Surgical management of an atypical chronic fracture of the third trochanter of the femur

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CASE REPORT

Surgical management of an atypical chronic fracture of the third trochanter of the femur

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Summary

Fractures of the third trochanter of the femur are an uncommon cause of hindlimb lameness in the horse. The diagnosis is easily made with ultrasonography. Reported prognosis is good after a period of rest and a progressive return to exercise. This case report describes a third trochanter fracture in a 5-year-old trotter mare, which is atypical in terms of both its clinical presentation and management. At the dynamic examination, a left hind lameness was only observed when harnessed at the track. Nuclear scintigraphic examination revealed a marked increase in radiopharmaceutical uptake on the third trochanter of the left femur. Radiographic and ultrasonographic findings confirmed an old complete fracture of the third trochanter of the left femur, with a displaced fragment. The mare was referred for surgical treatment in order to remove the fractured third trochanter. At the follow-up examination, the mare was sound in hand and imaging revealed successful resection of the main fractured fragment. After a period of stall rest, the mare progressively resumed training and then racing 7.5 months after the surgery, performing at its expected level. Surgical treatment may be an option for chronic fractures of the third trochanter.

KEYWORDS
horse, hindlimb, lameness, scintigraphy, trotter

INTRODUCTION

Fractures of the third trochanter of the femur are an uncommon cause of hindlimb lameness in the horse. The third trochanter is a salient tuberosity located on the lateral aspect of the femur. It provides insertion for both gluteal and femoral muscles: the *gluteus superficialis* muscle and caudal part of the *tensor fascia latae* that insert on its apex and the *quadriceps femoris* that attaches on its base (Barone, 2000a, 2000b; Budras et al., 2012). Because of its quite superficial position, the third trochanter is prone to direct traumatic fracture, during a fall on the side. Such fractures can also be caused by an eccentric contraction of the *gluteus superficialis* muscle during sudden extension and lateral rotation of the hip joint (Bertoni et al., 2013; Denoix, 2014). This can happen either traumatically, typically when a horse stops abruptly (Denoix, unpublished data), if the hind foot slips backward or during a fall (Bertoni et al., 2013) or as a result of repetitive cycles of excessive movement at high speed (Bertoni et al., 2013; Geissbühler et al., 1998).

Although seldom described in the literature, acute fractures of the third trochanter of the femur are reported to be associated with sudden onset of severe lameness (Bertoni et al., 2013; Davenport-Goodall & Ross, 2004; Dyson, 2011; Shields et al., 2015). In most cases, no specific physical abnormality nor typical clinical presentation is reported, although localised swelling and/

or pain on palpation may be present if examined soon after the injury (Bertoni et al., 2013; Davenport-Goodall & Ross, 2004; Dyson, 2011; Shields et al., 2015). Diagnosis is easily made with imaging, especially with ultrasonography, which is considered the primary procedure in the diagnostic approach. It is indeed rapid and easily performed in the field and allows excellent evaluation of bone surfaces, including detection of callus formation or fibrous union of the fracture, soft tissues and entheses (Bertoni et al., 2013; Geburek et al., 2009; Shields et al., 2015). In most of these published cases, however, ultrasonographic examination of this region was only performed after scintigraphic examination allowed localisation of increased radiopharmaceutical uptake (IRU) in this area. Recommended management is conservative with rest and progressive return to exercise, and prognosis is usually good (Bertoni et al., 2013; Davenport-Goodall & Ross, 2004; Dyson, 2011; Shields et al., 2015).

In this case report, we describe an unusual case of third trochanter fracture, in terms of both clinical presentation and management.

CASE HISTORY

A 5-year-old Standardbred female trotter (earnings 174,610€) was referred to the CIRALE for investigation with scintigraphic examination of a recent onset of left hind lameness at high speed on the track during a race 3 days prior to presentation, on a counterclockwise track. The mare had been at training and racing regularly for 2.5 years, but racing results had been irregular for several months, with recurrent disqualification for going off-stride.

CLINICAL FINDINGS

Physical examination

The mare was in good physical condition, and all vital parameters were within normal ranges. At standing examination, there was mild muscle atrophy of the left gluteal region and the mare showed a painful reaction with global flexion of the left hindlimb.

Dynamic examination

During in-hand examination, the mare was sound at trot on the straight line on hard ground but the left hind global flexion test was positive, inducing a mild left hind lameness (grade 1/5) (Ross, 2011). When examined harnessed on the track, the mare showed a grade 1 to 2/5 left hind lameness (Ross, 2011), more pronounced on the left rein and at high speed. Eventually, the mare broke stride into the 'traquenard' (trotting with the forelimbs and cantering with the hindlimbs).

DIAGNOSTIC IMAGING FINDINGS

Nuclear scintigraphic examination of the thoracolumbar spine, pelvis and hindlimbs was performed. After 15–20 min of exercise on the track, the mare received 10 mg of acepromazine intravenously (IV) in order to induce vasodilatation (Pequito et al., 2013). Ten minutes later, 4.8 GBq (10 MBq/kg bwt IV) of

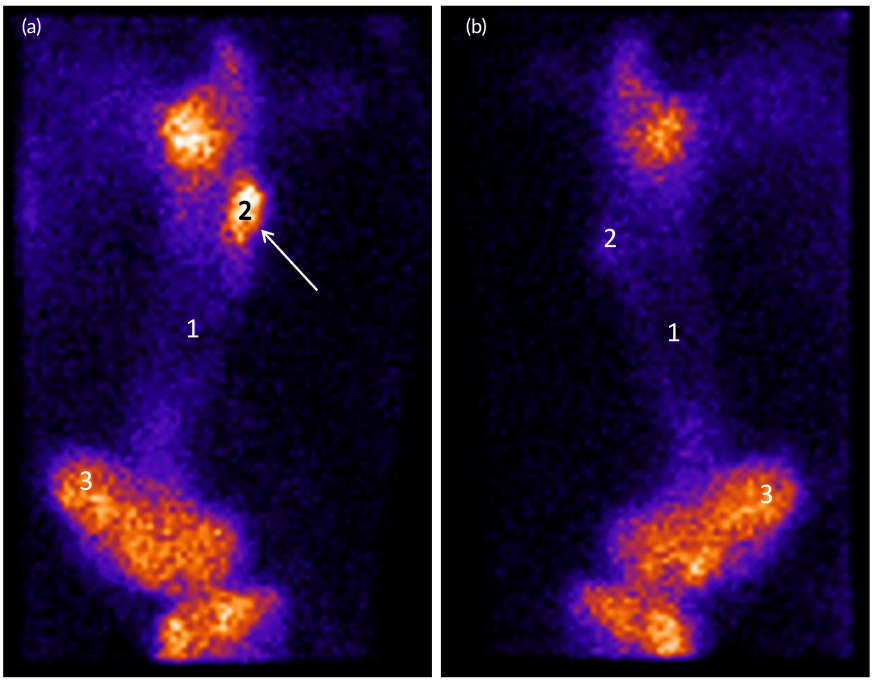

FIGURE 1 Craniolateral oblique scintigraphic images of the third trochanter of the left (a) and right (b) femur. There is marked increased radiopharmaceutical uptake (IRU) in the left third trochanter (arrow) compared with the right. 1. Femur. 2. Third trochanter. 3. Patella.

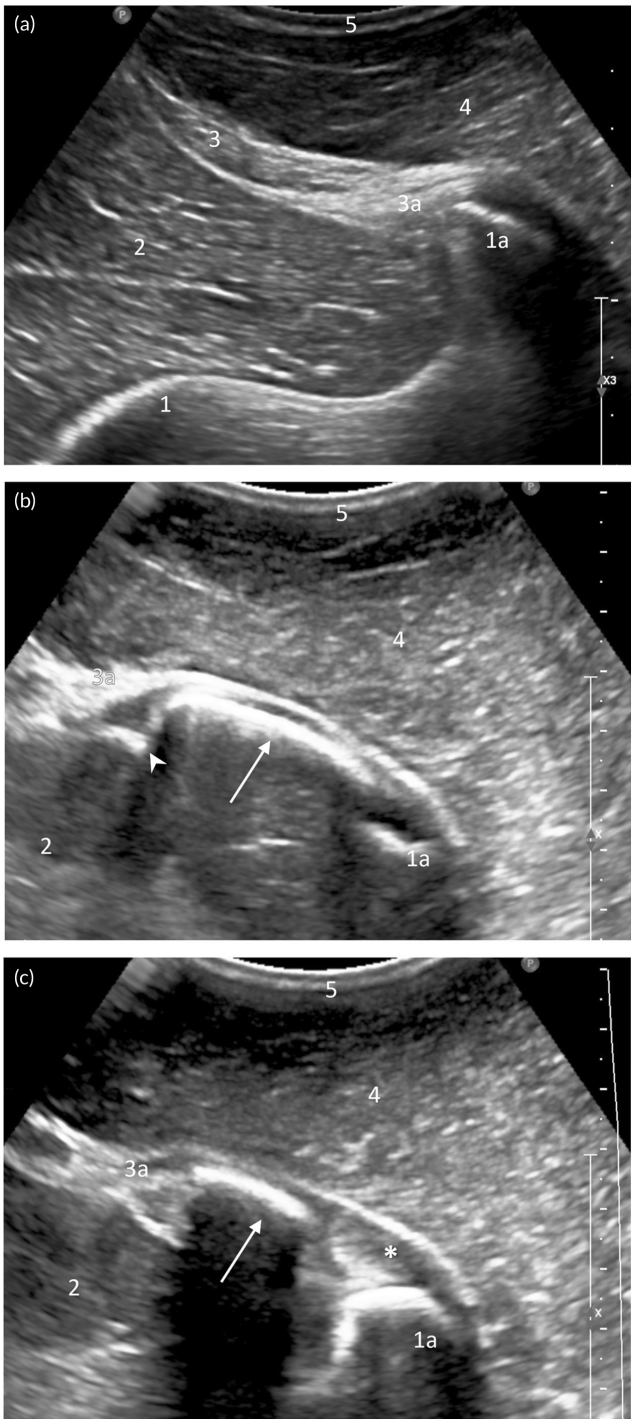

FIGURE 2 Transverse ultrasonographic images of the third trochanter (cranial is to the left). (a) Image of a normal third trochanter. (b, c) Images of the fractured left third trochanter of the mare at the initial examination, with a bone fragment bent and displaced cranially (arrow). Compared with the normal third trochanter (a), the fractured one is bent cranially and located more cranially (to the left of the image). At mid-height (b), the fragment is large and minimally displaced. There is bone remodelling at the cranial aspect of the fragment (arrowhead). At the distal end of the third trochanter (c), the fragment is smaller but displaced more cranially. The tendon of the *gluteus superficialis* muscle appears thickened and heterogenous at the level of its insertion on the third trochanter (star), indicating enthesopathy. 1. Femur. 1a. Third trochanter. 2. *Quadriceps femoris* muscle. 3. *Gluteus superficialis* muscle. 3a. Tendon of the *gluteus superficialis* muscle. 4. *Gluteofemoralis* muscle. 5. Skin.

99 m technetium-hydroxymethane diphosphonate (99mTc-HDP) was injected and furosemide (250 mg, IV) 1.5 h later. Bone phase images were obtained 3 h after injection of 99mTc-HDP according to a standard protocol, the mare being sedated with detomidine (total of 0.2 mg/kg bwt, IV) and morphine (0.1 mg/kg bwt, IV). The third trochanters were visualised on lateral images of the stifles and craniolateral oblique images of the femur and coxofemoral regions (Bertoni et al., 2013). Marked IRU was observed in the third trochanter of the left femur compared with the right (Figure 1). Additional findings were IRU in the spinous processes from the 17th thoracic to the third lumbar vertebrae and slightly in the lateral part of the right metatarsal condyle.

The lateral aspect of both femoral regions was examined ultrasonographically using transverse and longitudinal views with a 1- to 5-MHz multifrequency convex/curvilinear transducer and a 5- to 12-MHz multifrequency linear transducer. The lateral aspect of the right femur was normal (as in Figure 2a). On the left femur (Figure 2b,c), there was a complete fracture of the third trochanter with cranial displacement and bending of the fractured fragment, with peripheral bone remodelling along the fracture margins and the distal end of the tendon of the *gluteus superficialis* muscle was thickened and heterogenous (enthesopathy).

A cranio 25° lateral–caudomedial oblique radiographic view of each third trochanter was then acquired with a ceiling-mounted X-ray tube and a flat panel detector placed in a bucky column with the mare standing (Bertoni et al., 2013) and sedated with detomidine (0.1 mg/kg bwt, IV). The third trochanter of the right femur was normal (Figure 3a). On the left femur (Figure 3b), it revealed a simple complete longitudinal fracture of the base of the third trochanter with a lateral displacement of the distal part of the fragment and bone remodelling along the proximal margins of the fracture (callus formation). Increased opacity is seen on the two edges of the fracture proximally; this is induced by bone modelling of the margins on the fracture plane and it is a sign of chronicity. Besides, there was a marked thickening of the lateral cortex of the femur at the level of and just distal to the fractured third trochanter compared with the contralateral bone.

DIAGNOSIS

There was an old but active complete fracture of the third trochanter of the left femur, with a craniolateral displacement of the fractured fragment.

TREATMENT

The mare was referred at the Clinique Equine de Grosbois for surgical management. Procaine penicillin (13 mg/kg bwt i.m.),

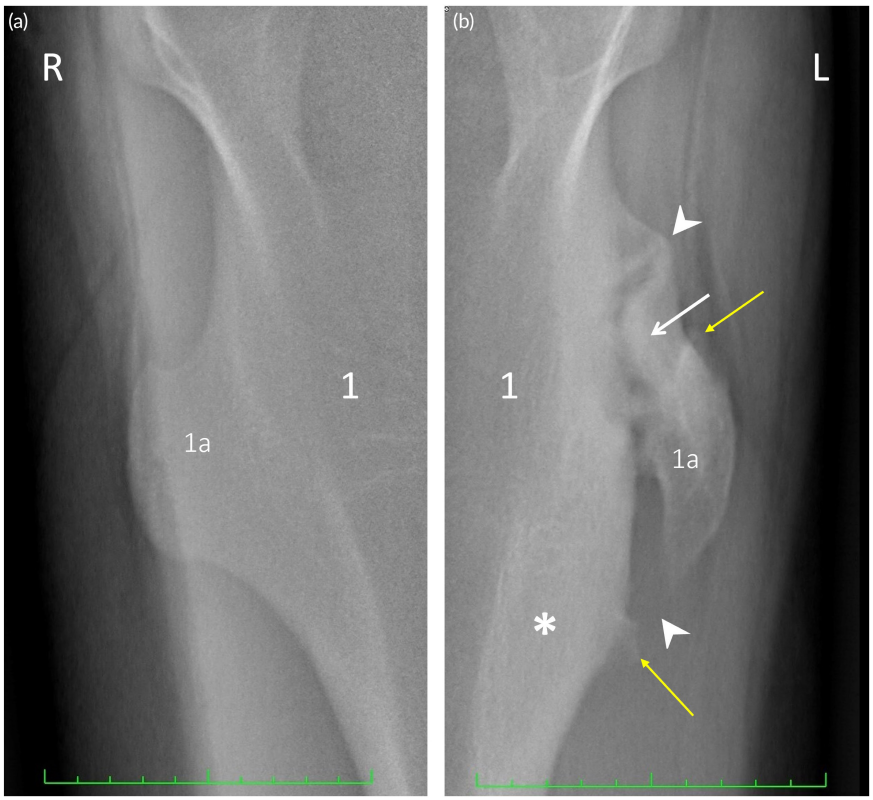

FIGURE 3 Cranio 25° lateral–caudomedial oblique radiographic views of the third trochanter of the right (a) and left (b) femur of the mare at the initial examination. (b) There is a simple complete longitudinal fracture of the base of the third trochanter, partially healed proximally with a callus, with a lateral displacement of the distal part of the fragment (arrowhead) and bone remodelling along the margins of the fracture (yellow arrows). Increased opacity is seen on the two edges of the fracture proximally (white arrow); this is induced by bone modelling of the margins on the fracture plane. The lateral cortex of the left femur (star) appears thickened compared with the right. 1. Femur. 1a. Third trochanter.

gentamicin (6.6 mg/kg bwt i.v.) and meloxicam (0.6 mg/kg bwt i.v.) were administered prior to the surgery and continued for respectively 7 days and 12 days post-operatively. The mare was then premedicated with detomidine (0.01 mg/kg bwt i.v.) and morphine (0.2 mg/kg bwt i.v.). General anaesthesia was induced using ketamine (2.2 mg/kg bwt i.v.) and diazepam (0.05 mg/kg bwt) and was maintained with isoflurane and oxygen administered via a large animal breathing circuit. Morphine was used to provide intraoperative analgesia (boluses of 0.1–0.2 mg/kg bwt i.v.) and post-operative analgesia (0.2 mg/kg bwt i.m. b.i.d.) for 2 days. The mare was placed in a right lateral recumbency. A skin incision of approximately 15 cm was made on the lateral aspect of the femoral area along the cranial margin of the *M. gluteofemoralis*, at the level of the third trochanter. (In the former concept of the caudal femoral muscles anatomy, the *M. biceps femoris* was composed of three heads: one cranial (the current M. *gluteofemoralis*) and two caudal (the true *M. biceps femoris*). Now (International Committee Veterinary Gross Anatomical Nomenclature, 2017), *M. gluteofemoralis* and *M. biceps femoris* compose the *M. gluteobiceps*.) The *septum femorale* between the *M. gluteofemoralis* and *M. gluteus superficialis* muscles (Denoix, 2018) and deep fascia along these muscles were incised. *M. gluteus superficialis* attachments on the third trochanter were transected. The third trochanter was then dissected following the fracture plane, and the proximal part, still attached to the body of the femur, was resected with an oscillating saw. The detached third trochanter was removed; muscular attachments were debrided and the area was abundantly rinsed with saline. A deep Penrose drain was placed, and fascia, subcutaneous tissue and skin were sutured. The recovery was assisted with head and tail ropes. It was uneventful; the mare could easily stand and then walk comfortably to the stall. The drain was removed 48 h after the surgery, and the mare was discharged from the clinic 5 days later.

The mare was kept at stall rest for 5 weeks after surgery. Daily outings of 10–20 min duration at the walk were then introduced and progressively increased.

OUTCOME

A follow-up examination was performed at CIRALE 2 months after surgery. The mare showed no lameness in hand (at walk and slow trot in a straight line). Ultrasonographic (Figure 4) and radiographic (Figure 5) examinations revealed successful resection of the main fractured fragment of the left third trochanter. However, a small fragment remained embedded in the distal tendon of the *gluteus superficialis* muscle, which appeared thick and hypoechogenic. The

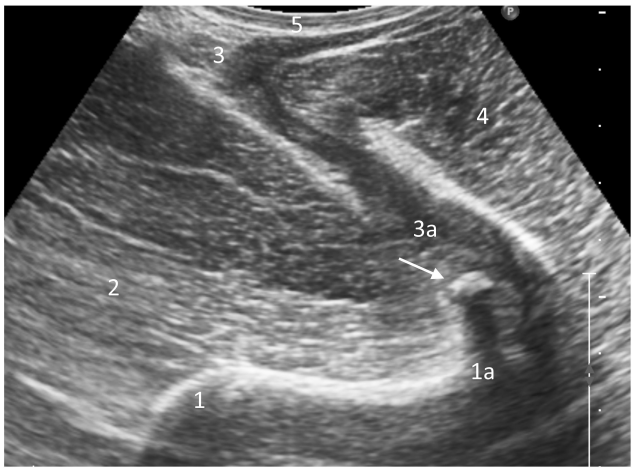

FIGURE 4 Transverse ultrasonographic image of the left third trochanter of the mare at the follow-up examination 8 weeks after surgery (cranial is to the left). The main fractured fragment of the third trochanter is not present anymore, but there is a small remaining fragment (arrow) embedded in the distal tendon of the *gluteus superficialis* muscle (3a), which appeared thick and with an heterogenous echogenicity. 1. Femur. 1a. Base of the third trochanter. 2. *Quadriceps femoris* muscle. 3. *Gluteus superficialis* muscle. 3a. Tendon of the *gluteus superficialis* muscle. 4. *Gluteofemoralis* muscle. 5. Skin.

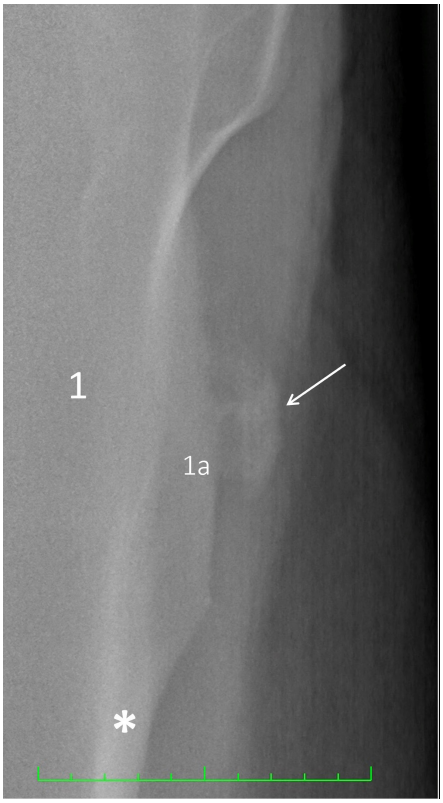

FIGURE 5 Cranio 25° lateral–caudomedial oblique radiographic view of the third trochanter of the left femur of the mare at post-operative examination. The main part of the third trochanter is not present anymore, but there is a small remaining fragment (arrow). Bone remodelling at the base of the third trochanter is not present anymore either and the lateral cortex of the left femur (star) appears thinner than on initial examination (Figure 3). 1. Femur. 1a. Base of the third trochanter.

lateral cortex of the left femur, though, was thinner than on the initial radiographic examination.

After another month at walk with increasing duration of outings, the mare progressively resumed harnessed outings: promenade and then jogging. It eventually returned to training and raced again for the first time 7.5 months after surgery. To date, the mare raced nine times and placed twice (22,030€ earnings). According to the owner and trainer, performances were at the expected level.

DISCUSSION

This mare showed lameness characteristics that were atypical for a fracture of the third trochanter. Lameness was only seen at high speeds, on the left rein, with a tendency to break the stride into 'traquenard', whereas current literature reports significant lameness in hand, in most cases (Bertoni et al., 2013; Davenport-Goodall & Ross, 2004; Shields et al., 2015). The positive global flexion test can be explained by the increased tension of the *M. gluteus superficialis* and *tensor fascia latae* muscles on the fractured third trochanter when the limb is flexed (*M. gluteus superficialis* being an extensor of the hip) (Barone, 2000b; Denoix, 2014).

Diagnostic imaging modalities were standard, as described in previous studies (Bertoni et al., 2013; Shields et al., 2015). In most cases presented at the CIRALE for investigation of a hindlimb lameness, ultrasonographic examination of the hip and trochanteric region is systematically performed as part of the routine imaging work-up when diagnostic anaesthesia suggests a proximal origin of the pain (negative distal blocks) or is performed after imaging (Bertoni et al., 2013). In this particular case, the mare was only lame at high speed on the track therefore diagnostic analgesia was not performed and the mare was specifically referred to the CIRALE for scintigraphic examination.

Radiographic examination of both third trochanters was performed using a cranio 25° lateral–caudomedial oblique view, described previously by Bertoni et al. (2013). Evolution of fractures of the third trochanter usually results in a fibrous union with a gap between the fragment and the parent bone (Bertoni et al., 2013; Butler et al., 2017). In this case, a callus was present proximally and a wide fibrous gap is seen distally. This aspect and the peripheral bone remodelling along the fracture margins were quite unusual for this type of fracture when compared to previous literature (Bertoni et al., 2013; Shields et al., 2015) and with other cases presented at the CIRALE. It also indicated the fracture was at least a few months old. This remodelling was not evident at ultrasonographic examination, probably because of the superimposition of the fractured fragment.

Considering the likely age of the fracture, the large amount of peripheral bone remodelling and the chronic *gluteus superficialis* muscle distal enthesopathy, the authors suspected that stall rest

or restricted activity would not improve the healing of the fracture; therefore, surgery was considered. It was hypothesised that surgical removal of the displaced fractured fragment could reduce local inflammation and traction by the *gluteus superficialis* muscle on the fragment and thus on the fracture line. To the authors' knowledge, this is the first published case describing surgical management of a fracture of the third trochanter of the femur. Surgery was successful, and no complications were encountered. Mean duration of recovery of third trochanter fractures slightly differs between published studies. Bertoni et al. (2013) and Davenport-Goodall and Ross (2004) reported a full recovery in less than 6 months for the majority of horses whereas Shields et al. (2015) reported an 8–18 months period of rehabilitation before return to previous level of activity. In our case, the mare successfully returned to racing 7.5 months after surgery; it performed as expected by its owner and trainer.

Surgical management was elected with the hopeful hypothesis that the sectioned tendon of *M. gluteus superficialis* would heal by inserting on the base of the third trochanter (only remaining part). Should adequate healing not occur, a protraction defect of the affected limb could be expected as *M. gluteus superficialis* acts a flexor of the hip and protractor of the hindlimb (Barone, 2000b; Budras et al., 2012; Denoix, 2014).

CONCLUSION

This case report describes diagnosis and treatment of an atypical chronic case of third trochanter fracture. It is the first report of surgical management of a third trochanter fracture, with resection of the fractured fragment. Surgery was uneventful and the mare successfully resumed racing activity. Surgical removal of the fractured fragment may be an option for the treatment of chronic fractures of the third trochanter.

AUTHOR CONTRIBUTIONS

A. Tischmacher, A. Beaumont and J.-M. Denoix contributed to the study design, data analysis and interpretation, and the preparation of the manuscript. A. Campos Schweitzer and F. Rossignol contributed to the study design and execution, data analysis and interpretation. All authors approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

No conflicts of interest have been declared.

ETHICS STATEMENT

Consent was gained from the owner for all diagnostic and therapeutic procedures and the use of case material for teaching and research purposes.

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