

# Comparison of arthroscopic and radiographic abnormalities in the hip joints of juvenile dogs with hip dysplasia

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**Objective**—To compare radiographic and arthroscopic abnormalities in juvenile dogs with clinically apparent hip dysplasia.

**Design**—Case series.

**Animals**—52 dogs (70 hip joints) with clinical signs of hip dysplasia scheduled to undergo triple pelvic osteotomy.

**Procedure**—A ventrodorsal radiographic projection of the pelvis was evaluated by a radiologist unaware of clinical and arthroscopic findings, and radiographic osteoarthritic abnormalities were judged and scored as absent (0), mild (1), moderate (2), or severe (3). Arthroscopy was performed by a surgeon unaware of clinical and radiographic findings, and arthroscopic abnormalities were graded from 0 (normal) to 5 (exposed, eburnated subchondral bone).

**Results**—In 30 of the 70 (43%) hip joints, no radiographic osteoarthritic abnormalities were seen. Severe, full-thickness articular cartilage lesions (grade 4) of the femoral head or acetabulum were seen arthroscopically in 14 (20%) joints. Lesions  $\geq$  grade 2 were seen in 60 (86%) joints. Partial tearing of the ligament of the femoral head was present in 57 (81%) joints, and complete rupture was seen in 5 (7%). Radiographic abnormalities were seen in 13 of the 14 (93%; 95% confidence interval, 66% to 99.8%) joints with grade 4 arthroscopic abnormalities but in only 23 of the 46 (50%; 95% confidence interval, 35% to 65%) joints with grade 2 or 3 arthroscopic abnormalities.

**Conclusions and Clinical Relevance**—Results suggest that radiography is not a sensitive method for identifying moderate cartilage lesions in juvenile dogs with hip dysplasia. If moderate cartilage lesions are an important prognostic indicator for the success of triple pelvic osteotomy, then methods other than radiography should be used to detect these lesions. (*J Am Vet Med Assoc* 2005;227:1091–1094)

Currently, clinical and radiographic findings are most commonly used to identify whether juvenile dogs with hip dysplasia are candidates for triple pelvic osteotomy (TPO).<sup>1</sup> Clinical evaluation includes palpa-

tion for hip joint laxity and assessment of range of motion and signs of pain. Radiographic evaluation includes assessment of the hip joints for subluxation and degenerative changes affecting the femoral head, femoral neck, and acetabulum. The presence of radiographically apparent osteoarthritis (OA) has often been cited as a negative prognostic factor for dogs undergoing TPO<sup>2</sup>; however, whether there is an association between radiographically apparent OA and grossly evident pathologic changes in the hip joint has not been well established.

Arthroscopic evaluation of the hip joint in dogs allows for direct examination of the major structures of the joint, including the articular cartilage, ligament of the femoral head, transverse acetabular ligament, joint capsule, and acetabular labrum.<sup>3</sup> Thus, lesions within the joint can be localized and subjectively graded as an alternate or complementary means of assessing whether juvenile dogs with hip dysplasia are suitable candidates for TPO. The purpose of the study reported here was to compare radiographic and arthroscopic abnormalities in juvenile dogs with clinically apparent hip dysplasia. Our hypothesis was that radiographic evaluation of such dogs would have low sensitivity in the detection of arthroscopically apparent lesions.

## Materials and Methods

**Dogs**—Juvenile dogs < 16 months old with clinical signs of hip dysplasia that were evaluated at the University of California–Davis Veterinary Medical Teaching Hospital, the Gulf Coast Veterinary Hospital, or the University of Missouri Veterinary Teaching Hospital between January 2000 and March 2003 for possible TPO were considered for inclusion in the study. Dogs were determined to be candidates for TPO only if the owner reported episodes of hind limb lameness or dysfunction and results of orthopedic and radiographic evaluations were compatible with a diagnosis of hip dysplasia and with a successful surgical outcome. Orthopedic examination findings considered compatible with a diagnosis of hip dysplasia included signs of pain on manipulation of 1 or both hip joints and detection of an Ortolani sign when the dog was sedated; findings considered compatible with a successful surgical outcome included the presence of a firm and easily palpated femoral head reduction during femur abduction as part of the Ortolani

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test. Radiographic findings considered compatible with a diagnosis of hip dysplasia and a successful surgical outcome included the absence of moderate or marked osteoarthritic changes in the hip joints and the absence of severe joint laxity or acetabular malformation on a standard ventrodorsal radiographic projection of the pelvis. In addition, dogs were included in the study only if a ventrodorsal radiographic projection of the pelvis obtained with the hind limbs extended and a videotape of the arthroscopic evaluation of the hip joints were available for review.

**Radiographic evaluation**—For purposes of the present study, a board-certified radiologist (WJH) unaware of the clinical and arthroscopic findings evaluated all ventrodorsal radiographic projections of the pelvis for dogs included in the study. Each hip joint was assessed for radiographic signs of OA, including osteophytosis, subchondral sclerosis, and osseous remodeling, and assigned a score of 0 (radiographically normal), 1 (mild OA), 2 (moderate OA), or 3 (severe OA).

**Arthroscopic evaluation**—Arthroscopic evaluations of the hip joints were performed with a 2.7-mm arthroscope through a supra-trochanteric lateral camera portal and videotaped for later analysis. A single individual (IGH) unaware of the clinical and radiographic findings retrospectively reviewed videotapes for all arthroscopic procedures. Lesions of the articular cartilage were subjectively graded on a scale from 0 to 5, where 0 = arthroscopically normal, 1 = chondromalacia, 2 = surface fibrillation, 3 = deep fissuring, 4 = full-thickness cartilage loss, and 5 = eburnation of exposed subchondral bone,<sup>4</sup> except that none of the joints were assigned a grade of 1 because of difficulties in identifying chondromalacia from videotapes (Figure 1). Location of the cartilage damage was assessed as cranial or caudal portion of the acetabulum, cranial or caudal portion of the femoral head, or the area directly surrounding the insertion of the ligament of the femoral head. Soft tissue structures, including the ligament of the femoral head, acetabular labrum, and transverse acetabular ligament, were also evaluated and graded as normal or abnormal.

**Statistical analyses**—Pearson  $\chi^2$  analyses were performed to determine, for dogs with grade 4 arthroscopic abnormalities and for dogs with grade 2 or 3 arthroscopic abnormalities, whether the percentage of dogs with radiographic abnormalities (grade 1, 2, or 3) was significantly different from 100%. Sensitivities of radiography (ie, percentage of dogs with grade 1, 2, or 3 radiographic abnormalities) in dogs with grade 4 arthroscopic abnormalities and in dogs with grade 2 or 3 arthroscopic abnormalities were calculated, along with their 95% confidence intervals (CIs).

## Results

Fifty-two dogs were included in the study. Dogs ranged from 5.5 to 15.5 months old (mean, 9.4 months) and weighed from 18.4 to 68 kg (40.5 and 149.6 lb; mean, 32.6 kg [71.7 lb]). For 18 of the 52 dogs, both hip joints were exam-

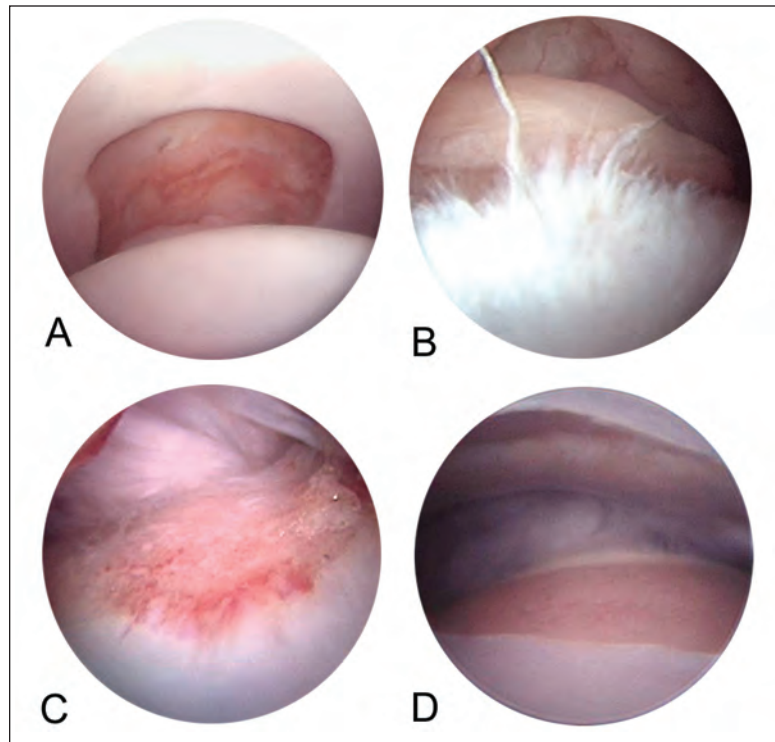


Figure 1—Arthroscopic appearance of the hip joints in juvenile dogs with clinical signs of hip dysplasia. A—Normal articular cartilage of the femoral head and acetabulum (grade 0). B—Surface fibrillation of the articular cartilage (grade 2). C—Deep fissuring of the cartilage with areas of full-thickness damage (grade 3). D—Full-thickness cartilage loss with exposure of subchondral bone in the acetabulum and dorsal aspect of the femoral head (grade 4).

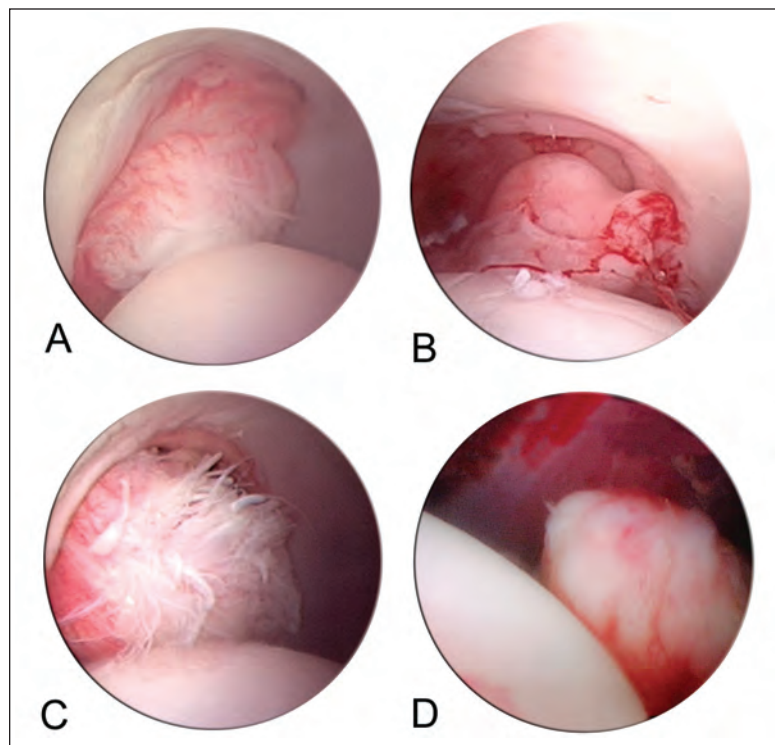


Figure 2—Arthroscopic appearance of the ligament of the femoral head in juvenile dogs with clinical signs of hip dysplasia. A—Mild swelling of the ligament, accompanied by fiber disruption and neovascularization. B—Severe swelling of the ligament. C—Substantial fiber disruption and tearing of the ligament. D—Rupture of the ligament.

ined arthroscopically; in the remaining 34 dogs, only 1 hip joint was examined arthroscopically either because of the individual surgeon's protocol or because results of orthopedic and radiographic evaluations were considered compatible with a successful outcome for only 1 hip joint. Thus, a total of 70 hip joints were included in the study.

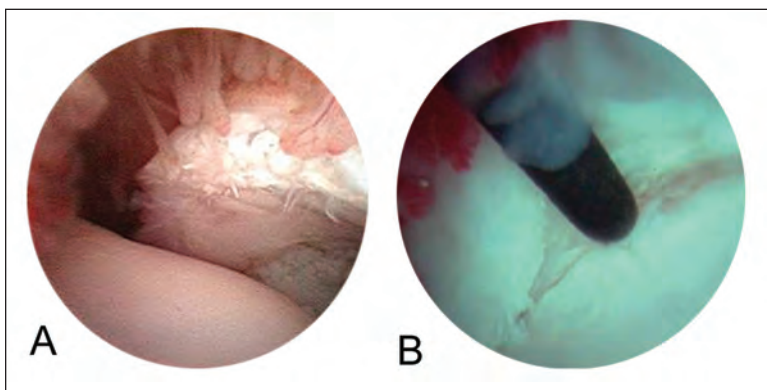
**Radiographic findings**—In 30 of the 70 (43%) hip joints, no radiographic signs of OA were seen (score 0), whereas mild OA (score 1) was seen in 23 (33%) hip joints, moderate OA (score 2) was seen in 14 (20%), and severe OA (score 3) was seen in 3 (4%).

**Arthroscopic findings**—In 3 of the 70 (4%) hip joints, there was no arthroscopic evidence of cartilage lesions (grade 0), whereas 25 (36%) joints had arthroscopic evidence of surface fibrillation (grade 2), 21 (30%) had deep fissuring (grade 3), and 14 (20%) had full-thickness cartilage loss (grade 4). None of the joints had eburnation of exposed subchondral bone (grade 5).

Partial tearing of the ligament of the femoral head was present in 57 of 70 (81%) hip joints, and complete rupture was seen in 5 (7%; **Figure 2**). Lesions of the acetabular labrum were seen in 65 of 70 (93%) joints and included tearing of the labrum in 31 (44%) and avulsion of the labrum in the remaining 34 (49%; **Figure 3**).

Cartilage lesions were most commonly seen surrounding the insertion of the ligament of the femoral head, with lesions of grades 2 to 4 evident in this area in 56 of the 70 (80%) joints. Lesions of grades 2 to 4 involving the cranial portion of the acetabulum were seen in 32 (46%) joints, and lesions involving the caudal portion of the acetabulum were seen in 28 (40%) joints.

**Sensitivity of radiography**—Grade 2 arthroscopic lesions were seen in 14 of the 30 (47%) hip joints that did not have any radiographic signs of OA (score 0), grade 3 arthroscopic lesions were seen in 9 (30%), and grade 4 arthroscopic lesions were seen in 1 (3%). Radiographic abnormalities were seen in 13 of the 14 (93%; 95% CI, 66% to 99.8%) joints with grade 4 arthroscopic abnormalities but in only 23 of the 46 (50%; 95% CI, 35% to 65%) joints with grade 2 or 3 arthroscopic abnormalities.



**Figure 3**—Arthroscopic appearance of the acetabular labrum in juvenile dogs with clinical signs of hip dysplasia. **A**—Moderate fibrillation of the acetabular labrum. **B**—Avulsion of the labrum.

## Discussion

Triple pelvic osteotomy is routinely recommended for treatment of hip dysplasia in dogs with palpable joint laxity but without evidence of OA,<sup>5</sup> as it is expected that in dogs in which OA is already established, the disease will continue to progress, whereas in dogs without evidence of OA, development of the disease will be slowed or prevented. Historically, a ventrodorsal radiographic projection of the pelvis has been used to determine whether dogs with clinical signs of hip dysplasia and palpable joint laxity have developed OA; however, whether there is a relationship between radiographic findings and cartilage lesions has not been well established. Other radiographic techniques that are used for preoperative assessment of dogs include distraction radiography, the dorsolateral subluxation score method,<sup>6</sup> and the dorsal acetabular rim method. These techniques are used to define the degree of hip joint laxity and assess the adequacy of the acetabular rim, in addition to assessing the degree of OA.

Results of the present study suggest that evaluation of a ventrodorsal radiographic projection of the pelvis has low sensitivity for detecting cartilage lesions in juvenile dogs with hip dysplasia that are being considered for TPO. In particular, moderate (grade 2 or 3) cartilage lesions were commonly seen arthroscopically in joints in the present study that did not have any radiographic evidence of OA. The relationship between preexisting cartilage lesions and the long-term clinical success of TPO has not been determined. However, if the presence of moderate cartilage lesions is a significant prognostic indicator for the success of TPO, then methods other than radiography are needed to identify these lesions. On the other hand, 1 study<sup>7</sup> has suggested that preoperative radiographic evidence of OA did not significantly affect clinical outcome or radiographic progression of OA after TPO.

The present study was limited by the fact that only hip joints thought likely to have a satisfactory outcome following TPO were included. This judgment was subjective, and the exclusion of more severely affected joints introduced some element of bias. Ultimately, a long-term study is needed to determine whether preoperative arthroscopic findings can be used to predict progression of OA following TPO or are associated with outcome.

Arthroscopy of the hip joint is a relatively new technique in dogs. Hip joint arthroscopy permits direct examination of most of the cartilage and soft tissues of the joint and biopsy of intra-articular lesions.<sup>3</sup> Structures that can routinely be examined include all cartilage surfaces of the joint with the exception of the ventromedial aspect of the femoral head, the ligament of the femoral head, the transverse acetabular ligament, the acetabular labrum, and the interior surface of the joint capsule. Arthroscopy has been used to grade severity of articular cartilage damage in humans for many years, and numerous grading scales have been used. Ultimately, all of these scales are subjective and dependent

on observer variation. Judgment of chondromalacia may be particularly difficult, as it is dependent on the instrument used for palpation and the pressure applied by the evaluator.

In previous studies,<sup>8-10</sup> results of arthroscopy of the hip joint in humans have been compared with radiographic findings. In 1 study,<sup>8</sup> 32% of 186 patients with radiographically normal hips had arthroscopically detectable chondral damage. In another study,<sup>10</sup> 76% of 94 patients with chronic refractory hip pain in which results of radiography were negative had arthroscopically evident lesions that were thought to be clinically important. Similarly, 2 previous studies<sup>11,12</sup> compared results of arthroscopy and radiography of the elbow and hock joints in dogs. Results of these studies similarly suggested that radiography may fail to demonstrate joint lesions that are identified arthroscopically.

Intra-articular lesions identified in the present study were similar to those identified in a previous study<sup>13</sup> of gross lesions in juvenile dogs with hip dysplasia. Cartilage damage around the insertion of the ligament of the femoral head and along the acetabular labrum is common in early hip dysplasia, as is fibrillation and rupture of the ligament. As these were the most common lesions in the present study and this previous study, future investigations should focus on the prognostic importance of these lesions. Of particular interest in the present study was the damage to the acetabular labrum. Labral tears have been infrequently reported in the veterinary literature but are a common source of pain in humans with hip joint disease and may represent an early source of pain in juvenile dogs with hip dysplasia.<sup>14</sup> The clinical importance of these soft tissue lesions in dogs is uncertain, as is the frequency of these lesions in joints that are not clinically affected. Additional studies are needed to document cartilage and soft tissue lesions in the hip joints of clinically normal dogs with or without radiographic changes.

Results of the present study suggest that arthroscopy is a better method than radiography for the identification

of cartilage lesions in juvenile dogs with clinical signs of hip dysplasia. However, whether arthroscopically apparent lesions are a prognostic factor in the outcome of TPO has not been determined and doing so would likely require long-term clinical studies. Until such studies are available, veterinary surgeons must rely on their experience when deciding whether arthroscopic findings can be used to determine if individual dogs are suitable candidates for TPO.

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