Investigation of pelvic problems in horses

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Despite the advanced diagnostic techniques that are currently available, diagnosing equine pelvic injuries and pain can be challenging for even the most experienced equine diagnostician. Due in part to its size and complexity, the equine pelvis is rather daunting to investigate as a site of pain. Localising diagnostic anaesthesia – required for the assessment of pelvic and thoracic limbs in horses – is restricted in the back and pelvis, leading to a degree of subjective assessment, which is obviously not ideal. The introduction of scintigraphic imaging has revolutionised the diagnostic potential of bone injuries of the pelvis but has contributed to a far lesser degree to the understanding of soft tissue pain. This article describes an approach to the investigation of pelvic pain in horses and outlines a number of pathological conditions that can be encountered.

Historical perspective

It had long been thought that pelvic injuries in horses were uncommon and almost invariably caused by traumatic events, such as falls over fences or during paddock turnout, but with the introduction of equine scintigraphic imaging in the 1970s, it became apparent that many pelvic fractures, particularly in racing thoroughbreds, were, in fact, the result of stress-related bone injuries developing over many weeks or months of cyclic bone fatigue and remodelling.

From the 1980s onwards, there has been considerable progress in our understanding of such stress injuries and innumerable equine lives have been saved by our ability to detect these problems before catastrophic events occur in training or at the race track.

The multitude of joints, ligaments and muscle groups that stabilise and support the bony structures of the pelvis are subjected to forces that can also lead to stress-related bone injuries in horses and yet these areas are largely overlooked as a cause of poor performance.

Horses competing at relatively slower speeds are less prone to bone stress injuries at any site, including the pelvis, but are susceptible to more subtle types of pathologies such as those causing lumbosacral (LS) and sacroiliac (SI) dysfunction and pain. The ability to definitively diagnose problems at these sites remains limited in many cases of subtle injury.

Essential anatomy

The bones of the pelvis comprise:

- The os coxae, which is made up of:
  - The ilium;
  - The ischium;
  - The pubis;
- The sacrum;
- The first two or three (fused) coccygeal vertebrae.

The component parts of the os coxae fuse by one year of age and growth plate closure occurs variably around four to seven years of age. Each hemipelvis is symmetrical and joined at the pelvic symphysis (technically a joint), which forms a firm, bony union in older horses. The head of the femur and the acetabulum form the coxofemoral (hip) joint on either side and the ventral surface of the ilium forms a third joint with the sacrum (the SI joint [SIJ]) to complete the three main joints of the pelvis.

The five articulations of the pelvis with the caudal aspect of the lumbar spine are equally important when considering possible sites of pelvic pain. Collectively known as the LS junction (LSJ), these articulations include paired lumbar–sacral facet joints, paired intertransverse joints (ITJs) and the LS joint itself between the sixth lumbar vertebra and the first sacral vertebra, between which lies the LS disc. These sites are variably amenable to investigation by diagnostic techniques and imaging, but all should be considered in cases of suspected pelvic injury.

Clinical examination

External structures

A working knowledge of the anatomical structures outlined above is necessary to obtain information regarding a pelvic injury from a clinical examination. The large muscle mass in the area is clearly prohibitive to the individual palpation of all but the bony extremities of the pelvis, and an appreciation of surface anatomy and how that relates to deeper structures is important. The bony landmarks and how they relate to each other can give clues about the nature of a bone injury.

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Fig 1: Right-sided gluteal muscle wastage in a three-year-old filly that had sustained an acetabular fracture eight months previously

The horse should be standing completely square if a visual appraisal of this area is to be meaningful. Viewed from behind, a lack of symmetry in the tubera coxae could indicate a stress or traumatic fracture in one of these structures. Cranioventral displacement of the fracture fragment into the sublumbar fossa is readily detectable clinically when it is completely fractured and may negate the need for any further investigations.

Disparity in the level of the tubera sacralae is often seen in the absence of any known previous or current pelvic injury or current lameness but may indicate a displaced iliac wing fracture. A pain response on firm digital palpation of the tubera sacralae and, in some cases, crepitus of the underlying bones, aids a diagnosis of iliac wing fracture.

The clinical relevance of mild asymmetry of the overlying gluteal muscles (Fig 1) is questionable and may be indicative of a long-standing, low-grade hindlimb lameness of any origin rather than a pelvic injury per se. However, disuse and/or neurogenic atrophy of the pelvic musculature can be dramatic in a complete pelvic fracture, particularly in acetabular or iliac shaft fractures. Discrepancies in muscle tone and apparent pain or 'guarding' on deep tissue palpation may be seen in cases of acute muscle strain and stress-related bone injuries.

It is worth bearing in mind that resentment to palpation of the gluteal muscles and tubera sacralae can be misleading in cases of skin-sensitive thoroughbreds, as this commonly occurs in horses with no history of lameness and no detectable back or pelvic pathology.

Internal structures

Examination of the internal structures of the pelvis per rectum, where palpation of the soft tissue and bony internal structures may yield useful information, is essential to maximise the detection of any injury. Before sedating the horse for examination, the application of firm pressure to the iliopsoas major muscles per rectum as they course bilaterally adjacent to the terminal aorta may result in an apparent pain response. Iliopsoas strain is a well-recognised performance-limiting injury in human athletes and may play a role in pain of soft tissue origin in equine athletes.

Digital pressure applied to the LS joint may result in convincing pain responses in cases of traumatic subluxation and partial disc herniation in this region. More subtle osteoarthritic changes to the LSJ that are detected by ultrasonography do not appear to be associated with pressure point pain.

Callus formation and/or soft tissue swelling are often readily detectable when there is a complete fracture of the acetabulum, iliac shaft, sacrum or pubis.

Imaging techniques

Ultrasonography

By virtue of its relatively cheap and portable nature, ultrasonography is often used as the first-line imaging modality in cases of suspected pelvic injury. Alcohol saturation of the animal's coat may be the only preparation needed if the aim of the ultrasound examination is to detect gross skeletal pathology; however, clipping the hair coat and thoroughly cleaning and degreasing the area is recommended if more subtle pathology is involved, particularly that of the dorsal SI ligaments (DSLs). The primary indication of pelvic ultrasonography is usually to rule out cases of suspected pelvic fracture; however, in busy sports horse practices, it is increasingly being used to investigate cases of poor performance.

There is no need to be daunted by the array of transducers and expensive ultrasonographic machines now common in referral centres. Armed with a basic linear or rectal probe and a good appreciation of pelvic anatomy, most common sites of injury can be adequately evaluated (Table 1). Rectal ultrasonography should be carried out even in cases where rectal palpation is unremarkable. Meaningful transcutaneous ultrasonography requires the use of a decent sector or curvilinear probe. A linear transducer, used for tendon ultrasonography, will allow evaluation of DSLs situated close to the skin surface, but will not allow assessment of the deeper bony structures in all but the smallest of patients.

The paired short DSLs originate from the mildly roughened caudal aspect of the tuber sacrale and course

Table 1: Suggested transducer specifications and technical details for ultrasonography of the pelvic region in horses

	Structures to evaluate	Transducer details
Transcutaneous		
Superficial structures	Tuber sacrale, tuber coxae, dorsal sacroiliac ligaments, tuber ischii	Linear, high/mid-frequency, 8 to 13 MHz, depth 4 to 7 cm
Deeper structures	Iliac wing, iliac body (shaft), coxofemoral joint, dorsal aspect of the sacrum	Curvilinear or sector, low frequency, 2 to 5 MHz, depth 10 to 20 cm
Per rectum	Sacroiliac joints, ventral sacroiliac ligaments, lumbosacral joint and disc, intertransverse joints, nerve roots and fossae, axial aspect of the coxofemoral joint, pubic symphysis	Rectal or microconvex, mid-range frequency, 8 to 10 MHz, depth 4 to 8 cm

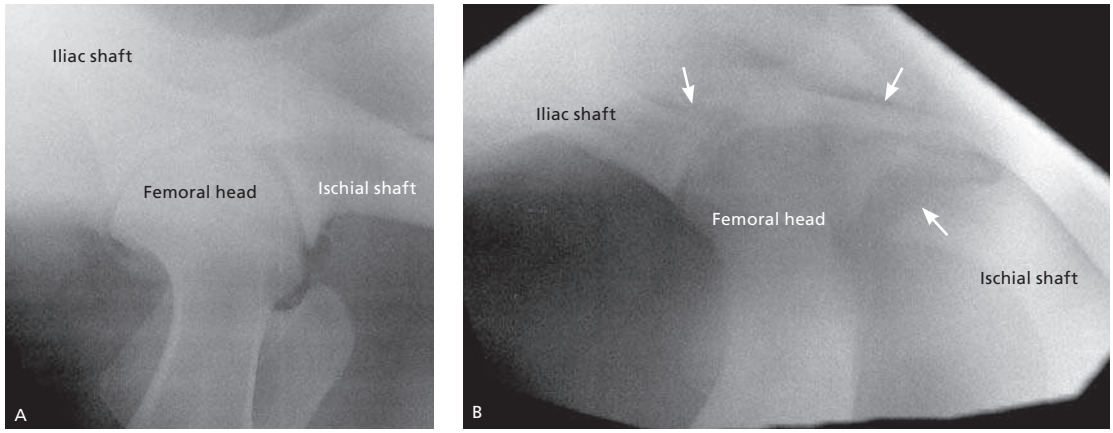

Fig 2: (a) Radiograph of the right hip of a normal horse taken under standing sedation. This mediolateral projection is taken from the contralateral side with the limb weightbearing. (b) The same radiographic projection as in (a) in a horse with a comminuted acetabular fracture (arrows)

caudoaxially to insert on the caudal dorsal sacral processes. Each ligament should be evaluated individually in transverse and longitudinal planes, and assessed for shape, size and symmetry compared to the contralateral ligament, as well as for echogenicity (typically homogeneous) and fibre pattern (usually good).

Some variation in appearance of the DSLs may be seen in clinically normal horses and can confound the detection of subtle injuries. The caudal extension of the thoracolumbar fascia (sometimes termed the thin DSL) can sit variably dorsal or medial to the short DSLs, giving the latter a somewhat bipartite appearance.

Transcutaneous assessment of the fused lateral transverse processes of the sacrum, combined with rectal scanning, may help to detect sacral fractures.

Ultrasonography is a variably sensitive tool in the detection of fractures of the iliac wing, iliac shaft, acetabulum and ischium, and its usefulness depends largely on the degree of callus formation and/or displacement of fracture edges. A negative ultrasonographic scan in thoroughbreds with the clinical presentation of a pelvic fracture should not reduce the index of suspicion, as subtle or early injuries are easily missed. Scintigraphy may be indicated (if it is safe and humane to transport the horse) or a repeat ultrasonographic scan carried out 10 to 14 days after injury may subsequently reveal developing callus.

Radiography

Radiography is carried out infrequently in adult horses with a suspected pelvic injury because:

- The gluteal and lumbar muscles and material within the gastrointestinal tract obscure the bony structures, preventing the acquisition of high-quality images in most cases;
- General anaesthesia may be required but contraindicated in horses with suspected fracture pathology;
- Although good-quality images of the coxofemoral joint and caudal aspect of the iliac shaft are possible in slightly built horses under standing sedation and may be definitive in cases of advanced disease (Fig 2), subtle changes are easily missed.

For these reasons, ultrasonography and scintigraphy are the imaging modalities of choice when investigating pelvic problems in horses.

Radiography is, however, feasible in foals and some small-breed ponies, and high-quality ventrodorsal and lateral views can be acquired with the foal recumbent under moderate sedation.

Computed tomography

Computed tomography (CT) gives exquisite detail of bone injuries (Fig 3) and can be used to identify fractures of the pelvis. However, its use is limited by the size of the animal and the bore size (gantry diameter) of the CT scanner. Pelvic CT also requires general anaesthesia, for which the same contraindications apply as for conventional radiography.

Scintigraphy

Scintigraphic evaluation of the pelvis is an established part of the clinical work-up in horses with suspected pelvic pathology. It is extremely useful for identifying stress or traumatic fractures, including those of the iliac wing, sacrum, tuber ischii and coxofemoral joint, and is commonly employed when clinical and/or ultrasonographic examination is indicative of, but inconclusive for, the presence of such injuries. However, there are limitations, not least the problem of pelvic muscle mass attenuating the gamma rays in large animals, which prevents subtle areas of bone modelling from showing significant increased radionuclide uptake (IRU) on bone-phase images. It has been suggested that a 10- to 14-day delay between the onset of

Fig 3: Three-dimensional reconstruction of a computed tomography (CT) data set of a horse with a comminuted acetabular fracture. Although CT images are exceptional for assessing the configuration of a fracture, they are rarely possible to obtain from live horses due to the size of the patient and the risk of general anaesthesia

lameness and the bone scan ensures that a significant amount of bone modelling is present for a 'hot spot' to be observed; however, this is likely to be overemphasised and, in stress-related injuries, the onset of bone modelling is likely to precede the detection of overt lameness by some margin.

Scintigraphy cannot be considered a 'high-yield' diagnostic procedure in cases of low-grade lameness or non-specific poor performance. Bone scans are frequently requested in horses with suspected SI dysfunction, which has often been intimated as a possible cause of lameness by paraprofessionals. Despite subjecting high-quality, motion-corrected images to visual, profile and region of interest analysis, it may still be difficult to determine the presence of clinically relevant IRU in the region of the SIJ or LSJ. It must be remembered that the validity of IRU in a number of anatomical locations remains somewhat unproven. Postmortem studies have reported a high incidence of subclinical pathology of the equine pelvis (and spine) that is not supported by the prevalence of clinically detectable 'hot spots' on bone-scan images. The reverse may also be true, as information obtained at postmortem examination is rarely available in live horses showing areas of IRU, and diagnostic local analgesia is often not possible in these regions.

Pelvic fractures

Lameness associated with pelvic stress fractures may present similarly to hindlimb stress injuries at other sites (eg, those of the tibia or distal metatarsal condyles), as a plaiting, short-striding hindlimb gait is typical. Careful clinical examination is therefore necessary to aid localisation to the pelvis. The history may be of variable degrees of lameness, from sudden-onset, non-weightbearing lameness in cases of complete fracture to low-grade lameness when the horse is ridden, which improves but does not fully resolve with rest.

Types of fracture

Iliac wing

Stress fractures of the iliac wing are one of the most common types of stress injury seen in racing thoroughbreds. Horses with bilateral iliac wing lesions may mimic cases of exertional rhabdomyolysis ('set fast' – which can be ruled out on biochemistry) due to the animals' action and the fact that they may show lumbar and gluteal muscle spasms and fasciculation following firm digital palpation. There may be pain on palpation over the tubera sacralae or even displacement of one tuber sacrale in cases of complete iliac wing fracture.

Iliac shaft and acetabulum

Muscle wastage over the affected side may be detectable clinically and occurs rapidly and dramatically when there is a complete fracture of the iliac shaft or acetabulum. Iliac shaft fractures usually cause severe lameness, and asymmetry of the tubera coxae may be seen clinically. Gentle rocking of the pelvis may produce a 'clunking' sound (crepitus), which is also common in fractures with acetabular or pubic involvement. Horses with an acetabular fracture consistently show a dramatic reduction in the caudal phase of their stride, and the hip region may appear more prominent on clinical examination due to a loss of muscle mass, together with soft tissue swelling.

Sacrum

Sacral fractures are relatively uncommon and may present as focal muscle loss to one or both sides of the dorsal spine of the sacrum. If the nerve roots are affected, which can occur due to extensive callus formation surrounding the nerve root fossae or by direct damage to the nerve roots by displaced fracture edges, there may be loss of bladder control and anal sphincter reflex.

Tuber coxae

Fractures of the tuber coxae ('knocked-down hip') may result from a stress-related injury or trauma. They are relatively easy to diagnose from a good clinical examination, as appraisal of the bony landmarks reveals displacement of the fractured bone ventrally and cranially, so it can be palpated in the sublumbar fossa. Horses with fractures of the tuber coxae are often lame when walking but this improves rapidly with time. If the sharp edge of the parent bone protrudes through the skin (compound fracture), the wound can take many months to heal.

Ischial tuberosity

Fractures of the ischial tuberosity may follow an observed traumatic incident (eg, a fall) or while the horse is in transit, and are also straightforward to detect clinically. There is often obvious swelling of the caudal thigh, loss of definition of the ischial tuberosity and pain when firm digital pressure is applied to the area. Tears of the semitendinosus/semimembranosus (hamstring) muscle group may mimic ischial fractures clinically but can be differentiated by ultrasonography (Fig 4).

Diagnosis

If a pelvic fracture is suspected, ultrasonography should be the first imaging technique employed. The iliac wings and shafts should be examined in trans-

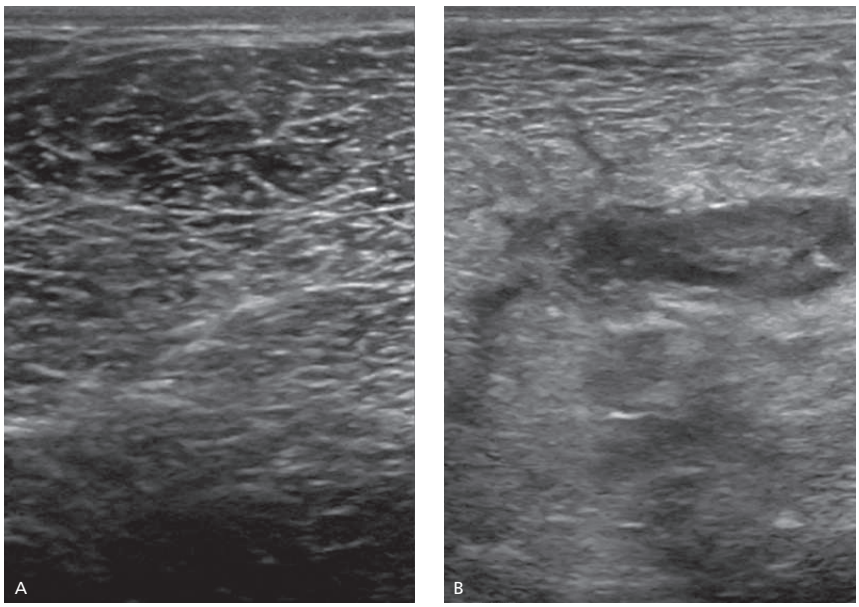

Fig 4: Transverse ultrasonographic images of the left (a) and right (b) hindlimbs of a mare with an acute tear of the semimembranosus muscle of the right hindlimb just distal to its origin from the ventral surface of the ischial tuberosity. Firm digital palpation revealed focal pain. The medial region is to the left of both images

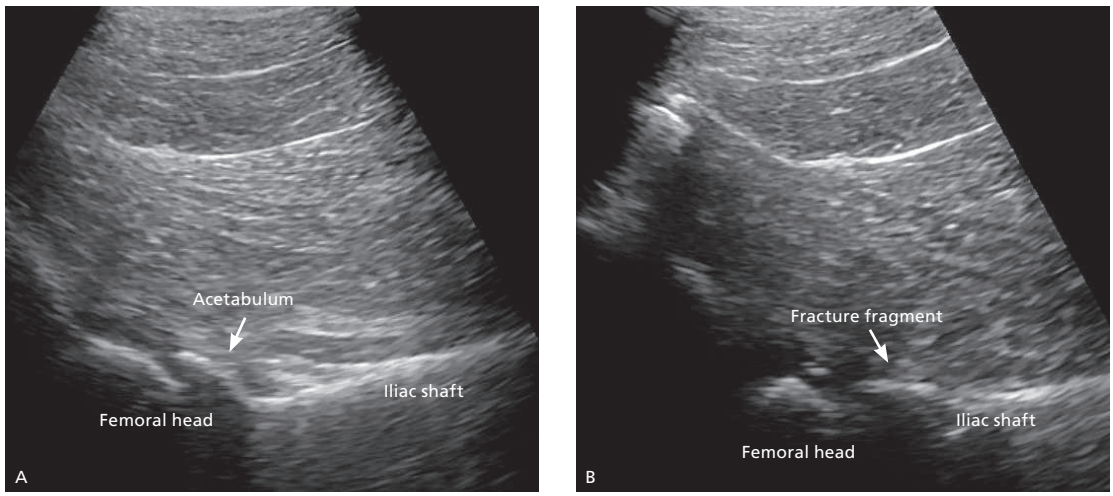

Fig 5: Ultrasonographic images of the right (a) and left (b) coxofemoral joints of a thoroughbred racehorse with a comminuted acetabular fracture of the left hindlimb. A large bone fragment is visible in the affected limb and the normal contour of the acetabular rim and femoral head is lost

verse and longitudinal planes, paying particular attention to the caudal aspect of the wings and junction of the wings and shafts, where subtle roughening may indicate an early stress fracture. As iliac wing lesions can occur bilaterally, the contralateral wing should be imaged even in cases of unilateral lameness.

Complete coxofemoral joint fractures may be detected with relative ease ultrasonographically in lightly muscled horses (Fig 5). Fractures through the acetabular physis may be detected on rectal palpation in the form of large soft tissue masses at the 4 o'clock or 8 o'clock positions within the pelvis. The transcutaneous and transrectal ultrasonographic appearance may range from incongruity of the bone surface at the level of the physis and fracture fragments in comminuted cases, to large callus reactions, depending on the type and age of the injury.

Detection of sacral fractures may be difficult transcutaneously, especially if the area affected is deep to the iliac wing, but may be seen on transrectal ultrasonography, where particular attention should be paid to the nerve root fossae if clinical signs of nerve root impingement are evident.

If the initial ultrasonographic scan is negative, scintigraphic examination is the next logical step. Horses with severe non-weightbearing lameness that are considered unfit to travel, or if financial constraints do not permit the cost of a bone scan, should remain tied up in the stable and ultrasonography repeated 10 to 14 days later when any callus may be more readily detected. If the ultrasound scan is inconclusive and a scintigraphic examination is not possible, the horse should be managed as if a fracture is present until proven otherwise.

Scintigraphy is the preferred method for determining whether there is a fracture within the pelvis. Oblique projections of the iliac wings, coxofemoral joints, pubis and ischium, together with dorsal and lateral views, are necessary to maximise the chance of fracture detection and to locate areas of IRU. High-quality bone-phase images devoid of motion artefact with careful masking are essential for the detection of subtle IRU at any site but particularly in deeper locations such as the coxofemoral joint (Fig 6) and pubis.

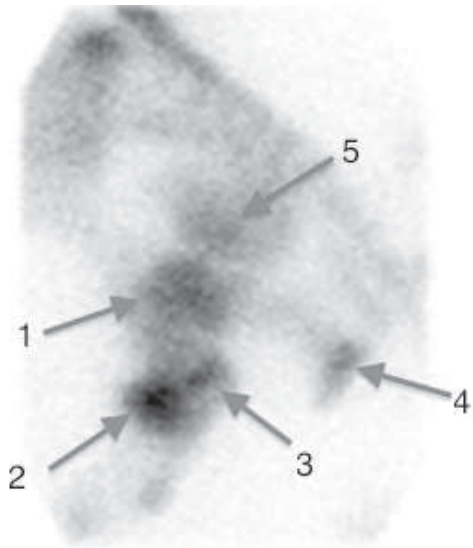

Fig 6: Oblique delayed (bone)-phase scintigraphic image of the left coxofemoral joint (with the cranial aspect to the left) showing increased radionuclide uptake (IRU) within the region of the acetabulum, which is likely to represent a fracture. A good knowledge of the anatomy of the region and of areas of normal IRU is essential when making an evaluation. 1 IRU associated with the acetabulum, 2 Cranial part of the greater trochanter, 3 Caudal part of the greater trochanter, 4 Ischial tuberosity, 5 IRU associated with the bladder

Care should be taken to ensure that the bladder is emptied before image acquisition or masked during post-processing so that it does not obscure the pelvic bones. Any muscle wastage detected clinically should be taken into account to ensure it does not mimic unilateral IRU.

Scintigraphy is rarely indicated in fractures of the tuber coxae and ischial tuberosity, as clinical examination is often conclusive; however, lateral scintigraphic views of the region can demonstrate the displaced fragment of the tuber coxae and caudal views of the pelvis can show marked unilateral IRU in the ischial tuberosity.

Assessment of the images by clinicians with experience of scintigraphy will prevent lesions being missed or overinterpreted.

Sacroiliac and lumbosacral dysfunction

A firm diagnosis of SI dysfunction and/or LS pain is rare and it may be a diagnosis of exclusion in some cases. It is important to be honest with clients regarding the inability to be definitive about the exact source of pain, even when lameness is localised to the region by regional diagnostic anaesthesia. Cases may present with low-grade lameness, poor performance or poor propulsion over fences, while others show overt lameness and occasional reluctance to elevate the hindlimbs (eg, while being shod). It may be reported in the history that a paraprofessional friend of the rider has suggested the 'sacros' are 'out' – a presumptive, meaningless and anatomically inaccurate phrase that should be avoided! Chartered veterinary physiotherapists are unlikely to make such a comment but occasionally it is made in an attempt to simplify a cause of non-specific pelvic pain.

Comprehensive diagnostic local analgesia often reveals a source of pain at a more distal site. Horses with chronic low-grade lameness originating from, for example, the origin of the suspensory ligaments, may have a second site of pain abolished by blocking the region of the SIJs. In referral practice, it usually takes several days and multiple imaging techniques to arrive at a diagnosis of true SI or LS dysfunction. Careful assessment of the horse in hand and when ridden, comprehensive diagnostic local anaesthesia, transcutaneous and per rectal ultrasonography, and scintigraphic examination are almost invariably required in cases of subtle low-grade pain.

As with most pelvic conditions, SI or LS dysfunction may relate to a known traumatic incident (eg, slipping or falling) or be more insidious in onset. Horses with acute injuries, such as SI ligament rupture and instability, usually have palpable discomfort surrounding the tuber sacrale. Those with an LSJ injury and subluxation may be ataxic. In cases of chronic SI dysfunction, a rider may complain of the horse bucking after jumping fences or during ground work. Apparent back stiffness or lack of impulsion and resistance to going forward are also frequently reported. To complicate matters, these signs are also common in recently purchased, unfit, poorly schooled or downright naughty horses with novice riders! Careful clinical examination may reveal a reluctance to flex and extend the LS region, causing the horse to unlock the hock and stifle temporarily rather than dorsiflex the pelvis when focal pressure is applied just cranial and lateral to the tuber sacrale. Horses may resent bearing weight on the affected side while the contralateral limb is elevated. Lameness evaluation may reveal mild bilateral lameness with a shortened cranial swing phase and toe drag. Proximal limb flexion tests are usually negative.

Specific tests to localise pain to the SIJ have been described but can be misleading and require considerable experience to interpret. Horses with pain that is alleviated by blocking the region of the SIJ may also be suffering from LSJ pain due to the close anatomical association of these structures. Cranial, cranial midline and caudal approaches to blocking the SIJ have been described and a combination of all three may be preferable to maximise the chances of local anaesthetic desensitising the origin of pain in such a large and complicated region. This combined approach clearly desensitises a large variety of structures but consideration of the clinical presentation together with imaging findings will help to differentiate possible conditions. Due to the risk of ataxia or recumbency from desensitisation of the LS joint and disc itself, blocking this joint specifically is not possible; however, the ITJ, which is the joint formed between the caudal aspect of the last lumbar transverse process and the cranial aspect of the sacrum and forms part of the LSJ, can be desensitised by both the cranial and cranial midline approaches. SI pathology may be located in the caudal aspect of the SIJ, so it is essential that an attempt is also made to direct diagnostic local anaesthetic to this area. Ataxia is an infrequent sequela to SIJ block if carried out by experienced clinicians. However, if it does occur, ridden block assessment should clearly be avoided.

Diagnosis

A combination of ultrasonography and scintigraphy is the most useful method of imaging the SIJ/LSJ because, in isolation, the significance of any ultrasonographic

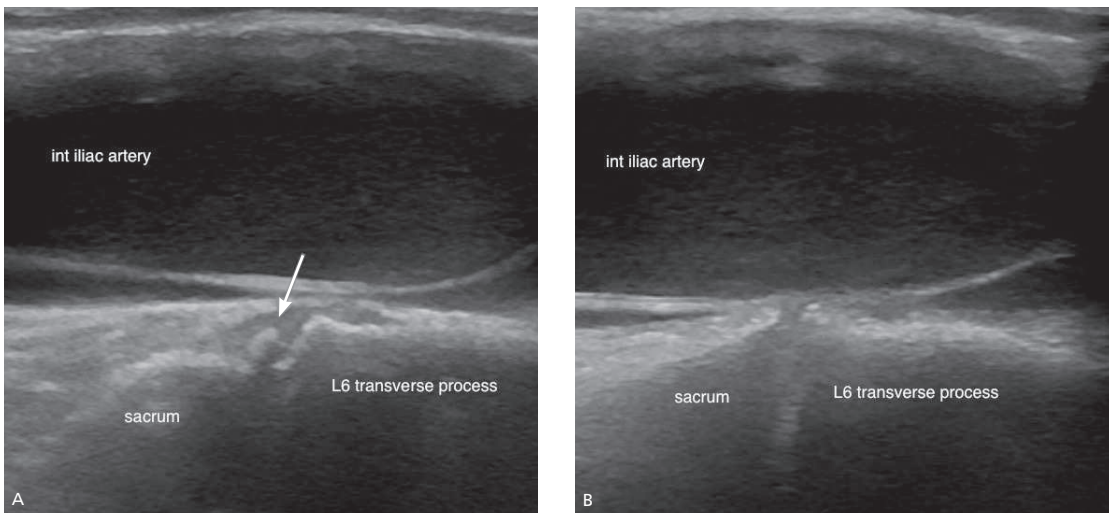

Fig 7: Ultrasonographic images acquired per rectum of the left (a) and right (b) intertransverse joints formed between the cranial articular surface of the sacrum and the apposing caudal articular surface of the lateral transverse processes of the sixth lumbar vertebrae. There is a large osteophyte on the sacral aspect of the left intertransverse joint (arrow). int Internal

findings may be difficult to determine. However, it is not uncommon for horses with no history of hindlimb lameness to have IRU in the region of the SIJ and, conversely, cases with clinical and ultrasonographic findings consistent with SIJ/LSJ may be unremarkable scintigraphically.

The LS disc usually appears homogeneous ultrasonographically and similar to the medial meniscus of the stifle. Modelling of the joint margins, dystrophic mineralisation and/or hypoechoic or hyperechoic regions within the disc tissue and protrusion of the disc outside the ventral margins of the sixth lumbar and first sacral vertebral bodies may indicate degeneration. The abaxial margins of the joint should also be examined. The disc space may be partially or completely fused (sacralised) and is reported to be so in up to 30 per cent of normal horses. This can be detected by increasing the gain and depth of the beam to assess whether it penetrates the space to produce an echo from the dorsal and ventral intervertebral ligaments. In these cases, the intervertebral disc space between the fifth and sixth lumbar vertebrae commonly contains more disc material than in horses without sacralisation.

Despite their close proximity, the ITJ may show signs of modelling (Fig 7) in the absence of any detectable change to the LS and SI regions, and vice versa.

Assessment of the ventral SI ligament requires per rectum ultrasonography and can be carried out while the joint margins are being assessed. Ultrasonographic evaluation of the DSL has been described above.

Periarticular modelling of the caudal aspect of the SIJ may also be detected during per rectum ultrasonography. Occasionally, chronic SIJ modelling can be identified as a result of iliac wing fractures propagating through the SIJ in thoroughbreds, although this does not appear to cause a clinical problem. The LSJ (including the ITJ) should be imaged transrectally.

A systematic approach to ultrasonographic assessment of the ITJ, SIJ, nerve roots and fossae should be developed to ensure a thorough examination and to aid localisation and assessment of the pelvic structures.

Summary

Pelvic injuries in horses present a diagnostic challenge. They often make for interesting clinical mystery solving, and require clinicians to piece together the clues gleaned from a thorough history taking, detailed clinical examination, lameness investigation and multimodal diagnostic imaging to reach a conclusion. However, cases involving presumed pelvic pain may also result in a frustrating succession of inconclusive and expensive diagnostic procedures, which, in a worst-case scenario, may result in disgruntled owners and unsettled insurance claims. It is therefore of primary importance that all cases are approached systematically and perhaps, above all, with an honest appreciation of the fact that this area of the equine anatomy has limited diagnostic potential.