Angular Limb Deformities and Management

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Foals are often afflicted with limb deformities, and they are classified as flexural or angular deformities. Occasionally, rotational deformities are also present.[1,2] Many of the congenital angular limb deformities correct with no treatment or with only conservative treatment. In some cases of severe orthopedic disease in young horses, the supporting limb can develop an acquired angular deformity, but angular deformities are generally congenital or developmental.

ANGULAR LIMB DEFORMITIES

Foals with angular limb deformities (ALD) have either a valgus or varus presentation. Valgus deformities deviate laterally distal to the origin of the deformity, while varus deformities deviate medially distal to the origin. Carpal valgus is the most common ALD seen, followed by fetlock varus.[4,5] The etiology of ALD is not fully understood in every case and is likely multi-factorial. We do know that unequal growth can occur across the metaphyseal growth plate, or physis. Most of the long bone growth occurs at this level and with disparate growth, deformities can occur. It is theorized that perinatal as well as developmental factors can influence the occurrence of ALD.[1] Trauma (or irregular pressure) across the physis may be a reason for incongruent growth rates. Abnormal pressure on the physis could occur due to joint laxity, malposititioning in utero, excessive exercise in young foals, or lameness in the opposite limb.[1,5] It is also possible that nutritional factors may lead to excessive or anomalous growth in some cases. Another cause for ALD is incomplete ossification of the cuboidal bones. In premature or dysmature foals and in twins, the carpal or tarsal (cuboidal) bones may not be completely ossified. The carpal/tarsal structures consist of cartilage instead of bone when this occurs, and even normal weight bearing can deform the cartilage template. The bones then ossify in that crushed shape and the consequence can be an ALD of the carpus or tarsus.

ALD: DIAGNOSIS

Angular limb deformities are diagnosed based on physical exam. Examination of the leg or legs involved can be done from different angles to evaluate the deformity. Radiographs are also performed in most cases to determine the source(s) of the deformity as well as to determine if crushing of cuboidal bones is present. Manipulation of the limb can also aid in diagnosing joint laxity, or flaccid supporting structures. Most foals are born with some degree of angular deformity, and many will correct over time. Foals also have small chests and long legs, which make many foals appear “close-kneed” because of their toed-out posture. A good physical exam can determine if and where there is a serious deformity. Diagnosis of fetlock and phalangeal deformities should be made and treatment initiated as early as possible. The distal metacarpal or metatarsal physis has little remaining growth potential after 60-90 days. Moderate carpal or tarsal deformities with no cuboidal bone involvement can be treated at a later age, as the growth plates of the distal radius and tibia have substantial growth occurring for up to a year.

ALD: NON-SURGICAL MANAGEMENT

Conservative management can sometimes be very useful in treating foals with ALD. Stall rest or restricted exercise (small periods of turnout or hand walking with the mare) is a technique that will allow many, if not most foals to correct. Frequent hoof trimming is recommended for all cases, both surgical and non-surgical. Valgus cases should have the outside or lateral wall of the hoof trimmed slightly shorter (lower), while varus deformities need the medial aspect of the hoof slightly shorter. This results in the longer side of the foot hitting the ground first, and rotating it "away" from the deformity (i.e., medially for a valgus deformity). In addition, shoes or composite material may be used to extend the foot medially for valgus deformities and laterally for varus deformities. These extensions prevent wear on that aspect of the hoof as well as assisting in the foot contacting the ground first on that side. Splints and casts have limited use in foals with ALD unless they have incomplete ossification of the cuboidal bones, and decreasing weight-bearing in those cases has ideally been implemented *before* a significant ALD is present.

Foals with incomplete ossification of the cuboidal bones *must* be on strict stall rest, and in some cases sleeve casts, splints, braces or slings may be warranted. These adjunctive therapies may help reduce weight-bearing and deformation of cartilage template as mentioned above. Most neonatal specialists advocate repeated radiographs every 2 weeks to monitor ossification of the bones.

If the bones are ossified, foals with carpal or tarsal deformities can be treated with stall rest and trimming for several months if there is no worsening of the condition. If the foals are improving with stall rest and limited turnout (from one to a few hours a day), even 4-6 months is an acceptable period to wait. I have treated foals as old as 9 months of age, and still had successful results after transphyseal bridging in those that did not eventually correct with conservative management. It typically takes foals of this age longer to correct. It must be noted however, that it is important to identify foals with cuboidal bone abnormalities, joint laxity, and deformities that worsen over time to recommend a different course of treatment than only conservative management for this length of time.

In foals that have fetlock deformities, surgical treatment is encouraged early (~ 3-4 weeks of age), as the window for manipulating growth with surgical procedures is much smaller. As such, we generally do not recommend stall rest as a treatment option in these cases. Foot trimming and extensions, if warranted, are included in the treatment for these cases as well.

ALD: SURGICAL TREATMENT

Surgical management of ALD cases is most common for the carpal region; up to 85% of those referred for surgery are carpal deformities.[4] Options for surgical treatment include growth acceleration or growth retardation. Growth acceleration is carried out on the lateral side of the physis for valgus deformities, and retardation on the medial side. This can be thought of as increasing growth on the "short" side or decreasing growth on the "long" side. Some clinicians have used both techniques in the same case.

Growth Acceleration

Growth acceleration became very popular and was widely accepted after the mid-80s.[4,6,7] The technique is named hemicircumferential transection of the periosteum and periosteal elevation (HCPTE), and is commonly known as periosteal stripping. Despite its popularity, the true efficacy of this technique is controversial, and in a recent study, periosteal stripping was no more effective in correcting experimentally induced angular limb deformities than stall rest and hoof trimming alone.[8] In another study, there was no difference between medial and lateral growth rates at the proximal or distal end of the radius in foals that had received HCPTE or those used as controls.[9] In addition, the study that introduced HCPTE for use in foals was an experimental model using six pony foals. The study was not blind, and there was no significant difference in growth at the distal radial physis after the procedure in principal limbs compared with controls.[6] Differences in angulation of the limbs were found to be significantly different; the greatest difference during the study in average angulation between control and principal limbs was 3.2 degrees. It was concluded that an angulation was created in the principal limbs beyond that of the control limbs. In contrast, much of the literature concerning this procedure claims that a limb cannot be overcorrected with this procedure. Most of the measured angulations throughout that study were within what are considered normal ranges.[10] Furthermore, all the foals were 60 days of age or less, and most were 45 days of age or less. This is an age range when it is expected that there is a change in angulation as the foal matures.[1,6,11] There are also no studies comparing growth retardation directly with HCPTE. The two procedures are sometimes used in combination, usually when the clinician decides the deformity is severe or the foal is older and has less growth potential.[1]

Though abandoned by many, the procedure for HCPTE is still practiced and will be described. An approximately 3 centimeter skin incision is made on the concave aspect of the limb over the physis starting about 4-5 cm proximal to the physis. The incision is continued to the level of the periosteum. After reflecting the tendons, in inverted T shaped incision is made in the periosteum. An elevator is used elevate 2 triangular flaps that this creates. After elevation, the periosteum is laid back onto the bone, and the subcutaneous tissues and skin are closed with absorbable suture. Bandaging and after the procedure is routine, and this is usually performed on farm, or on an outpatient basis. Hoof trimming and restricted exercise is recommended as discussed above in non-surgical management.

Transphyseal bridging

Transphyseal bridging inhibits the growth rate on one side of a physis. There are several different procedures that can be employed to retard growth of the physis. Placement of two cortical screws and figure-eight cerclage wires, transphyseal staples, or single transphyseal screws are all viable options. Using an implant to bridge the physis *may* result in overcorrection of the deformity (resulting in the opposite deformity) if the implant is not removed when the leg is straight. Thus, owners should be educated about monitoring and making an appointment for removal when transphyseal bridging is used. All of these techniques are performed on the "long" or convex side of the deformity (across the medial physis for a valgus deformity).

Screws and cerclage wires have been widely used for growth retardation. Two 4.5 mm cortical screws are placed through stab incisions; one is made in the center of the epiphysis, and one proximal to the physis – or one screw on either side of the physis. They are inserted in routine fashion, but not tightened. The soft tissues between the stab incisions are elevated, and a wire loop is inserted and hooked over the distal screw head. The wire ends are twisted together and tightened at the proximal screw head. The screws are then tightened and the stab incisions are closed with single interrupted sutures.

Transphyseal staples have been used since the late seventies after being adapted from human techniques for deformities in children. Staple placement was compared to screw and wires in a retrospective study published in 1978.[12] From this study it was concluded that the overall success rate did not differ, but surgical complications were greater with staple application. The authors reported marked blemishes, wound dehiscence, staple spreading and staple extrusion requiring reinsertion.[12] The staples used in that study were vitallium staples originally manufactured for use in humans. The complications described in this study have lead to a negative view of using staples for transphyseal bridging. This technique has been seldom recommended, and is widely not considered as secure as screws and wire. In contrast, transphyseal stapling has met with success at our clinic.[13] However, we use custom made staples which makes them more secure than the vitallium staples. Staples can be readily made by any practitioner with materials that are readily available. Surgery time is short using this method, and the cosmetic result is excellent in almost all cases. We experience very few incisional complications; the staples stay in place and are easy to remove.

Steinmann pins of 7/64 inch diameter are used to make staples. A 90 degree angle is bent in the end of the Steinmann pin with heavy pliers at approximately 1.25 inches from the end. An identical bend is placed approximately 1.25 inches from the first, and the pin is cut with sidecutters at approximately 1.25 inches from the second bend. The cut end is sharpened on a bench grinder. This yields a U-shaped staple approximately 1.25 inches on all three sides. The same procedure is repeated on the other end of the pin, and thus two staples are made from one pin. The staples are sterilized individually or in pairs in an autoclave and stored until use. Smaller staples can be made in the same manner with smaller Steinmann pins for distal metacarpal (metatarsal) physis or miniature horses.

When performing this surgery, we use towel clamps to retract skin dorsally. This is an important step as it allows the skin incision, when released, to not be directly over the staple. The skin incision is made centered over the widest part of the physeal area through the skin and subcutaneous tissues. The incision is approximately 4 cm in length. The physis is identified using a needle, the antebrachial carpal or fetlock joint identified via palpation, and the staple is centered over the physis. The staple is inserted into the bone using a hammer. The proximal end is not driven down flush with bone, leaving it slightly "proud". This makes palpation and elevation of the proximal edge of the staple easier during removal. It is possible to take intraoperative radiographs or use fluoroscopy to verify placement of the staple at this point in the surgery, but with experience, this is not necessary. The skin is released and it is closed with absorbable suture (usually Monocryl) continuous horizontal mattress or subcuticular pattern. The leg is bandaged, and the feet are trimmed if necessary before moving to recovery.

Another technique developed for transphyseal bridging is the use of a single screw. This initial report describes the use of a lag screw technique to correct tarsal valgus deviation with a screw across the growth plate of the medial malleolus of the tibia.[14] Lag screws were initially used, but a position, or neutral, screw technique is currently utilized because excessive tension lag screws result from limb growth.[15] This leads to difficult removal or potential screw breakage. The technique has been described.[15] The screw is placed via a stab incision across the physis. The screw can be backed out and tightened several times to seat and prevent over tightening/facilitate removal. Placement of screw can be confirmed with intra-operative radiographs or fluoroscopy. A single suture is used to close the skin, although some practitioners leave the incision open.[15] Bandaging is routine.

Removal of each of these implants can be done standing in the sedated animal. The occasional foal is too fractious or not well-trained enough to stand for this. I like to sedate the smaller foals and lay them on a padded table. We have owners bandage the legs for 2 weeks after insertion, and for 1-2 weeks after removal. Cosmetic results with any of the above surgical procedures are excellent in most cases. Occasionally, foals that have transphyseal bridging surgeries develop scar tissue over the implant, but the scar tissue usually remodels after removal and is aesthetically acceptable when the foal is mature. A retrospective of foals that had transphyseal stapling over 6 years (2000-2006) showed few incisional complications.[13] Incisional complications were encountered in 6 out of 63 total cases (9.5%). All were minor complications that resolved with bandaging and conservative management. Two foals had seromas; these were resolved with drainage and bandaging. One foal's bandages were not maintained by the owner after surgery, and the surgical incisions dehisced. The foal was returned to our clinic, and with bandaging, the wounds healed. The staples remained in place during this time. One foal had severe valgus deformities, and when bandaging was discontinued by the owner, the distal radii rubbed together and caused some dehiscence of the surgical sites. This also resolved with bandaging. One foal had drainage at one of the surgery sites at the time of staple removal. The staples were removed, and the infected side was left partially open. One foal had some scar tissue at the previous surgery site noted during a recheck a month and half after staple removal.

CONCLUSION

Veterinarians in equine practice should be able to diagnose, treat, and refer horses with angular limb deformities. Unique characteristics of each type of deformity dictate the treatment that will be applied to these cases. Many cases can be corrected with appropriate conservative management or surgical treatment. Exact cause is often unknown, and ongoing research is needed to help answer questions about etiopathogenesis and the efficacy of some popular treatments.

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