splint or cast should be applied to the injured area before performing a radiographic examination or transporting the patient. Finally, after consideration of the nature and location of the fracture, the available medical resources and the wishes/expectations of the owner, should this horse be euthanized?

Although acute unstable fractures of horses are usually obvious, it is important to consider the possibility of occult fractures when performing the clin-

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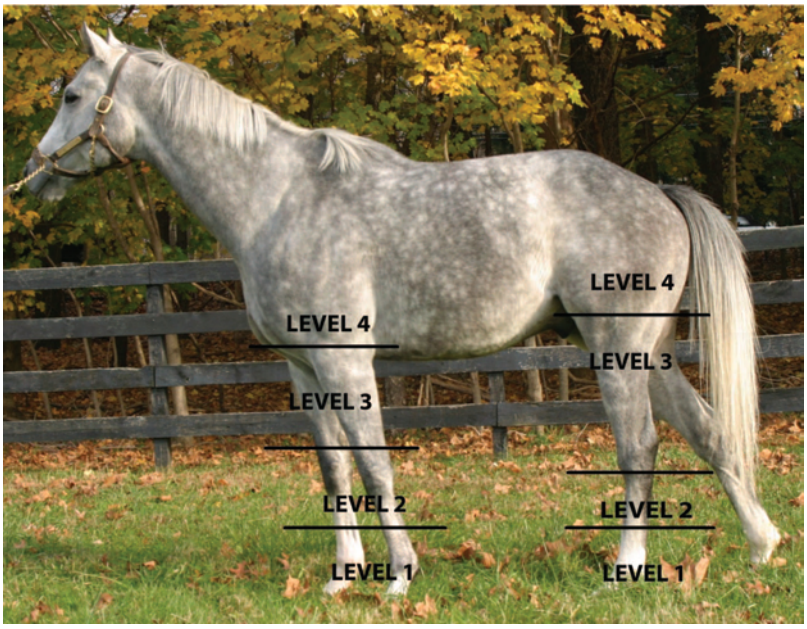

Fig. 1. Fractures of the horse can be grouped into 4 levels of the fore and hind limbs with recommendations for external support that are specific to each level.

ical examination. For example, kick wounds of the forearm proximal to the carpus may be accompanied by a nondisplaced fracture of the radius. Horses with this type of fracture often will be more lame than would be expected for a typical laceration. These fractures may respond favorably to conservative management and usually do not require splinting, but practitioners should have a high index of suspicion when evaluating the injured horse, particularly if a significant lameness is present. Occasionally, nondisplaced fractures may be difficult to detect on the initial radiographic examination, but will be visible on a follow-up study performed several days later. Practitioners are well advised to be conservative when making recommendations for the treatment of horses whose degree of lameness is not consistent with the clinical and/or radiographic findings.

It is also important for practitioners to appreciate the clinical difference between nondisplaced medial and lateral condylar fractures of the metacarpus/metatarsus. Nondisplaced lateral condylar fractures in which the fracture line clearly communicates with the lateral cortex of the bone represent a relatively stable situation with a good prognosis for surgical repair. Nondisplaced medial condylar fractures or lateral condylar fractures that spiral into the medial component of the diaphysis of the bone represent a much more serious fracture. These fractures can propagate into a potentially catastrophic complete fracture and should be splinted as for unstable level 2 fractures as below. Medial condylar fractures are candidates for plate fixation and recovery in a pool, if available. During an emergency situation, it is important for the practitioner to communicate the increased risk of this type of fracture to the horse owner/trainer, since there is no way to guarantee that these fractures will not develop into complete fractures, even if properly splinted or placed in a cast. Fractures of the horse can be grouped into 4 levels of the fore and hind limbs with recommendations for external support that are specific to each level (Fig. 1). F1

Prognosis for Unstable Fractures

In all cases, closed fractures have a better prognosis for repair than do open (compound) fractures. Simple fractures similarly have a better prognosis than do comminuted fractures. Except as noted above with medial condylar fractures, nondisplaced fractures generally have a better prognosis for repair than do displaced fractures. The prognosis for unstable level 1 fractures varies with the degree of bone comminution and specific bone involvement. For example, simple fractures of the pastern have a good chance for survival, whereas severely comminuted fractures have a decreased prognosis for successful repair. The same is true for proximal sesamoid bone fractures and condylar fractures of Mc3/Mt3. Horses with traumatic disruption of the fetlock require fetlock arthrodesis, and their prognosis for successful repair is variable according to the degree of soft tissue injury present.[1]

Level 2 (mid-diaphyseal) fractures of the third metacarpal and third metatarsal bones have minimal soft tissue coverage and are often open due to external trauma or penetration of the skin by the edges of the fractured bone, leading to a poor prog-

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nosis. Unstable fractures of the carpus and tarsus have a poor prognosis for athletic soundness but may be salvaged in some cases for breeding.

In general, the prognosis for level 3 fractures in adult horses is poor, although fractures of the ulna are often repaired with a good prognosis. Radial fractures typically seen in foals may be amenable to repair with internal fixation.[2] Complete diaphyseal fractures of the tibia may be successfully repaired in foals, but diaphyseal fractures in adults have a poor prognosis.[3]

Level 4 fractures that involve disruption of the diaphysis of the humerus in adult horses have a poor prognosis for a successful outcome. In foals and yearlings, some humeral fractures can heal without surgery. Successful repair of humeral fractures in foals and yearlings that do undergo surgery is more likely than similar procedures in adults, unless radial nerve damage is present.[4] Simple fractures of the neck of the scapula that are repaired with internal fixation may have a good prognosis for athletic function, but comminuted fractures of the glenoid or the neck of the scapula have a poor prognosis. Fractures of the scapula spine have a good prognosis.[5] Diaphyseal fractures of the femur in adult horses have a grave prognosis for repair. Diaphyseal femoral fractures in foals younger than 3 months of age have a guarded to fair prognosis for successful repair, but distal physeal femoral fractures in foals have a guarded prognosis.[6] Pelvic fractures are uncommon in the horse. Overall, the survival rate for pelvic fractures is 50% to 70%. Whereas fractures of the tuber coxae have a good prognosis for athletic activity, pelvic fractures that involve the articular surface of the coxofemoral joint have a 20% chance for athletic soundness.[7]

Initial Stabilization of the Fracture Patient

Medical Treatment

Depending on the temperament of the injured horse, sedation (often in combination with a tranquilizer) is a priority. The goal is to achieve relaxation and pain relief without ataxia. The first choice for sedation is xylazine[a] (0.2 to 0.5 mg/kg IV), due to its minimal cardiovascular side effects and its excellent analgesic effects for deep skeletal pain.[8] Butorphanol[b] (0.02 to 0.03 mg/kg IV or IM) or detomidine[c] (0.005 to 0.02 mg/kg IV or IM) may be added to extend the duration of sedative/analgesic effect, but care should be taken not to induce ataxia. It is better to start with a minimal dose and add supplemental treatments only as necessary. Although shock is a rare consideration with most acute fractures, excessive blood loss or fatigue, particularly in cases of extreme exertion or high temperatures, may result in compromised perfusion that will require appropriate fluid therapy. Hypovolemic patients initially may be treated with 10 to 20 mL/kg of IV fluids, followed by critical patient assessment.[9] If a compound fracture is present, or if there is significant soft tissue trauma associated with the fracture, broad-spectrum systemic antimicrobial medication is indicated in conjunction with nonsteroidal anti-inflammatory therapy.

Concepts and Materials

An effective splint must provide rigid support to neutralize, as much as possible, the forces acting on the fracture site that can damage the fracture surfaces as well as adjacent soft tissues. When a fracture occurs between the origin and insertion of a muscle, that muscle no longer has an intact skeletal frame over which to act and often engages in an action different from its intended function.[10] For example, the flexors of the forelimb act as adductors of the distal limb in the presence of an unstable fracture of the radius. Under such circumstances, muscle contraction creates unphysiologic loading of the fracture site that can exacerbate the degree of injury, complicating or eliminating options for successful surgical repair.

Materials required for proper immobilization of distal (level 1) fractures are sufficient bandage materials (2 to 4 rolls of cotton, 4 gauze bandages, 2 ACE bandages, Elasticon®, and duct tape) to create multiple bandage layers and two 18- to 24-inch lengths of PVC splints. PVC splints may be made by longitudinally splitting conventional 4-inch PVC pipe into thirds and smoothing the edges with a hoof rasp before incorporating the splints into the bandage. The ends of the PVC pipe may be covered with Elasticon tape to prevent sharp edges from injuring soft tissues. Fiberglass cast material[h] may also be used to provide increased support. If fiberglass cast material is used for support, practitioners should wear examination gloves coated with a thin layer of K-Y jelly to facilitate application and smoothing of the cast material and to prevent accumulation of cast adhesive on the hands during application. For extended splints, any rigid strut, such as a broom or pitchfork handle, board, or metal bar can be incorporated into the bandage to provide rigid support. Splint lengths of 36 inches (from ground level to the elbow) are required to stabilize level 2 fractures of the forelimb or to fix the carpus in extension in adult horses. Board splints approximately 5 feet in length are required to provide extended lateral support for more proximal fractures of the thoracic and pelvic limbs of mature horses.

Thoracic Limb Fractures

Level 1

Unstable fractures of the phalanges, proximal sesamoid bones, and distal metacarpus are managed with a cast or a padded bandage and dorsal splint to align the dorsal cortices of the bones of the digit in a straight line to neutralize bending forces at the fracture site and protect the soft tissues from further damage. This bandage/splint combination should extend

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Fig. 2. A, The Kimzey Leg Saver Splint is a commercial splint that helps to align the bones of the metacarpus and digit to stabilize level 1 fractures of the horse. B, Level 1 fractures may also be stabilized with a Robert Jones bandage that incorporates a rigid splint in the dorsal aspect of the bandage.

from the distal carpus to the toe. The Kimzey Leg Saver Splint[i] is a commercial splint that can be easily applied over a padded bandage to stabilize level 1 fractures and is particularly useful for treating horses with disruption of the suspensory apparatus (Fig. 2). It is helpful to have an assistant suspend the injured limb by holding it above the carpus to achieve alignment of the bones of the digit in a straight line while the splint is applied. It is important to apply the splint/cast over minimal padding when stabilizing level 1 fractures to achieve proper alignment of the bones of the digit. Thick padding allows for excessive movement of the ends of the fracture within the bandage when the horse puts weight on the limb.

Level 2

Fractures of the mid forelimb (distal radius to mid-metacarpus) are best stabilized with a Robert Jones bandage that incorporates caudal and lateral splints. The Robert Jones Bandage is created with multiple layers of cotton padding (approximately 1 inch thick) that is compressed with gauze and Elasticon bandage (Fig. 3 and Fig. 4). The diameter of the finished bandage should be approximately 3 times the diameter of the limb at the fracture site.[10] The splints are secured to the surface of the Robert Jones bandage with nonelastic tape such as duct tape and must extend from the elbow to the ground. The tape should be applied as tightly as possible to prevent movement of the splints when load is applied to the limb.

Level 3

Fractures of the middle and proximal radius are often open fractures, are more difficult to mobilize,

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Fig. 3. A Robert Jones bandage with caudal and lateral splints is used to stabilize level 2 fractures in the forelimb.

Fig. 4. A Robert Jones bandage with a caudal splint and an extended lateral splint is used to stabilize level 3 fractures of the forelimb.

Fig. 5. A padded bandage with a caudal splint that extends from the elbow to the ground is used to fix the carpus and thus support horses with level 4 fractures of the forelimb.

and have a grave prognosis. Because the major muscle groups that flex or extend the proximal forelimb are found on the lateral aspect of the limb, contraction of these muscles in the presence of fractures that disrupt the skeletal frame in this area causes abduction of the limb distal to the fracture site. This often leads to penetration of bone fragments through the skin on the medial side of the limb. Therefore, the primary goal of splinting level 3 fractures is to prevent abduction of the injured limb. Foals may be stabilized with a Robert Jones bandage that extends from the axilla to the toe with a lateral splint that extends up the lateral aspect of the chest and lies against the ribcage. Euthanasia is often recommended for adults with this type of fracture because of the poor prognosis for successful repair.

Level 4

Fractures of the humerus, ulna, and the distal scapula are well protected by substantial overlying muscles and are generally not splinted at the fracture site (Fig. 5 and Fig. 6). However, horses with fractures in this area cannot fix the elbow, which is essential for normal weight-bearing. Horses with level 4 fractures are best treated by applying a simple full-leg padded bandage with a caudal splint to fix the carpus. Horses thus supported have improved balance for transportation, but they will have difficulty walking and will require assistance for loading into the van or trailer. F5,F6

Pelvic Limb Fractures

Level 1

The goal of stabilizing fractures of the phalanges and distal metatarsus in the pelvic limb is the same as that in the thoracic limb. However, natural flexion of the pelvic limb induced by the reciprocal apparatus makes application of a plantar splint or cast more convenient to align the solar surface of the foot with the bones of the digit and metatarsus. As in the thoracic limb, it is helpful to have an assistant suspend the injured limb from the hock in a slightly

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Fig. 6. A Robert Jones bandage with a caudal splint is used to stabilize level 1 fractures of the hind limb.

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Fig. 7. A Robert Jones bandage with plantar and lateral splint is used to stabilize level 2 fractures of the hind limb.

caudal position while the splint is applied. If available, a Kimzey Leg Saver Splint may also be used to stabilize level 1 fractures of the pelvic limb.

Level 2

Fractures of the middle and proximal metatarsus are also managed with a cast or a Robert Jones bandage with a plantar and lateral splint. The tuber calcis acts as a functional extension of the metatarsus and provides additional support when incorporated into a bandage that includes caudal and lateral splints that extend from the point of the hock to the ground. The padding of this bandage should be somewhat less than that used in the thoracic limb because it is more difficult to include the tarsus in the bandage, and too much padding under the splints will make it more difficult to stabilize the fracture.

Level 3

Fractures of the tibia and tarsus are more difficult to mobilize and have a grave prognosis in adults. The biomechanical load placed on the reciprocal apparatus in the pelvic limb presents unique challenges to immobilization of fractures in this area. If an unstable tibia fracture is present, flexion of the stifle will occur without flexion of the hock. This results in overriding of the ends of the fracture fragments and additional trauma to both the bones and soft tissue. As in the case of radius fractures of the thoracic limb, level 3 fractures of the pelvic limb create abnormal abduction of the distal portion of the limb, which must be prevented. Foals may be stabilized with a Robert Jones bandage with an extended lateral splint that prevents abduction and rotation of the limb and transported to a hospital for repair. Euthanasia is often recommended for adults with this type of fracture because of the poor prognosis (Figs. 7 and 8). F7,F8

Level 4

Fractures of the femur or pelvis are protected by large muscle groups and are generally not splinted. These horses should, however, be kept quiet and assisted as much as possible when loading or transporting to another facility.

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Fig. 8. Fractures at level 3 in the hind limb are supported by a Robert Jones bandage with an extended lateral splint.

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Transportation of the Fracture Patient

Loading the splinted horse for transportation to a clinic or hospital should be as atraumatic as possible. The trailer or van should be positioned close to the horse, and the ramp should be positioned on a grade to level the ramp as much as possible for loading. Assistants should be used to help stabilize the horse when loading.

Adult horses should be placed in a partitioned/confined space in the trailer, restrained with chest or rump bars, and the head should be tied loosely to allow the horse use of the head and neck for balance. In the case of a thoracic limb fracture, position the horse facing rearward to allow for use of the pelvic limbs to brace when stopping. Horses with a pelvic limb fracture should be placed facing forward to allow for use of the thoracic limbs as a brace when stopping. Foals should be shipped with the mare, and an attendant may be used to help stabilize the foal during shipping. Bales of hay may be used to provide a reduced stall space for an injured foal if an attendant is not available. Foals will usually travel in a recumbent position.

3. Discussion

Appropriate emergency stabilization of fractures should provide rigid support of the fractured bones to minimize trauma of the fracture surfaces and prevent further damage to adjacent soft tissues. Although it may be difficult or impractical to have all the necessary materials in your vehicle to stabilize every type of fracture of the horse, a minimal inventory of emergency support materials should be kept in good condition and be readily accessible. The most common site of injury is the distal extremity, and many injuries are commonly associated with a particular sport discipline. For example, practitioners who attend to Thoroughbred racehorses should be prepared to adequately splint and support traumatic injuries of the fetlock and digit, which comprise a majority of potentially catastrophic injuries in that breed. The successful repair of an equine fracture always begins with emergency care that incorporates a rigorous application of the principles described herein. Proper splinting and transportation of the fracture patient improves the chances of successful surgical repair.[11] In some cases, the correct application of these basic principles will literally be a matter of life or death of the patient.

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[a]AnaSed® Injection, Lloyd, Shenandoah, IA 51601.
[b]Torbugesic®, Pfizer Animal Health, Exton, PA 19341.
[c]Dormosedan®, Orion Corp., Pfizer Animal Health, Exton, PA 19341.
[d]Rolled cotton, Kendall/Covidien, Mansfield, MA 02048.
[e]Brown gauze, National Health Care, Scottsdale, AZ 85222.
[f]ACE Bandage, Jorgensen, Loveland, CO 80538.
[g]Elasticon, Johnson & Johnson, Skillman, NJ 08558.
[h]Vetcast™ Plus Casting Tape, 3M Animal Care Products, St Paul, MN 55144-1000.
[i]Kimzey Leg Saver Splint, Kimzey Welding Works, Woodland, CA 95695.

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