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Distal Physeal Radius Fracture in a Colt

Varsan distaalisen radiuksen kasvulinjamurtuma

SUMMARY

Non-displaced distal physeal Salter-Harris II fracture of the radius was diagnosed in a 4-month-old Warmblood colt. The colt had been in an outside paddock with the mare. Clinical signs included a 5/5-degree lameness on AAEP scale and swelling on the medial aspect of the left carpus. The radiographical examination of the limb revealed a fracture. The treatment was conservative. The foal was discharged 7 weeks later from the hospital with a satisfactory short-term outcome but the athletic prognosis was regarded guarded. One year later, the prognosis became poor due to severe angular limb deformity.

YHTEENVETO

Neljän kuukauden ikäisellä orivarsalla todettiin Salter-Harris II -tyypin murtuma radiuksen distaalisessa kasvulinjassa. Varsa oli ollut tarhassa emänsä kanssa. Varsalla todettiin voimakas ontuma vasemmassa etujalassa, 5/5 astetta AAEP-asteikolla sekä turvotusta vasemman etupolven mediaalipuolella. Röntgenkuvassa todettiin radiuksen distaalisen kasvulinjan murtuma. Varsa hoidettiin konservatiivisella hoidolla ja kotiutettiin hevossairaalasta 7 viikkoa myöhemmin. Hoidon lopputulos kotiutettaessa oli kohtalaisen hyvä, mutta ennuste urheilukäyttöön oli varauksellinen. Vuotta myöhemmin jalkaan kehittyi vakava virheasento (carpus valgus).

YDINKOHDAT:

- Non-displaced distal physeal Salter-Harris II fracture of the radius was diagnosed in a Warmblood colt.
- The colt was lame and its left carpus was swollen.
- Conservative treatment included physiotherapy and lead to satisfactory short-term outcome, but one year later the colt was found to have a severe angular limb deformity.
- The prognosis for distal radial physeal fractures in growing animals is guarded for an athlete.

INTRODUCTION

Radial fractures in horses can affect any breed and age, although foals seem to sustain radial fractures more frequently than adults.[1] These fractures are the result of an external trauma, for instance kick injury[1-3] stress fractures,[2,4] entrapment of the leg proximal to the carpus,[3,5] step of the mare on the limb[2,6] or an abrupt stop after high-speed exercise.[1]

In foals and young horses fractures of the radius occur most frequently as a transverse, shortly oblique fracture on the mid-diaphyseal region or on the proximal physis along the ulna. However, other configurations affecting distal physis, metaphysis, epiphysis and joint surface are possible.[1,6] More commonly, these fractures are not comminuted compared to those in adult horses.[1,3] On the other hand most frequent physeal fractures in foals are located at the proximal physis of the radius and are usually Salter-Harris type I or II and involve the ulna.[5,6]

In the physical examination, signs closely reflect the severity and location of the fracture. If the fracture is incomplete or non-displaced, clear signs are not always present or they are less evident. The lameness can vary initially from 3 to 5/5 AAEP (American Association of Equine Practitioners)[2,4] and can improve during the 12–72 hours following the accident to full weight bearing and sound walk.[1,2] The diagnosis is confirmed with radiographic examination although fissures or non-displaced fractures may not be visible in radiographs until 4–10 days after the trauma. Persistent lameness associated with a kick injury over the radius may indicate a fracture.[1,2]

The initial management of the fracture focuses on avoiding nerve

FIGURE 1 KUVA

Left carpus, craniolateral to caudomedial 45° oblique view. The fracture is visible on the dorso medial aspect of the distal radius.

Vasen karpus, kraniolateraalinen-kaudomediaalinen 45° viistosuunta. Murtuma on nähtävissä radiuksen distaaliosassa dorso mediaalipuolella.

and vascular damage, avoiding the opening of the closed fracture, cleaning skin wounds in order to reduce the contamination and the stabilization of bone fragments.

The horse can be treated either conservatively or surgically. Conservative treatment is recommended in horses with incomplete[1-3,4] or non-displaced fractures.[2,3,6] The goal is to reduce the mobility of the horse. At least 2–4 months of box or stall rest is recommended with gradual re-introduction of hand walking or exercise in a small paddock. The return to normal activity should follow after 6 months.[2] The horse is prevented from lying down with slings or cross tying in order to avoid a catastrophic fracture. External support with Robert Jones bandages[1] and splints (caudal and lateral up to the withers) or fiber-glass casts can be used as well.[1-4] Surgical treatment is essential to repair displaced or complete fractures. Surgery is performed either by external coaptation with transfix pins or with external or internal fixation.[1,3,6,7]

Complications are common and include infection, non-union, contra-lateral or support limb laminitis and catastrophic or fatigue failure of the fracture repair. In foals, angular limb deformities including the contralateral limb, premature closure of the physis, shortening of the bone and subluxation or arthrosis of the elbow are also a concern.[1-3,6]

Prognosis is good for a non-displaced fracture treated conservatively. Horses are even able to return to their previous level of performance.[2,4] Foals usually have a better prognosis than adults. The prognosis is fair in transverse fractures located on the mid-diaphyseal region,[1,2] short oblique fractures[1] or physeal fractures, especially Salter-Harris type I and II.[3,6] Fractures in other locations such as metaphysis, physis and through joint surfaces have a guarded prognosis for future athletic use.[1,2]

CASE HISTORY

A 4-month-old Warmblood colt was referred to the Veterinary Teaching Hospital of the University of Helsinki with acute lameness and severe swelling on the dorsomedial side of the left carpus. The colt and the mare shared the yard with other mares and foals.

On arrival the colt was bright and alert. Rectal temperature was slightly increased (38.9° C) and the colt had a cough. Auscultation of the thorax was unremarkable. Non-weight bearing lameness of the left fore-limb was evident (5/5 AAEP). Swelling on the dorsomedial aspect of the carpus extended about 7 cm proximally on the radius with no apparent carpal joint effusion. The manipulation

FIGURE 2 KUVA

Craniocaudal view of the left carpus, radius and third metatarsal. Note 7.26° valgus.

Kraniokaudaalinen suunta vasemmasta karpuksesta, radiuksesta ja kolmannesta metatarsaaliluusta. Valguksen kulma on 7,26°.

of the limb was moderately painful and there was no abnormal movement, crepitation or skin disruption.

Radiographs of the left carpal area showed a minimally displaced fracture (2 mm) through the distal radial physis, starting on the lateral side with slight periosteal reaction and extending into the metaphysis on the dorsomedial aspect and valgus deformity (5.30°, figure 1). Radiographs of the thorax revealed a mild bronchial pattern. Ultrasonographic examinations of the carpal joints, tendons and tendon sheaths as well as results from the ultrasonography of the thorax were unremarkable. Haematological and biochemical analysis of the blood revealed mild leukocytosis

(16.8 x 10^9 cells/l) and increased fibrinogen concentration (7.9 g/l). The diagnosis was Salter-Harris type II fracture of the distal radius with a slight displacement.

The foal was treated conservatively based on the minimal displacement of the fracture. Treatment consisted initially on placing a Robert Jones bandage with a palmar splint (PVC half-pipe) from the fetlock up to the elbow, anti-inflammatory therapy (meloxicam 0.6 mg/kg orally once daily, for 2 weeks) and prophylactic gastric mucosa protector (omeprazol 4 mg/kg orally once daily). The foal was kept in box rest.

Athletic prognosis was guarded because of the mild angular deformity detected on arrival. Distortion and premature closure of the affected physis and flexural and/or angular deformities on the contralateral limb were expected as mid and long-term complications. However, the owner elected to treat the foal.

The foal improved during the first days of hospitalization and began to use the leg with full weightbearing. However, a week later laxity of the flexor tendon was evident on the affected limb. Additionally, atrophy on the extensor carpi radialis, common digital extensor muscles, flexor muscles, humeral and scapular muscles (m. supraspinatus) was noticed after 18 days of treatment. The foal also showed difficulty to flex and protract the leg with mild toe dragging. Differential diagnoses were brachial plexus and/or distal nerve damage or muscle disuse or compression atrophy. The splint was changed to Robert-Jones bandages. Physiotherapy consisting of neuromuscular electrical stimulation (NEMS) was initiated at a frequency of 65 Hz, pulse duration of 270 µs and intensity of 13 mA with $6s^{rest}/3s^{contraction}$ cycle for the maximun of 5 minutes at once under the fatique treshold, 1–3 times per day. The treatment was applied over the atrophying supraspinatus, deltoideus, triceps, biceps brachialis and extensor carpi radialis muscles. Two weeks later walking was added to the physiotherapy. Control radiographs were taken 3 weeks after the fracture diagnosis. They revealed lateral bony bridging of the physis, valgus on the left carpus (7.26°, figure 2) and mild valgus on the right carpus (4.80°).

Laxity improved, the muscle tone was recovered and the angular limb deformities did not progress further. The colt improved significantly and was able to use the limb after 7 weeks of hospitalization. Radiograph showed evidence of callus formation and bone healing.

FIGURE 3 KUVA

Cranio caudal view of the left carpus, radius and third metatarsal. Note 7.19° valgus.

Kraniokaudaalinen suunta vasemmasta karpuksesta, radiuksesta ja kolmannesta metatarsaaliluusta. Huomaa 7,19 asteen valgus.

FIGURE 4 KUVA

Cranio caudal view of the left carpus one year after the accident. Note 12.33° valgus.

Kraniokaudaalinen suunta vasemmasta karpuksesta vuosi murtuman toteamisen jälkeen. Huomaa 12,33 asteen valgus.

The colt was discharged after 53 days. Box rest was recommended for 8 weeks with controlled exercise in a small paddock (10 x 10 m, 1–2 hours daily). After 8 weeks, controlled exercise was prescribed in a bigger paddock for another 8 weeks (25 x 25 m) during daytime. Weaning was recommended as soon as possible, to limit the energy intake and to avoid overfeeding.

The colt was rechecked 2 months after discharge. He walked well and showed only a slight lameness at trot. The hoof of the left forelimb was smaller, straighter and longer at heels than that of the opposite limb. Swelling on the carpal area was almost unnoticeable. The colt was sound at walk but showed 2/5 degree lameness

on the left fore-limb while trotting on a hard surface. Radiography revealed good healing of the fracture and carpal valgus in both fore-limbs, 7.19° on the left (figure 3) and 4.80° on the right fore-limb. The colt was discharged with hoof trimming recommendations.

One year later the colt was sound at walk although trotting on straight line was slightly irregular and asymmetric. The left fore-limb presented an evident carpal valgus. The radiographs showed a closed physis and uneven growth of epiphysis with the lateral aspect being shorter and valgus of 12.33° (figure 4). The prognosis was poor for high-level dressage competition.

DISCUSSION

There are few reports of distal Salter-Harris fractures of radius.[1,3,5,6] Embertson et al[6] described the incidence, management and outcome of 70 different physeal fractures over a period of 9 years. Of these only four affected the distal radial physis and two were classified as Salter-Harris II. Moreover, only one was identical to our patient's fracture. Other authors have also reported that fractures at the proximal physis or ulna[3,4,6] and mid-diaphyseal region[1,3] are the most common.

This type of fracture is generally of acute traumatic origin[1-7] and indeed, the history and clinical findings of the present case point to an acute and traumatic event. Besides, the fracture configuration pointed to a trauma caused by a lateral impact (for instance a kick).[5] Potential differential diagnoses include developmental and infectious physitis.[2] However, developmental physitis occurs most frequently in animals at 8 to 24 months of age. Septic physitis was ruled out as well by serial radiographs and by the favourable evolution of the clinical signs.

We chose conservative treatment because there was only minimal displacement (2 mm) and the fracture was closed. The possible benefits of surgery were not considered superior to those of conservative treatment. Possible surgical treatment consists of physeal bridging by means of screws and wires, transphyseal screws, intramedullary pins, DCP plates, DCS plates or T plates.[1-3,5]The presence of a closed and "non-displaced" fracture precluded any invasive method.[1,4,6] Instead of using a splint,[1] the use of fiberglass cast was considered, but it would have required general anaesthesia or a very deep sedation. We considered that the colt would have been in risk of non-fitting or a loose cast. Creating an open fracture would have been a risk as well. The benefit of the splint was that it could be closely controlled as it was changed every 3 to 7 days.

Complications such as angular limb deformity of the affected limb[1-3,5,6] and of the contralateral limb were expected as a consequence of the over-loading[6] as well as flexural deformities of the affected limb (i.e. tendon laxity).[2,3,6] These kind of complications can appear in adult horses as well. However, sequelae are more severe in growing patients where the future athletic career is of concern. For choosing the optimal treatment, the prognosis should be discussed with the owners. In our case the owners complied with conservative management.

Carpal valgus of both fore-limbs was expected as a mid and long-term complication. Surgical correction such as physeal bridging was, however, not considered because of the outcome and evolution of an already damaged physis. On arrival, the foal was already 4 months old. The rapid growth of long bones from the distal radial physis declines by 5 to 6 months of age[2,6] with a definitive closure between 12 to 20 months of age.[2,3,8,9] Surgical intervention may have lead to a catastrophic fracture during the recovery or postoperative period. Besides, the possible benefits of the surgery in our patient, despite the growth potential until 8 to 10 months of age,[10] were difficult to predict. The physis was, most probably, completely damaged. Hoof trimming should have been combined with other corrective treatments, but for the reasons stated before they were not considered.

Limb support and subsequent loss of muscle tone resulted in limb laxity. At the same time, muscle atrophy in the proximal limb and scapular muscles were detected. Nerve damage of the plexus brachialis and/or radial nerve was considered. However, nerve damage is not the usual complication in distal physeal fractures of the radius. Compression of the bandage and splint and the excessive abduction of the limb when the colt was lying down, getting up and slipping were likely causes of the nerve or plexus brachialis damage.

Radial nerve damage produce extensor muscle and triceps atrophy. Clinical signs include difficulties in protracting the limb, a dropped elbow and the inability to lean on the limb.[11] Suprascapular nerve damage affects supraspinatus and infraspinatus mucles although no atrophy was detected in the latter. Atrophy of the flexor muscles can be related to the damage of the ulnar and median nerves but also of the brachial plexus.[11] In our case no pastern or fetlock hyperextension were detected.

Electromyography would have been helpful to find out if there was true neurogenic atrophy and to detect the muscle group's involved. Without electromyography the conclusion was that muscle

atrophy was the consequence of muscle disuse or compression and mild damage of the radial, suprascapular nerves and/or plexus brachialis.

Based on the previous conclusion, physiotherapy in form of electrical muscle stimulation was justified.[12-14] To the knowledge of the authors, there are no earlier reports on physiotherapy as part of treatment regimen for this type of equine patients. Our case indicates that foals with secondary atrophy either due to immobilisation or due to peripheral nerve injury may benefit from different forms of physiotherapy. For humans with a similar trauma physiotherapy is routine for treatment and even for prevention. Physiotherapy as a part of treatment regimen in horses calls for further reports.

The prognosis for non-displaced fractures is generally good, particularly in foals.[1,2,4] As in our case the fracture type and related complications were remarkable, the prognosis was guarded to poor. Some reports point out that physeal fractures have a worse prognosis than mid-diaphyseal fractures[1,2] while others state that prognosis is better in Salter-Harris II fractures and foals under 4.5 months of age.[3,6] Moreover, closure of the physis happens in up to half of the cases regardless of the type of treatment.[6] The colt presented a 5.30° valgus on arrival. It evolved to 7.19° before the discharge 7 weeks later and remained stable for another 2 months. This could be the result of a not perfectly fitted splint or the repeated change of it and the subsequent manipulation of the limb. The use of a fibreglass cast placed under general anaesthesia with the limb in a good aligned position would have minimized this problem.

The owner presented the colt only 1 year later with a 12.33° carpal valgus. The colt was then 20 months old. Partial closure and an uneven growth of the damaged physis contributed to the valgus. Delayed attempt for surgery could have helped to partially correct the deformity in the previous months.

We conclude that distal radial physeal fractures in growing animals should be considered to have a guarded prognosis for an athlete and that delayed attempts for surgical correction should be considered.

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