How to Take and Interpret Radiographs of the Equine Stifle

David A. Wilson, DVM, MS, Diplomate ACVS

Author's address: University of Missouri, College of Veterinary Medicine, Columbia, MO 65211; e-mail: wilsonda@missouri.edu.

1. Introduction

Stifle radiography in the young performance horse is a fairly routine procedure for most equine practitioners. The primary reasons for taking radiographs of the stifle include radiographic evaluations for purchase, stifle joint effusion, lameness associated with the stifle, evaluation after a traumatic event associated with the stifle, and comparison of the perceived normal stifle to the affected stifle. Acquisition of stifle radiographs is not always intuitive for the beginner. A thorough knowledge of the 3D anatomy of the stifle as well as the anticipated pathologies of the stifle are necessary to properly position the x-ray generator and detector plate. Proper positioning results in acquisition of radiographs with sufficient quality to allow the veterinarian to make an informed diagnosis.[1–4]

2. Immature Horse

From birth until ~36 months of age, the stifle matures from a structure with six ossification centers: metaphysis and distal epiphysis of the femur, proximal epiphysis and metaphysis of the tibia, tibial tuberosity (apophysis), and patella. The lateral and medial trochlear ridges of the femur are initially fairly equal in size and the proximal portions of these ridges often have an irregular contour and opacity that must be differentiated from a suspected septic joint. This irregularity generally resolves by 3 to 5 months of age.

The distal femoral physis generally closes by 24 to 30 months of age. The physis between the tibial tuberosity and the tibial epiphysis tends to close by 9 to 12 months, and the physis between the tibial tuberosity and the tibial metaphysis closes at 30 to 36 months. The proximal tibial physis, between the proximal tibial epiphysis and the tibial metaphysis, closes at 24 to 30 months of age.

3. Stifle Joint Pathology

Osteochondrosis is reportedly the most common abnormality in the young performance horse stifle, affecting the trochlear ridges of the femur, the femoral condyles and the patella, and less frequently, the proximal tibia. Osteochondritis dissecans (OCD) of the trochlear ridges involves primarily the lateral trochlear ridge with the medial trochlear ridge less commonly affected. The articular surface of the patella also is a common site for OCD. Subchondral bone cysts are primarily observed in the medial femoral condyle, with much less frequency in the patella and even less frequently in the lateral femoral condyle.

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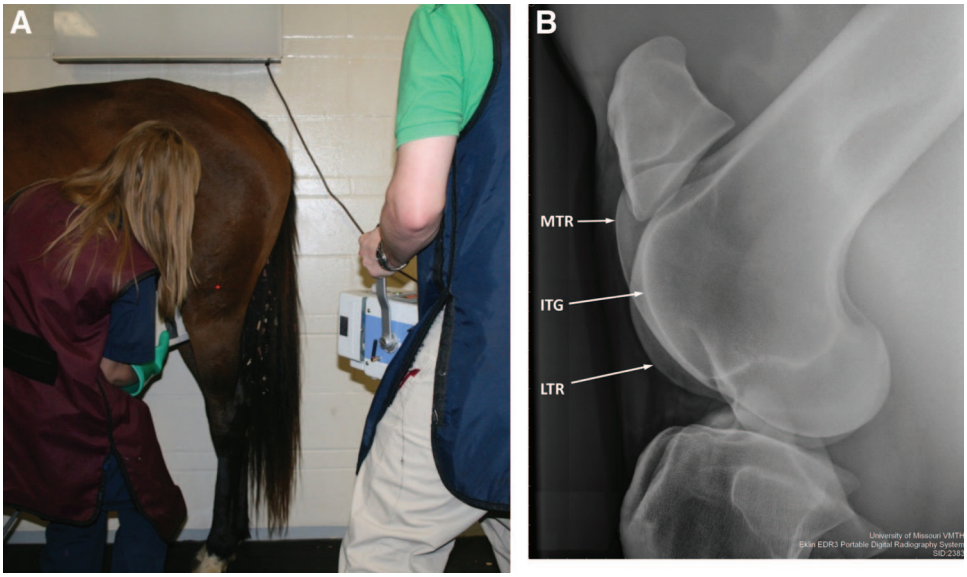

Fig. 1. (A) Positioning for lateromedial view. (B) Apparently normal lateromedial radiographic view of a mature Thoroughbred gelding highlighting the medial trochlear ridge (MTR), the lateral trochlear ridge (LTR), and the intertrochlear groove (ITG).

Other abnormalities include osteoarthritis, tumoral calcinosis (calcinosis circumscripta), collateral and patellar ligament desmititis, meniscal injuries, injuries to bone and soft tissues from acute

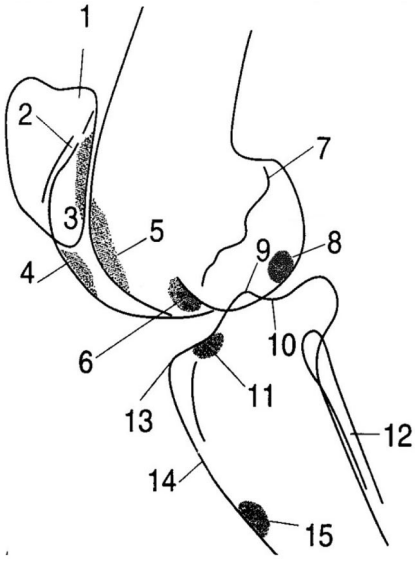

Fig. 2. Line drawing of lateromedial radiographic view identifying anatomical structures of importance. (1) Base of patella; (2) periarticular and subchondral areas of the patella*; (3) apex; (4) medial ridge of femoral trochlea*; (5) lateral ridge of femoral trochlea*; (6) area of extensor fossa*; (7) distal femoral physeal scar; (8) femoral condyles*; (9) tibial spine (medial intercondylar eminence); (10) tibial condyle; (11) area of attachment for the cranial ligaments of the menisci; (12) fibula; (13) tibial tuberosity; (14) tibial crest*; (15) areas of attachment for the tendon of semitendinosus muscle. *Common sites of pathology noted on lateromedial view. Adapted from O'Brien.[3]

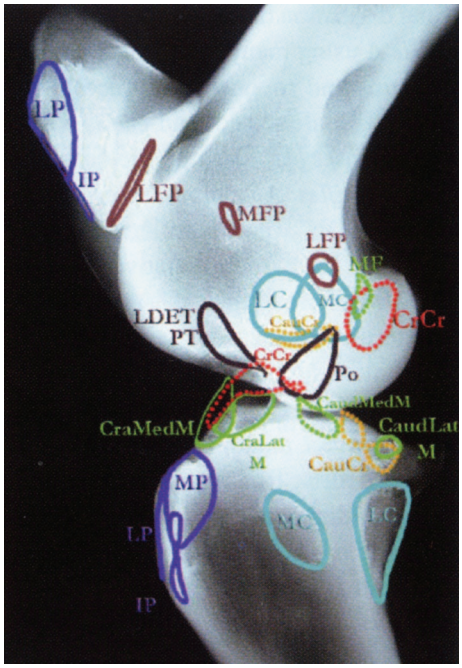

Fig. 3. Lateromedial radiographic map of ligament and tendon attachments to the stifle. Structures attaching within the intercondylar area of the tibia and the femur are indicated with dotted lines. From Maulet et al.[4] LP indicates lateral patellar ligament; IP, middle patellar ligament; MP, medial patellar ligament; LFP, lateral femoropatellar ligament; MFP, medial femoropatellar ligament; LC, lateral collateral ligament; MC, medial collateral ligament; CraLatM, cranial ligament of the lateral meniscus; CraMedM, cranial ligament of the medial meniscus; MF, meniscofemoral ligament of the lateral meniscus; CrCr, cranial cruciate ligament; CauCr, caudal cruciate ligament; Po, origin popliteus muscle; PT, origin of peroneus tertius; LDET, origin of long digital extensor; FP, femoropatellar joint capsule; LatFP, lateral femorotibial joint capsule; MedFT, medial femorotibial joint capsule.

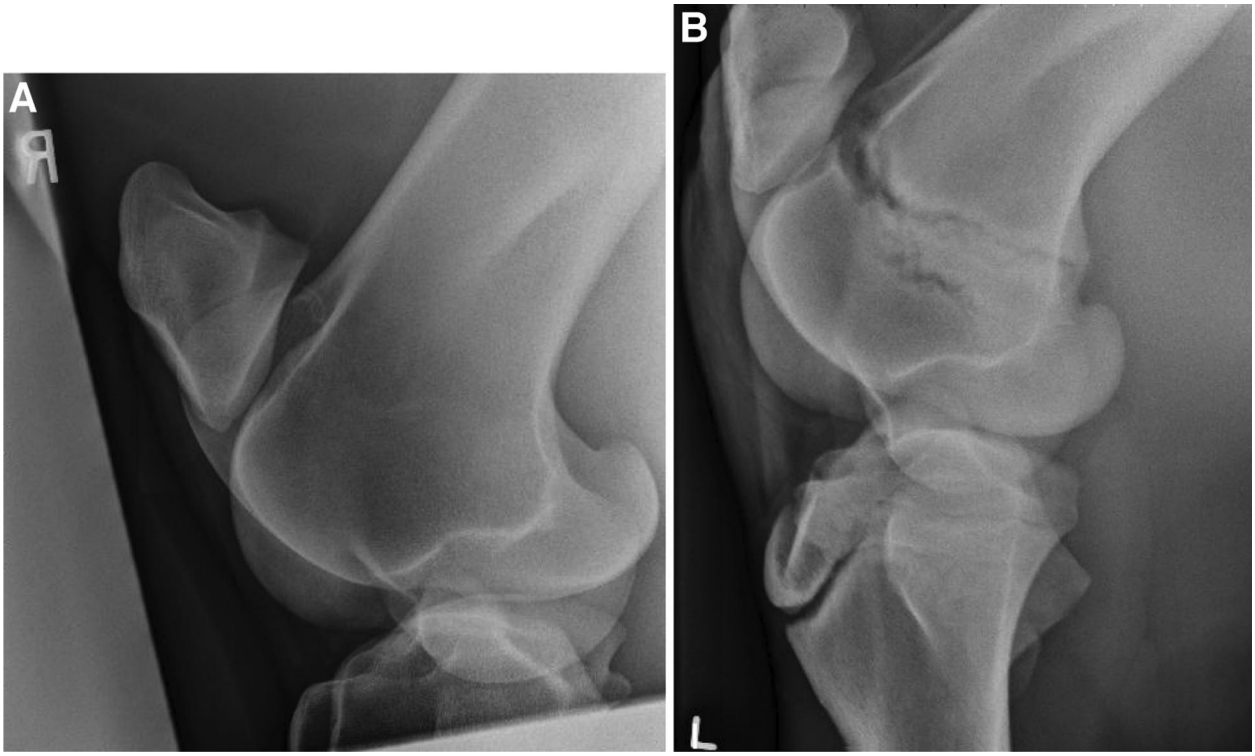

Fig. 4. A and B, Typical poor positioning for lateromedial view. Beam is directed at a proximal to distal angle instead of horizontal.

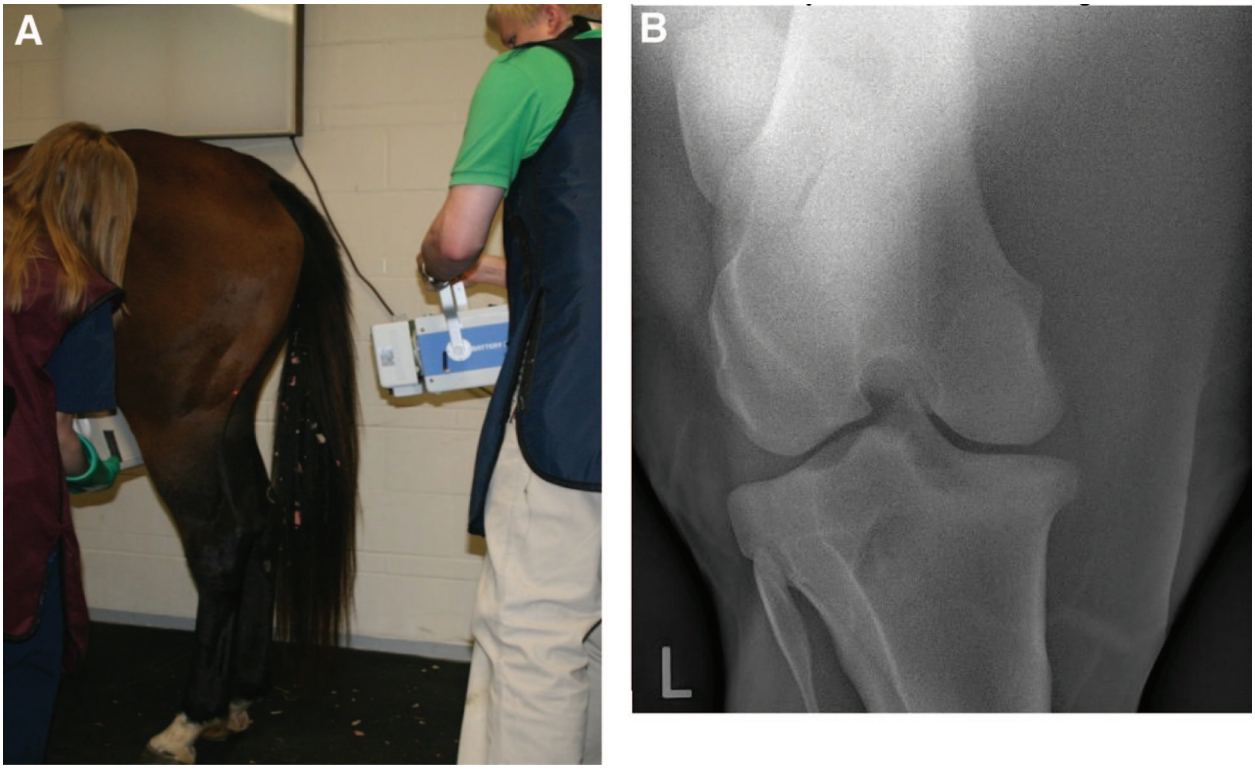

Fig. 5. (A) Positioning for caudocranial view. (B) Apparently normal caudal-cranial radiographic view of a mature Thoroughbred gelding.

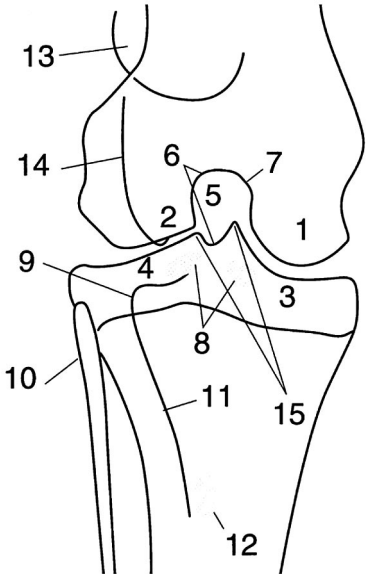

Fig 6. Line drawing of caudocranial radiographic view identifying anatomical structures of importance. (1) Medial femoral condyle; (2) lateral femoral condyle; (3) medial tibial condyle; (4) lateral tibial condyle; (5) intercondylar fossa of the femur; (6) areas of attachment of the cranial cruciate ligament; (7) area of attachment of the caudal cruciate ligament; (8) areas of attachment for the cranial ligaments of the menisci; (9) tibial tuberosity; (10) fibula; (11) tibial crest; (12) attachment site for the semitendinosus tendon; (13) patella; (14) lateral ridge of the trochlea of the femur; (15) intercondylar eminences: medial (spine) and lateral. Adapted from O'Brien.[3]

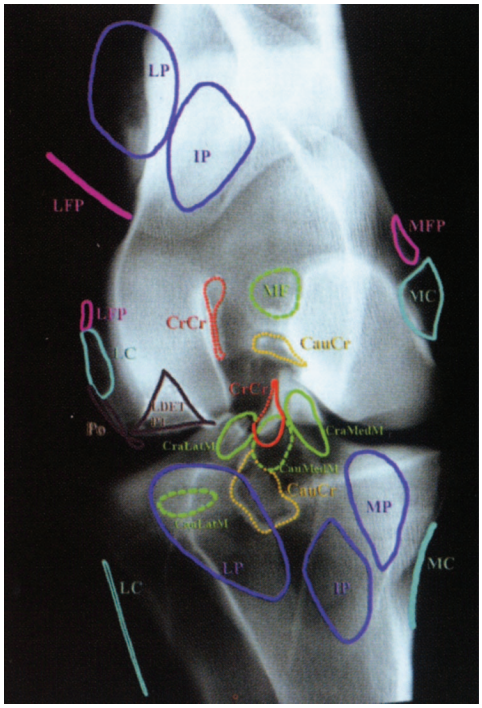

Fig. 7. Caudocranial radiographic map of ligament and tendon attachments to the stifle. Structures associated with the caudal half of the femur or tibia are indicated with dotted lines. From Maulet et al.[4] LP indicates lateral patellar ligament; IP, middle patellar ligament; MP, medial patellar ligament; LFP, lateral femoropatellar ligament; MFP, medial femoropatellar ligament; LC, lateral collateral ligament; MC, medial collateral ligament; CraLatM, cranial ligament of the lateral meniscus muscle; CraMedM, cranial ligament of the medial meniscus; MF, meniscofemoral ligament of the lateral meniscus; CrCr, cranial cruciate ligament; CauCr, caudial cruciate ligament; Po, origin popliteus muscle; PT origin of peroneus tertius; LDET, origin of long digital extensor; FP, femoropatellar joint capsule; LatFP, lateral femorotibial joint capsule; MedFT, medial femorotibial joint capsule.

traumatic events, and other miscellaneous sclerosis and lucencies of the trochlear ridges and proximal tibia).

4. Radiographic Views

There are three standard radiographic views that are commonly acquired for most stifle evaluations, including the lateromedial, caudal to cranial (10–20° proximodistal), and 30° caudolateral-craniomedial oblique. Optional views that are not acquired routinely, but are necessary views to highlight specific anatomic structures, include the patellar skyline, flexed lateromedial, and 30° to 45° caudomedial-craniolateral oblique views. In addition, special oblique projections can be very useful for specific joint abnormalities when the standard radiographic views do not sufficiently demonstrate the abnormality.

Lateromedial View

The horse should be positioned with both hind limbs fully weight-bearing with the limb to be imaged slightly caudal to the contralateral limb (Figs. 1–4). The x-ray beam should be directed horizontally, centered on the femorotibial joint, caudal and distal to the apex of the patella. The beam will most commonly be directed ~10° to 20° caudal to cranial to the frontal plane to accommodate for the typical hind limb anatomy of most horses. As a rule of thumb, align the beam parallel to the heel bulbs of the limb to be imaged.

The lateromedial view highlights the medial and lateral ridges of the femoral trochlea, the intertrochlear groove, the periarticular and subchondral areas of the patella, the tibial crest, the tibial plateau and areas of attachment of the cranial cruciate ligament and the cranial ligaments of the menisci, the extensor fossa, and the femoral condyles.

Caudal to Cranial View (10–20° Proximodistal)

The horse should be positioned with both hind limbs fully weight-bearing. The center of the beam should be directed at the soft tissue indentation at midline and the angle of the beam directed 10–20° proximodistally (Figs. 5–8).

30° Caudolateral-Craniomedial Oblique

The horse should be positioned with both hind limbs fully weight-bearing. The center of the beam

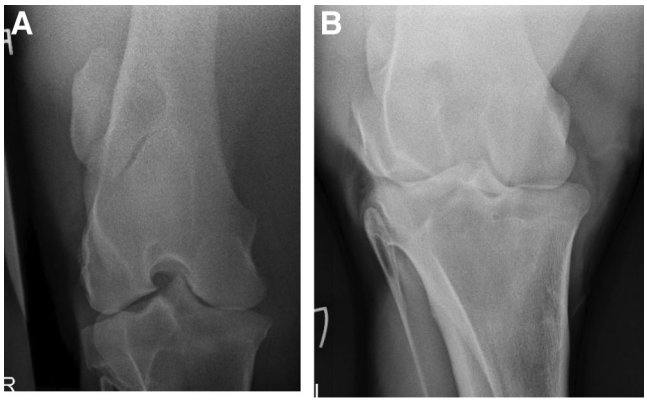

Fig. 8. A and B, Typical poor positioning for caudocranial view. Beam is directed horizontal rather than proximal to distal resulting in failure to achieve separation to evaluate femorotibial joint spaces.

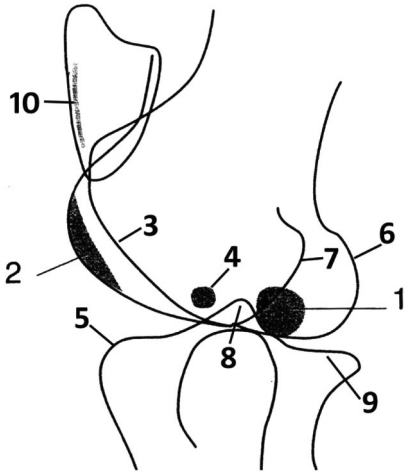

Fig. 10. Line drawing of a 30° caudolateral-craniomedial oblique view. The view is taken primarily to evaluate (1) site of typical subchondral cyst in medial femoral condyle; (2) typical area for OCD of the lateral trochlear ridge of the femur; (3) medial ridge of the femoral trochlea; (4) area of the extensor fossa; (5) tibial tuberosity; (6) medial femoral condyle; (7) lateral femoral condyle; (8) spine of the tibia; (9) medial condyle of the tibia; (10) attachment site for the biceps femoris and lateral patellar ligament. Adapted from O'Brien.[3]

should be directed on the femorotibial joint, ~10 cm caudal to the cranial aspect of the limb. The x-ray beam should be directed horizontal to the ground or slightly proximal to distal 10°–15° (Figs. 9–13).

Patellar Skyline (Cranioproximal-Craniodistal Oblique View)

The patellar skyline view is taken with the stifle flexed and the tarsus either flexed or extended. The cassette is held approximately horizontal with its caudal edge against the cranial aspect of the tibia, centered just proximal to the tibial crest. Depending on the horse, the beam angle may range from a proximal 10° lateral-distal medial oblique direction to a 30°–40° proximocranial-distocaudal direction. Adducting the flexed limb may facilitate positioning by rotating the stifle outwards.

The indications for the patellar skyline view include assessment of a suspected patellar fracture, and to better assess a known patellar fracture or suspected osteochondrosis of the patella or lateral trochlear ridge of the femur (Figs. 14 and 15).

Flexed Lateromedial View

Positioning is similar to the lateromedial view. The degree of flexion of the stifle can vary from just slightly flexed with the horse resting the toe on the ground to moderate flexion. The beam is directed horizontal, centered on the patella (Figs. 16 and 17).

The indications for the flexed lateromedial view include a better assessment of the apex of the patella, to

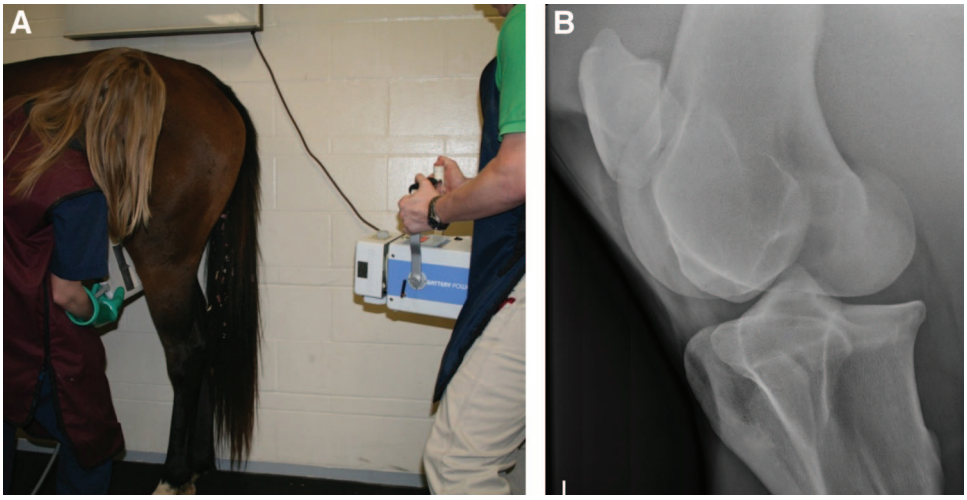

Fig. 9. (A) Positioning for 30° caudolateral-craniomedial oblique view. (B) Apparently normal 30° caudolateral-craniomedial oblique radiographic view of a mature Thoroughbred gelding.

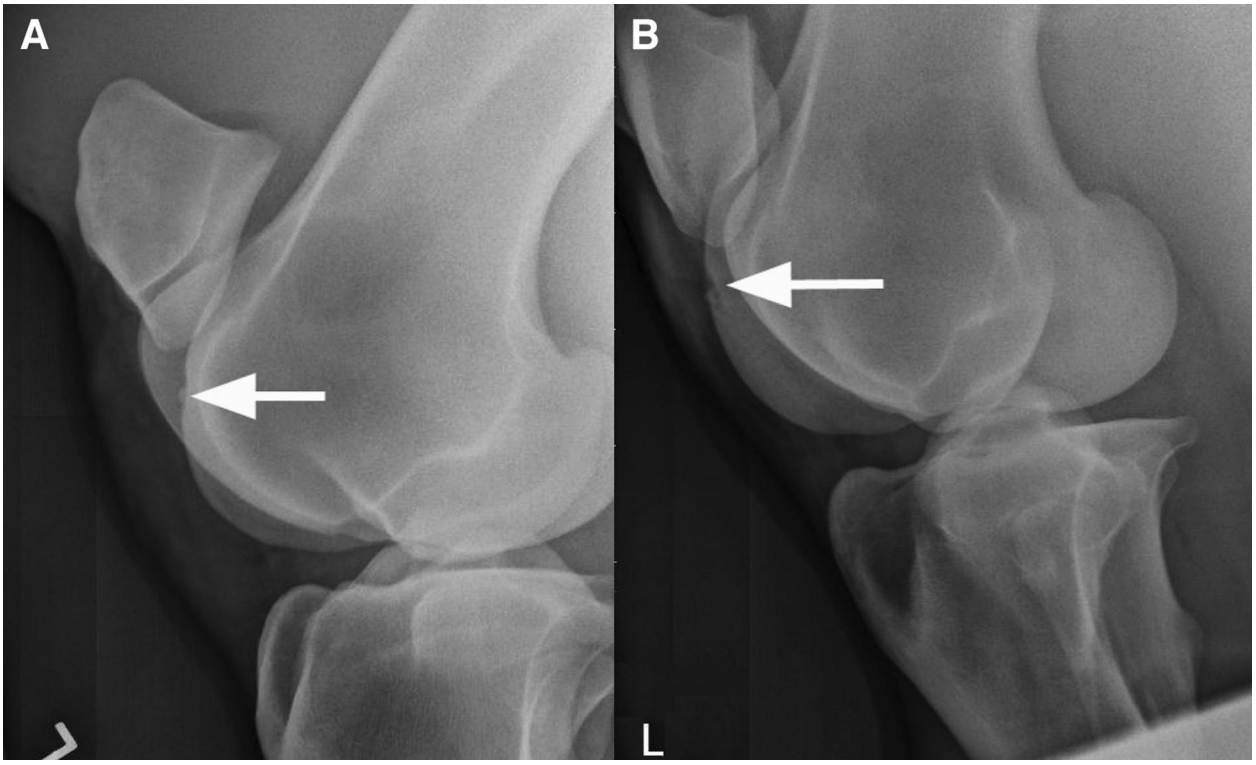

Fig. 11. (A) Lateromedial view and (B) 30° caudolateral-craniomedial oblique view of mild osteochondral defect (arrow) in the lateral trochlear ridge in an 18-year-old Warmblood gelding.

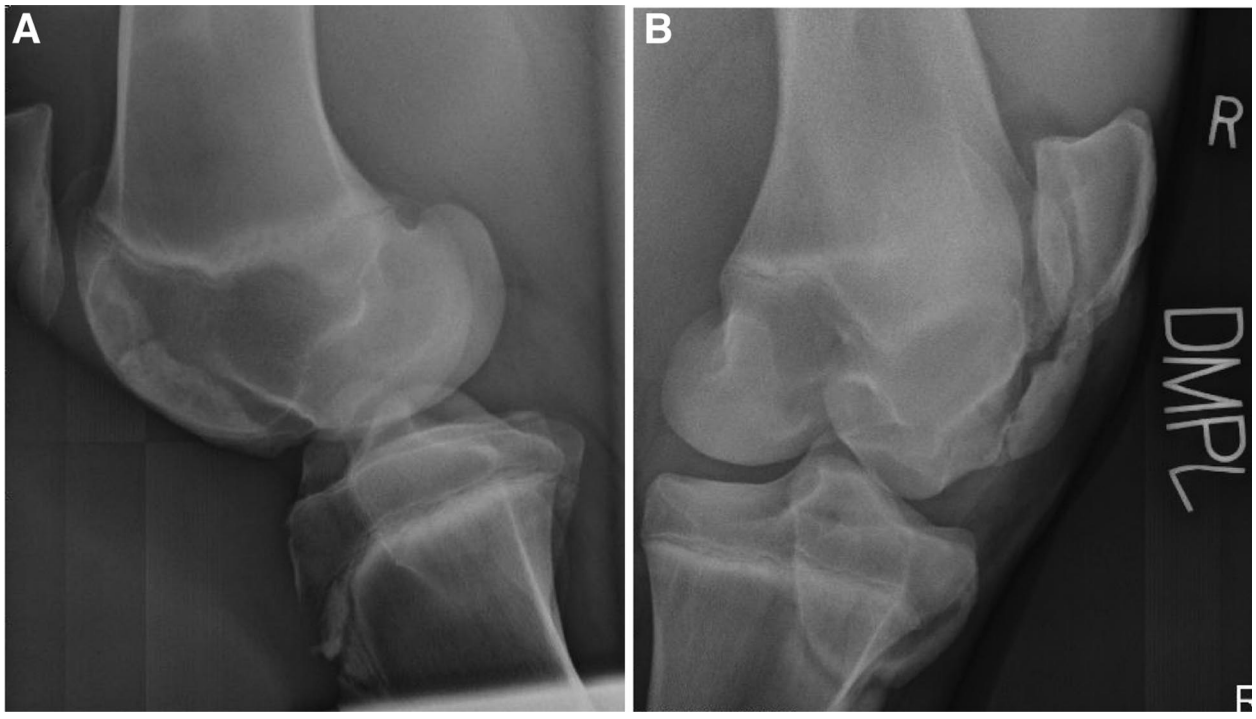

Fig. 12. (A) Lateromedial view and (B) 30° caudolateral-craniomedial oblique view of a large osteochondral fragment of the lateral trochlear ridge of the femur in a 15-month-old Standardbred filly.

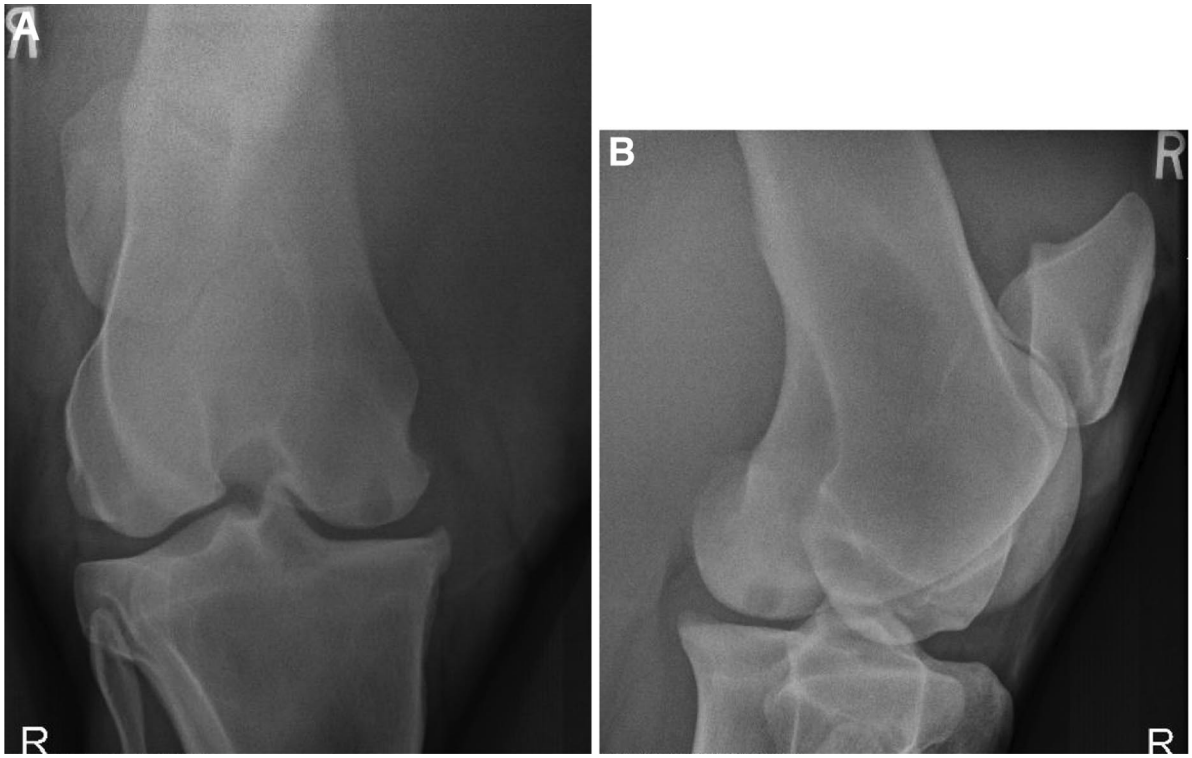

Fig. 13. (A) Caudo-cranial and (B) 30° caudolateral-craniomedial oblique view of small subchondral bone cyst of the medial femoral condyle with secondary mild osteophyte on medial tibial condyle in a mature Quarter Horse gelding.

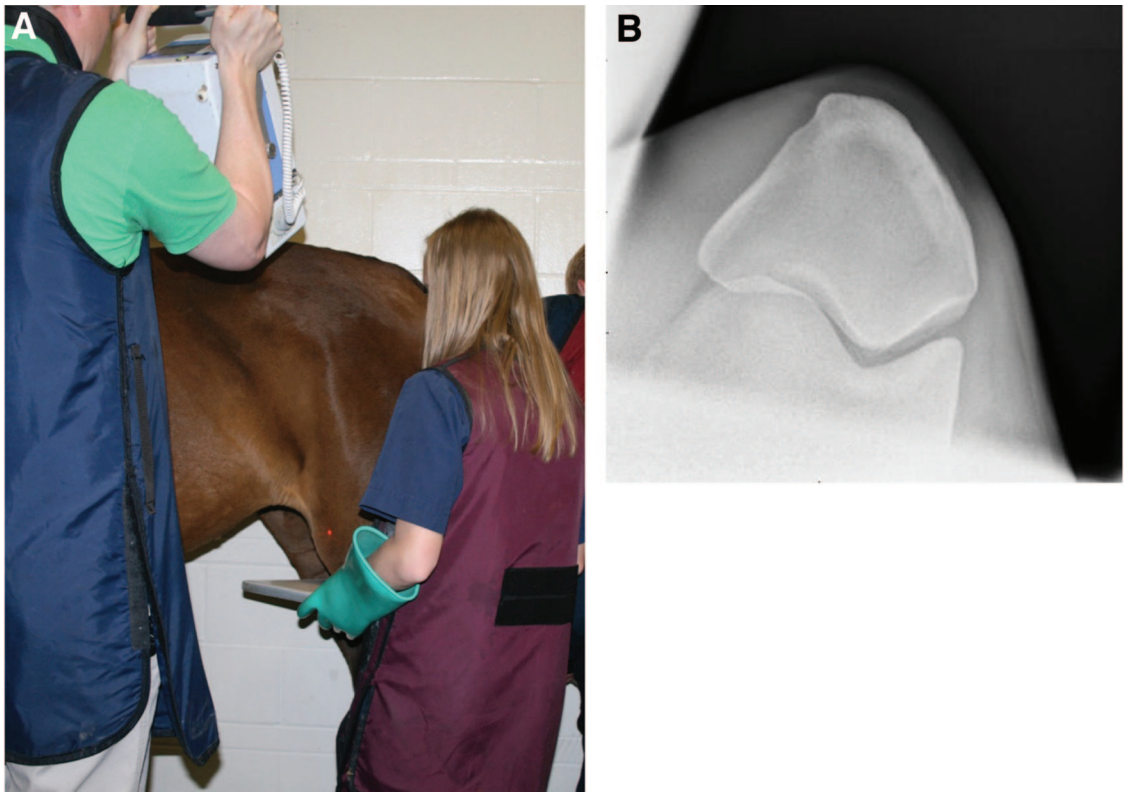

Fig. 14. (A) Positioning for patellar skyline view. (B) Apparently normal patellar skyline radiographic view of a mature Thoroughbred gelding.

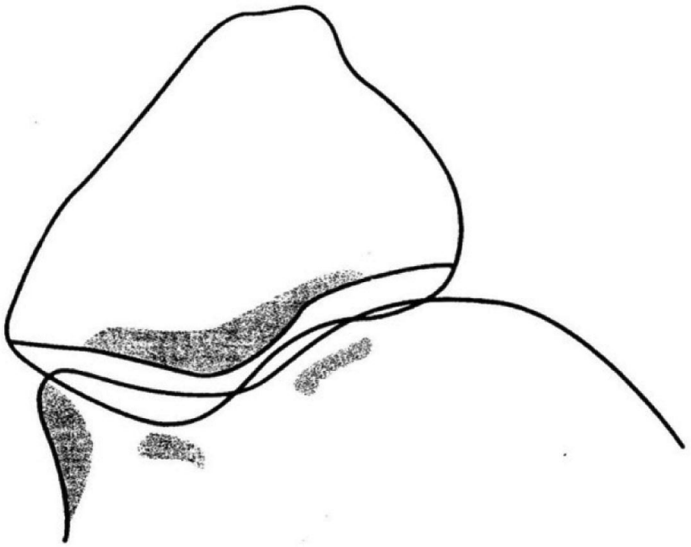

Fig. 15. Patellar skyline (cranioproximal-craniodistal oblique view). Shaded areas are common sites of subchondral lucency with/without sclerosis. Adapted from O'Brien.[3]

separate and better assess the articular surfaces of the patella and the proximal aspects of the trochlear ridges of the femur, and to better as-sess the attachment sites of the cranial ligaments of the menisci and cranial cruciate ligament in the region of the cranial aspect of the intercondylar eminences.

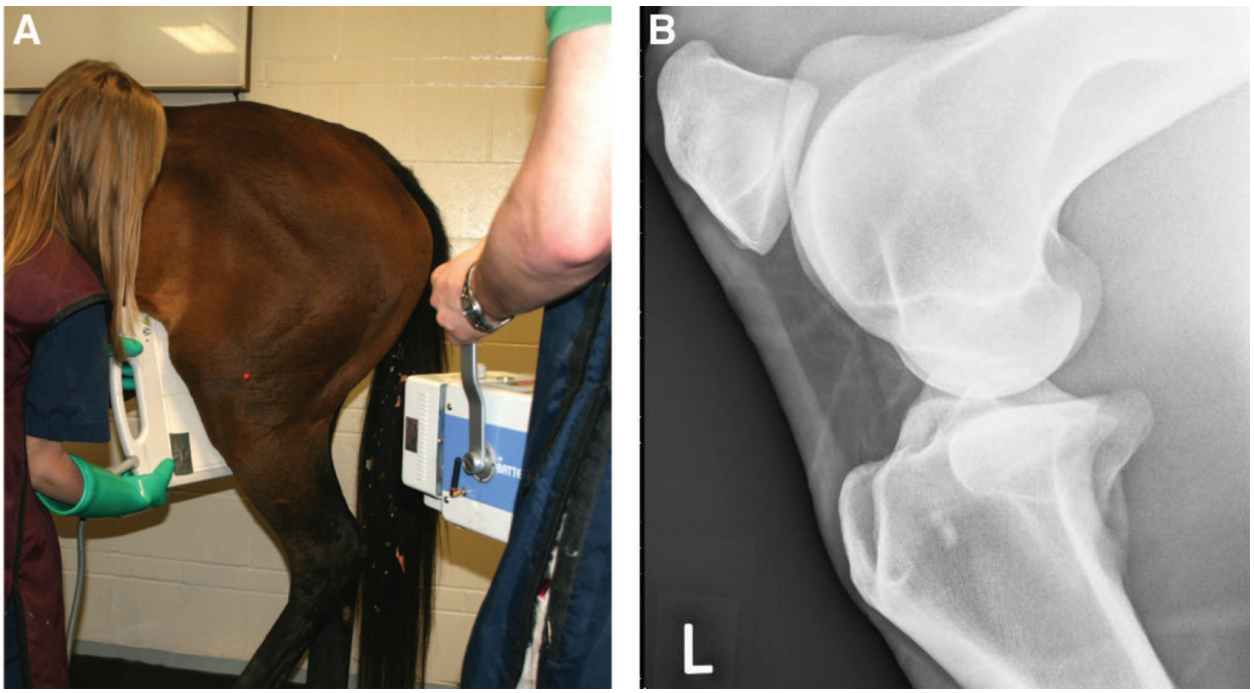

Fig. 16. (A) Positioning for flexed lateromedial view. (B) Apparently normal flexed lateromedial radiographic view of a mature Thoroughbred gelding.

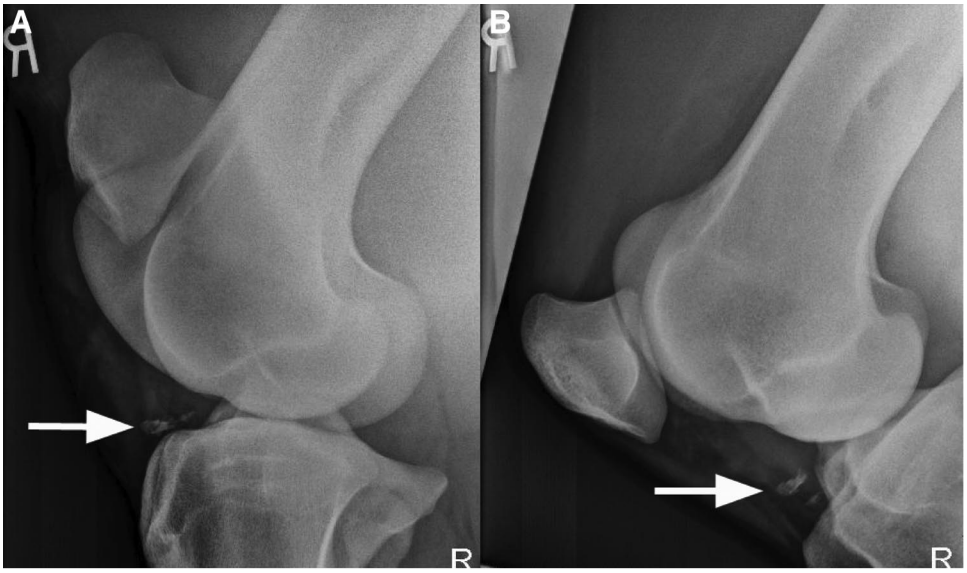

Fig. 17. (A) Lateromedial and (B) flexed lateromedial view of calcification (arrow) of the cranial attachment of the medial meniscus in a 3-year-old Standardbred filly.

References

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4. Maulet BEB, Mayhew IG, Jones E, et al. Radiographic anatomy of the soft tissue attachments of the equine stifle. *Equine Vet J* 2005;37:530–35.