Part II: Arthrodesis of the Metacarpal/Metatarsal Phalangeal Joint in the Horse

Larry R. Bramlage, DVM, MS

1. Introduction
There are two primary indications for surgical arthrodesis of the fetlock joint: anatomic crippling of the joint to the point that joint function is disabled and weight bearing is not possible, and functional crippling of the joint to the point that joint function cannot occur without excessive pain and the horse chooses not to use the joint.

Conditions that result in anatomic crippling of the fetlock joint include: traumatic disruption of the suspensory apparatus of the fetlock joint, permanent non-responsive flexor contraction or laxity, fractures of the distal cannon bone or first phalanx that cannot be reconstructed to the point of function, and severe angulation as a result of growth deformity or malunion of a traumatic injury.1,2 Conditions that cause functional crippling include previous infectious arthritis or ongoing degenerative arthritis that has resulted in destruction of the joint and causes such severe pain within the fetlock joint on weight bearing that the horse chooses not to use the joint because of the pain. In both conditions, the necessary goal is to restore function in the affected limb to prevent laminitis from overload weight bearing in the paired good limb.

Degenerative arthritis of the fetlock joint to the point that pain-free weight bearing cannot occur happens primarily in cases where previous infectious arthritis or rapidly progressing degenerative arthritis has created severe arthritic change to the point that comfortable weight bearing is not possible. In most natural occurrences of slow degeneration of the fetlock joint, the process is accompanied by ankylosis, which attempts to eliminate the pain by stiffening the joint naturally through elimination of joint motion. If, however, degeneration occurs more rapidly than the horse can accommodate and horse refuses to use the joint, then arthrodesis can be used as a means of re-establishing pain-free weight bearing on the degenerate limb for protection of the paired limb from overload laminitis.

Voluntary splinting of the fetlock joint by the horse is not possible. It is a totally passive joint.3 If weight bearing occurs, the fetlock joint will move, because the horse has no muscular control to reduce joint motion and therefore, cannot decrease the pain and aid in healing. Pain in a joint is the product of

Unreferenced statements are the opinion of the author.
the arthritis and motion of the joint. It is preferable to eliminate or mitigate the arthritis, but if the degeneration is irreversible, the only option is to eliminate the motion by surgical fusion of the joint (arthrodesis). If the motion is eliminated in a painful joint, the pain is eliminated.

Degeneration of the articular surface of the sesamoid bones and asymmetric degeneration of one of the condyles of the distal cannon bone and proximal first phalanx to the point of asymmetric collapse of the joint surface are particularly difficult conditions for the horse to survive because of the pain, and the horse will choose not to use the limb. With this scenario, arthrodesis to protect the opposite limb is indicated. Any severely painful fetlock joint that creates markedly asymmetric weight bearing and increased weight bearing of the opposite limb can be an indication of fetlock arthrodesis.

Anatomic crippling of the fetlock joint disables the joint to the point that the horse cannot use the joint, even if it chooses to try. Traumatic disruption of the suspensory apparatus is the most common example of this situation. Traumatic disruption of the suspensory apparatus of the fetlock joint involves rupture of one of the components of the suspensory apparatus. The damage can occur (1) to the suspensory ligament proximal to the sesamoids, (2) through the sesamoid bones with fractures of both sesamoids, (3) below the sesamoids through the distal sesamoidean ligaments, or (4) through combinations of the above that disable both the medial and lateral halves of the suspensory apparatus.

Appropriate first-aid splinting and support of the fetlock joint after traumatic disruption of the suspensory apparatus is particularly important to prevent hyperelongation of the digital arteries, which supply blood to the foot (Fig. 1).6 Splints that prevent hyperextension reduce the tension on the structures of the back of the limb.6 If unsupported weight bearing is allowed with traumatic disruption of the suspensory apparatus, overstretching of the arteries and thrombosis of the blood supply frequently occurs. So, with this injury, first-aid support for the limb, which aligns the dorsal cortex and prevents extension of the fetlock joint, and antithrombotic therapy are important to protect the blood supply for survival of the foot and support the healing of the primary injury. The lack of support on the palmar/plantar aspect of a limb with an injured suspensory apparatus overstretches the vessels encouraging thrombosis if hyper-extension is allowed. Therefore, splinting to prevent the hyper-extension (Fig. 1) is imperative.

Primary suspensory ligament rupture is not usually an indication for surgical intervention. Fibrosis resolves an injury to the suspensory ligament, unless total disruption occurs and the ends of the ligament are partially or totally separated. Primary suspensory ligament rupture is more often treated by confinement with external splinting acutely and then intermittent splinting only if needed to aid in the fibrosis and to protect the vasculature. Unless progress is so slow toward a pain-free weight-bearing limb that laminitis becomes a
possibility, surgery is not necessary, because the horse can restabilize an injured suspensory ligament with fibrosis to restore functionality. Splinting should be minimized to encourage weight bearing on the injured limb as soon as possible.

More supportive therapy such as cast immobilization is ill advised, because it tends to weaken the flexor tendons and makes it more difficult to return the limb to weight bearing after immobilization. With a disabling injury to the suspensory apparatus, the flexor tendons are the only intact support structures behind the fetlock joint and to weaken them with a period of cast immobilization makes collapse of the fetlock on return to weight bearing a certainty. If the injury causes such chronic pain that the contralateral good limb is at risk, surgery should be undertaken before the good limb begins to fail.

Fractures through the sesamoid bones separate the proximal suspensory ligament insertions from the base of the sesamoid and the distal sesamoidean ligament attachments. Tension on the proximal sesamoid fragments by the suspensory ligament and traction on the distal sesamoidean fragments created by weight bearing separate the bone fragments, and this distraction prevents healing. The transected sesamoids prevent the suspensory apparatus from supporting the fetlock. Therefore, primary arthrodesis of the fetlock joint is the treatment of choice for comminuted sesamoid fractures.

Rupture of the distal sesamoidean ligaments from the base of the sesamoid is always accompanied by the proximal displacement of the sesamoid bones, indicating complete detachment of the suspensory ligament and sesamoids from the distal sesamoidean ligaments. When the distal sesamoidean ligaments are avulsed from the sesamoid bones, healing of the injury cannot occur, because support to the fetlock joint is lost permanently. Surgical arthrodesis is the best solution for this injury.

Resolution of injuries through or below the sesamoids cannot occur by healing of the suspensory apparatus. Splinting works very well temporarily; the horse is able to use the limb for ambulation, but during standing, all the weight is carried on the good limb. Without arthrodesis to restore pain-free weight bearing, few horses survive this injury. Most experience contralateral laminitis and eventually, are euthanasized.

Contraindications for fetlock arthrodesis include avascularity of the distal limb (as indicated by a cold limb that does not bleed when punctured with a needle), pre-existing serious infection, lack of the potential for a second career, and laminitis in the opposite limb to the point that the horse cannot survive, even if the arthrodesis is successful. If the vascular damage to the limb distal to the injury is so severe as to preclude survival of the foot and other structures, there is no point in fusing the fetlock joint. Surgery should be delayed to allow appropriate therapy to restore normal blood supply to the distal limb, if possible. The author recommends anticoagulants and antithrombotics such as heparin, aspirin, and pentoxyfylline. After a viable blood supply is restored, surgery can take place.

Fusion of a fetlock joint does not allow athletic activity to resume on recovery. The procedure is solely for salvage for pasture activity for a broodmare, stallion, or valued retiree. If the horse has no value in a second career as a brood animal or companion, euthanasia is recommended. The long-term goals of the surgery are to allow comfortable weight-bearing activity and to protect the other limbs from overload weight bearing. If irreversible laminitis is already present in the paired limb, then the surgery has little hope of salvaging the horse. If laminitis is present but has not reached the irreversible state, then the surgery can help save both limbs, because it will quickly restore comfort to the injured limb, which will aid in the treatment of the laminitis limb.

2. Surgical Technique

The horse is anesthetized and placed in lateral recumbency with the affected limb in an uppermost position. The limb is prepped for aseptic surgery from the coronary band to the carpus. A tourniquet is not used. A dorso-lateral skin incision is made from 4 cm below the carpus following the path of the lateral digital extensor tendon to the fetlock joint and then is curved dorsally along the extensor branch of the suspensory ligament to the midline, just proximal to the pastern joint. The incision is carried through the skin and SC tissue. The tendon of the lateral digital extensor and the extensor branch of the suspensory ligament are split longitudinally. The periosteum, transected tendon and ligament, joint capsule, SC tissue, and skin are all reflected as a unit from lateral to medial, exposing the dorsal surface of the fetlock joint and dorsal cortex of the cannon bone and first phalanx.

The plate is fitted to the dorsal surface of the bone, allowing the most contact between the plate and the bone to be obtained. A locking compression plate can be used but is not necessary.6,7 In horses with prominence to the joint capsule insertion on the dorsal surface of P-I, the attachment of the joint capsule to the dorsal surface of the first phalanx is flattened with a chisel to make contouring of the plate easier. Normally, a 14- or 16-hole broad dynamic compression plate is used, depending on the size of the horse. The length of the plate is determined by the need to obtain purchase on the majority of the cannon bone without leaving a stress concentrator directly in the middle of the cannon bone. Ending the plate immediately under the top of the cast is also undesirable, because the abrasion of the top of the cast increases soft-tissue problems over the surface of the plate post-operatively.

Three or four holes of the plate are used to insert screws into the first phalanx; the fifth and sixth holes from the distal aspect of the plate are placed on either side of the joint, and the remaining holes...
extend up the cannon bone. The plate is fitted to the bone with the fetlock joint in \(-15^\circ\) of extension. It is especially important to determine that the long axis of the plate aligns with the cannon bone; 4.5-mm cortical bone screws are used through most holes of the plate, but the most distal hole in the plate and the holes immediately proximal and distal to the joint are filled with 5.5-mm cortical bone screws.

After the plate is fitted to the first phalanx, the joint surface is approached to debride the articular cartilage from the ends of the cannon bone and first phalanx. This can be done by surgically transecting the soft tissue around the lateral aspect of the fetlock joint or by creating a condylar osteotomy. It is my preference to cut the condylar osteotomy with a bone saw and reattach it with a cortical bone screw rather than transecting the soft tissue, which must be sutured. After the osteotomy and medial luxation of the fetlock joint, the articular cartilage is removed from the distal end of the metacarpus and proximal aspect of the first phalanx. The distal end of the cannon bone can be fenestrated with drill holes to allow access to the metaphyseal blood supply, which clinically appears to aid fusion.

After the fetlock joint articular surface has been eliminated, the type of palmar/plantar support used to stabilize the fetlock joint is selected. If the suspensory apparatus of the fetlock joint is intact, then fixation of the sesamoid bone through lag screws and resultant tightening of the distal sesamoidean ligaments will provide caudal support to aid the plate in resisting dorsal flexion of the fetlock joint. If the suspensory apparatus has been disrupted, then the suspensory apparatus must be replaced.

If the sesamoid bones are to be used for lag-screw fixation, then their articular surface must be denuded of articular cartilage before realignment of the fetlock joint. If the ruptured suspensory apparatus is the indication for surgery and the sesamoids are not useful, the caudal aspect of the limb is supported with a “figure-eight” tension band wire placed on the caudal aspect of the joint.

When a tension band wire is used, a transverse hole is drilled in the mid-P-I and the cannon bone a similar distance proximal to the fetlock joint. These holes are drilled between the screws of the plate to avoid intersecting the wire with later screw placement. The wire is then threaded through the first phalanx, passed up the palmar/plantar aspect of the first phalanx by means of a wire passer, crossed behind the fetlock joint, and threaded through the cannon bone to exit on the lateral aspect of the cannon bone on reduction of the fetlock joint luxation. After the wire is in place, the fifth and sixth hole from the distal aspect of the sesamoid bones is used for lag-screw fixation to stabilize the limb. Two 4.5-mm cortical bone screws are passed, in lag fashion, through the distal end of the cannon bone to lag them to the back of the cannon bone, thereby tightening the distal sesamoidean ligaments to form a tension band on the palmar aspect of the limb (Fig. 2).

Once the tension band has been established and the limb is reduced, the plate is attached to the first phalanx by all four screws in the phalanx and depressed to the surface of the cannon bone. A tension device is used to increase the tension on the plate and place compression across the cannon bone by creating tension in both the palmar tension band support and the plate. The tension device is tightened, and then, the screws of the dorsal aspect of the cannon bone are inserted sequentially using all of the holes in the plate. The author uses a 5.5-mm screw immediately proximal to the fetlock joint because of the amount of stress applied to this screw. The fifth and sixth hole from the distal aspect of the wires when the fetlock joint is extended during subsequent plate attachment.

If the sesamoids are to be used without wires, the luxation is reduced, and the limb is held in slight flexion. Two 4.5-mm cortical bone screws are passed, in lag fashion, through the distal end of the cannon bone through the center of each sesamoid bone to lag them to the back of the cannon bone, thereby tightening the distal sesamoidean ligaments to form a tension band on the palmar aspect of the limb (Fig. 2).

Fig. 2. These radiographs show the use of the sesamoid bones and distal sesamoidean ligaments to support the back of the fetlock joint.
The fifth hole is angled through the first phalanx into the cannon bone (Fig. 2). Two additional lag screws are then placed across the joint through the first phalanx from distal to proximal into the distal cannon bone, one on either side of the plate to broaden the area of compression across the fetlock joint and increase the rotational stability of the fixation. These screws are inserted as lag screws to obtain maximum compression between the joint surfaces (Fig. 3).

A suction drain is placed alongside the plate to exit proximally, and closure occurs sequentially using the lateral digital extensor tendon, the SC tissue, and then, the skin to close over the plate. Use of the extensor tendon for anchorage of the sutures is a valuable means of allowing soft-tissue closure, especially in the traumatized limb, which frequently has considerable soft-tissue swelling. After the incision has been properly closed, a cast is placed on the distal limb for recovery from surgery and to protect the implants against cyclic loading. After placement of the cast, the horse is placed in the recovery stall and assisted in rising on recovery from general anesthesia.

3. Post-Surgery Aftercare

Post-operatively, suction drainage is maintained until the serous drainage from the limb subsides, and the operative cavity is free of accumulated fluid. The horse is maintained on IV antibiotics for a period of time appropriate for the amount of damage to the soft tissues and depends on surgeon preference and the amount of contamination. Culturing of wounds to determine microorganism sensitivity to antibiotics is recommended when the limb wounds have contamination. Phenylbutazone at 2.2–3.3 mg/kg administered daily is used post-operatively. The first cast is used for recovery from general anesthesia and to protect the fixation for ~2 wk.

After the initial 2-wk period, the cast is removed and replaced. Often, the second cast is placed as a cylinder, allowing the foot to exit the bottom of the cast. This allows the horse to use the limb with tension on the flexor tendons, helping to prevent tendon flaccidity that often accompanies cast immobilization, especially in situations where the tendons have been badly traumatized. The second cast is kept in place 2 wk.

Post-operative restriction of exercise normally consists of stall rest for 2 mo with follow-up radiographs at that time to determine the degree of healing. If everything appears to have proceeded satisfactorily, a period of hand walking is used before free exercise is allowed in a large paddock or field. The most important aspect of the graduated return to exercise is the accommodation of the adjacent articulations, such as the pastern joint, to having a fused fetlock joint. These joints will absorb additional stress normally absorbed by the fetlock joint.

4. Complications

The most significant complication associated with this surgery is laminitis in the contralateral limb. This laminitis is predisposed by lack of comfortable weight bearing in the injured limb, which may result
from numerous causes, including instability of fixation or infection.

Avascularity of the injured limb may occur because of damage to the arteries of the distal limb. Lack of adequate blood perfusion is seen in two forms. Immediate avascular necrosis causes the limb to become and remain cold, whereas transient avascularity results in reperfusion injury to the foot and loss of skin or hoof wall ~2 wk after the injury. The first is easily diagnosed, but the second is impossible to predict.

Rupture of the distal sesamoidean ligaments disables the superficial distal sesamoidean ligament support to the pastern joint, which can create instability in the pastern joint and partial or complete palmar subluxation of the pastern joint. This damage to the pastern joint causes discomfort and increases the chance of laminitis in the contralateral limb.

Implant removal is indicated only in instances where infection of the implants causes drainage. After healing, implant removal is routine.

5. Results
In a retrospective study of results of fetlock arthrodesis, 34 of 52 horses with fusion of the fetlock joint survived to have unrestricted activity (Fig. 4). The results were better for horses that were treated with fetlock arthrodesis as a primary treatment than situations where non-operative treatment was tried initially and the fetlock arthrodesis was elected as a last resort. The prognosis was also better for horses treated with degenerative arthritis than for horses treated with rupture of the suspensory apparatus because of the lesser trauma to the limb pre-surgery.

Making a blanket prognosis is difficult and must be modified for each injury. Stable internal fixation is easily obtainable with this method if the veterinarian pays careful attention to surgical technique and adheres to internal fixation principals. Stable fixation can negate the effects of the primary injury. The secondary injuries, such as vascular injury and pastern luxation, then become the primary determinants of the outcome.

References