Managing Flexural and Angular Limb Deformities: The Newmarket Perspective

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Angular Limb Deformities

Introduction

Angular limb deformities can be classified into two categories. Valgal deformities occur when the deviation occurs lateral to the axis of the limb. Varal deformities occur when the deviation is medial to the axis of the limb. Many factors contribute to axial alignment of the limb. Newborn foals of good conformation should have a slight carpal valgus of approximately 2–5°. As the foal develops and its chest expands, the limbs become straight producing a normally conformed animal. In some young foals ligament laxity may lead to an angular limb deformity. This disappears rapidly as the foal becomes stronger. Deformity of the small bones of the carpus and tarsus due to incomplete ossification and consequent deformity upon weight bearing may produce an angular deformity. Other osseous or articular abnormalities may also lead to angular limb deformities. The most common type of deformity is related to differential growth at the level of the physis. It is this type of deformity which may respond to medical or surgical management in the form of growth plate manipulation.

Rotational Deformity

Many other limb deformities are accompanied by a degree of rotation about the limb axis. There is no effective practical means of correcting such a deformity. It is therefore essential that foals with deformities which are primarily rotational in nature are identified as they are usually unrewarding candidates for physeal surgery or even conservative management.

Investigating Angular Limb Deformities

When I examine the axial alignment of a foal's forelimb I look at the foal from both front and rear, as it stands on a level surface. With hindlimb deformities I examine the limb while standing behind the foal. I pick up and flex each limb carefully in turn to assess any deviations from axial alignment. This may allow differentiation between complex deformities involving, for example, a fetlock and carpus. I also assess the foal walking, which is helpful in localizing the site of the deformity.

Radiographic views in a dorso-palmar or dorso-plantar direction are obtained, and it is preferable to obtain a latero-medial projection of each affected area as well. It is important to have as much of the limb, both proximal and distal to the suspected site of angulation, on the plate to assess and measure

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the degree of angulation. It should be noted that it is easy to create a deformity artificially by having the foal standing incorrectly on the leg. Care should therefore be observed in properly restraining the foal to ensure optimal limb position. Having obtained a dorso-palmar radiographic projection of the affected limb, I usually attempt to define the site of angulation by drawing a perpendicular line bisecting the long bone proximal to the site of deformity and a similar line bisecting the long bone distal to the deformity and trying to identify where these lines intersect. Drawing horizontal lines through the joint and the physes is also valuable in assessing the location and extent of the osseous deformity.

I find this form of evaluation useful but prone to misinterpretation. In many cases it is not possible to identify precisely where the deformity occurs. Generally speaking I prefer to avoid physeal surgery if a clinical and radiological assessment indicates that the deformity is related to a joint. However, if there is any doubt, it is probably better to attempt physeal manipulation in the hope that this may be helpful to some degree.

Conservative Management of Angular Limb Deformities

Having identified and located an angular limb deformity, my first line of treatment is usually conservative management. With varal deformities there is usually excessive wear of the lateral aspect of the hoof and therefore we trim the medial side of the hoof wall to produce an even solar conformation. Conversely, with valgal deformities there is usually excessive wear of the medial aspect of the hoof. Therefore we trim the lateral aspect in an attempt to produce a level solar surface. We are always cautious not to trim the foot excessively as this may result in distortion and twisting of the hoof capsule which may ultimately be disadvantageous to the foal's future athletic soundness.

An alternative form of farriery involves the application of an extension shoe. Thus, for a varal deformity we use a lateral extension to the shoe and for a valgal deformity the shoe should be extended medially for 3–5 cm to encourage more axial weight-bearing through the physis.

Whichever form of corrective farriery is employed, and in most cases a combination of both types of foot treatment may be used, the foal should have restricted exercise. In those cases where there is significant physeal imbalance, exercising the foal may compound the uneven physeal growth, further worsening the angular limb deformity.

In most cases we also recommend complete rest following both surgical and conservative treatment in order to correct the deformity as soon as possible.

Surgical Correction of Angular Limb Deformities

In those cases where the deformity appears to be related to a functional (open) physis, manipulation of the physis may result in correction of the deformity. There are two basic methods of manipulating physeal growth, and both have their place in correcting angular limb deformities.

Periosteal Transection

The principle behind this method of physeal manipulation is that tension in the periosteum is released stimulating the physis to grow more rapidly on the concave side of the bone. The method was adapted from a technique described originally in children for elongation of long bones, using a longitudinal periosteal incision to stimulate bone growth.

Hemicircumferential periosteal transection with or without elevation is carried out on the lateral aspect of the limb in valgal deformity and the medial aspect of the limb in a varal deformity. I make an incision into the periosteum approximately 1.5 cm on the metaphyseal side of the physis, the skin and fascia are incised in a vertical direction and these tissues are elevated along with any tendons and tendon sheaths in the surgical site allowing a curved scalpel blade to engage the periosteum on both the palmar (plantar) and dorsal aspect of the bone. The blade is then drawn across the periosteum transecting it hemicircumferentially. It should be noted that in the foal the periosteum is very thick and vascular and this usually produces some hemorrhage.

The dorsal and palmar (plantar) incisions are joined and in those foals in which the periosteum is to be elevated a vertical incision is created from the first incision in the direction of the metaphysis for approximately 1 cm. The corners of the periosteum produced by this inverted T-shaped incision are then gently undermined. Some clinicians believe elevation is unnecessary and produces a greater cosmetic blemish, but there is little clinical evidence to support this view. The advantage of this type of surgery is, in my experience, that it is very easy to perform and while there may be some swelling at the site of surgery and the development of a fibrous and or bony lump there are few other complications.

I have never caused over correction by this method. Although postoperative care involves restricted exercise, there is no risk to implants if it is decided that the foal has to be turned out of doors. The surgery is less expensive than transphyseal bridging and no second operation is required to remove the implants following this operation.

The disadvantage of this approach is that the degree of correction obtained is less dramatic than that following transphyseal bridging. Therefore, in cases where the degree of angulation is severe, or where there is little time until functional physeal closure, it may be preferable to perform transphyseal bridging alone, or combined with periosteal transection.

Temporary Transphyseal Bridging

In this technique an attempt is made to retard growth on the more active side of the physis. Consequently, in valgal deformities the bridge is performed on the medial aspect of the limb and in varal deformities on the lateral aspect. Although stainless steel staples may be used to bridge the physis, I prefer to use 4.5 mm cortical screws proximal and distal to the physis. These are joined by a figure-eight cerclarge wire (18 g), which is twisted tight using a pair of pliers. It is preferable to tighten the wire before the screws are screwed home into the bone as this increases compression across the physis.

Following insertion of screws and wires, the foal is usually given penicillin and gentamycin for 24–48 hrs following surgery and complete box rest until the limb is almost straight. In some particularly severe deformities, transphyseal bridging may be combined with periosteal transection at the same time.

It is critical that foals with a transphyseal bridge are monitored very closely. Over-correction of the limb can result in a deformity of the opposite type. It is mandatory that postoperative radiographic views be obtained of the implants and follow-up pictures at monthly intervals until the limb is almost straight. At this stage I remove the implants to avoid over-correction and to improve the cosmetic appearance of the limb.

The advantage of this surgery is that it has a more dramatic effect on physeal growth, but its disadvantages are the extra cost of implants and the necessity for a second operation to remove them after correction.

Specific Angular Deformities

Fetlock Valgus

Mild fetlock valgus is commonly encountered in newborn foals and may also be complicated by carpal or tarsal valgus. In most cases conservative treatment will resolve the situation, although if the carpal valgus is severe it may merit a periosteal transection (see Windswept Foals).

Fetlock Varus

Fetlock varus is a condition most commonly seen in the hindlimb and the degree of angulation is often more severe than noted with fetlock valgus. In these cases it is important to assess the foal early in its life as functional closure of the distal physis of the third metatarsal (metacarpal) bone occurs at approximately twelve weeks of age. Therefore I usually perform corrective surgery no later than 4 weeks of age, to give the best opportunity for correction of a deformity.

Every year foals are referred to our hospital at approximately three months of age with fetlock deformities and clients are disturbed to discover that there is no satisfactory means of manipulating the growth plate at this age. Obviously, with any angular limb deformity after functional closure of the physis it is still possible to correct a deformity by a wedge-osteotomy technique. However, this is considered to be heroic and there are few indications for its use. Because of the short period of time of function of the physis it is usual to combine transphyseal bridging with either the application of a lateral extension shoe and or a periosteal transection which should be performed proximal to the insertion of the origin of the medial colateral ligament of the fetlock joint. In some cases there may also be a deformity of the proximal epiphysis of the proximal phalanx. In these cases a periosteal transection can be carried out distal to the insertion of the colateral ligament of the fetlock joint in order to try to correct the deformity of the proximal phalanx. Although the asymmetry of the proximal phalanx is usually the result of a longer lateral portion of the bone, in some foals the medial side may be longer. Obviously the site of the transection is orientated accordingly.

Carpal Valgus

Carpal valgus is the most common angular limb deformity encountered in young foals. Many newborn foals have a degree of carpal valgus (usually less than 15°) which usually resolves spontaneously within the first few weeks of life. Generally speaking my approach is to be very patient when dealing with carpal valgus. Time is a great healer of this condition. However, some foals are born with a very severe deformity, (greater than 30°) which is often bilateral. These foals may potentially be candidates for temporary transphyseal bridging of the medial aspect of the distal radial physis. In these severe deformities it is important to evaluate carpal bone maturity as some are related to hypoplastic carpal bones.

If the carpal bones appear hypoplastic then the application of a tube cast from the mid-radius to distal third cannon is an appropriate means of maintaining axial alignment of the limb allowing the carpal bones to mature and ossify. With less severe deformities it is my usual practice to restrict the foal's exercise, carry out corrective farriery and in many cases the problem will resolve without need for further interference.

However, those with a moderate degree of valgus (i.e., greater than 15°) are probably candidates for periosteal transection which I perform on the lateral aspect of the distal radius. It should be noted that a rudimentary ulna is often present and it is normal to transect this during surgery.

I have carried out periosteal transection for carpal valgal deformities up to almost one year of age, with apparently good results. In the older animal (i.e., greater than four months of age) periosteal transection is usually combined with the application of medial extension shoes. It is not unusual for these to

be applied even to younger foals, particularly if the deformity is not severe or in combination with surgery in more severe cases.

Carpal Varal Deformity

Carpal varus is much less common than carpal valgus. It can occur in young foals or as a result of overload from a contralateral forelimb lameness. A syndrome is recognized in an older weanling (i.e., between 8 and 12 months of age) which may suddenly develop a carpal varal abnormality.

Typically this is bilateral, but usually one leg is more severely affected than the other. At this age it is usually recommended that a temporary transphyseal bridge be carried out on the lateral aspect of the distal radial physis. This is often combined with use of lateral extension shoes.

Tarsal Valgus

Tarsal valgus is less common than carpal valgus as a cause of angular limb deformity. Occasionally this abnormality may be related to hypoplastic or crushed tarsal bones, but these foals often have a sickle hock conformation as well. Radiological appraisal is very important in such cases. Tarsal valgus is usually managed in the same way as carpal valgus and with the same lack of urgency unless the deformity is very severe. Most cases can be effectively managed by periosteal transection, although rarely a severe deformity (greater than 25°) will be treated with a transphyseal bridge.

Tarsal Varus

This is an unusual condition unless it is part of a more complex deformity. Occasionally tarsal varus accompanies severe lameness on the contralateral hindlimb. Management is either by periosteal transection or by temporary bridging of the distal tibial physis depending on the severity of the deformity.

"Windswept Foal"

Occasionally foals are born with a combination of angular limb deformities which are thought to result from the in-utero position of the fetus. Typically they will have a carpal/fetlock varus on one fore leg and a carpal/fetlock valgus on the contralateral, with a tarsal fetlock varus on one hindlimb and a tarsal/fetlock valgus on the other hindlimb. Occasionally this will be associated with other deformities such as scoliosis and rhinocampylus lateralis "wry nose." I treat angular limb deformities in these cases as described previously depending on their severity. Particular attention is paid to the fetlock deformities because of the short period of functional physeal activity of the distal cannon.

Other Considerations

It should be remembered that if foals have restricted exercise, many mild to moderate angular limb deformities will correct themselves. The fetlock joints represent a special challenge and any angular limb deformity with a fetlock joint should be assessed early in a foal's life. Any foal with implants inserted should be monitored more closely than those with periosteal transection. Monthly radiographic views should be obtained to evaluate the degree of correction.

All foals undergoing surgical treatment for angular limb deformity should be given gastric ulcer prophylaxis. Foals with implants usually receive perioperative penicillin/gentamycin for 24 hr.

Flexural Deformities

Introduction

Flexural deformities are usually found in foals at birth or develop in the first two years of life but may be acquired at any age.

The Cause of Acquired Deformities

Acquired flexural deformities usually occur for an obvious reason such as when a horse does not bear normal weight on a limb for any period of time. The classical example of this is a horse with a conservatively treated olecranon fracture which forms a fibrous union causing chronic pain. Such animals frequently stand with their carpus in a flexed position for a prolonged period resulting in a permanent flexural deformity. This may happen with other joints such as the fetlock or distal interphalangeal joint due to unresolved painful lesions in the affected limb.

The Cause of Primary Flexural Deformities

These may occur at or soon after birth or at some stage during the first 24 months of life. The cause of the deformity in most cases is not known. Despite the colloquial description of "contracted tendons," there is no evidence to suggest that the cause is relative overgrowth of bone compared to tendon, even though in many cases the flexural deformity develops at a time of rapid bone growth. There is good evidence in some cases that such flexural deformities may be the result of pain, possibly at the physis. Judicious use of non-steroidal anti-inflammatory drugs (NSAIDs) resolves the problem in some cases. Although horses with flexural deformities may also suffer from osteochondritis dissecans (OCD) their link is tenuous and the two conditions should be considered separately rather than being arbitrarily grouped together as "developmental orthopedic disease."

Carpal Contracture

Carpal contracture is most commonly encountered in newborn foals. In the most severe cases it may cause dystocia and carpal contracture may be just one component of a more generalized contracted foal syndrome. In my experience, if the carpus cannot

be extended manually when the foal is relaxed or sedated the prognosis for treatment is very poor. In these severe cases surgical section of all the soft tissues between the skin and the palmar aspect of the carpus may fail to correct the deformity. However, the vast majority of foals can either stand on their own or be manually assisted to their feet to suckle the mare. In such cases we obtain radiographic views of the carpus to evaluate the structure of the carpal bones. In a small number of cases carpal contracture may be related to severe deformity of the bones associated with the carpus. However, in my experience carpal bone hypoplasia almost always results in an extensor or angular limb deformity. With flexural deformities there may be more bizarre changes for which there is no satisfactory treatment.

The vast majority of foals born with carpal flexural deformity will recover without need for specific treatment. Splinting can be used in some cases, but this is generally regarded as unnecessary.

Affected foals become very tired when they stand. The muscles of the forearm maintain extension of the carpus and they fatigue rapidly, as they are responsible for maintaining the foal in an upright position. However, most cases will gradually improve provided the foal is able to suckle the mare, either on its own or with help. Judicious use of exercise in a paddock is also considered to be of help in these cases, although care must be taken not to over-tire the foal.

Surgical treatment of carpal flexural deformity is possible. I have sectioned the tendons inserting on the accessory carpal bone (i.e., ulnaris lateralis and flexor carpi ulnaris) which has been shown to be effective in a small number of foals. However, the vast majority of cases can be managed successfully by conservative means.

Flexural Deformity of the Lower Limb

This occurs in newborn foals and may involve either a fore or hindlimb, and occasionally the condition may be bilateral. The use of proprietary splints is very effective in resolving the condition. In my practice a series of gradually extending splints is used to passively extend the fetlock joint and the vast majority will improve quite dramatically following the use of such splints. Some clinicians use intravenous oxytetracycline (dose rate 20–60 mg/kg IV) and find this to be effective either on its own or in combination with splinting. The theory is that the oxytetracycline binds calcium ions, therefore relaxing the musculotendinous unit. In a small number of cases the degree of deformity is so severe we give the foal a general anaesthetic and a fiberglass cast is applied with the fetlock and foot held as extended as possible.

Fixed casting of a limb produces tendinous and ligamentous laxity. Using this principle the cast is changed every 3–4 days and a severely contracted fetlock will gradually straighten. If the deformity is very severe radiographic views should be obtained to ensure there is no osseous anomaly.

However severe, these congenital deformities of the distal limb can usually be resolved readily by conservative means.

Distal Interphalangeal Joint

While some foals are born with a contracture of the distal interphalangeal joint, this is usually part of a flexural deformity of the distal limb involving the fetlock as described above. However, a more specific contracture of the distal interphalangeal joint is seen in foals of 6 weeks to 6 months of age. It tends to affect one front leg, but occasionally the contralateral forelimb may also be affected usually to a lesser degree. Rarely is it seen in a hindlimb. Typically these foals walk with their heels elevated and excessive heel growth occurs because of lack of ground contact and normal hoof wear. This results in the development of a “boxy” or club foot.

Corrective farriery is usually employed as the first line of treatment. This involves rasping any excessive heel growth, which allows gravity to “stretch” the musculo-tendinous unit. Some farriers are also enthusiastic about applying shoes with toe extensions, although in my experience this technique is not particularly effective. The theory behind this is that the lever effect of the toe extension will discourage breakover and encourage the foal to bear more weight on the palmar aspect of the foot.

However, if the deformity is very severe a toe extension may cause trauma to the dorsal hoof wall and the application of aluminium shoes with toe extensions has been associated with dorsal hoof fracture. This can make the foal foot sore, worsening the contracture. An alternative approach is to provide a wedge shoe to allow the foal to bear weight on the heels with the distal interphalangeal joint in flexion. The theory behind this is that pain associated with the deep flexor tendon is the cause of the problem and providing heel support resolves the pain. Gradually the heel may be lowered, and the foal will resume a more normal foot and limb conformation. I have had little success with this technique.

If there is minimal response to corrective farriery or if the flexural deformity is severe, surgical treatment is recommended. This involves section of the carpal head of the deep digital flexor tendon. The operation is carried out under general anesthesia usually from a lateral approach (a medial approach provides a more cosmetic outcome but is technically more difficult). In the majority of cases this procedure combined with dressing the heels provides a rapid improvement in the foot position. A controlled postoperative exercise program on a firm surface is also recommended. While there is always some swelling at the surgical site, with a cosmetic blemish in the short to medium term, the results

of this surgical releasing procedure are excellent. Affected animals usually go on to make a complete athletic recovery with a normal foot shape. I have had success with this procedure even in some 2-year-olds.

Occasionally a similar condition may be seen in an older horse. While some of these cases represent failure of recognition of the problem at a younger age, in others the condition appears to be acquired later in life. If contracture has been present for several years, section of the carpal head of the deep digital flexor tendon may not be effective in correcting the deformity. In such cases I have sectioned the deep flexor tendon itself. This is usually carried out under general anaesthesia at the mid metacarpal region.

The prognosis for successful resolution of these less common deformities is much more guarded than for the situation in the foal. Most horses are dramatically improved by deep flexor tenotomy and they usually don't show elevation of the toe associated with clinical deep flexor severance. However, the deformity recurs after some months in a significant proportion of operated cases.

Fetlock Contracture

This condition is typically seen in horses from 12–24 months of age. Usually the affected animal becomes more upright through the fetlock joint. Some may remain with a rather straight limb conformation, while in others the fetlock becomes so flexed that the horse is unable to bear weight correctly through the limb, with the fetlock knuckling dorsally on weight bearing. In the most mild cases administration of nonsteroidal anti-inflammatory medication may result in a more normal limb conformation.

In such circumstances it is assumed that the lesion may be due to physeal pain, and the treatment for such animals is to rest them while administering nonsteroidal anti-inflammatory medication. In many cases there is little response to such treatment.

If the deformity does not appear to be resolving, or is of such severity as to preclude normal weight bearing, serious consideration should be given to surgical treatment without delay.

In these cases the horse will be noted to have normal foot conformation and position and the deformity involves only the fetlock itself. Careful palpation of the limb usually reveals increased tension in the superficial digital flexor tendon and in some cases the deep digital flexor tendon also appears to be more tense than normal.

The logical method of treating such cases involves section of the radial head of the superficial digital flexor tendon. I perform this with the horse under general anaesthesia via a medial approach to the caudal radius. The easiest approach to this structure is through the sheath of the flexor carpi radialis muscle which is nonsynovial and provides an excellent means of closure following surgery. The ligament is identified on the lateral aspect of the sheath, and care must be taken with several large blood vessels which penetrate the ligamentous tissue at this site. An arthroscopic approach has recently been described, but I have no experience of using it.

In contrast to section of a carpal head of a deep flexor tendon for distal interphalangeal joint contracture this procedure is much less effective in correcting a fetlock contracture. If there is any tension in the deep flexor tendon it is preferable to perform section of both the radial head of the superficial digital flexor tendon and the carpal head of the deep digital flexor tendon at the same time. Following surgery an aggressive post-operative physiotherapeutic regime should be instituted. This should involve actively exercising the affected limb by lungeing the horse or hopping it on its contracted leg with the other forelimb held up. If the fetlock continues to knuckle in a dorsal direction on weight bearing it may be necessary to provide a splinting device or a brace shoe with a strap that anchors the fetlock in a more palmar position. Elevating the heels may be useful in some cases, but in many animals I find it counterproductive because it encourages the fetlock to "knuckle over."

The results of surgical treatment of flexural deformities of the fetlock are relatively disappointing in my experience; the most successful cases still often have very upright front legs. If the deformity is very severe it may be preferable to destroy the horse on humane grounds and certainly this should be done if there is no response to surgical treatment and aggressive physiotherapy.

Other Flexural Deformities

Congenital Lateral Luxation of the Patella

While it is possible for any joint to suffer a flexural deformity there are only two other joints in which a clinical syndrome is relatively common; the first is the stifle. Congenital lateral luxation of the patella results in a flexural deformity of the stifle because the quadriceps muscle acts as a flexor rather than an extensor of the limb when the patella is in its displaced position. The condition may occur bilaterally, in which case the affected foal is unable to stand but adopts a squatting frog-like stance. While in most circumstances affected foals are born with this deformity, in some animals it seems to be acquired in the first few weeks of life. It may be possible to position the patella manually in its normal position, however in the majority of cases it rapidly becomes re-luxated.

Surgical repositioning of the patella is possible. It requires a general anaesthetic and in most cases it is necessary to release the soft tissues lateral to the patella which may be anchoring it in its abnormal position. In some cases I have found it

helpful to section the lateral patellar ligament to achieve manual repositioning of the patella in the trochlea of the distal femur.

In the most severe case there is usually failure of the trochlear groove to develop and it may be necessary to create a groove by trochleoplasty. The joint should be approached by a cranio-medial arthrotomy. This allows closure of the joint with a medial capsular overlap, much as is used for treating the condition in small dogs.

The prognosis for a return to athletic soundness in such cases is considered guarded, but is better if there is no need to interfere with the distal femur to secure the patella firmly in its normal position. Tension sutures of polydioxanone may be applied across the medial aspect of the joint to provide added security to the repair.

Collapsed Tarsal Bones

Compression of the dorsal aspect of the immaturely ossified tarsal bones results in a flexural deformity of the hock. Unless such cases are identified before major osseous deformity occurs (which is rare) there is no effective treatment for the condition (see Angular Limb Deformities).