

Fractures of the tuber coxa of the ilium in horses: 29 cases (1996–2007)

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Objective—To determine history; clinical, radiographic, ultrasonographic, and scintigraphic abnormalities; treatment; and outcome in horses with tuber coxae fractures and to describe a useful technique for obtaining a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in standing horses.

Design—Retrospective case series.

Animals—29 horses with fractures of tuber coxa.

Procedures—Data collected from medical records included signalment; history; horse use; severity and duration of lameness; radiographic, ultrasonographic, and scintigraphic findings; treatment; and outcome.

Results—All horses had a traumatic event leading to acute, unilateral hind limb lameness. Eighteen horses had a more severe lameness at the walk than at the trot; 22 of 29 horses had an abnormal gait with the hind limbs tracking to 1 side of the forelimbs. Twenty-four of 29 horses had palpable and visual asymmetry between the affected and unaffected tuber coxae. Twenty horses had radiography performed while sedated but standing, and fractures were reliably identified on the dorsomedial-ventrolateral 50° oblique radiographic views. Twenty-seven (27/29 [93%]) horses returned to athletic use. Horses sustaining partial fractures of the caudal aspect of tuber coxae returned to previous use significantly earlier (mean, 3 months), compared with horses with complete tuber coxae fractures (6.5 months).

Conclusions and Clinical Relevance—Horses with tuber coxae fractures returned to athletic soundness following extended periods of rest. Findings emphasized the need for obtaining a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in horses suspected of sustaining injury to this region. (*J Am Vet Med Assoc* 2009;234:1303–1307)

Fractures of the pelvis are uncommon in horses, ranging in proportion from 0.9% to 4.4% of all lameness.^{1–3} Fractures through the wing or shaft of the ilium have been described and usually occur in horses > 6 years old, usually as a sequel to jumping or racing at high speeds.⁴ Fractures involving the acetabulum, pubis, and ischium are seen more frequently in young horses sustaining a traumatic event.⁵ There are few reports in the literature describing pelvic fractures in horses. In 1 study,¹ 19 horses had pelvic fractures but none involved tuber coxae. In another study,² 100 horses had pelvic fractures, of which only 6 involved tuber coxae. In an additional study,⁶ scintigraphic abnormalities of the pelvic region were described for 128 horses, of which 25 had abnormal radiopharmaceutical uptake in affected tuber coxae; however, only in 6 of these 25 horses was the abnormal radiopharmaceutical uptake associated with the primary cause of lameness. Follow-up information was only available for 5 of the 6 horses, and only 1 returned to racing.⁶ To our knowledge, there are no published studies in which the clinical signs, radiographic description, treatment, and outcome in a large group of horses sustaining tuber coxae fractures are described. The purpose of the study reported here was to determine signalment; history; clinical signs; radiographic, ultrasonographic, and scintigraphic ab-

normalities; treatment; and outcome in horses with tuber coxae fractures and to describe a technique for obtaining a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in standing horses.

Materials and Methods

Case selection—Medical records of all horses examined at Texas A&M University between 1996 and 2007 with pelvic fractures located in the tuber coxa of the ilium were reviewed. Horses were included in the study if a diagnosis of fracture of the tuber coxa of the ilium had been made on the basis of history, physical examination findings, and radiographic, scintigraphic, or ultrasonographic abnormalities.

Medical records review—Information obtained from the medical records included signalment; horse use; history; affected hind limb; severity and duration of lameness; radiographic, ultrasonographic, and nuclear scintigraphy findings; treatment; and outcome. Diagnosis of fracture of the tuber coxa was made on the basis of the combination of physical and clinical examination findings and results of radiographic, ultrasonographic, or nuclear scintigraphic findings. Long-term follow-up information was obtained through reevaluation of horses at the referral hospital and telephone conversations with referring veterinarians, owners, and trainers. Follow-up information was obtained a minimum of 1 year after injury.

Outcome was considered successful if the horse returned to its previous use or athletic soundness or, if untrained, was able to be used for the specific activity

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intended by the owner. Outcome was considered unsuccessful if the horse was no longer fit for its previous use or was euthanatized because of the injury or if follow-up information could not be obtained.

Radiographic evaluation—All radiographs of tuber coxae taken with the horse standing were done by use of a 400-speed film-screen combination^a with a ceiling-mounted x-ray tube.^b The mean kVp was 77 (kVp range, 74 to 90), and the mean mAs was 27 (mAs range, 20 to 40). The view obtained was a dorsomedial-ventrolateral oblique image; a 91.4-cm (36-inch) focal film distance was used. No grid was used. This radiograph was obtained with the horse in a standing position and bearing weight on the affected limb. This caused the pelvis on the affected side to shift dorsally, allowing for better radiographic evaluation. The x-ray beam was centered slightly off of midline (toward the affected side) at about a 50° angle in a dorsomedial to ventrolateral projection (Figure 1). Horses were sedated by administering xylazine hydrochloride (0.4 to 1.5 mg/kg [0.18 to 0.68 mg/lb], IV).

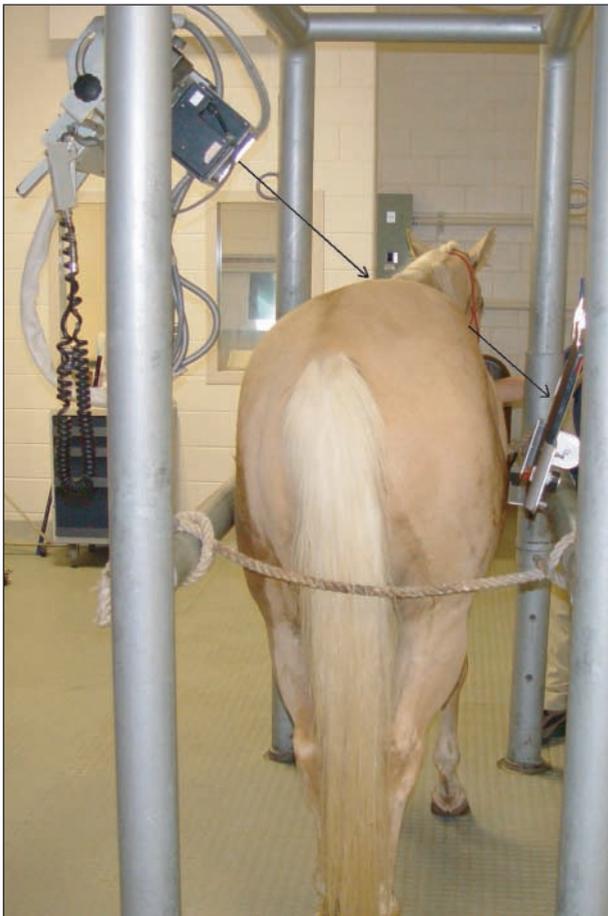


Figure 1—Photograph of the correct radiographic beam projection to obtain a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in a horse that is standing while under sedation. A 91.4-cm (36-inch) focal-film distance was used without a grid. To obtain the dorsomedial-ventrolateral oblique view, the horse should bear weight on the affected limb. This causes the affected side of the pelvis to shift dorsally allowing the correct view. The x-ray tube is directed downward at a 50° angle centered at a point just lateral to midline. Notice that the radiographic cassette is positioned at an angle to match the x-ray beam.

Radiographs of tuber coxae obtained while horses were recumbent were done by use of a 400-speed film-screen combination^a with a ceiling-mounted x-ray tube.^b The mean kVp was 82, and the mean mAs was 300. An 8:1 grid ratio was used.^c The radiographic projection was a ventromedial-dorsolateral oblique.

Nuclear scintigraphic evaluation—All scintigraphic images were static bone-phase images performed while horses were sedated and standing, which was achieved by administering detomidine hydrochloride (0.3 mg/500 kg [0.3 mg/1,100 lb], IV). Horses received furosemide (200 mg, IV) approximately 1 hour prior to imaging and were allowed to urinate freely to decrease background radiation. Images were obtained approximately 2 to 3 hours after IV injection of 200 mCi of technetium Tc 99m hydroxymethylene diphosphonate. Right and left dorsal oblique, lateral, and dorsal views of the pelvis were obtained. Images were acquired for 60 seconds by use of a large field-of-view gamma camera fitted with a high-resolution, low-energy collimator.^d Motion correction techniques were not used, and images were evaluated by a board-certified radiologist (RCC) using visual assessment. Images were stored in a computer^e that was dedicated for nuclear medicine.

Ultrasonographic evaluation—Three horses had an ultrasonographic evaluation of affected tuber coxae. Both transverse and longitudinal images were obtained by use of a 7.5- or 6.0-MHz linear probe transducer.^f

Treatment—Horses with closed fractures were treated with phenylbutazone (1.1 to 2.2 mg/kg [0.5 to 1.0 mg/lb], PO, q 12 h) for 7 to 10 days after the injury. Horses were confined to stall rest or a stall and small run for 60 days, followed by a various period of pasture turnout before gradually returning to their normal exercise regime.

Horses having an open wound over affected tuber coxae were treated surgically under sedation while standing. Briefly, horses were sedated with IV administration of detomidine hydrochloride (3 mg) and butorphanol (5 mg). The skin over the wound was clipped and prepared for aseptic surgery. The skin and musculature over affected tuber coxae were locally infused with mepivacaine. A 15-cm-long curved skin incision was made from a caudodorsal to caudoventral direction approximately 4 cm proximal to the wound. Bony fragments were debrided from underlying muscle and removed. The wound was closed following placement of a rubber drain. The incision was closed routinely in 3 layers, and tension sutures were placed over the closed incision by use of No. 1 polydioxanone suture material in a near-far, far-near pattern.

Statistical analysis—A Student paired *t* test was used to compare time (months) to return to previous use between horses with partial versus complete tuber coxae bone fracture. A value of $P < 0.05$ was considered significant.

Results

Signalment and horse use—Twenty-nine horses met criteria for inclusion in the study. Mean age was 6 years

(median, 4 years; range, 1 to 16 years); there were 17 geldings, 8 mares, and 4 sexually intact males. Breeds included 15 Quarter Horses, 5 Thoroughbreds, 4 American Paint Horses, 2 Arabians, and 1 each of pony, Missouri Fox Trotter, and Tennessee Walking Horse. Nine horses were used for barrel racing, 5 were untrained, 5 were used for roping, 4 were used for racing, 2 were used for Western performance, 1 was used for English performance, 1 was a trail horse, and 1 stallion was used for breeding.

History—Duration of lameness prior to examination at the teaching hospital ranged from 1 day to 60 days (mean, 8 days; median, 6 days). All horses sustained a traumatic event prior to injury that was witnessed by the owner, or the horse was found with a wound or abrasions over the affected tuber coxa. Sixteen (16/29 [55%]) horses were observed to run into a gate, stall door, or pipe fence; 3 horses hit a barrel during a barrel racing performance; 4 horses fell on the affected side; 2 horses were kicked by another horse; and 4 horses came in from the pasture with a wound or abrasion over affected tuber coxae.

Clinical findings—Twenty-four (24/29 [83%]) horses had pain and swelling upon palpation of affected tuber coxae. Eighteen (62%) horses had fragmented bone or crepitus palpated at the time of hospital admission. A wound or abrasions were located over the tuber coxa area in 6 (21%) horses, and in 24 (83%) horses, there was a palpable asymmetry between tuber coxae, with the affected one being lower or flatter than the unaffected tuber coxae. Palpation of the pelvis per rectum was performed in 10 horses, and no abnormalities were found.

All horses had unilateral hind limb lameness. Twenty-one (21/29 [72%]) horses fractured the right tuber coxae, and 8 (28%) horses injured the left tuber coxae. All horses were lame at the time of admission, with a mean lameness score of 3.6 (median, 4; range, 2 to 5) on the basis of a scale from 0 to 5.⁷ There were 6 (21%) horses that had a grade 5 lameness, and all of these horses were admitted to the teaching hospital within 2 days of injury. There were 17 (59%) horses with grade 4 lameness, and all of these horses had a duration of injury of < 6 days. The other 6 (21%) horses had grade 2 to 3 lameness, and all of these horses were admitted to the hospital between 14 and 60 days after injury. Eighteen (62%) horses had a more severe lameness at the walk (mean, grade 4 lameness) than at the trot (mean, grade 2 lameness), and all horses had negative hind limb flexion test results. Twenty-two (76%) horses had an abnormal gait observed at the walk but not at the trot. The gait was described as the hind limbs tracking off to 1 side of the forelimbs instead of tracking directly behind the forelimbs or as an abnormal limb carriage such as external rotation or adduction swinging motion to the affected limb. There was no information in the medical records regarding the cranial and caudal phases of the stride.

Radiographic findings—Radiographs of the tuber coxa of the ilium were taken on 20 of 29 (69%) sedated horses that were standing. Radiographs were taken on 3 (10%) horses while under anesthesia and in dorsal recumbency; 6 (21%) additional horses had radiographs taken both when standing (under sedation) and when recumbent (under anesthesia). Twelve (41%) horses had a comminuted fracture with fragments originating from

the caudal aspect of tuber coxae. Of these 12 fractures, 8 fractures involved bone fragments that were displaced in a caudoventral direction, 3 fractures were minimally displaced, and 1 fracture involved craniomedial fragment displacement. Two of the 12 comminuted fractures were open. Five (17%) horses had fractures involving only the caudolateral aspect of tuber coxae, and all fragments were displaced in a caudoventral direction. One horse fractured the cranial aspect of the tuber coxa, which was displaced ventrally (Figure 2). Five (17%) horses had complete transverse tuber coxae fractures that were displaced caudally. Five (17%) horses had complete oblique fractures through tuber coxae, of which 4 were displaced caudolaterally and 1 was minimally displaced. One horse (3%) had a longitudinal fracture of the tuber coxa that extended into the body of the ilium and was displaced caudally.

Nuclear scintigraphic findings—Ten (10/29 [34%]) horses underwent scintigraphic evaluation of the pelvis and hind limbs under sedation while standing. All horses had a marked increased radiopharmaceutical uptake within affected tuber coxae at the time of the initial scintigraphic evaluation. Three horses had sequential scintigraphic evaluations to assess healing at 6-month intervals. All 3 horses still had a moderate increase in radiopharmaceutical uptake involving affected tuber coxae, although it was less intense, compared with the original scintigraphic image taken at the time of admission 6 months previously. At 12 months after injury, the increase in radiopharmaceutical uptake in affected tuber coxae of these 3 horses was mild. In 4 horses, the area of increased radiopharmaceutical uptake was associated with displacement of tuber coxae fragments, creating a shorter distance from the pelvic midline to the affected tuber coxa, compared with the unaffected side.

Ultrasonographic findings—Three (3/29 [10%]) horses had the injured area evaluated by use of ultrasonography. Cortical surfaces of affected tuber coxae were irregular, suggesting fragmentation, and in 2 horses, a fragment of displaced bone was identified. In these 2 horses, the fragment of bone was surrounded by a hypoechoic region of fluid suggestive of a moderate-sized hematoma.

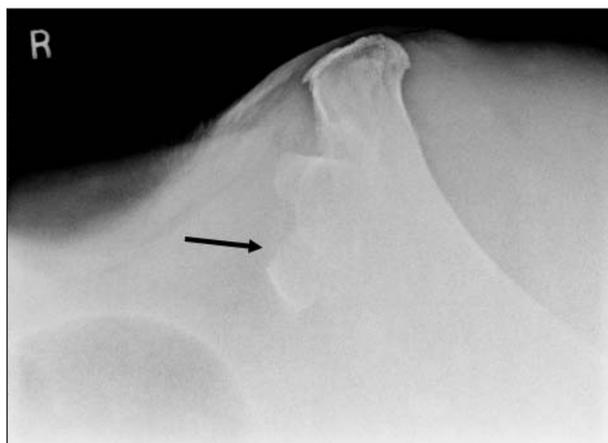


Figure 2—Dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in a horse. Notice that the fracture fragment originates from the cranial aspect of the tuber coxa. The large bone fragment (arrow) is displaced in a ventral direction.

Treatment—All horses received phenylbutazone for several days after the injury. All horses were confined to stall rest or a stall and small run for 60 days, followed by a various period of pasture turnout that ranged from 1 to 12 months (mean, 3.5 months) before gradually returning to their normal exercise regime.

Two horses had open, draining wounds over affected tuber coxae and underwent surgical removal of any loose, bony fragments under sedation while standing. These 2 horses were treated before and after surgery with procaine penicillin (20,000 U/kg [9,090 U/lb], IM, q 12 h) and phenylbutazone (2.2 mg/kg, PO, q 24 h) for 5 days. Exercise after surgery consisted of stall rest for 60 days followed by small paddock turnout for 2 to 4 months.

Outcome—Twenty (20/29 [69%]) horses had muscle atrophy and an abnormal flattening over affected tuber coxae, compared with opposite unaffected tuber coxae at follow-up evaluation. Twenty-seven (93%) horses had a successful outcome. These horses either returned to their previous performance level or, if not ridden at the time of injury, were able to perform the activity intended by the owner. Horses (18/29 [62%]) with partial fractures of the caudolateral or cranial aspect of tuber coxae or those having small bony fragments originating from the caudal aspect of tuber coxae returned to previous use within 3.5 months (mean, 3 months; range, 2 to 4 months) after injury, which was a significantly ($P = 0.006$) shorter rest period than that of horses sustaining complete tuber coxae fractures. Horses (11/29 [38%]) with complete transverse, oblique, or longitudinal tuber coxae fractures required 5 to 12 months (mean, 6.5 months; range, 5 to 12 months) of rest (60 days of stall rest followed by pasture turnout) before returning to previous use. One horse was euthanized 7 days after surgery for tuber coxae fragment removal because of the development of clostridial myositis, colitis, and disseminated intravascular coagulation, and 1 horse was euthanized 1 year after injury because of unrelated laminitis.

Discussion

Results of our study indicate that most horses (27/29 [93%]) with fractures of the tuber coxa of the ilium can return to athletic soundness following surgical or nonsurgical treatment. Horses sustaining incomplete or partial fractures involving just the caudolateral or cranial aspect of tuber coxae were able to return to previous activity within 3.5 months of injury, which was significantly earlier than horses sustaining complete tuber coxae fractures. This is a higher success rate than described by Davenport-Goodall and Ross⁶; on nuclear scintigraphic evaluation, they found that only 1 of 5 horses that had increased radiopharmaceutical uptake in tuber coxae regions returned to racing and the other 4 horses were retired. All 4 racehorses (3 Thoroughbreds and 1 Quarter Horse) in our study returned to racing. It is feasible that horses of our study were not valuable in terms of being used for breeding and thus not retired or perhaps sustained a less severe injury, compared with those in the previous study.⁶

The reported proportion of horses sustaining pelvic fractures ranges from 0.9% to 4.4% of all lameness.³ Tuber coxae fractures are an infrequent cause of lameness in horses. In a study² on 100 pelvic fractures in horses, only 6 involved tu-

ber coxae. Findings in another study⁴ on 51 pelvic fractures in horses revealed that the wing of the ilium was the most common site of fracture, with only 2 horses having fractures of the tuber coxa. It appears that involvement of the tuber coxa is rare even in horses sustaining pelvic injuries or fractures. It is also possible that horses sustaining an acute, severe injury localized to the tuber coxa region may be euthanized instead of referred for further evaluation.

Many horses (16/29 [55%]) in our study sustained tuber coxae fractures while entering a stall door, gate, or pipe fence. Findings in other studies^{1,3} indicate that falling down was the most frequent cause of pelvic fractures in horses. Falling down resulted in tuber coxae fractures in only 4 horses in our study. Interestingly, 4 horses used for barrel racing sustained the fracture after hitting a barrel. This was not reported as a cause of lameness in a recent report⁸ describing musculoskeletal injuries in horses used specifically for barrel racing. Seventy-two percent (21/29) of horses in our study fractured the right tuber coxae, which differs from the equal distribution of right- and left-sided pelvic bone fractures previously described.¹⁻³ We cannot explain the high incidence of right-sided tuber coxae fractures in this study. One potential explanation is that horses are led from the left side and a misbehaving horse commonly bends their head to the handler as the hind limbs sway to the right. Because trauma when traveling through a stall or door is a common cause, this seems like a logical cause for more right-sided tuber coxae injuries.

Most horses in our study had signs of pain upon palpation and swelling (24/29 [83%]) over affected tuber coxae, palpable bone fragments (18/29 [62%]) and crepitus, and external asymmetry (24/29 [83%]) with affected tuber coxae being lower and flatter, compared with the opposite side, making a diagnosis on the basis of clinical findings fairly obvious. Findings in another study¹ indicated that a clinical diagnosis of pelvic fracture in horses is difficult because findings of crepitus are unreliable and not detected in horses examined more than 48 hours after injury; however, only 2 horses in that study had tuber coxae fractures. Findings in another study² involving 100 horses with pelvic fractures revealed that only 23% had clinical findings of external swelling, 50% had external skeletal asymmetry, and only 50% had either external crepitus or crepitus detected on palpation of the pelvis per rectum. Although only 10 horses had a rectal examination performed in our study, no abnormalities were found. Because the tuber coxa is located close to the skin surface and easily palpable, compared with other bones of the equine pelvis, it is logical that clinical findings of external swelling, pain, and crepitus were helpful in making the diagnosis in the horses in our study.

In our study, horses admitted to the hospital within 2 to 6 days of injury had a severe unilateral hind limb lameness (grade 4 lameness); however, horses that were examined 2 to 4 weeks after injury had a less severe lameness (grade 2 to 3 lameness), which is consistent with other reports^{1,2} on pelvic fractures in horses. Interestingly, horses in our study had a more severe lameness at the walk versus the trot and hind limb flexion did not change the severity of lameness. Additionally, most horses in our study (22/29 [76%]) had an abnormal gait at the walk, not the trot. Findings in a study² of 100 horses with a pelvic fractures revealed that horses had abnormal limb carriage such as abduction and

external rotation of the affected limb, which was also seen in some of the horses in our study.

However, the most common gait abnormality in horses in our study with tuber coxae fractures was described as a crab-like gait in which the hind limbs tracked off to the side of the forelimbs. These clinical findings and gait abnormalities should be beneficial in localizing the site of injury. To our knowledge, this has not been reported in horses with other types of pelvic injuries.

In our study, radiographs of the tuber coxa of the ilium were taken on 26 of 29 (90%) horses under sedation while standing. The dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa revealed fractures reliably in all horses. Radiographic techniques currently used for imaging pelvic fractures or abnormalities of the hip joints are ventrodorsal radiographic views obtained with the horse in dorsal recumbency and under anesthesia or ventrodorsal radiographic views in the horse under sedation while standing.⁹ More recently, the usefulness of a lateral oblique radiographic projection obtained while the horse is standing has been described in evaluating horses with pelvic injuries.¹⁰ This lateral oblique projection allows visualization of the caudal half of the ilial shaft, greater trochanter of the femur, femoral head, acetabulum, and hip joint on the side closest to the cassette; however, the ilial wings, tuber sacral, sacroiliac joints, and tuber coxae cannot be visualized from these radiographic images.¹⁰ To our knowledge, this is the first report of obtaining a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa in the standing horse. This technique is noninvasive and easy to perform and provides an invaluable diagnostic tool in horses suspected of having tuber coxae or ilium fractures. In addition to the complications related directly to anesthesia, horses with suspected pelvic trauma or fracture may be subject to additional risks when radiographs are obtained under general anesthesia.

Ten horses underwent scintigraphic evaluation of the pelvis and hind limbs under sedation while standing. There was a marked increase in radiopharmaceutical uptake within affected tuber coxae, which was expected. Three of these horses had sequential scintigraphic evaluations at 6 and 12 months after injury, and although the horses were sound and back to previous exercise, there was still a moderate increase in radiopharmaceutical uptake at affected tuber coxae. These 3 horses had incomplete tuber coxae fractures. At 12 months after injury, the increase in radiopharmaceutical uptake was minimally visible.

Davenport-Goodall and Ross⁶ found that 25 of 128 horses undergoing scintigraphic evaluation of the pelvic area had abnormal radiopharmaceutical uptake involving tuber coxae. Scintigraphic results revealed a mild increase in radiopharmaceutical uptake in 3 horses, a moderate increase in radiopharmaceutical uptake in 8 horses, and an intense increase in radiopharmaceutical uptake in 12 horses. In addition, they reported that uptake decreased in 3 horses that had ventral displacement of fragments. The authors also reported a shorter midline-to-tuber coxae distance on the affected side. In 12 of the 25 horses, the area of abnormal radiopharmaceutical uptake was not associated with the primary lameness, and in 7 horses, the clinical relevance

of the area of abnormal radiopharmaceutical uptake in tuber coxae could not be determined. In 6 of the 128 horses, abnormal radiopharmaceutical uptake in tuber coxae was associated with the primary lameness.⁶ It appears that increased radiopharmaceutical uptake in the region of tuber coxae must be interpreted with caution, especially if the history and clinical examination do not support injury to this area. In addition, in our study, sequential scintigraphic evaluations of the fractured tuber coxae were not useful in determining when the horse could return to previous use.

Twenty-seven (27/29 [93%]) horses in our study with tuber coxae fractures returned to previous use. This is a better outcome than that of previous studies,^{3,4} which had a success rate of 27% to 51% for horses sustaining fractures of the pelvis. Those 2 previous studies grouped all pelvic fractures, both acetabular and nonacetabular. In our study, horses with partial fractures of the caudolateral aspect of tuber coxae returned to previous use in a significantly shorter period (mean, 3 months), compared with horses sustaining complete tuber coxae fractures (6.5 months). Most horses in our study did have muscle atrophy or abnormal bony flattening over affected tuber coxae. In conclusion, results of our study indicate that horses with fractures of the tuber coxa of the ilium can return to athletic soundness following extended periods of rest and emphasize the need for obtaining a dorsomedial-ventrolateral 50° oblique radiographic view of the tuber coxa of the ilium in horses suspected of sustaining injury to this region.

- a. Kodak X-OMatic cassette, Eastman Kodak Co, Rochester, NY.
- b. Coll-M150, Varian Power Grid and X-ray Tube Products, San Carlos, Calif.
- c. Liebel-Flarsheim, Cincinnati, Ohio.
- d. SHRV model, IS2 Medical Systems, Ottawa, ON, Canada.
- e. NucMac, version 5.8, Scientific Imaging Inc, Rochester, NY.

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