How to Obtain Flexed Lateral Oblique Radiographs of the Equine Stifle

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1. Introduction
Lesions of the medial femoral condyle (MFC) are a common concern when evaluating radiographs of the equine stifle and include subchondral bone cysts, concave subchondral bone defects, flattening, and sclerosis.1 These lesions can affect many breeds in a variety of disciplines but are of particular concern in Quarter Horses. Generally, the lesions are found on the weight bearing articular surface of the MFC.2

The views most frequently recommended to evaluate the MFC are the cranial-caudal (CC) and caudo 45° to 60° lateral-craniomedial oblique (CdL-CrMO).3–5 The advantages of these views are that they are performed in a weight-bearing position, do not require extra personnel, and can often provide good radiographic information. However, there are limitations of these projections. Both views require increased radiographic technique to penetrate surrounding prominent musculature as well as the thick bone of the distal femur. A disadvantage of the CC view is that because the lesions are frequently located on the mid-cranial aspect of the MFC, the x-ray beam may not be directly tangential to the area of interest on the CC view and can obscure or underestimate the lesion. The CdL-CrMO can be more challenging to position properly, lesions can be obscured by superimposition with the tibial eminence, and the full length of the lesion may not be visualized.

The cranio 5° disto10° lateral-caudoproximomedial oblique (flexed lateral oblique) is a view that isolates the medial femoral condyle. The mid to cranial portion is highlighted in this radiographic projection. If the radiograph is obtained correctly, superimposition of other osseous structures is eliminated. This radiographic projection allows for better evaluation of the cranial to caudal length of lesion, can provide further information regarding the size of a cystic lesion, and can highlight more subtle lesions that may be difficult to visualize on the other standard radiographic images.

2. Materials and Methods
The flexed lateral oblique can be obtained in addition to the standard lateral, CC and CdLCrMO, or can be used as a substitute for the CdLCrMO. (However, if lateral trochlear ridge lesions are a concern, the CdLCrMO should not be eliminated.) Radiographic technique will vary, depending on the x-ray system used, but will be similar to the technique...
used for the standing lateral. Using flat panel, indirect digital radiography (DX), images are obtained with a film focal distance of 100 cm or 60 cm, depending on the x-ray generator. Field radiographs require portable x-ray generator use, which requires a film focal distance of 60 cm. The most common configurations of these generators include a high frequency 80 kVp 15 mA or 100 kVp 30 mA. In house x-ray generators often have the capability much higher kVp (~120 kVp) and mA (~1000 mA). Radiographic techniques for obtaining the flexed lateral oblique are summarized in Table 1.

Generally, horses tolerate the study without sedation; however, anxious horses or horses with little training may benefit from light to moderate sedation. Heavy sedation is not recommended because the patient is more likely to sway or be resistant to lifting the hind limb.

Table 1. Technique for Obtaining a Flexed Lateral Oblique

<table>
<thead>
<tr>
<th>Generator</th>
<th>kVp</th>
<th>mAs</th>
<th>Film Focal Distance</th>
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</thead>
<tbody>
<tr>
<td>HF, 80 kVp 15 mA</td>
<td>80</td>
<td>3 (0.2 seconds)</td>
<td>60 cm</td>
</tr>
<tr>
<td>HF, 100 kVp 30 mA</td>
<td>80</td>
<td>3 (0.1 second)</td>
<td>60 cm</td>
</tr>
<tr>
<td>3-Phase, 150 kVp</td>
<td>90</td>
<td>8</td>
<td>100 cm</td>
</tr>
<tr>
<td>1000 mA</td>
<td></td>
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Fig. 1. Proper positioning of the limb for the flexed lateral oblique view of the stifle. The handler faces cranially to be protected by the lead apron and adjust the limb as needed for the plate holder. The light field and cross-hairs of the x-ray beam are centered over the flexed stifle. White tape has been placed as a marker over the middle patellar ligament.

Fig. 2. Positioning of the x-ray machine relative to the limb and the plate. A plate handle is useful for minimizing radiation exposure and risk of kicking to the plate holder.

Fig. 3. An ideally positioned flexed lateral oblique radiograph of the stifle. The white arrows point to the most frequently affected area of the MFC. Note how the MFC is projected cranial to the tibia and has minimal superimposition with the lateral femoral condyle.
Patient positioning requires that the limb is flexed and held with the tarsus and femorotibial joint at 90° angles. While in flexion, the natural position of the limb is in slight abduction. The flexion of the limb is similar to that of the stifle flexion test.

The x-ray tube is positioned lateral to approximately 5° cranial to the femorotibial joint and horizontal with the ground. When the joint is flexed, it can be difficult to visually assess the cranial and proximal margins of the joint. Palpation of the patellar ligaments is an easy way to assess the position of the joint.

To minimize superimposition of osseous structures, 10° to 15° of proximodistal obliquity is required. This can be approached in two ways: (1) the limb can be abducted 10° from lateral (the natural position of the leg while in flexion); or (2) the x-ray beam can be directed 10° from distolateral to proximomedial (“aiming up” with the machine). In some cases, the limb must both be mildly abducted and the x-ray beam directed proximally to achieve adequate obliquity (Fig. 1). Once the limb is positioned properly and the x-ray tube is in place, a third person can place the plate on the medial aspect of the stifle joint. The plate should be oriented at an oblique angle in the plane of the limb to include as much of the stifle as possible. Positioning the plate last is recommended as this is often the portion of the examination that the horses are most likely to resent, and therefore the length of time the plate is in place should be minimized (Fig. 2).

The goal of the flexed lateral oblique view is to project the medial femoral condyle cranially and proximally to eliminate superimposition with the lateral femoral condyle and tibial eminences (Fig. 3). There are frequently errors when obtaining this radiographic projection. The most common error is

Fig. 4. A flexed lateral view with insufficient obliquity resulting in superimposition of the condyles, not allowing for adequate evaluation of the medial femoral condyle.

Fig. 5. A flexed lateral oblique view in which the x-ray machine was positioned too caudally, resulting in increased superimposition of the medial femoral condyle and tibial eminence. Arrows demonstrate the area of superimposition.

Fig. 6. A, CdLCrMO of the stifle of a full-size draft horse. A faint mild subchondral bone defect is visualized on the MFC. B, Flexed lateral oblique demonstrates a moderate subchondral bone defect (black arrows) with surrounding sclerosis. Note the improved trabecular bone detail relative to the CdLCrMO view.
insufficient obliquity, resulting in image closer to a true lateral and superimposition of the medial and lateral femoral condyles (Fig. 4). This may be a result of insufficient abduction of the limb or distal to proximal angling (“aiming down”) of the machine. A commonly encountered error is the natural tendency of the x-ray tube handler to position the machine perpendicular to the abducted limb, in a proximolateral-distomedial position, or aiming down. This effectively removes the obliquity from the image.

Another common error is to position the x-ray tube too far caudally. This caudal lateral position will result in the MFC being projected further caudally and increasing the superimposition with the tibia. It is better to err in the direction of positioning the tube slightly craniolateral to the joint because this will project the medial femoral condyle cranially and decrease tibial superimposition (Fig. 5).

3. Results

Starting in 2009, the stifle radiograph protocol at Colorado State University was modified to include a standing lateral, CC, CdLCrMO, and a flexed lateral oblique. This allows direct comparison of radiographic changes of the MFC on all views. Currently, a study is underway to objectively quantify the size and subjectively grade the appearance of lesions between the CC, CdLCrMO, and flexed lateral oblique. Early review of 19 initially collected cases shows that in 6 cases the length of the lesion measured the longest on the flexed lateral oblique. In 5 cases, sclerosis that was graded mild to moderate on the CC or CdLCrMO was found to be at least one grade higher (moderate to severe) on the flexed lateral oblique. In one case, the flexed lateral oblique demonstrated a subchondral bone defect that appeared only as mild flattening on the CC and

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Fig. 7. A, CC view shows a faint subchondral cystic lesion on the axial aspect of the MFC. B, On the CdLCrMO view, the subchondral cystic lesion is faintly visualized, as well as a mild concave subchondral bone defect. C, The flexed lateral oblique view gives a clear projection of the dimensions of the subchondral cystic lesion (black arrows) and length and depth of the subchondral bone defect (white arrowheads). Adjacent moderate sclerosis is easily appreciated.
CdLCrMO. In another case, what appeared to be a mild subchondral bone defect on the other views was graded as moderate on the flexed lateral oblique. In one draft horse, the thickness of the limb resulted in poor visualization of the MFC on the CC and CdLCrMO, even using a high mA in house x-ray generator. A faint cystic lesion could be seen on the CdLCrMO; however, on the flexed lateral oblique, visualization of the cystic lesion and surrounding trabecular bone sclerosis was obvious and could be easily measured. Most impressively, in two cases, the flexed lateral oblique view was the only view that demonstrated a subchondral cystic lesion.

4. Discussion
Although more cases need to be collected and results of this comparative study are not finalized at this time, our subjective opinion, based on clinical experience, is that the flexed lateral oblique view provides more complete evaluation of the medial femoral condyle and lesion dimension, free from superimposition. Although the CC view is useful for measuring the medial to lateral width of a lesion, the length of lesions in a cranial to caudal dimension is more apparent on the flexed lateral oblique. Being able to adequately assess the subchondral bone defect in both dimensions is important because the size of the defect has been shown to affect prognosis.6

In addition to being able to assess the length of a lesion, some lesions that are not visualized or are mild to moderate on the CC and CdLCrMO view appear much more obvious, larger, and/or more severe on the flexed lateral oblique view (Fig. 6). In some cases, subchondral cystic lesions have an associated longer subchondral bone defect, which can be well visualized on the flexed lateral oblique and may be missed or underestimated with the other conventional views (Fig. 7). Additionally, because of the decreased superimposition, more subtle changes, such as mild diffuse sclerosis of the medial femoral condyle, can be better appreciated.

An additional advantage of the flexed lateral view is that it does not require the x-ray beam to penetrate the same thickness of soft tissues that is needed for the CC and CdLCrMO. Many portable x-ray generators are operating at the highest setting when obtaining CC and CdLCrMO and yet still often have poor penetration and trabecular bone detail. This results in a risk of missing more subtle subchondral cystic lesions. Because of the decreased soft tissue attenuation, the flexed lateral oblique allows for better trabecular bone detail of the MFC, using the same or decreased radiographic exposure, and minimizes the likelihood of missing subtle lesions.

The flexed lateral oblique view is a view that is rarely discussed in the literature and is often underutilized. When discussed, the radiographic projection is not well explained or is described as a true lateromedial flexed view in commonly used lameness and imaging texts.3,4 Although it takes some more practice to master than other views, the extra information provided is worth the effort. Although obtaining this view may not be feasible in cases of limited personnel or poorly trained patients, becoming proficient in obtaining and interpreting the flexed lateral oblique will often allow for greater and more accurate radiologic evaluation of the medial femoral condyle.

References