EVALUATION OF FEMORAL TORSION
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Femoral torsion has been implicated in the pathogenesis of patellar luxation and cranial cruciate ligament disease (CCLD). However, obtaining an objective and reproducible measurement of this conformation remains a challenge, thereby preventing accurate surgical correction. The purpose of this presentation is to review the traditional methods for assessing femoral torsion, discuss their limitations, and propose alternatives specifically tested in dogs with or without CCLD.

Femoral torsion has traditionally been measured via radiographic determination of the angle of antversion of the femoral head. The angle of anteversion (AA), which quantifies femoral torsion can be measured on an axial projection of the femur, as the angle between the axis of the femoral neck and the transcondylar axis. Alternatively, it may be calculated based on the ventrodorsal view of the pelvis and the mediolateral projection of the femur (Bardet 1983). This technique falsely assumes that the degree of magnification is identical on both radiographic projections and requires good positioning. The positioning of the femur on the ventrodorsal projection of the pelvis is assessed in dogs based on the position of the patella and symmetrical superposition of the fabellae with the femur. The positioning of the femur on the mediolateral view is evaluated based on superposition of both fabellae in the craniocaudal plane. We have developed a simpler method for estimating the AA based on a single mediolateral radiographic projection (lateral plane AA). The angle of anteversion is affected by other conformational characteristics of the hindlimb, such as the angle of inclination of the hip (coxa valga tends to increase the angle of anteversion) and femoral angulation. Anteversion angles may be measured on CT based on cross sections or using a volume rendered technique (Figure 1). We evaluated the correlation between the radiographic and CT methods for measuring the angle of anteversion in the pelvic limbs (n = 28) of 14 dogs without CCL deficiency classified as control limbs, and in limbs of 16 dogs with CCL deficiency considered as affected by (18 limbs) or predisposed to (10 contralateral limbs) CCL deficiency. There was a significant correlation between biplanar and lateral plane AAs but neither correlated with CT assessment of femoral torsion. This lack of correlation may result from slight variations in radiographic positioning and selection of landmarks, affecting the accuracy and variability of radiographic measurements. Our findings are in contradiction with Dudley et al., who previously reported that femoral torsion could be accurately evaluated with radiographs and CT in normal dogs. The discrepancy between our results and this previous publication may relate to differences in populations as well as statistical methodology. Dudley et al. looked for statistically significant differences between radiographic and CT measurements within nine normal cadavers, whereas we tested the correlation between corresponding measurements in clinical patients with or without CCL disease.

Although computed tomography allows correction of positioning artifacts, measuring the angle of anteversion does not differentiate femoral neck version from distal femoral torsion. This limitation has immediate clinical implications when considering corrective osteotomy of the femur in dogs with medial patellar luxation. We have developed CT measurements to determine the level of torsion along the femur, based on the relative position of the femoral head and condyles with the lesser and greater trochanter (Mostafa et al. 2009). A significant correlation was identified between the overall AA and each of the distal, proximal, and femoral head trochanteric (FHT) angles in dogs with or without CCLD. Pelvic limbs of Labrador Retrievers
with, or predisposed to, CCL disease had evidence of internal torsion of the distal femur (increased overall anteversion and distal anteversion angles and decreased femoral condyle trochanteric angle) and normal femoral neck anteversion (normal proximal AA, femoral head trochanteric angle. This internal torsion of the femur was detected on radiographs and CT of predisposed limbs, but only via CT in CCL deficient limbs. Nonetheless, radiographic evaluation of femoral torsion appears to be valuable as a predictive tool for CCLD (Ragetly et al. 2011). Comparing Labrador Retrievers at low risk for CCLD (older, normal dogs) and Labrador Retrievers with unilateral CCLD, we determined that, among all factors measured, a combination of tibial plateau angle (TPA) and femoral anteversion angle measured on radiographs was optimal for discriminating predisposed and non-predisposed limbs for CCL disease in Labrador Retrievers.

Assessing predisposition to CCL disease with a combination of conformational measurements including anteversion angle therefore appears more promising than using univariate parameters. Although this radiographic measurement may have a predictive value, computed tomographic evaluation seems warranted prior to surgical correction.

In summary, CT may be especially relevant in the pre-operative evaluation of dogs with moderate to severe patellar luxation and suspected femoral angulation and/or torsion. The availability of CT and the possibility to generate studies under sedation have improved the feasibility and cost effectiveness of this imaging modality in small animal practices. CT quantification and localization of the level of angulation in three dimensions could provide objective guidelines as to the selection of patients considered for corrective osteotomies. This information would also be relevant to the pre-surgical planning of corrective osteotomies, potentially improving surgical outcome.

Selected references:


