DORSAL CORTICAL FRACTURES - SCREW, DRILL OR BOTH?
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One of the most common injuries that results in lost training and racing time in Thoroughbreds involves the dorsal cortex of the third metacarpal bone. “Bucked shins” has been extensively (and variably) described in the lay and medical literature and every competent racehorse trainer looks for the clinical signs regularly in their young horses. There is little doubt that dorsal cortical injury in young Thoroughbreds is a result of some unknown product of the number and amplitude of loading cycles applied to their metacarpi. It is also clear from clinical experience and published data that geometric changes of the metacarpi consequent to training and maturation will lead to bones with improved mechanical properties capable of withstanding the “normal” cyclic loading of a Thoroughbred racehorse.\(^1\-^3\)

Because such a large proportion of young racehorses “buck” their shins and normal adaptive responses of the bone eliminate the problem, there are and have been myriad treatments that have been used and largely successful. Most horses with dorsal cortical metacarpal injury do not develop “true” fractures. Those that do, however, become major economic problems because of the timing of the injury. The typical history of a horse with a dorsal cortical fracture is that it had dorsal cortical problems in its 2 year old year and then was taken out of work for several months. As a 3 year old, it is usually well into its training when it develops lameness, dorsal cortical pain, focal heat and swelling. Radiographs then may reveal a radiolucent line within the dorsal cortex. The typical stress fracture of the dorsal cortex involves the mid-distal, dorsolateral aspect of the left third metacarpal bone. The radiolucent line typical runs at about a 30-35° angle from the dorsal cortex in a proximopalmar direction but many variations occur including fractures extending distopalmarly and “complete” saucer fractures curving back towards the dorsal cortex. Most fractures do not extend completely to the endosteal surface of the dorsal cortex.

Treatment of dorsal cortical fractures of MC3 continues to be controversial for many reasons but foremost is probably the recognition that surgical treatment is not really “essential”. These injuries are not unstable such that surgical treatment immediately improves the horse’s comfort. They are not injuries that involve an articular surface so surgery does not mitigate damage to a joint. They are not injuries that consistently fail to heal without surgery. They are injuries that can cost a lot of money due to lost time and productivity. The primary justification for surgery is that surgery is quite reliable in getting the fracture looking good enough radiographically in 4 months that the horse can be confidently returned to training.

Surgical treatment of dorsal cortical stress fractures is not always indicated. Stress fractures that involve the distal or proximal ends of the bone typically develop much more callus than the “indolent” fractures of the middle of the bone. Very distinct fractures that traverse the entire cortex also tend to develop a more successful healing response and may not benefit much from surgery. The optimal candidate for surgical treatment is a 3 or 4 year old with an obvious dorsal oblique crack that has minimal healing response and is causing distinct clinical signs. Some horses with stress fractures will heal with alterations in training but it is extremely difficult to predict which ones will do so. Most 2 year olds will heal without surgery and many trainers/owners are more willing to give a 2 year old adequate rest.
Although osteostixis alone can lead to healing, it has been my impression (and that of others) that a combination of screw fixation and osteostixis is the most reliable surgical treatment. Because these are not unstable fractures, the placement of a screw probably does not induce healing by affording stability. It is more likely that the drilling, insertion and continued presence of the screw stimulates a non-specific healing response possibly associated with what is termed a regional acceleratory phenomenon. It may be that the improved results are due to the necessity of a second surgery to remove the screw; the screw removal presumably stimulates the bone anew.

Technique:
The surgery can be performed under general anesthesia or local anesthesia and sedation. I much prefer the latter but it should be emphasized that the risk of anesthetic recovery following this surgery is low.

The horse is given a relatively low dose of xylazine (150-250 mg IV) and the metacarpus is clipped and aseptically prepared. The region is blocked with a 2 point block; 5-6 ml 2% mepivacaine is injected through a 1/2 inch 25 g needle inserted to its hub about 1.5 cm distal to the distal margin of the accessory carpal bone. Another similar volume is injected over the medial palmar nerve a few cm distal to the carpometacarpal joint.

Draping is simplest with a transparent adhesive drape. I prefer to cut the drape in half and wrap it proximal and distal to the prepared area. A single drape sheet can be used to cover the floor below the site, towel clamping it to the plastic (or to the skin). In most cases, the fracture can be located by palpation. The “bump” that can be felt is usually at the distal end of the fracture in a typically configured fracture so the incision should be centered proximal to it. If there is no palpable sign of the fracture, skin staples can be applied and radiographs taken. The common fracture location is dorsolateral so a 3 cm incision is made between the extensor tendons directly down to the bone. No lateral dissection is desirable. The periosteum is elevated and a sharp Weitlaner retractor used to maintain exposure. A 2.5 mm hole is drilled completely through the dorsal cortex approximately perpendicular to the fracture line. I prefer a light battery operated drill because they are quieter and less cumbersome in a standing horse. Inexpensive (hardware store) battery powered drills can be gas sterilized and the battery covered with sterile tape strips or sterile plastic bags.

After the first hole is made, a 2 mm pin is placed in the hole and a radiograph taken. If the hole was accurately placed, the hole is measured and tapped. If it is not correctly positioned, simply use it to guide another hole proximally or distally. A 22-24 mm 3.5 mm cortical screw is inserted and tightened. Do NOT tighten excessively or the screw head will bend because there is no countersink depression. I do not countersink the screw because I do not use the screw with a lag technique. The countersink tool does not fit in the 2.5 mm hole and removal is more difficult if the screw head is buried in the bone. After the screw is placed, additional 2.5 mm holes are drilled around it for additional non-specific stimulation of the region. Usually, a total of 5-7 holes are drilled, spaced about 1 cm apart.

There are a number of specific cautions with this surgery:

1- The bone is dense and the cortex is thick. The drilling should be done cautiously with abundant irrigation and very frequent cleaning of the drill bit. The smaller the bit, the more frequently it should be cleaned. The surgeon should probably remove and clean a 2.5 mm bit at least 3-4 times while drilling across the dorsal cortex of the metacarpus. This helps minimize a natural tendency to push too hard and the latter leads to breakage.
of drill bits or taps, both of which are major complications of this procedure. It is very difficult to convince an owner or trainer that a broken piece of metal in the dorsal cannon bone of their horse is not a big deal.

2- Be sure to drill towards the center of the bone. It is a major mistake to start a drill hole on the dorsolateral surface and drill in a straight palmar direction. You will miss the medullary cavity. Also, try not to drill into/through the palmar cortex.

3- The hex head of the 3.5 mm screw is relatively shallow so be certain that the screwdriver is fully inserted before tightening (or removing) in order to minimize stripping of the hex.

4- Be absolutely certain that the tap enters at least a couple of threads into the medullary cavity. If you try to insert a 3.5 screw through even a mm or two of untapped equine cortical bone, it is possible to snap the screw.

5- In the standing horse, it is important to have adequate sedation and complete anesthesia. Try to keep a hand or arm on the horse’s distal limb as you are drilling; this will often allow you to predict a movement that might otherwise result in a broken instrument.

6- Warn the owner/trainer that an unsightly firm swelling is likely to develop at the surgery site. A permanent blemish (“bump”) is common.

The incision is closed in 2 layers and a padded bandage maintained for at least 3 weeks. The horse is hand walked for the first month then begins daily turnout in a small paddock. In 60-75 days, the horse is returned for screw removal. I remove the screw at this time even if the fracture has not healed radiographically. The removal surgery is very straightforward if the screw head is readily palpable. Many horses, however, have enough fibrous tissue that the exact location of the screw head is difficult to determine by palpation. If so, surgically prepare the area and place a grid of skin staples over the area. A radiograph roughly parallel with the screw is taken and an accurate idea of where to make a 1 cm incision can be determined. A regional nerve block is not necessary. Usually, sedation and local infiltration of the dorsal cortex is sufficient. It is important to get the screwdriver fully inserted in the head of the screw before trying to remove it. Otherwise, the shallow hex can be stripped. (Old, worn-out hex-head screw drivers also will have a tendency to strip the heads.) Have a pair of sterile vise grips ready for such “emergencies”.

After the screw is removed, the horse goes back to walking and turnout for another 60 days then radiographs taken. If they look good, the horse is returned to regular training. The fracture and the osteostixis holes do not have to be completely healed. If the fracture line is still very distinct, an additional month is given before returning to regular exercise.

Other popular techniques for treating dorsal cortical fractures are shock wave therapy and local periosteal “scraping”. These have been used alone or in combination with different surgical procedures, including osteostixis alone. There is not much more than anecdote about such treatments. In fairness, it should also be emphasized that controlled studies of all treatments of stress fractures (including that described) are not available and case treatment remains a matter of surgical preference. A retrospective study by Dallap et al looking at the screw/osteostixis technique reported a very high success rate with virtually no complications. A 2010 retrospective study of 116 horses treated with 4.5 mm screws placed in lag fashion without osteostixis also showed an excellent outcome. All of the horses in these two studies were done under general anesthesia.
References:


There is a spectrum of fracture configurations but most propagate proximally from the dorsolateral mid-cortex. If you can estimate or feel the site of the fracture, it is a good idea to drill a 2.5 mm hole in the estimated location to cross the fracture and take an intraoperative radiograph. The screw can then be placed in that hole or an adjusted location. The angle across the fracture is probably not critical.

It is critical to drill one cortex and to enter the medullary cavity. Aim to the center of the bone.