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CASE REPORT

Conservative management of a fracture of the greater trochanter of the femur in an adult horse

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Summary

An 8-year-old Warmblood cross mare was presented for further investigation of an acute-onset lameness of the right hindlimb. Three weeks prior to presentation, the horse was found markedly lame at walk following a fall during exercise. The horse was initially managed with field rest, but the lameness persisted. A marked right hindlimb lameness at trot graded 5/10 was confirmed. Atrophy of the right gluteal musculature was evident, and palpation over the region of the right coxofemoral joint provoked a pain reaction. Nuclear scintigraphy revealed a diffuse area of increased radiopharmaceutical uptake in the right femoral head, neck and greater trochanter. Radiographs identified a complete, slightly displaced fracture of the base of the greater trochanter of the right femur. Ultrasound examination of the proximal femur demonstrated an irregularity of the caudolateral bone surface of the greater trochanter, extending along its attachment to the femur; this was consistent with the radiological findings. On re-examination, after 9 months of stable rest, the horse was found to be sound when trotted in a straight line on the hard surface. Follow-up two and a half years after the initial incident reported the horse to be nonlame and at its previous level of work.

KEYWORDS
horse, conservative management, fracture, lameness, proximal limb

INTRODUCTION

Fractures of the proximal femur in nonracehorses are uncommon (Dyson, 2011) whilst fractures of the femoral capital physis have only been reported in foals (Hunt et al., 1990). Fracture of the greater trochanter of the femur has only been reported once previously in a 14-month-old Thoroughbred filly (Beccati et al., 2012). In this case, the fracture had been sustained whilst undergoing treatment for colic and the horse was euthanised. The acquisition of diagnostic radiographs of the region in the standing animal was described alongside confirmatory ultrasonographic images. This case report describes the successful management of an adult horse which sustained a fracture of the greater trochanter.

To the authors' knowledge, no report on the successful management of a greater trochanter fracture in an adult horse has been published previously.

CASE HISTORY

An 8-year-old Warmblood cross mare was presented to the Royal Veterinary College Equine Referral Hospital (RVC ERH) for investigation of an acute-onset severe lameness of the right pelvic limb; the lameness was graded 7/10 (May & Wyn-Jones, 1987) at trot in a straight line. The injury was sustained by falling, after bolting and cantering into a ditch, 3 weeks previously. Since then, the horse had been maintained on field rest and received suxibuzone (Danilon Equidos Gold, Ecuphar, 3.1 mg/kg, SID, PO). There had been no improvement in the horse's comfort.

Clinical findings

On presentation, the horse showed marked lameness at walk; at trot, a grade 5/10 (May & Wyn-Jones, 1987) right hindlimb lameness was present. The level of lameness was reduced compared with what was reported by the referring veterinarian. The right hindlimb showed a reduced cranial phase of the step, but the horse was able to weight bear on the limb and no obvious stance abnormalities were noted. However, flexion of the right hind proximal limb was resented. There was asymmetry of the pelvic musculature with marked atrophy of the gluteal muscles on the right side. When pressure was applied on the right gluteal region, over the coxofemoral joint, and specifically the middle gluteal muscle, a pain response was elicited.

DIAGNOSTIC IMAGING

Nuclear scintigraphy

Nuclear scintigraphic evaluation was performed using a standard sedation protocol consisting of detomidine (0.01 mg/kg intravenously (IV)) and butorphanol (0.01 mg/kg IV), and additionally acepromazine (0.02 mg/kg IV). The horse was injected with technetium^{99m} methylene bisphosphonate (10 MBq/kg bodyweight), and two and a half hours later, dynamic bone phase scintigraphic images of the hindlimbs were acquired. Dorsal and lateral scintigraphic images of the pelvis showed marked diffusely increased radiopharmaceutical uptake (IRU) in the region of the right femoral head, neck and greater trochanter (Figure 1) and extended distally along the right femur over a small distance. There was also a moderate diffuse IRU over the right sacroiliac joint region, ilial wing and tuber coxae compared with the left side. The marked diffuse IRU was most consistent with a fracture of the right proximal femur. The moderate diffuse IRU of the right sacroiliac joint region, ilial wing and tuber coxae was most likely caused by the reduced attenuation of the radiopharmaceutical due to the marked right-sided gluteal muscle atrophy.

Radiography

Radiographs of the proximal femurs were obtained using the standard sedation protocol. The following projections were acquired: cranio70°ventro30°medial-caudodorsolateral oblique view of the right coxofemoral joint, left 30°dorsal-right ventral oblique and right 30° dorsal-left ventral oblique views of both the right and left coxofemoral joints and cranio70°ventral-caudodorsal oblique views of the pelvis and coxofemoral joints.

A well-defined, irregular, 10-cm radiolucent line was identified coursing across the base of the greater trochanter of the right femur in a cranioproximal to caudodistal direction (Figure 2). An irregularly marginated, concave, radiolucent area at the caudodistal aspect of the greater trochanter of the right femur, measuring approximately 2 cm proximodistally and 1.5 cm craniocaudally, was also evident. A radiographic diagnosis of a complete, nonarticular, closed, mildly displaced fracture of the right femur, at the base of the greater trochanter, affecting both the cranial and caudal cortices of the bone, was made.

Ultrasonography

Ultrasonographic examination of the proximal femur and coxofemoral joint was performed using the standard sedation protocol. The examination was performed on the left and right limbs using a convex array 4 MHz probe. A defect in the bone surface echo was identified over the caudolateral surface of the distal aspect of the greater trochanter, extending along its attachment to the femur (Figure 3). In the fracture gap, multiple small hyperechoic fragments were evident. The presence of heterogenous

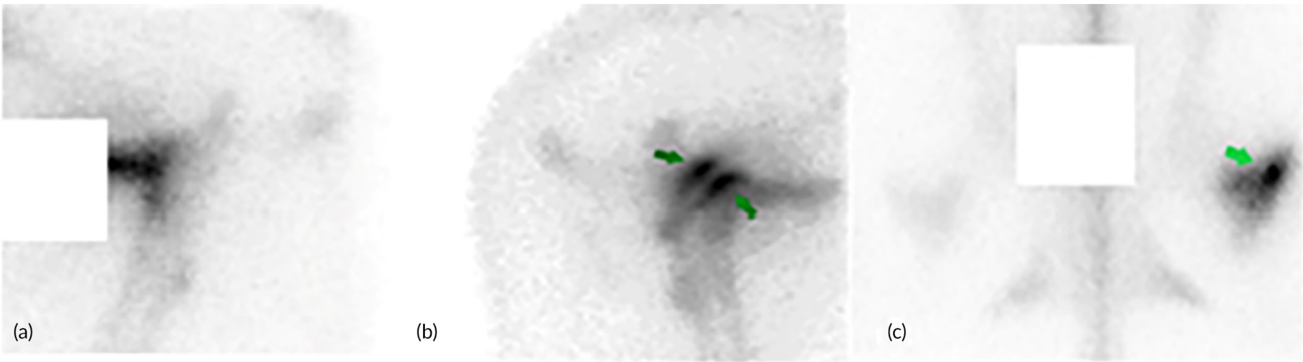

FIGURE 1 Left (a) and right (b) scintigraphic coxofemoral lateral images. (a) The normal left coxofemoral joint. (b) The right coxofemoral joint with marked diffuse increased radiopharmaceutical uptake of the femoral head/neck and greater trochanter (green arrows). (c) Scintigraphic caudodorsal pelvis view. Note the difference between the radiopharmaceutical uptake over the femoral head and greater trochanter, with the right showing a marked increased uptake (green arrow).

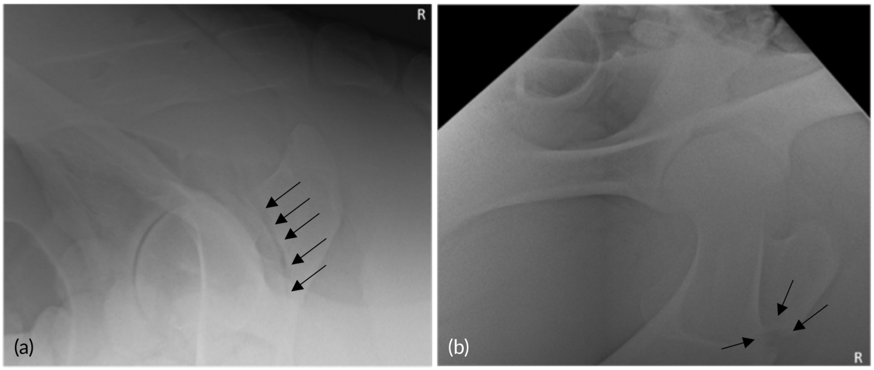

FIGURE 2 (a) left 30° dorsal-right ventral oblique view of the right coxofemoral joint, showing a well-defined, mildly irregular, radiolucent line across the base of the greater trochanter (black arrow). (b) cranio70°ventro30°medial-caudodorsolateral oblique view of the right coxofemoral joint, which shows the mild displacement of the greater trochanter (black arrow).

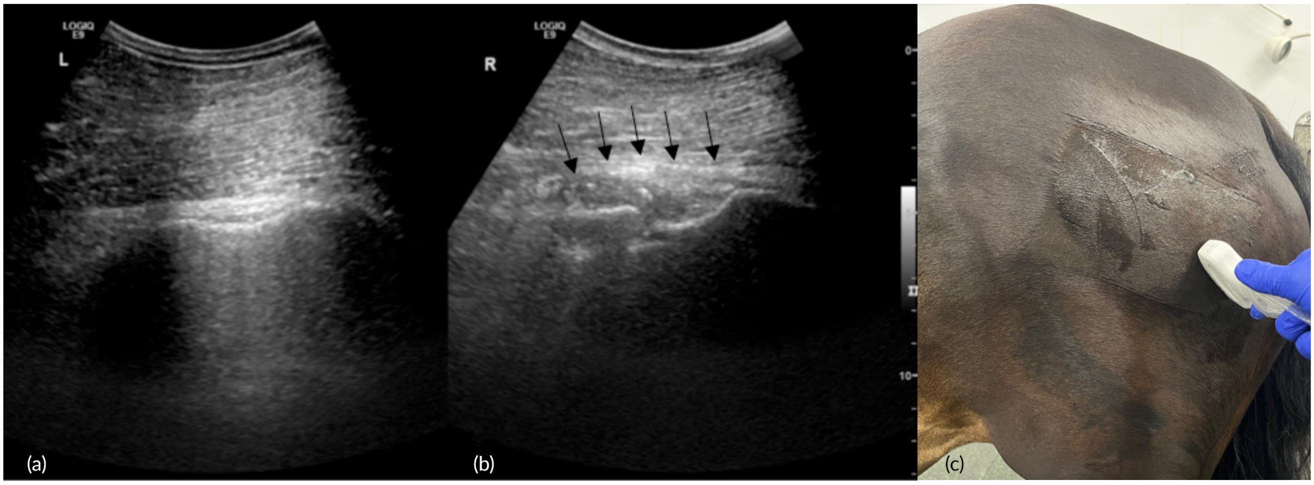

FIGURE 3 Ultrasonographic images of a longitudinal view of the attachment of the left (a) and right (b) greater trochanters of the femurs. The orientation of the probe (c) is craniodorsal to caudoventral, left and right of the image respectively. Image (a) depicts a smooth bone surface echo, whereas image (b) shows an irregularity of the bone surface echo with multiple hyperechoic fracture fragments and heterogenous hypoechogenic fluid, seroma formation, surrounding the fracture site (black arrows). Image (c) shows the positioning of the ultrasound convex array probe on the horse to visualise the greater trochanter.

hypoechoic fluid was detected in and adjacent to the fracture gap consistent with a haematoma or seroma. During the ultrasound evaluation, movement of the fracture gap was seen when the horse shifted its weight. There were no ultrasonographic abnormalities of the coxofemoral joint.

Treatment

The decision to proceed with conservative management was based on the following considerations. Internal fixation of the fracture was deemed not feasible in this case given the deep location of the fracture, limited bone stock available and large complex forces acting on the greater trochanter, which could have led to implant failure. In addition, financial limitations precluded this option. Conservative management of this fracture was attempted considering evidence of successful conservative management of a similar proximal limb bony protuberance in the forelimb, the deltoid tuberosity (Fiske-Jackson et al., 2010) and the third trochanter of the femur (Bertoni et al., 2013).

The horse was discharged with instructions to be managed on strict box rest with phenylbutazone (Equipalazone, Dechra, 2.2 mg/kg, BID, PO) for 5 days, followed by phenylbutazone (Equipalazone, Dechra, 2.2 mg/kg, SID, PO) for 5 days. The horse's comfort improved, and the phenylbutazone treatment was discontinued. Routine husbandry was provided daily during the box rest period with continued companionship provided by a horse stabled nearby and could be seen by the case. The horse was unshod, but the feet were trimmed every 6 weeks; it was able to weight bear on the affected leg, allowing the farrier to trim the contralateral foot. The owner reported that she did not see the horse lying down during the beginning of the convalescence period; later, the horse was seen lying down and did not appear to experience difficulties getting up.

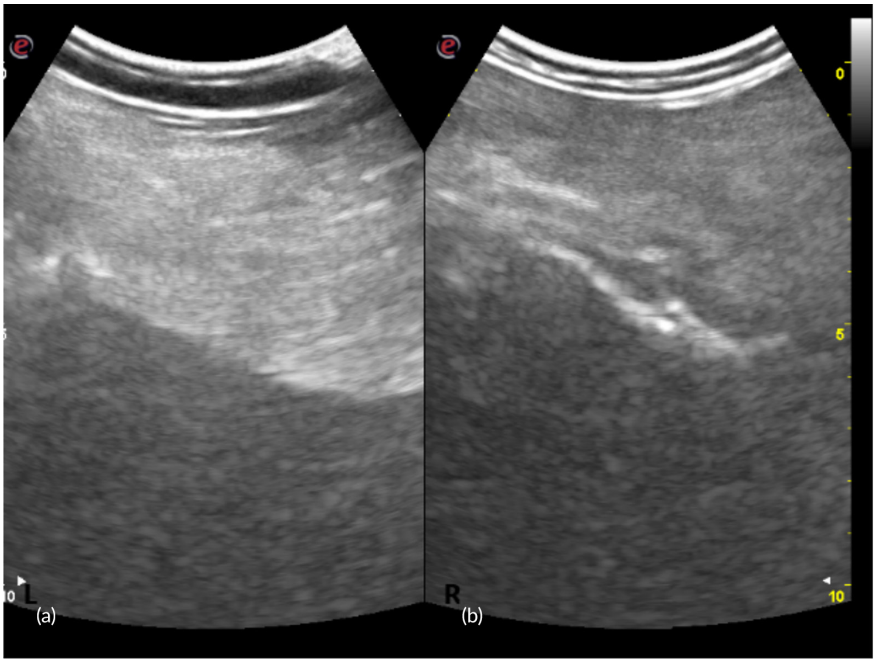

FIGURE 4 Ultrasonographic images in a longitudinal view of the attachment of left (a) and right (b) greater trochanters of the femurs, the same orientation is used as described in Figure 3. In image (a), the greater trochanter has a normal smooth bone surface echo. In image (b), there is irregular new bone formation, callus, around the previous fracture site.

During the first reassessment performed a month after diagnosis, a mild right hindlimb lameness at walk was present with a grade 4/10 (May & Wyn-Jones, 1987) at trot. The pain response on palpation of the right middle gluteal muscle was still evident. The decision was made to keep the horse on box rest over the winter period. The stable was converted to a double-size box (approximately 3 m by 5 m) after 3 months.

After 5 months of box rest, the horse was reassessed and found to be sound at walk. At trot, a grade 4/10 (May & Wyn-Jones, 1987) right hindlimb lameness persisted. The muscle atrophy over the right gluteal region was still evident, but firm palpation of the right middle gluteal muscle and hip region did not elicit a pain response.

Three months later, whilst remaining on box rest, the horse was nonlame at the straight line in trot and managed turning tight circles at a walk well. Ultrasonographic evaluation demonstrated an irregular bone surface echo in the fracture gap consistent with callus formation (Figure 4). At this stage, an incremental exercise programme was commenced with hand walking twice daily for 10 min, gradually increasing with 5 min every week.

The horse remained sound after 6 weeks of walking exercise and was reassessed at the RVC ERH (11 months post-injury). Due to the horse becoming difficult to manage when walking in hand, ridden walking exercise was introduced during this period, which was tolerated well. The gluteal musculature was now symmetrical. Repeat radiographs of the pelvis, right proximal femur and coxofemoral joint were acquired. These revealed an incomplete chronic fracture of the right greater trochanter, which was slightly distally displaced with proximomedial remodelling and callus formation at the fracture site (Figure 5). The fracture gap at the distolateral aspect of the greater trochanter was still evident. The exercise programme was gradually increased, commencing trot work approximately 2 months later. The horse subsequently returned to its previous level of work.

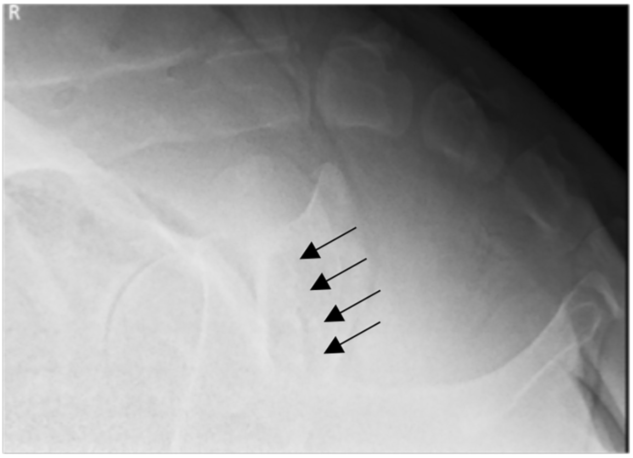

FIGURE 5 Left 30°dorsal-right ventral oblique view of the right coxofemoral joint 11 months post-injury, which reveals mild distal displacement of the greater trochanter with healing of the proximal fracture site.

Outcome

Two and half years following the injury, the referring veterinarian reported the horse was nonlame during a ridden assessment at walk, trot and canter and was still performing at its previous level of ridden work, consisting of low-level general riding activities.

DISCUSSION

The greater trochanter, situated on the lateral aspect of the proximal femur, has three prominent features: the cranial aspect, the caudal aspect and the intertrochanteric crest. The separation between the cranial and caudal aspects is formed by the trochanteric notch. The cranial aspect, situated opposite the femoral head and rising proximally to the level of the caudal aspect, receives a tendinous insertion from the gluteus profundus (Getty, 1975). The gluteus profundus originates on the ischiatic spine and the adjacent body of the ilium; it inserts on the cranial edge of the greater trochanter. Its function is to abduct and medially rotate the limb (Sisson, 1975). The cranio-lateral aspect of the greater trochanter is covered with cartilage, providing a nonabrasive surface for the tendon of the gluteus medius to partially reach over and insert on the femoral crest (Getty, 1975; Sisson, 1975). The caudal aspect of the greater trochanter furnishes the insertion of part of the gluteus medius muscle (Getty, 1975). The deep part of the gluteus medius, also known as the gluteus accessorius, inserts on the crest of the greater trochanter (Sisson, 1975). The gluteus medius originates from the aponeurosis of several structures: the longissimus lumborum, gluteal surface and tubera of the ilium, the dorsal and lateral sacroiliac and broad sacrotuberous ligaments, and the gluteal fascia. The gluteus medius extends the coxofemoral joint and abducts the limb (Sisson, 1975).

The caudal aspect of the greater trochanter is situated caudal to the plane of the femoral head and rises more proximally than the cranial aspect. The caudal border of the greater trochanter continues distally as the intertrochanteric crest, which forms the lateral wall of the trochanteric fossa (Getty, 1975).

The decision to use nuclear scintigraphy as a primary imaging modality was based on the limited ability of radiography and ultrasonography to survey the entire pelvis and hip region, and its sensitivity in detecting fractures (Richardson & Ortved, 2018). In addition, the rapid atrophy of the right gluteal musculature alongside the history of acute-onset lameness raised suspicion of a fracture aetiology. The marked, diffuse, IRU was consistent with a fracture in the hip region. The lateral 30° dorsal-lateroventral oblique view of the pelvis described by Barrett et al. (2006) provided sufficient visualisation of the fracture. Due to superimposition, an additional cranio70°ventro30°medial-caudodorsolateral oblique view of the right coxofemoral joint was performed, which highlighted the greater trochanter and showed displacement of the fracture. Ultrasonography is an easily accessible and well-tolerated imaging modality both in ambulatory and referral practice. In this case, it proved to be useful in confirming the presence of a fracture of the greater trochanter and allowed sequential monitoring of fracture healing.

A fracture of the greater trochanter can either be an isolated fracture or as part of a complex of fractures of the femoral head/neck or proximal femoral shaft (Nixon et al., 2020). Repair, via internal fixation, of these fractures in adult horses has not been described. Alternatively, excision of the greater trochanter as described for the third trochanter of the femur (Tischmacher et al., 2023) may have been a feasible option. However, the significant attachment of several muscles, the depth of the structure and the proximity to the coxofemoral joint would have increased the complexity of the surgery with an uncertain outcome. Complications of fracture healing in horses include infection, failure of fixation, prolonged healing times or failure of bony union. In this case, the fracture was closed, making it over four times less likely to get infected compared with an open fracture (Lopez, 2018). Therefore, prophylactic systemic antimicrobial treatment was not justified.

Conservative management was attempted based on previous reports of a successful return to athletic function after fracture of similar structures including the deltoid tuberosity (Fiske-Jackson et al., 2010), the third trochanter of the femur (Bertoni et al., 2013) and pelvic fractures (Moiroud et al., 2019). The average time of stall confinement was 6.9 weeks for the deltoid tuberosity fractures (Fiske-Jackson et al., 2010), 4 weeks for the third trochanter fractures (Bertoni et al., 2013) and 2 months for the pelvic fractures (Moiroud et al., 2019). In this case, the stall confinement continued for a longer period principally because the horse remained lame in a straight line at a trot. On reflection, walking exercise should have been initiated when the horse was sound at a walk; this may have stimulated increased bone modelling and faster fracture healing. However, concerns of delayed or nonunion of the fracture without the option to proceed a surgical management led to the decision to persist with box rest. In addition, the owner did not feel the horse would have been amenable to in-hand walking and this was evidenced once in-hand walking was commenced. Furthermore, the owner reported the horse was settled and tolerated box rest well.

Within species, social contact was provided with other horses being present in the barn. The authors acknowledge that the prolonged period of box rest should be avoided where possible as it reduces the ability of the case to express natural behaviour that can have welfare-compromising negative effects (Mellor et al., 2020). Therefore, practitioners should reflect on the ethics of long periods of box rest and only commit to this treatment option when there is robust clinical indication to do so. Behavioural indicators of stress include stereotypic behaviour, aggression towards humans, a withdrawn state and expression of stress behaviours (Ruet et al., 2019).

Regular re-examinations should assess for improvement in comfort and consideration of whether introduction of exercise will benefit healing; the period of confinement should be as short as clinically required. Where box rest is required, environmental stimulation should be provided alongside regular social interactions. Three housing and management factors have been shown to positively affect the welfare of a horse on box rest: straw bedding (which facilitates lying down), a window opening to the external environment and reduced quantity of concentrated feed received daily (Ruet et al., 2019). Appropriate physiotherapy exercise can also be performed to maintain and develop core stabilisation muscles (Stubbs et al., 2011). Client communications are important to establish the mental compliance of the horse. In this case, the horse was reported to settle well with a companion in the stable nearby but further environmental enrichment and social stimulation could have been provided. Such improvements in the management could have been in the form of a mirror in the stable, hung vegetables, in-hand grazing, baited stretches, a treat ball in the stable and regular grooming (Prescott, 2022).

In this case, there was a risk of delayed or nonunion of the fracture leading to prolonged instability and pain. Given the radiographic appearance, it is assumed that the fracture healed partially by callus formation and partially by fibrous union. Once stable, there will be no implications for the middle gluteal and deep gluteal muscle attachments as these will continue to function normally. The middle gluteal muscle contributes to the extension of the hip and abduction of the limb whilst the deep gluteal muscle adducts the thigh and rotates it medially (Sisson, 1975). Given the absence of lameness after re-introduction of work, and normal stance and flight phase of the limb, it is assumed the repair was sufficiently strong to withstand the forces of these muscle contractions. Given the fact that the horse is only used for low-level activities, we cannot be certain that a more intense exercise schedule would be tolerated.

In conclusion, this report suggests that complete, nonarticular, closed, mildly displaced fractures of the greater trochanter of the femur can be managed successfully with a prolonged (9-month) period of complete box rest. In this report, the horse was able to return to full work without re-injury with a two-and-a-half-year follow-up. The authors would like to emphasise that the prolonged period of box rest could have been supplemented with in-hand walking as healing progressed and may have shortened the convalescence period as well as improving the welfare of the horse.

AUTHOR CONTRIBUTIONS

Manon W.J. Peeters: Writing – original draft; writing – review and editing. **Andrew G. Wallace:** Writing – original draft; writing – review and editing. **Matthew Chesworth:** Writing – original draft; writing – review and editing. **Dagmar Berner:** Writing – original draft; writing – review and editing. **Andrew Rodger Fiske-Jackson:** Supervision; writing – original draft; writing – review and editing.

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All authors contributed to case management and manuscript preparation. All authors have given their final approval of the final manuscript.

CONFLICT OF INTEREST STATEMENT

No conflicts of interest have been declared.

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ETHICS STATEMENT

The owner's consent was given.

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