

Management of Congenital and Acquired Flexural Limb Deformities

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Flexural limb deformities in foals are a common orthopedic problem. Deformities of the metacarpophalangeal and distal interphalangeal joints can be mild to severe and no single treatment regime is always successful. Analgesia, balanced nutrition, oxytetracycline administration, limb splintage, and surgical transection of flexor tendons or accessory ligaments may be required for successful treatment. Many congenital flexural limb deformities can be treated successfully without surgery. Acquired flexural limb deformities often require surgical intervention in addition to medical treatment. Deformities of the distal interphalangeal joint may be treated surgically by desmotomy of the accessory ligament of the deep digital flexor tendon or by deep digital flexor tenotomy. Desmotomy of the accessory ligament of the superficial digital flexor tendon, desmotomy of the accessory ligament of the deep digital flexor tendon, superficial digital flexor tenotomy, or a combination of these procedures in addition to aggressive medical therapy is often required for successful correction of metacarpophalangeal flexural deformities. Author's addresses: Department of Veterinary Clinical Sciences, School of Veterinary Medicine, Purdue University, West Lafayette, IN 47907-1248 (Adams); and University of Wisconsin, School of Veterinary Medicine, 2015 Linden Dr., West Madison, WI 53706 (Santschi). © 2000 AAEP.

Introduction

In foals restriction of a joint in a flexed position or the inability to extend a joint completely is termed a flexural limb deformity. Flexural limb deformities may be congenital or acquired. In some affected foals, in addition to the superficial and deep digital flexor musculotendon units and their accessory ligaments, the suspensory ligament, joint capsules, and collateral ligaments prevent normal extension of the joints. Malformed bones occasionally occur with congenital flexural deformities and rarely occur with acquired deformities. In utero malposition, genetic predisposition, poor nutrition, and exposure to teratogens have been suggested as causes of congenital flexural limb deformities. Acquired flexural

limb deformities may be caused by nutritional imbalances, rapid growth, and trauma.¹ Lameness in the affected limbs may precede some acquired flexural limb deformities, suggesting that pain may predispose foals to develop flexural limb deformities. Congenital flexural limb deformities most commonly involve the carpus, metacarpophalangeal, or metatarsophalangeal (fetlock) joints. Acquired flexural limb deformities usually occur in the distal interphalangeal joint of the forelimbs, or the metacarpophalangeal joints.^{1,2}

Congenital Flexural Deformities

Congenital flexural deformities usually involve the carpal or fetlock joints and range in severity from mild flexion of one joint to severe flexion of several

NOTES

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Fig. 1. This foal could stand and walk unassisted. The deformity resolved after 2 weeks of controlled exercise. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)

joints. Although foals with severe distal limb flexural deformities may respond to treatment, foals with severe flexion of the carpus (palmar angle 90° or less) or congenital arthrogryposis are unlikely to improve and often are euthanized.

Medical Treatment

When examining a neonatal foal affected with flexural limb deformities, it is important to determine if the foal can stand without assistance. If the foal can stand, specific therapy for flexural limb deformities is often unnecessary (Fig. 1). The foal should have controlled exercise such as turn out in a small paddock with the mare for 1 h daily. The goals of controlled exercise are to help lengthen or stretch the palmar or plantar soft tissues (musculotendon units, ligaments, joint capsules) while protecting the limbs from overuse. Progress towards normal limb extension should be monitored daily. Some foals can bear weight on the limb with fetlock joint knuckled forward (flexed). As a result, the extensor tendons become taut and the flexor tendons are lax.



Fig. 2. Splints can be made from thick walled PVC plastic drainage pipe that is cut in half longitudinally. This foal splint is being made from 4-inch diameter pipe and has been notched on each side and heated to bend it at the level of the fetlock joint.

In these instances the limb should be splinted to extend the fetlock joint and load the flexor tendons.

If the foal cannot stand, splinting the limb in extension is necessary to allow the foal's body weight to load and stretch the tendons and palmar soft tissues. Splints should be applied carefully as they can easily cause pressure sores due to the fragility of the integument and the pressure that is sometimes necessary to extend the limb. Any strong, light material is suitable for a splint, however, polyvinylchloride (PVC) pipe is readily available and easily cut and shaped to the required size. For neonates, 4-inch diameter thick-walled pipe, cut longitudinally into thirds or halves, is appropriate. The ends of the splint are padded with roll cotton covered with elastic tape. When applying a splint, the limb is bandaged amply, and the splint is positioned over this bandage on the palmar or plantar aspect of the limb. The splints are left on for a maximum of eight h. If re-application of the splints is necessary, the limb should be unsplinted for several hours before the splints are applied again.

A straight splint should be used if the deformity is severe. When the deformity improves, a bend can be placed in the splint at the level of the fetlock joint to further extend this joint. PVC splints can be bent easily by notching each side of the splint and heating it over a flame (Fig. 2). Cooling the splint with cold water will hasten hardening of the splint in the bent position. The use of splints should be discontinued when joint angles approach normal and the foal can stand unassisted. At this point, controlled exercise will usually result in complete correction of the deformity.

Corrective shoeing in foals with congenital flexural deformities is usually limited to applying toe extensions. Toe extensions are most valuable in cases of distal interphalangeal joint flexural deformities. Toe extensions can be difficult to keep on the foal's foot, and hoof acrylic and aluminum plates



Fig. 3. (A) Congenital fetlock flexural limb deformity in the rear limbs. (B) Same foal 48 h later following 2 doses of oxytetracycline and application of splints. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)

are often used in such instances. Commercial glue-on shoes are also available.

Intravenous administration of oxytetracycline may be useful in treating foals with congenital flexural deformities to relax flexor musculotendon units.^{3,4} The most commonly used dose of oxytetracycline for neonatal foals is 2–3 g given slowly intravenously once a day until the limbs are in a position where the foal can bear weight without assistance. Improvement is frequently observed after a single treatment but up to three consecutive days of treatment may be needed. This dose of oxytetracycline far exceeds the dose recommended for treatment of bacterial infections, but appears safe for healthy foals.⁵ Oxytetracycline should be used cautiously in sick foals, particularly those with renal compromise, as the drug can be nephrotoxic. Fetlock deformities are the most refractory to treatment, and early treatment is indicated. Oxytetracycline appears to be most efficacious if used in the first few days of life, but it may be useful in older foals. Splints are often used in conjunction with oxytetracycline administration (Fig. 3).

Nonsteroidal anti-inflammatory drugs should be used in the treatment of flexural deformities because the limbs are often painful from stretching the palmar soft tissues. These drugs may cause ulcers, although ketoprofen may be less ulcerogenic than either phenylbutazone or flunixin meglumine. Reducing limb pain and promoting exercise will aid recovery.

Surgical Treatment

Surgery to transect restrictive ligaments, tendons, or joint capsules is often not necessary for treatment of foals with congenital flexural deformities, and should be reserved for foals that fail to respond to other therapy. However, palmar carpal joint capsule transection may be needed for foals with severe flexural limb deformities of the carpus.⁶ Tenotomy of the ulnaris lateralis and flexor carpi ulnaris 2 cm

proximal to the accessory carpal bone has been advocated for treatment of carpal flexural deformities in foals that can stand to nurse.⁷ Transection of flexor tendons or the suspensory ligament in animals intended to be used as athletes is not recommended. Arthrodesis may be the treatment of choice for animals with severe fetlock deformities with marked flexion and abnormally shaped bones. This procedure can result in a pasture sound animal.⁸

Ruptured extensor tendons may occasionally lead to flexural limb deformities. More commonly, however, ruptured extensor tendons occur secondary to flexural deformities. Usually extensor tendon ruptures do not require specific therapy. If foals with ruptured extensor tendons have difficulty placing the foot in extension, a firm half-limb support bandage can be used to stabilize the fetlock joint and allow ambulation.

Acquired Flexural Limb Deformities

Acquired flexural deformities usually occur in the distal interphalangeal joints of the forelimbs or the metacarpophalangeal joints. These deformities occur uncommonly in the metatarsophalangeal and carpal joints.

Distal Interphalangeal Joint

Acquired flexural deformities of the distal interphalangeal joint usually occur in foals 6 weeks to 8 months of age. Affected foals are often rapidly growing and nursing heavily lactating mares. Flexural deformity causes the angle formed by the dorsal hoof wall and the ground under the sole of the hoof (hoof-ground angle) to increase. This deformity may occur rapidly over 3 to 5 days so that the heel of the hoof raises off the ground causing the foal to “walk on its toes.” With more slowly developing deformities the heel maintains contact with the ground and grows excessively long. Over 2 to 3 months the heel may grow to a length equal to the toe of the hoof. Hooves with this deformity have

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Fig. 4. This mild acquired flexural limb deformity of the distal interphalangeal joint resulted in a long heel and prominent dorsal coronary area. This deformity is often called a boxy foot or club foot. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9-16 with permission from the publisher.)

been termed club feet or boxy feet (Fig. 4). The coronary band may appear prominent in horses with club feet. Deformity of the dorsal hoof wall with dishing and distraction of the sensitive and insensitive laminae may occur in long standing disease and lead to seedy toe and toe abscesses. Because osteitis and remodeling of the distal phalanx can also occur, radiographs of the foot should be taken as part of the clinical evaluation.

Medical Treatment

Balanced nutrition should be ensured for all affected foals. Energy intake should be reduced when much higher than minimal requirements, particularly in rapidly growing foals. In foals with mild flexural deformities the heels can be lowered with a rasp if they are long and in contact with the ground. When the toes of the hoof are worn, bruised, deformed, or very short, a plastic acrylic cap (Technovit, Jorgensen Laboratories, Inc.) or glue-on shoes can be applied to the foot for protection. Extending

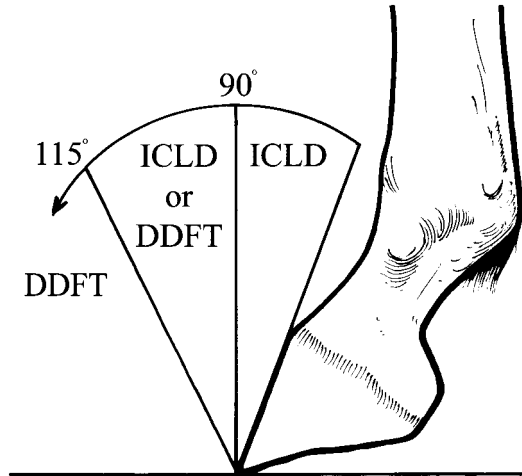


Fig. 5. Guidelines for surgical treatment of flexural deformities of the distal interphalangeal joint based upon hoof-ground angle. ICLD = inferior check ligament desmotomy; DDFT = deep digital flexor tenotomy.

the toe with the acrylic or with glue-on shoes can increase tension on the deep digital flexor tendon during break-over and help to lengthen the musculotendinous unit. Foals with flexural deformities of the distal interphalangeal joint that occur rapidly may also benefit from the administration of oxytetracycline to relax the deep digital flexor musculotendon units. Foals should be walked several times daily. Pain may contribute to development of flexural deformities and stretching of the shortened musculotendon units during correction of the flexural limb deformity may be painful, so non-steroidal anti-inflammatory drugs should be administered.

In foals that do not respond to this approach to medical therapy an alternative to surgery is to trim the feet to a near normal shape and apply glue on shoes with raised heels. This relaxes the deep digital flexor tendon and allows the weight-bearing load to be shifted to the entire solar surface of the foot. Several resets of the shoes may be necessary and success is variable. We generally prefer to surgically correct nonresponsive flexural deformities of the distal interphalangeal joint.

Surgical Treatment

The severity of the flexural deformity determines the surgical procedure necessary for correction. Guidelines for selecting either inferior check ligament desmotomy or deep digital flexor tenotomy based upon the hoof-ground angle are given in Figure 5. These are general recommendations and there are exceptions.

Desmotomy of the accessory ligament of the deep digital flexor tendon (inferior check ligament desmotomy) is the treatment of choice in foals with the hoof-ground angle 90° or less that do not respond in 10 days to conservative therapy (Fig. 6). This surgery is relatively easy, very effective for mild flex-



Fig. 6. (A) Flexural deformity of the distal interphalangeal joint with a hoof-ground angle of 75° in a 5-month-old foal. (B) The same foal 7 days after desmotomy of the accessory ligament of the deep digital flexor tendon and lowering of the heel with a rasp. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)

ural deformities, and often corrects the deformity immediately. Some owners are reluctant to authorize surgery in foals intended for sale because of the potential to decrease value. The alternative to surgery is long term corrective shoeing, analgesics administration, and physical therapy, all of which can be time consuming, expensive, and may not be successful. Descriptions of the surgical technique for desmotomy of the accessory ligament of the deep digital flexor tendon are found in most equine surgery textbooks. In some foals two to three days of exercise are needed after surgery to relax or stretch other restrictive soft tissues and thereby to correct the flexural deformity.⁹

Desmotomy of the accessory ligament of the deep digital flexor tendon may be successful in some horses where the hoof-ground angle is greater than 90° but less than approximately 115° and where marked hoof wall deformity and remodeling of the distal phalanx have not occurred.^{1,2,9,10} In questionable cases, desmotomy can be performed first, and deep distal flexor te-

notomy later if correction is insufficient following the first procedure (Fig. 7). Horses with hoof-ground angles of 115° or greater usually require a deep digital flexor tenotomy. Tenotomy of the deep digital flexor tendon can be performed at the level of the middle of the metacarpus or at the level of the pastern joint. Tenotomy in the mid-metacarpal region is simple to perform and does not require entering a tendon sheath. Excessive scarring at the mid-metacarpal incision site has been described as an undesirable complication, but in our experience this is a minor problem if the operated limb is effectively bandaged and exercise is limited to walking for 3 weeks after surgery. Correction of the flexural deformity may take several days due to restriction of extension by joint capsule, ligaments, and periarticular tissues. Pain may be marked and analgesics should be administered in the postoperative period. Elevation of the toe of the hoof from the ground during weight bearing is uncommon, but if this instability does occur, a heel extension should

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Fig. 7. (A) The flexural deformities of the distal interphalangeal joints of both forelimbs in this Quarter Horse colt were approximately 115° and did not improve with desmotomy of the accessory ligament of the deep digital flexor tendon. Tenotomy of the deep digital flexor tendons was then performed at the mid-metacarpal level. (B) Six months after surgery the alignment of the joints is nearly normal. There is minimal scar tissue and near normal appearance of the flexor tendons. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)

be placed on the hoof. Many horses can be used for riding following tenotomy of the deep digital flexor tendon.

Younger foals with severe chronic flexural limb deformities of the distal interphalangeal joint resulting in weight bearing on the dorsal surface of the hoof wall have an unfavorable prognosis. Tenotomy of the deep digital flexor tendon may be performed, but the success rate is variable due to contraction and fibrosis of joint capsule and ligaments and marked deformity of the distal phalanx and hoof wall (Fig. 8).

Metacarpophalangeal Joint

Acquired metacarpophalangeal (fetlock) joint flexural limb deformities occur most commonly in rapidly growing horses 10 to 18 months of age and are often bilateral.¹¹ The angle of the affected joint increases from a normal angle of about 140° (mea-

sured from the dorsal surface of the limb) to 180° and greater.

Three structures support the fetlock joint when it is in the normal weight-bearing position: the deep digital flexor tendon, the superficial digital flexor tendon, and the suspensory ligament. Metacarpophalangeal joint flexural deformities are often caused primarily by a shortened superficial digital flexor musculotendinous unit relative to the skeletal column. Although the superficial digital flexor musculotendinous unit may initiate the flexural limb deformity, the deep digital flexor musculotendinous unit may shorten secondarily and contribute to the deformity. In some horses with marked flexural deformity of the metacarpophalangeal joint, the suspensory ligament may be taut. One, two, or all three structures may be involved in flexural limb deformities of the metacarpophalangeal joints, making treatment of these flexural limb deformities challenging.



Fig. 8. The severe flexural limb deformities of the distal interphalangeal joints in the forelimbs of this foal were of several months duration. No improvement was made after tenotomy of the deep digital flexor tendons. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)



Fig. 9. Moderate flexural deformity of the metacarpophalangeal joints in a 2-year-old Saddlebred filly. Note the prominent extensor tendons which have become taut to prevent the horse from knuckling over. (Reprinted from Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16 with permission from the publisher.)

The severity of the deformity may be classified into three grades.¹¹ Horses with mild deformities have upright metacarpophalangeal joints that rarely flex greater than 180°. The flexor tendons and suspensory ligament are loaded during weight bearing. Horses with moderate deformities have flexion of the metacarpophalangeal joints past 180° while standing so that the fetlock joints are forward of the hoof. However, when these horses walk or trot, the metacarpophalangeal joints may extend to a position caudal to the hoof. Severely affected horses have metacarpophalangeal joints which are flexed past 180° at all times. These horses are said to be “knuckled over.” When the metacarpophalangeal joint flexes greater than 180°, the extensor tendons support the fetlock from further flexion and stand out prominently on the dorsal surface of the limb. No stress is placed on the flexor tendons or suspensory ligament (Fig. 9).



Fig. 10. The flexor tendons and suspensory ligament should be palpated for tautness while forcing the fetlock into maximal extension by pushing back with the opposite hand. The tautest structure is usually the first one released at surgery.

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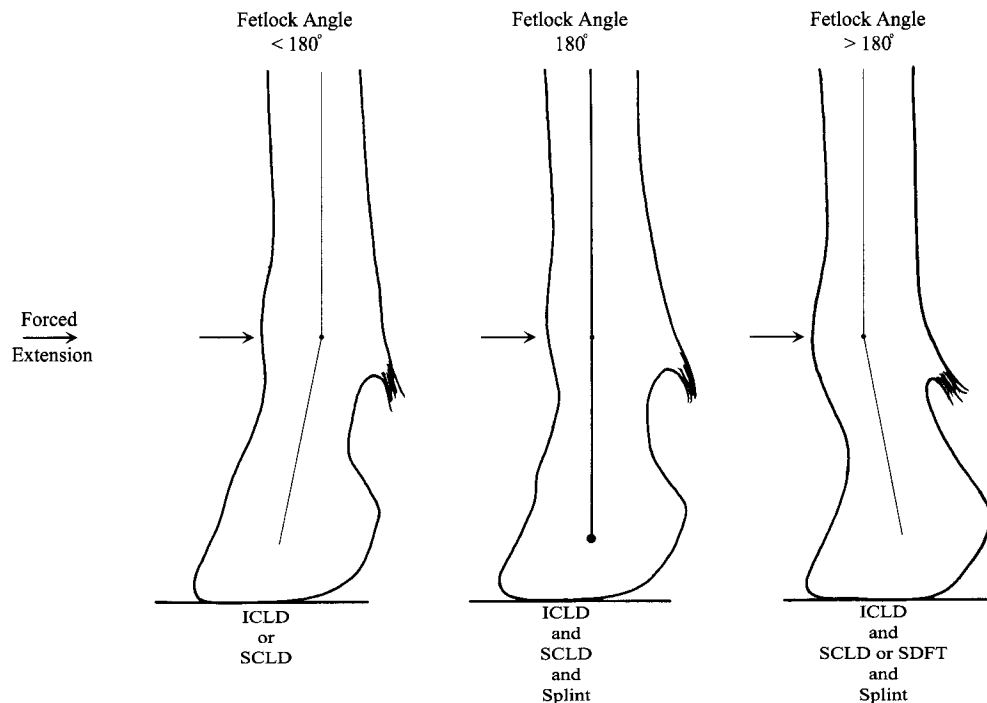


Fig. 11. Guidelines for surgical treatment of flexural deformities of the metacarpophalangeal joints based upon maximal extension of the joint during weight bearing. ICLD = inferior check ligament desmotomy; SCLD = superior check ligament desmotomy; SDFT = superficial digital flexor tenotomy.

Medical Treatment

Splints and corrective shoes may be successful in treating horses with mild flexural deformities of the metacarpophalangeal joint. A balanced diet should be ensured and non-steroidal anti-inflammatory drugs should be administered to reduce pain.¹ Physical therapy, consisting of manual stretching of the flexor musculotendon units by extending the foot and metacarpophalangeal joint can be done two to three times daily. In most horses a corrective shoe with a 1–2 cm toe extension and a 2–3 cm heel elevation will be beneficial. The elevated heel shoe reduces tension on the deep digital flexor musculotendinous unit which may allow the fetlock joint to resume a more normal position. Hoof angle has very little influence on the tension in the superficial digital flexor tendon.¹²

Splints that position the metacarpophalangeal joint caudal to the hoof and force the horse's weight onto the flexor tendons during weight bearing can be helpful. Splints can be made of 6-inch diameter, thick-walled PVC pipe split in half longitudinally and cut to the proper length. A bend may be put in the splint to conform it to the fetlock joint.

Surgical Treatment

Surgical treatment is indicated for mild flexural deformities when no response to medical therapy is noted after 10–14 d. Surgery should be considered immediately for treatment of chronic deformities in which the fetlock angle is always greater than 180° .

Selection of the best surgical procedure or combination of procedures to correct metacarpophalangeal joint flexural deformities can be difficult because more than one structure supporting the fetlock may prevent normal extension of the joint. The clinician should determine which structures prevent return of the fetlock to a normal position by palpating the suspensory ligament and the flexor tendons just above the fetlock with the horse bearing weight and the fetlock firmly pushed palmarally into extension (Fig. 10). At this time the angle of the fetlock at maximal extension is determined. In all but the most severe deformities, one or both of the tendons are the most taut during palpation.

Guidelines for selection of surgical treatment for metacarpophalangeal joint flexural deformities are given in Figure 11. Flexural deformities less than 180° during forced extension usually respond to inferior or superior check ligament desmotomy.¹³ The inferior check ligament is transected when the deep digital flexor tendon is the most taut structure during palpation and the superior check ligament is transected when the superficial digital flexor tendon is most taut or both tendons seem to be equally taut. Splints may help maintain the fetlock in a normal position but are often not needed.

When the fetlock angle during forced extension is approximately 180° , surgical transection of both the inferior and superior check ligaments is recommended followed by postoperative splintage. Severe flexural deformities greater than 180° usually

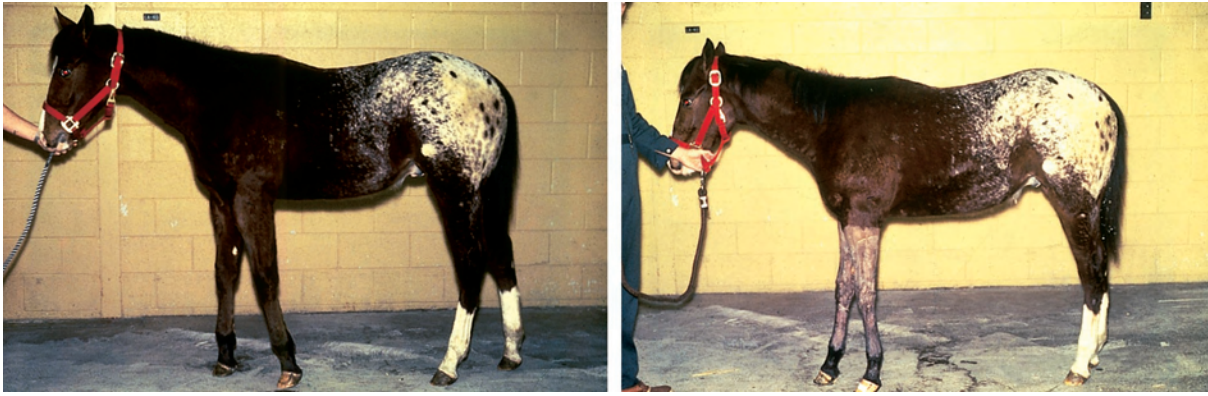


Fig. 12. (A) An 18-month-old filly with moderate flexural limb deformities in which the fetlock joints could be forced into extension to about 180°. (B) Ten days after inferior and superior check ligament desmotomies on both forelimb the flexural deformities have improved so angles of approximately 165° are present in both forelimbs. The filly could walk without knuckling for short periods of time but required splints periodically to maintain the angle less than 180°.

require desmotomy of both check ligaments or inferior check ligament desmotomy plus tenotomy of the superficial flexor tendon (Fig. 12). Very rarely the suspensory ligament will require transection. The goal of all surgical procedures is to get the fetlock in a position less than 180° so flexor structures are loaded during weight bearing. Postoperative splinting will be helpful in maintaining the fetlock joint in a proper position. Splints may need to be applied for 3 to 14 days depending on the progress. All horses undergoing surgery should receive postoperative analgesics.

Prognosis

The prognosis for young horses with mild and moderate flexural deformities of the distal interphalangeal joint is good for athletic use. Horses requiring desmotomy of the accessory ligament of the deep digital flexor tendon may race successfully.^{14,15} Horses requiring tenotomy of the deep digital flexor tendon for resolution of the flexural limb deformity can often be used for light pleasure riding.¹

The prognosis for horses with mild or moderate acquired flexural deformities of the metacarpophalangeal joint depends on the response to therapy and may be fair for pleasure riding. It is often difficult to successfully correct severe metacarpophalangeal joint flexural deformities and relapse may occur in horses which initially seem to respond to treatment.¹¹

References

- Adams SB, Santschi EM. Management of flexural limb deformities in young horses. *Equine Pract* 1999;21:9–16.
- Auer JA. Flexural deformities. In: Auer JA, ed. *Equine Surgery*. Philadelphia: WB Saunders Company, 1992: 957–971.
- Lokai MD, Meyer RJ. Preliminary observations on oxytetracycline treatment of congenital flexural deformities in foals. *Mod Vet Pract* 1985;66:237–239.
- Madison JB, Garber JL, Rice B, et al. Effect of oxytetracycline on metacarpophalangeal and distal interphalangeal joint angles in new born foals. *J Am Vet Med Assoc* 1994; 204:240–249.
- Wright AK, Petrie L, Papich MG, et al. Effect of high-dose oxytetracycline on renal parameters in neonatal foals, in *Proceedings*. 38th Ann Conv Am Assoc Equin Practnr 1993; 297–298.
- Wagner PC. Flexural deformity of the carpus. In: White NA, Moore JN, eds. *Current practice in equine surgery*. Philadelphia: JB Lippincott, 1990:480–482.
- Vasey JR, Pascoe RR, Hazard GH, et al. Surgical management of carpal flexural deformity in foals. *Vet Surg* 1995; 24:452.
- Whitehair KJ, Adams SB, Toombs JP, et al. Arthrodesis for congenital flexural deformity of the metacarpophalangeal and metatarsophalangeal joints. *Vet Surg* 1992;22: 228–233.
- McIlwraith CW, Fessler JF. Evaluation of inferior check ligament desmotomy for treatment of acquired flexor tendon contracture in the horse. *J Am Vet Med Assoc* 1978;172: 293–298.
- Fackelman GE, Auer JA, Orsini J, et al. Surgical treatment of severe flexural deformity of the distal interphalangeal joint in young horses. *J Am Vet Med Assoc* 1983;182:949–952.
- Wagner PC, Saines MH, Watrous BJ, et al. Management of acquired flexural deformity of the metacarpophalangeal joint in Equidae. *J Am Vet Med Assoc* 1985;187:915–918.
- Thompson KN, Chung TK, Silverman M. The influence of toe angle on strain characteristics of the deep digital flexor tendon, superficial flexor tendon, suspensory ligament, and hoof wall. *Equine Athlete* 1992;5:1–6.
- Blackwell RB. Response of acquired flexural deformity of the metacarpophalangeal joint to desmotomy of the inferior check ligament, in *Proceedings*. 28th Ann Conv Am Assoc Equine Practnr 1982;107–111.
- Stick JA, Nickels FA, Williams MA. Long-term effects of desmotomy of the accessory ligament of the deep digital flexor muscle in Standardbreds: 23 cases (1979–1989). *J Am Vet Med Assoc* 1992;200:1131–1132.
- Wagner PC, Grant BD, Kaneps AJ, et al. Long-term results of desmotomy of the accessory ligament of the deep digital flexor tendon (distal check ligament) in horses. *J Am Vet Med Assoc* 1985;187:1351–1353.