EQUINE FRACTURES IN THE NEW DECADE; WHAT CAN WE REPAIR?
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Advances in equine orthopedics are slowed by limited opportunity to repair fractures based on economic pressures and requirements in most circumstances for a return to athletic soundness, usually at a high level. Despite these limitations equine orthopedic surgery continues to make strides in the management of fracture repair. Veterinarians in general and equine orthopedic surgeons specifically have done a good job to share our collective knowledge to advance the profession as a whole. Some of the specific advances in equine orthopedic surgery include the commonplace use of arthroscopy in fracture repair of articular fractures, development and utilization of fixed angle screw / plate construct (Locking Compression Plate), development of interlocking nail systems, proactive laminitis management and advancement in the management of distal limb fractures including arthrodesis techniques.

Familiarity and experience with arthroscopic techniques has made arthroscopic aided fracture repair of articular fractures state of the art. Direct examination of fracture reduction, ability to treat additional articular disease simultaneously during fracture repair and avoiding the morbidity associated with arthrotomy has improved outcomes.

Interlocking nails and IL nail plate combinations. Surgical outcome after surgical repair of mid diaphyseal humeral and femoral fractures has been improved by the use of IL nail and IL nail plate combinations. Overall results are up to 75% with animal as large as 300 kg being successfully repaired. Unfortunately these systems are not commercially evaluated so there utilization has been limited.

The use of fixed angle screw – plate constructs (Locking Compression Plate System) has perhaps been our most important advancement in the past decade. Fixed angle screw plate constructs do not rely on the screw thread bone interface or plate bone friction to provide stability in fracture repair. The significant result of this is improved holding strength of our constructs with a much lower risk of implant loosening or constructs failure even in the face of sepsis. The fixed angle screw – plate constructs have been used in the repair on most long bone fractures in foals, arthrodesis techniques, cervical vertebrae repair as well as revision surgeries for failed orthopedic repairs. Disadvantages of these implants include increased costs, difficulty in avoiding screws while double plating and potential risks of bone failure due to difficulty in angling screws across the medullary cavity and creating a stress riser in a cortex.

Significant advances in the management of fractures of the first and second phalanx have occurred over the past 10 to 15 years. In the past treatment of such cases was relegated to standard or transfixation cast techniques. Complications such as the collapse of the bony column, development of open fractures discomfort and laminitis led to overall poor results. Aggressive management with internal fixation to reestablish the boney column and improved post operative comfort have improved outcomes and resulted in early weight bearing and decrease incidence of weight bearing laminitis.

Internal fixation when successful has distinct advantages over copatation or external fixation including more anatomic reconstruction of the limb restoration of joint surfaces and generally better functional outcome. That being said some fractures are not amendable to internal fixation. Complete fractures of the proximal phalanx are candidates for internal fixation. In acute, minimally displaced fractures reduction may be achieved by percutaneous placement of
bone reduction forceps and radiographic control. In moderately to severely displaced fractures, chronic fractures or fractures in which fragments of bone prevent reduction of the fracture fragments open reduction and/or arthrotomy/arthroscopy are required. After debridement of the fracture bed and reduction of the fracture compression of the fracture fragments is accomplished using 4.5mm or 5.5mm cortex bone screws in a manner similar to that for incomplete fractures. External coaptation with a half limb cast may be required for recovery or for the immediate post-operative period. Prognosis after treatment of non comminuted complete fractures is dependent upon whether the proximal interphalangeal joint is involved. In fractures that enter the proximal interphalangeal joint there is approximately 50% chance to return to racing. In complete fractures that exit the lateral cortex proximal to this joint 71% return to racing.

Horses with comminuted fractures of the first phalanx have acute non weight bearing lameness and often limb deformity. Comminuted fractures can be divided into two categories in regards to treatment strategy; those with and those without an intact column of bone extending from the proximal to distal articular surface. This intact strut of bone allows reconstruction of many comminuted fractures of the proximal phalanx by lag screw fixation of the fracture fragments to this intact column of bone. Treatment strategies include complete reconstruction via bone screws and/or plates by open reduction, partial reconstruction and transfixation cast or external fixator, transfixation cast alone and placement of an external fixator. In the authors’ opinion the use of half limb casts alone is not the best method of sole treatment for most comminuted fractures of the first phalanx. There are reports of successful outcomes after cast management alone. Half-limb casts have been shown to significantly reduce axial loading in the intact skeleton. However in the fractured limb the risks of fracture compression, skin injuries leading to open fractures and contra lateral limb laminitis are significant with this method alone.

Comminuted fractures with an existing strut of bone are candidates for open reduction and reconstruction with bone screws. An initial study reported an unacceptably high risk of infection after open reduction and internal fixation. A more recent description reveals a good prognosis for pasture soundness after reconstruction of comminuted fractures of the first phalanx with bone screws if an intact strut of bone exists extending from the MCP(T)-P joint to PIP joint. If the strut has a transverse fracture but enough bone stock proximal and distal to the transverse fracture the author has reconstructed these fractures with two 4.5 mm narrow dynamic compression plates and bone screws. In both screw fixation alone and plate and screw fixation external coaptation with a half limb cast is required. Partial reconstruction of the articular surfaces and placement of a transfixation cast or external fixator is elected when possible in severely comminuted fractures to reduce degenerative changes, improve long term comfort and reduce the requirement for subsequent arthrodesis. The use of a transfixation cast is required when comminution is severe enough to prevent anatomic reconstruction and protection of the fracture from collapse is required. Transfixation casts have been shown to significantly improve axial stability compared to standard casts in an osteotomy model. External fixators are used in place of a transfixation casts and in cases when the fracture is open to allow direct access to the injury site. Treatment of horses with comminuted fractures of the proximal phalanx is for salvage purposes. If anatomic reconstruction of the fracture fragments to an intact strut occurs than overall success for pasture soundness is good.

Arthrodesis of the proximal interphalangeal joint is indicated in horses with advanced osteoarthritis or articular fractures. Lag screw fixation of simple fractures can be performed, but because of difficulty in obtaining anatomical reduction of the proximal interphalangeal joint surface and resisting tension forces at the palmar/plantar eminences, lag
screw fixation alone is usually unsuccessful in preventing osteoarthritis and returning horses to athletic soundness. Therefore I recommend proximal interphalangeal joint arthrodesis in horses with most articular fractures. There are many methods of arthrodesis of the proximal interphalangeal joint are described, and opinions vary as to which is preferred. Current preferred methods involve the insertion of three parallel 4.5- or 5.5-mm screws or dorsally applied plate or plates with additional transarticular screws. I have used both methods and prefer the plating technique because it improves comfort in the immediate post-operative period and reduces the necessity for prolonged cast application. This method requires cast coaptation for 2 to 3 weeks to protect the incision site versus 4 to 6 weeks for the screw alone technique. The plating technique provides improved stability compared with the three 5.5-mm parallel screw technique in fatigue testing. After arthrodesis of the proximal interphalangeal joint with screws alone, approximately 80 to 89% of horses with hind limb and 46% to 80% of horses with forelimb lameness returned to athletic soundness. Long-term follow-up data for the plate / screw technique revealed 81% of horses with forelimb and 95% of horses with hind limb arthrodesis were able to resume performance careers. The author prefers the plate / screw technique due to increased biomechanical stability, improved earlier comfort and reduce time for coaptation. With the advent of the locking compression plate (LCP) this has been recently advocated for arthrodesis of the proximal interphalangeal joint. The newer design of the Synthes® LCP with the stacked combi hole at one end avoids the disadvantages of the long pointed end interfering with the extensor process of the third phalanx. Long term follow up data regarding the use of LCP / screw technique for pastern arthrodesis is not yet available.

Horses with comminuted middle phalanx fractures or those that involve the distal interphalangeal joint should undergo arthrodesis of the proximal interphalangeal joint with single or double plating and potentially transfixation casts or external skeletal fixation. Comminuted fractures of the middle phalanx should be repaired if possible to preserve the distal interphalangeal joint surface. Displacement of the distal articular surface considerably worsens prognosis. Single or double plating can be used depending on the configuration of the fracture. The use of additional screws placed in lag fashion is usually required to reduce large fragments and reconstruct the articular surface. Cast coaptation is required for 6 to 8 weeks after surgery. Transfixation pins are used to prevent collapse of the fracture in horses with severely comminuted fractures. This technique may be combined with plate and screw fixation. Prognosis after double-plate fixation of 10 horses with comminuted fracture of the middle phalanx was good for pasture soundness, and 5 horses were able to be ridden or shown, but mild lameness persisted.

Increasing experience with transfixation pin casting have improved outcomes in complex distal limb fractures with reduced risk of pin tract infection and fracture coupled with aggressive internal fixation of the fracture region when appropriate. A variety of methods are advocated but in general the development of techniques which use progressive drilling of pin holes and divergent smaller diameter pins placed in the distal ½ to 2/3 of the metacarpus /tarsus have reduced morbidity associated with pin tracts. Increasingly, the use of transfixation pins with limited or definitive internal fixation of the primary fracture has lead to improved outcomes by protecting the primary repair during early fracture healing, improving comfort and allowing transfixation pins to be removed early.

While laminitis remains a devastating sequelae to orthopedic injury in the horse some strides have been made. Proactive management of the supporting limb using early intervention at the time of injury or repair and advanced cushion support materials have improved outcomes.
SELECTED REFERENCES


MacLellan KN, Crawford WH, MacDonald DG: Proximal interphalangeal joint arthrodesis in 34 horses using two parallel 5.5 mm cortical bone screws, *Vet Surg*, 30:454, 2001


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Use of a 2 LCP’s in the repair of a distal diaphyseal radial fracture in a 2 month old TB foal

Use of a single broad LCP in the management of a fracture of the ventral aspect of C5 in a TB yearling resulting in ventral displacement and acute ataxia
Use of a plate (4.5 mm N DCP) / wire construct to repair a proximal ulnar fracture in a 30 day old TB foal.

Initial radiographs and CT images of 12 TB QHG. 6 week and 5 month follow up radiographs in a 8yr QH G. Cast/splint coaptation for 5 weeks post op.