

Surgical management of a severe congenital deformity of the hind limb in a Shetland pony foal – a case report

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Abstract

This case report describes the surgical management of a severe congenital deformity in a Shetland pony. A two-week-old foal was presented with the right hind limb showing a 90-degree torsion of the tarsal region towards the medial side and the metatarsophalangeal joint forced in a 90-degree extension behind the right tarsus. As assessed through radiography, the tibial malleoli and the trochlea of the talus were poorly developed, the flexor tendons inserted topographically correctly on the phalanges but due to articular torsion, the tenaculum of long and lateral digital extensor tendons were projected laterally and the common digital extensor tendon on the medioplantar aspect. At the age of one month, a corrective ostectomy of the tibial malleoli, trochlear ridge, and talus was performed to reposition the adjacent bones. The tarsal bones were repositioned through an arthrotomy and subsequently the tarsal region fused by means of two cortex screws inserted in a lag fashion. Complete correction of the torsion was achieved through metatarsal osteotomy. A 20-hole 3.5-mm reconstruction plate was used for stabilization of the tibia and metatarsus, resulting in a pantarsal arthrodesis. Partial tibia shortening was performed to improve angulation of the tarsal region. At nine months after surgery, the pony was keeping the right limb hoof sole on the ground.

Congenital deformity, tarsal varus, hyperextension of the metatarsophalangeal region

The most vulnerable period in the horse's lifetime are the first four weeks of life (Trumble 2005). Congenital musculoskeletal disorders, such as angular limb deformities and flexural deformities must undergo rapid corrections to allow the foal to develop normally with minimal future compromise (Trumble 2005; Colles 2008; Kidd 2017; McCarrel 2017).

Angular limb deformity (ALD) represents a deviation of the distal portion of a limb from the normal axis in the frontal plane (Dutton et al. 1999). There are two types of ALDs: the varus deviation is defined as a medial deviation of the limb distal to the location of the deformity; the valgus deviation is defined as a lateral deviation of the limb distal to the location of the deformity (Modesto et al. 2015). These deformities are located at the physis, epiphysis or in the joint and rarely in the diaphysis, with the distal radial physis and distal third metacarpal or metatarsal physes being more frequently affected than the distal tibial physis (Auer 2012). Either type of ALD can be associated with additional rotational deformities. In foals with the valgus deformity, this concurrent rotation is displayed as an outward rotation of the foot (splay foot), whereas with the varus deformity, as a medial rotation of the foot (pigeon toes) (Bramlage and Auer 2006). The ALD treatment depends on the age of the foal, growth stages of the physes of interest, and the degree of deviation and/or rotation (McCarrel 2017). Mild angular deformities can be treated effectively with non-surgical procedures (e.g. stall rest, splits and casts, hoof manipulations), whereas for severe cases a surgical approach should be considered the treatment of choice, based on

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the appearance and severity level (e.g. growth acceleration and/or retardation, corrective osteotomy/ostectomy) (Auer and von Rechenberg 2006; Bramlage and Auer 2006; Smith 2010; Auer 2012; McCarrel 2017). Assessment of clinical signs and radiographic evaluation are indicated for determining the location, direction, and severity of the deformity (Coleman and Whitfield-Cargile 2017; McCarrel 2017).

Flexural deformities of the limb represent deviations in the sagittal plane and involve a joint held in an abnormally extended or flexed position, in which the soft tissues are primarily affected (Auer 2006; Kidd 2017). Hyperextension deformities in the front limbs lead to a back-at-knee conformation and/or dropped metacarpophalangeal (MCP) region (Gaughan 2017). The majority of these deformities are congenital in origin and can result from abnormal development of the foetus, teratogens or a malnutrition state of the mare (Gaughan 2017; Kidd 2017). The most frequently affected joints are the carpal and MCP regions, although the tarsal and metatarsophalangeal (MTP) regions can also be affected. Less commonly affected are the proximal and distal interphalangeal joints (Kidd 2017). The management approach is decided based on the type of flexural deformity. The congenital contractural deformities are usually treated with non-surgical procedures, such as medical means, bandaging, splints, and casting, whereas digital hyperextension deformities are treated by physical therapy and exercise, and surgical procedures in severe cases (Auer 2006). The diagnosis of flexural deformity is based on the clinical signs; radiographic evaluation is rarely required (Kidd 2017).

In Shetland ponies, persistent ulna/fibula, lateral patellar luxation, and congenital flexural deformity of the stifle have been reported (Shamis and Auer 1985; Hermans et al. 1987; Tyson et al. 2004; Rafati et al. 2016; Kidd 2017).

This report describes the surgical management of a severe congenital deformity of the hind limb displayed as the tarsal varus deviation with an additional rotational deformity and hyperextension of the MTP region in a Shetland pony. To our knowledge, this is the first report describing such a complex congenital deformity of a hind limb in a pony and its surgical management.

Case description

Clinical findings

In July 2016, a two-week-old Shetland pony was referred for a second opinion at the Equine Clinic of the Faculty of Veterinary Medicine of Cluj-Napoca, Romania. The pony was presented with a congenital deformity of the hind limb. The physical examination revealed all the vital signs being within the physiological range (heart rate 30 beats/minute, respiratory rate 14 breaths/min, temperature 38 °C, normal intestinal sounds, normal mucosa colour and the capillary refill time was 3 s). All haematological and biochemical indices were within normal limits. The right hind limb was showing a 90-degree torsion of the tarsal region towards the medial side and the MTP joint was also forced in a 90-degree extension behind the right tarsus (Plate I, Fig. 1A). The leg was non-functional but from time to time, the pony was supporting itself on the medial side of the right tarsal region.

Diagnosis

The radiographic examination showed that the tarsal bones were all present, but the tarsocrural joint was affected the most; the tibial malleoli and the trochlea of the talus were very poorly developed, the flexor tendons inserted topographically correctly on the phalanges, but because of the articular torsion, the tenaculum of long and the lateral digital extensor tendons had been projected laterally and were located on the medial aspect of the bone; the common digital extensor tendon was also projected on the medioplantar aspect of the limb (Plate I, Fig. 1B).

Treatment

Because of the young age of the foal, it was determined that the patient should be kept under constant monitoring until the age of one month, to avoid additional complications with the skin lesions already present. Because the patient was supporting itself periodically on the deformed limb, a splint bandage was applied to facilitate moving around.

Preoperative and intraoperative patient care

Five days before the surgery, prophylactic antibiotic treatment with gentamicin 6.6 mg/kg (Genta-Ject® 10%, Dopharma, Timisoara, Romania) and cefquinome 1 mg/kg (Cobactan® 2.5%, MSD Animal Health, Kenilworth, USA) was administered daily.

General anaesthesia was induced with diazepam 0.1 mg/kg intravenously (IV) (Diazepam® 5 mg/ml, Terapia S.A. Cluj-Napoca, Romania), acepromazine 0.025 mg/kg IV (Trankilrom inj®, Biotur, Alexandria, Romania) and ketamine (Ketamidol® 100 mg/ml, Richter Pharma, Wels, Austria). The patient was placed in lateral recumbency on the surgery table and intubated. General anaesthesia was maintained with isoflurane 1.5% (Isoflutek® 1000 mg/g, Caldes de Montbui, Barcelona). Regional anaesthesia was performed by a tibial nerve block with bupivacaine 10 ml perineural injection (INFOsint® 0.5%, Infomed Fluids S.R.L, Bucharest, Romania).

During the surgery, 50% glucose at 4 ml/kg/h and B. Braun lactated Ringer's solution at 4 ml/kg/h were administered IV. The patient was monitored and kept within the normal end-tidal CO₂ (35–45 mmHg), glycaemia within 80–120 mg/dl, blood lactate < 1 mmol/l, and heart rate > 60 beats/min.

Surgical technique

After preparation of the limb for aseptic technique, a craniodorsal incision was made through the skin and the subcutaneous tissues from the tibial crest down to the distal third of the metatarsus. The underlying long and the lateral digital extensor tendon, the tenaculum of the two tendons and the joint capsule were dissected free. Further dissection was conducted only of the area where the plate was to be applied. The tenaculum of the long digital extensor tendon was transected, thus freeing the tendon. The distal insertion of the lateral digital extensor tendon was also detached from the long digital extensor tendon and its tenaculum was left intact. The intervention was undertaken in the following phases:

1. The tarsocrural joint was opened, approaching it from the cranial aspect by transecting the joint capsule transversally, avoiding trauma to the saphenous vein. Subsequently, using an oscillating bone saw, the trochlear ridge and both malleoli of the distal tibia were removed to obtain a plane surface. The same process was used for the talus. The two surfaces were adjoined, the loss of substance being sufficient to allow the derotation of the limb and adaptation of the adjacent bones in an anatomically correct position of the calcaneus, at the back of the limb. This unusual approach was chosen to be able to obtain a good adjoint of the tarsal region without extensive trauma of the surrounding soft tissues. A completely normal angulation of the tarsal region could not be performed because it would have compromised medial saphenous vein flow and would have shortened the right hind limb.
2. This procedure was not sufficient for the complete correction of the limb axes; thus, an additional arthrotomy of the tarsometatarsal joint was performed, transecting the lateral long and short collateral ligaments, the medial long and short collateral ligaments, the long plantar and dorsal tarsal ligaments, and the soft tissues with a size 11 scalpel blade. The articular cartilage was curetted using a Volkmann spoon. The tarsal bones and the tarsometatarsal joint were fused using two 3.5 mm cortex screws (Medical Ortovit, Bucharest, Romania) that were inserted in a lag fashion.

1. To correct the limb's torsion by derotation, an additional transversal incision was made in the middle of the metatarsus. The long digital extensor tendon and the superficial and deep digital flexor tendons were pulled laterally. The digital arteries and veins, as well as the suspensory ligament were carefully dissected free along the entire plantar aspect of the limb. The vestigial metatarsal bones were transected with an osteotome, and the third metatarsal bone was osteotomized with the oscillating saw, which allowed derotation of the limb to the anatomically correct position. A 20 hole 3.5 mm reconstruction plate was applied along the entire dorsal aspect of the third metatarsal bone and cranial aspect of the tibia, with ten 3.5 mm cortex screws, followed by adaptation of the soft tissues using a 1.0 UPS polydioxanon (PDS) suture material.
2. Next, the long digital extensor tendon was repositioned to the dorsal aspect of the limb, and the previously transected ends of the tenaculum were sutured. Even though the tarsal region was fused in an extended position, repositioning was easily achieved. The lateral digital extensor tendon was passed through its tenaculum at the distal tibia and sutured to the lateral margin of the long digital extensor's tendon, using the traditional Krackow suture, as described by Veurink et al. (2015) in humans. The suspensory ligament was repositioned to the plantar aspect of the third metatarsal bone between the vestigial metatarsal bones, requiring a minimal fixation only proximally.
3. The subcutaneous tissues were closed using 1.0 PDS suture material in a simple continuous pattern and the skin edges were apposed using the same type of suture material in an interrupted vertical mattress pattern. After the surgery, the limb was bandaged and immobilized with a cast for 5 weeks.

Postoperative patient care

The antibiotic therapy with gentamicin was continued for 5 days after surgery (similar dose as given preoperatively). For pain management, a non-steroidal anti-inflammatory drug firocoxib 0.1 mg/kg/day (Equioxx® tablets of 57 mg, Boehringer Ingelheim, Lyon, France), was administered orally once per day for 10 days. To avoid the development of gastric ulcers, Gastricalm solution 20 ml (Lencare®, Le Mans, France) was administered twice per day for 10 days.

The tarsal and metatarsal regions, as well as the adjacent joints were immobilized through a bivalve Scotch cast maintained for 90 days. The bivalving of the cast allowed frequent inspection of the wound and physiotherapy procedures. The halves of the bivalve cast were secured in place with a nonelastic bandage. The size of the cast was regularly adjusted to allow foal growth and to avoid tightness-associated complications. To promote wound healing, an aluminium spray (Zinc-Oxid Spray®, Maravet, Baia Mare, Romania) was applied daily during the first five days after surgery, and then, the wound was evaluated closely on a weekly basis for the next 4 weeks. Figure 2 (Plates II, III) shows the clinical appearance of the right hind limb (A), a craniocaudal radiographic view (B) and a lateromedial radiographic view (C) at one month after surgery. After this period, physiotherapy procedures including daily flexions, extensions and massage of the affected limb were applied to stimulate local circulation. At three months after surgery, the cast was removed. Physiotherapy by manual exercise was given to the affected limb for 10 min daily in the first week and an additional 5-minute work period was added weekly for the next 3 weeks after cast removal. During these 4 months of a post-surgery recovery period, the pony and mare were kept in a box stall. After this period, they were transferred in a 15-square-foot paddock.

Results

At nine months after surgery, the pony was keeping the right limb hoof sole on the ground. A grade 1 lameness was still visible, but it was compatible with a day-to-day life

and the degree of the pony's abnormality was minimal. Clinical appearance of the right hind limb and a lateromedial radiographic view at 9 months after surgery are shown in Figs 2D and 2E, respectively (Plate III).

Discussion

The role of the Shetland pony as a companion animal has led to its increased breeding and consequent occurrence of undesirable congenital conditions, such as persistent ulna/fibula lateral patellar luxation, and congenital flexural deformity of the stifle (Speed 1958; Shamis and Auer 1985; Hermans et al. 1987; Tyson et al. 2004 Rafati et al. 2016; Kidd 2017). A case of marked digital hyperextension of both MCP regions has also been reported in a 2-week-old Icelandic pony (Auer 2006). To the author's knowledge, this is the first report of a severe tarsal varus deviation with rotational deformity and hyperextension of the right MTP region in a Shetland pony, which were successfully corrected by surgical techniques.

In this case report, ALD diagnosis was based on clinical examination and radiographic findings. In foals, ALDs can be the result of periarticular laxity, cuboidal bone hypoplasia, and deformities originating in long bones before or after cessation of physal growth (Jansson and Ducharme 2005). In the present case, the tibial malleoli and the trochlea of the talus were poorly developed, and a 90-degree medial rotation of the tarsal region was noted. This poor development could have been caused by the lack of direct contact between the distal tibia and the talus. Based on the ALD classification reported in the literature (mild: < 10 degrees; moderate: 10–20 degrees; severe: > 20 degrees) (Barr 1995), the deformity was categorized as severe. This abnormal conformation of the tarsal region led to the lateral projection of the tenaculum of the long and lateral digital extensor tendons, and their displacement to the medial aspect of the bone; the common digital extensor tendon was also displaced to the medioplantar aspect of the limb. Given the severe and complex tarsal limb deformity, surgical management by either transphyseal bridging with staples or wire placed in a figure-eight fashion around two screws, lag-screw technique for transphyseal bridging, or other surgical techniques recommended in the literature (Fretz et al. 1978; Witte et al. 2004; Auer and von Rechenberg 2006; Witte and Hunt 2009; Smith 2010; McCarrel 2017) were not applicable per se. Osteotomies and ostectomies have been described for the surgical management of ALDs of the MCP/MTP region (Fretz and McIlwraith 1983; Bramlage 1994; Epp 2007). Step osteotomy or ostectomy are preferred over closing wedge ostectomies because they maximize the bone-to-bone contact, provide a more stable fixation, maintain bone length, and can be performed in a way that rotational deformities are also corrected (Getman 2011). In the present case, a corrective ostectomy of tibial malleoli and of the talus were preformed, which allowed reposition of the adjacent bones to an anatomically correct position of the calcaneus. The arthrotomy of the tarsometatarsal joint allowed tarsal bones positioning (two cortex screws were inserted in the lag fashion). Complete correction of the 90-degree torsion was only achieved through metatarsal osteotomy which allowed derotation of the limb and its placement in the anatomically correct position. A reconstruction plate was used for stabilization of the tibia and metatarsus following osteotomy, resulting in a pantarsal arthrodesis. No screws were inserted in the proximal aspect of the tibia because proximal to the third screw inserted into the distal tibia, the plate was positioned off to the lateral aspect of the bone. In addition, as the foal was only one month old, an attempt was made to avoid excessive bone trauma or other complications that may have weakened the mechanical resistance of tibia and compromised the surgery outcome. To achieve a normal angulation in the tarsal region, additional shortening of the tibia would have to be performed, which the authors wanted to avoid.

To note, in foals, arthrodesis involving the distal tibia should only be performed after 4–6 months of age, since the distal tibia is highly active until this age (Getman 2011). However, if attempts to correct severe deformities by osteotomies or osteotomies would result in an unstable repair without engaging the physal region, arthrodesis is recommended as a salvage procedure (Getman 2011). The reduced athletic function and other possible complications associated with arthrodesis in horses should be considered and discussed with the owner before taking the decision (Getman 2011). The authors chose this option and the owner agreed, given that they wanted the foal as a companion animal.

The hyperextension of the MTP region was managed by the bivalve cast applied for immobilization of the hind limb and by the physiotherapy (manual exercise) applied during and after cast removal. Although swimming is a non-weight bearing exercise considered an excellent controlled physiotherapy and has led to rapid improvement of symptoms in a 2-week-old Icelandic pony with marked digital hyperextension of both MCP regions (Auer 2006), this therapeutic option was not applied due to the associated tarsal ALD surgery. For the same reason, neither the treatment with hoof manipulations was applicable (Kidd 2017). Moreover, the pony was not maintaining the hoof sole on the ground and the actual physiotherapy was initiated only after cast removal, when the pony was four months old. Splint bandages and casts incorporating the feet are usually contraindicated in hyperextension deformities of the MCP/MTP region because they totally support the limb, thereby leading to overprotection of the flexor tendons and a further loss of tone of the already hypotonic flexor tendons (Auer 2006; Kidd 2017). In the present case, this was the only therapeutic choice compatible.

In summary, this case report describes a technically difficult surgery for the correction of a severe tarsal varus deviation associated with rotational deformity and hyperextension of the MTP region in a Shetland pony foal. The perioperative clinical management was also described in detail.

Conflict of Interest

All authors have no conflict of interest to disclose.

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A



B

Fig. 1. Preoperative clinical appearance of the limb deformity in right lateral recumbency position (A) and the lateromedial radiographic view (B)





B



C



D



E

Fig. 2. Clinical appearance of the right hind limb (A), the craniocaudal radiographic view (B) and the lateromedial radiographic view (C) at 1 month post surgery; and clinical appearance (D) and the lateromedial radiographic view (E) at 9 months post surgery