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Patellar Luxation: CT and decision-making

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Medial patellar luxation (MPL) has been described as the most common orthopedic disease affecting the canine stifle, diagnosed in 7% of puppies in a study of 1,679 immature dogs. Although MPL has typically been considered as a disease of small breeds, a recent study of breed susceptibility for developmental orthopedic diseases expanded the list of breed predisposition for MPL to include larger dogs such as Chinese shar-pei, Flat-coated retriever, Akita, and Great Pyrenees. Complications are reported in up to 50% of cases, consisting mainly of recurrence and degenerative joint disease, with an risk increasing in larger dogs. Surgical treatment for MPL includes medial releasing desmotomy, lateral imbrication, modification of the femoral groove, tibial tuberosity transposition, and femoral and/or tibial corrective osteotomy. In the absence of objective guidelines, the decision making process for selecting these procedures remain subjective and varies between surgeons. In order to improve surgical outcome, efforts should focus on measuring conformational factors associated in the pathogenesis of this disease, the effects of surgical procedures on these factors and the post-operative impact of their correction. Computed tomography (CT) is one the diagnostic modalities that may assist clinicians achieve those goals.

This presentation will propose a decision making process for treating patellar luxation in small and large dogs. Clinical cases will be used to illustrate radiographic and computed tomographic measurements used to evaluate the coxofemoral joint and extensor mechanism, in particular femoral angulation and torsion in dogs with patellar luxation. The discussion will focus on the role and limitations of diagnostic techniques in this decision process, with an emphasis on computed tomography.

Although CT has been used to quantify the anatomic alterations resulting from surgical treatment of MPL, its most relevant indication may be in the pre-operative evaluation of dogs with patellar luxations and suspected limb angulation. Femoral angulation can be measured as the angle between the anatomic axis of the femur and the transcondylar axis of the distal femur (aLDFA: anatomic lateral distal femoral joint angle). Although surgical correction has been recommended in dogs with femoral varus greater than 10-12°, the normal values for aLDFA in Labrador Retrievers, Golden Retrievers and Rottweilers were reported to reach an approximate varus of 7-8° ± 3 (Tomlinson et al., 2007). Determination of femoral varus on well positioned radiographs of normal dogs correlates with computed tomographic measurements (Dudley et al., 2006). However, angles measured on radiographs are subject to vary with positioning and concurrent femoral torsion. Limited extension of the hips creates a “bowed” appearance of the femora, falsely increasing the degree of varus angulation. In that respect, CT evaluation of femoral angulation palliates these limitations. The main drawbacks of CT include availability, cost, expertise required to manipulate images and time to generate and analyze the studies. Alternatively, a lack of proximodistal superposition of the femoral condyles on well positioned mediolateral radiographs can strengthen a suspicion of femoral angulation. This evaluation also assumes that the shaft the femur lies parallel to the radiographic film and is therefore subject to artifacts. A cranio-caudal projection of the femur, obtained with a horizontal radiographic beam (similar technique as that used for templating femoral stems prior to total hip replacement) eliminates artifactual femoral varus generated on the ventrodorsal view of the pelvis due to a lack of hip extension in dogs with concurrent hip disease.

Femoral torsion remains even more challenging to measure and correct surgically. The angle of anteverision, 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

Figure 1: Pre-operative radiographs (A) of a dog with bilateral MPL and apparent femoral varus of 15°. CT (B) evaluation failed to confirm varus deformity. Successful outcome (C) after right trochlear block recession, soft tissue repair and tibial crest transposition.
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 with luxated patella based on 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. 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 2). 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 (M. Mostafa 2009). These measurements allowed identification of a distal femoral torsion in the sound contralateral limbs of Labrador retrievers with cranial cruciate ligament deficiency but has not been applied to dogs with patellar luxation.

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