**Short-term and long-term outcomes for overweight dogs with cranial cruciate ligament rupture treated surgically or nonsurgically**

Katja L. Wucherer, DVM; Michael G. Conzemius, DVM, PhD, DACVS; Richard Evans, PhD; Vicki L. Wilke, DVM, PhD, DACVS

**Objective**—To determine short- and long-term rates of successful outcomes of surgical and nonsurgical treatments for overweight dogs with cranial cruciate ligament rupture (CCLR).

**Design**—Prospective, randomized, clinical trial.

**Animals**—40 client-owned overweight dogs with unilateral CCLR.

**Procedures**—Dogs were randomly assigned to nonsurgical (physical therapy, weight loss, and NSAID administration) or surgical (tibial plateau leveling osteotomy) treatment groups; dogs in both groups received the same nonsurgical treatments. Dogs were evaluated immediately before and 6, 12, 24, and 52 weeks after initiation of treatments via owner questionnaires, gait analysis, and dual-energy x-ray absorptiometry. A successful outcome was defined as an affected limb net ground reaction force > 85% of the value for healthy dogs and a ≥10% improvement in values of questionnaire variables.

**Results**—Owner questionnaire responses indicated dogs in both groups improved during the study, but dogs in the surgical treatment group seemed to have greater improvement. Body fat percentages for dogs in both treatment groups significantly decreased during the study. Surgical treatment group dogs had significantly higher peak vertical force for affected limbs versus nonsurgical treatment group dogs at the 24- and 52-week evaluation times. Surgical treatment group dogs had a higher probability of a successful outcome (67.7%, 92.6%, and 75.0% for 12-, 24-, and 52-week evaluations, respectively) versus nonsurgical treatment group dogs (47.1%, 33.3%, and 63.6% for 12-, 24-, and 52-week evaluations, respectively). Surgical treatment group dogs had significantly higher peak vertical force for affected limbs versus nonsurgical treatment group dogs at the 24- and 52-week evaluation times. Surgical treatment group dogs had a higher probability of a successful outcome (67.7%, 92.6%, and 75.0% for 12-, 24-, and 52-week evaluations, respectively) versus nonsurgical treatment group dogs (47.1%, 33.3%, and 63.6% for 12-, 24-, and 52-week evaluations, respectively).

**Conclusions and Clinical Relevance**—Overweight dogs with CCLR treated via surgical and nonsurgical methods had better outcomes than dogs treated via nonsurgical methods alone. However, almost two-thirds of the dogs in the nonsurgical treatment group had a successful outcome at the 52-week evaluation time. (J Am Vet Med Assoc 2013;242:1364–1372)

**Abbreviations**

ACL Anterior cruciate ligament  
BCS Body condition score  
CBPI Canine brief pain inventory  
CCLR Cranial cruciate ligament rupture  
DEXA Dual-energy x-ray absorptiometry  
GRF Ground reaction force  
PVF Peak vertical force  
TPLO Tibial plateau leveling osteotomy  
VAS Visual analogue scale  
VI Vertical impulse

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Craniac cruciate ligament rupture is the most common cause of hind limb lameness in dogs, and billions of dollars are spent each year by pet owners to manage the problem. Veterinarians have typically believed that CCLR in dogs is best managed surgically. However, the belief that surgery is superior to nonsurgical management alone for the treatment of CCLR in dogs was made on the basis of results of 2 retrospective studies. In both of those studies, a smaller percentage of heavy dogs (>15 kg [33 lb]) treated via nonsurgical management alone had a successful outcome, compared with the percentage of light dogs with a successful outcome treated via that method. However, standardized patient management methods and objective outcome measures were not used in those studies. Another limitation of both of those studies is the retrospective study design; therefore, the results should be interpreted cautiously. Results of a meta-analysis study indicated that published scientific evidence does not support the theory that surgery is superior to nonsurgical management for the treatment of humans with ACL injuries. The authors of that meta-analysis study identified only 2 randomized clinical trials (both conducted in the 1980s) in which those 2 treatment options were compared, and both of those studies were considered to have poor methodology and randomization bias; results of those studies did not indicate that surgical management was superior to nonsurgical management regarding functional outcomes of patients. Despite differences between ACL injury in humans and CCLR in dogs,
these findings suggest that investigation of the efficacy of nonsurgical treatment of CCLR in dogs is warranted. Nonsurgical treatments for dogs with CCLR are intended to improve patient comfort and limb function. Reduction of body weight, administration of NSAIDs, and physical rehabilitation improve clinical signs of CCLR in dogs.\textsuperscript{6,9} Results of another study\textsuperscript{7} indicate weight reduction (decrease in body weight of at least 11%) alone improves limb function in dogs with osteoarthritis of a hip joint. Reduction of body weight via control of food intake improves clinical and radiographic signs of hip joint osteoarthritis in dogs predisposed to hip dysplasia.\textsuperscript{8} Nonsteroidal anti-inflammatory drugs (eg, deracoxib) are commonly used for the treatment of dogs with orthopedic disease, and results of other studies\textsuperscript{9,10} indicate such drugs improve function and quality of life for dogs with acute or chronic joint disease. In addition, physical rehabilitation improves limb function for dogs with lameness attributable to CCLR.\textsuperscript{11,12}

The objective of the study reported here was to use objective and subjective outcome measures of lameness and quality of life to determine short- and long-term rates of successful outcomes of surgical and nonsurgical treatments or nonsurgical treatments alone for overweight dogs with unilateral CCLR. We hypothesized that dogs that had both surgical and nonsurgical treatments would have better outcomes, compared with dogs that had nonsurgical treatments alone.

**Materials and Methods**

This study was approved by the Institutional Animal Care and Use Committee of the University of Minnesota, and informed client consent was obtained for each dog included in the study. Client-owned dogs \((n = 40)\) referred to our institution because of unilateral hind limb lameness attributable to CCLR were included in the study. The dogs were evaluated by 1 of 3 investigators (KLW, MGC, and VLW) and were determined to be overweight (BCS, \(\geq 6/9\)), otherwise healthy (on the basis of results of physical examination and laboratory analyses of blood samples), and without clinically relevant orthopedic disease other than unilateral CCLR. Nonsurgical and surgical treatment options for CCLR were discussed with owners of the dogs. For inclusion of a dog in the study, the owner had to agree to random assignment of their dog to receive nonsurgical treatment alone (nonsurgical treatment group; \(n = 20)\) or both surgical and nonsurgical treatment (surgical treatment group; 20). Additional inclusion criteria for dogs were a body weight \(> 20\) kg (44 lb), no treatment with an NSAID during the preceding 7 days, no treatment with a corticosteroid during the preceding 4 weeks, and no previous stifle joint surgery. Randomization was performed via drawing group assignments out of a hat.

Outcome measures for dogs were determined before initiation of treatments (day 0) and 6, 12, 24, and 52 weeks after the start of the study; for the 52-week evaluation time, dogs were evaluated between 50 and 54 weeks after the start of the study. For dogs in the nonsurgical treatment group, day 0 was defined as the day before the first treatment, and for dogs in the surgical treatment group, day 0 was defined as the day prior to surgery. Owners and investigators were aware of treatment group assignments for dogs.

**Subjective outcome measures**—Owners completed 2 questionnaires (the CBPI\textsuperscript{10,13} and the canine movement assessment VAS\textsuperscript{14}) at each outcome measure time. The CBPI and VAS are both validated questionnaires for determination of owner perceptions of animal comfort and amount of activity.

At each outcome measure time, one of the investigators (VLW) assessed lameness in each dog by use of a VAS and numeric rating scale (0 [no visible lameness] to 4 [no weight bearing on the affected limb]).\textsuperscript{15} This assessment was performed during force platform gait analysis. A lameness assessment was performed after force platform gait analysis via determination of signs of joint pain (0 [no signs of pain during palpation of an affected joint] to 4 [dog does not permit examiner to palpate the joint]). During assessment of signs of joint pain, the examiner applied digital pressure to the joint at a location slightly medial to the patellar tendon. The amount of cranial drawer motion detected during physical examination was reported as the maximum distance the tibia was advanced cranially in relation to the femur during manipulation of stifle joints in unsedated dogs that were in lateral recumbency.

Lateral and craniocaudal radiographic images of stifle joints were obtained on day 0 (dogs in both treatment groups) and during 6- and 12-week recheck examinations (only dogs in the surgical treatment group). Day 1 radiographic images were used for assessment of stifle joint effusion and osteoarthritis. Subsequent radiographic images (only dogs in the surgical treatment group) were evaluated to assess healing of osteotomies and implant integrity. Osteotomy sites were graded as healed (bridging osteosynthesis with no or minimal evidence of an osteotomy), not healed with stable implants, or not healed with loosening of implants. Complications were also recorded.

For each dog, a BCS was determined at each evaluation time. Body condition scores were determined with a 9-point scoring system by 1 of 2 investigators (KLW or VLW).

**Objective outcome measures**—Body weight was determined at each evaluation time for each dog with the same digital scale.\textsuperscript{2} For each dog, DEXA was performed by use of a densitometer\textsuperscript{6} on day 0 and 12 and 24 weeks after the start of the study. Dogs were sedated with dexmedetomidine\textsuperscript{6} (0.4 µg/kg [0.18 µg/lb], IV) and hydromorphone\textsuperscript{4} (0.1 mg/kg [0.045 mg/lb], IV) and positioned in sternal recumbency with their hind limbs extended. Images for the first DEXA scan during which a dog did not move were evaluated for analysis. Body fat percentage and lean muscle mass were calculated for each dog by use of DEXA images via selection of a region of interest that included the dog’s entire body.

Ground reaction forces were measured with a force platform\textsuperscript{2} at each evaluation time. Ground reaction forces were determined for the first 5 valid trials for both hind limbs at a walk (1.0 to 1.3 m/s; acceleration, \(\pm 0.5\) m/s/s). The GRFs determined as outcome measures included PVF and VI; values were normalized to...
trial stance times and patient body weights. For each trial, net GRF was calculated by use of the following equation: Net GRF = (PVF/42.55) + (VI/14.09). The constant values for that equation were obtained from the results of another study, in which PVF and VI were determined for clinically normal dogs that walked at the same velocity and acceleration as dogs of the present study. Net GRF was calculated because a velocity range was used during force platform analysis of dogs in this study; values of PVF and VI change inversely with changes in velocity, values of PVF and VI have been determined via various methods in other studies, and PVF and VI are not independent. A net GRF value of 2.0 indicates clinically normal limb function. Hind limb lengths of CCLR-affected and unaffected limbs were determined for each dog via measurement of the distance from the floor to the greater trochanter while dogs were standing; this variable was determined for assessment of differences in heights of dogs between groups.

Treatment—Dogs in the nonsurgical treatment group received NSAIDs each day, were started on a weight loss program, and underwent supervised physical therapy during the first 12 weeks of the study. Dogs in the surgical treatment group received those same treatments and underwent a TPLO procedure for the CCLR-affected limb on day 1 of the study. For dogs in the surgical treatment group, administration of NSAIDs and initiation of the weight loss program were started on day 0 of the study and supervised physical therapy was started on day 14 of the study; dogs in the surgical treatment group received these treatments for 12 weeks. At the end of the standardized treatment period, owners of dogs in each treatment group were given similar long-term care instructions that included recommendations regarding body weight management and daily exercise. Dogs were excluded from analysis if they developed neurologic or orthopedic diseases or a treatment complication that required surgical intervention during the study period or if the owner withdrew the dog from the study. Data collected prior to development of these exclusion criteria were included in the data analysis.

Nonsteroidal anti-inflammatory drug treatment consisted of administration of deracoxib (1 to 2 mg/kg [0.45 to 0.9 mg/lb], PO) once per day for 12 weeks. Adverse events in dogs detected during the study period that were attributable to deracoxib administration were recorded and reported to the manufacturer.

The weight loss program was designed to achieve a 0.5% to 2% reduction in body weight of dogs per week. Owners were instructed to feed their dogs an amount of a prescription weight loss diet (dry food, canned food, or both) equal to 80% of the resting energy requirement. Food for the dogs was provided to owners at no cost to encourage use of the prescribed diet. The amount of calories fed to dogs was adjusted as needed on the basis of body weights determined at each evaluation time.

An initial physical therapy evaluation at the start of the study and a minimum of 6 supervised physical therapy sessions at our institution were required for all dogs included in the study. The physical therapy sessions were individually designed for each dog; these sessions typically included hydrotherapy (ie, underwater treadmill exercise) and exercises intended to improve flexibility, strength, balance, and proprioception of dogs. Owners were also advised regarding a home exercise program for their dogs. Dogs in the surgical treatment group did not undergo initial physical therapy evaluation and did not start the supervised physical therapy sessions until 2 weeks after surgery.

All TPLO surgeries for dogs in the surgical treatment group were performed by a board-certified veterinary surgeon or a surgical resident under the direct supervision of a board-certified veterinary surgeon. Stifle joints of dogs were evaluated via a medial parapatellar arthrotomy approach or arthroscopy. If meniscal damage was detected, a partial meniscectomy was performed. If such damage was not detected, menisci were left intact or a medial meniscal release was performed (at the surgeon’s discretion). A standard TPLO procedure was performed for CCLR-affected limbs immediately following surgical evaluation of a stifle joint.

Statistical analysis—Summary statistics were used to verify data quality and distributional assumptions for statistical analyses. For repeated-measures interval data (eg, PVF), multivariate ANOVA was performed to determine group, time, and group by time interactions controlled for baseline (day 0) values. If a group by time interaction was significant, a cross-sectional analysis was performed to determine group effects at each evaluation time. Results were evaluated as a binary variable. The first variable was whether the net GRF value was > 85% of the value for clinically normal dogs (1.70). The second variable was whether the owner questionnaire responses regarding lameness and quality of life of dogs indicated an improvement of ≥ 10% for postintervention responses, compared with preintervention responses (determined for evaluations performed 12, 24, and 52 weeks after the start of the study). A successful outcome was determined when both of these conditions were true for an evaluation time. The treatment groups were compared regarding successful outcomes via a Fisher exact test. For all analyses, values of P < 0.05 were considered significant. Data for each evaluation time until the end of the study or until exclusion of dogs from the study (because of a major complication, contralateral cranial cruciate ligament damage, or loss to follow-up) were evaluated for each dog.

Results

Forty dogs were enrolled in the study. Fourteen dogs developed additional orthopedic diseases during the study period; data for these dogs were included in statistical analyses for evaluation times before they were excluded from the study. Five dogs were excluded 6 weeks after enrollment in the study because of contralateral CCLR (3 dogs in the nonsurgical treatment group and 1 dog in the surgical treatment group) or fracture of a femur (1 dog in the surgical treatment group). Six dogs were excluded 24 weeks after enrollment in the study because of contralateral CCLR (2 dogs in the nonsurgical treatment group and 3 dogs in the surgical treatment group) or infection associated with a TPLO plate and subsequent plate removal.
(1 dog in the surgical treatment group). Six dogs were excluded 52 weeks after enrollment because of contralateral CCLR (1 dog in the nonsurgical treatment group and 1 dog in the surgical treatment group), unrelated orthopedic disease (1 dog in the nonsurgical treatment group), death unrelated to CCLR (1 dog in the nonsurgical treatment group), or loss to follow-up (1 dog in the nonsurgical treatment group and 1 dog in the surgical treatment group). Therefore, data were available for 35 dogs at the 6- and 12-week evaluation times, 29 dogs at the 24-week evaluation time, and 23 dogs at the 52-week evaluation time. Contralateral CCLR was the most common cause for exclusion of dogs from the study (11/40 [27.5%] dogs [6 dogs in the nonsurgical treatment group and 5 dogs in the surgical treatment group]).

Nineteen spayed female dogs (10 in the nonsurgical treatment group and 9 in the surgical treatment group) and 21 neutered male dogs (9 in the nonsurgical treatment group and 12 in the surgical treatment group) were enrolled in the study; no significant differences were detected between groups regarding sex of dogs. The mean ± SD age of dogs in the nonsurgical and surgical treatment groups at time of their initial evaluations was 5.53 ± 0.45 years and 5.26 ± 0.46 years, respectively; no significant differences were detected between groups regarding age of dogs. The mean duration of CCLR before enrollment of dogs in the study for the nonsurgical and surgical treatment groups was 3.65 ± 1.59 months and 4.76 ± 1.54 months, respectively; no significant differences were detected between groups regarding duration of injury. The most common breeds of dogs in the study were Labrador Retriever or Labrador Retriever cross (n = 11), American Staffordshire Terrier (3), and Rottweiler (3); the rest of the dogs in the study were of various other breeds. The left hind limb was affected with CCLR in 26 dogs, and the right hind limb was affected with CCLR in 14 dogs.

Complications and adverse events—No adverse events were reported that were attributed to feeding of the prescription diet or administration of deracoxib to dogs in either treatment group. The initial physical therapy evaluation and 6 physical therapy sessions were completed by all dogs in both treatment groups.

Crural cruciate ligament rupture in dogs from the surgical treatment group was confirmed via stifle joint arthroscopy (n = 10) or arthroscopy (10). The medial meniscus was intact in stifle joints of 13 (65%) dogs and torn in stifle joints of 7 (35%) dogs. A partial medial meniscectomy was performed for all dogs with a medial meniscus tear. A medial meniscus release was performed for 5 of the 13 dogs with intact menisci. A standard TPLO procedure was performed in the CCLR-affected limb for all dogs in the surgical treatment group. Radiography performed during the 12-week recheck examination indicated complete healing of osteotomies for 16 of 18 dogs and incomplete healing with stable implants for 2 of 18 dogs evaluated at that time. Three dogs developed mild complications associated with surgery, including patellar tendinitis (n = 2), tibial tuberosity fracture (1), a broken screw (1), and infection (2; some dogs developed more than one complication).

Subjective outcome measures—No differences in CBPI or VAS scores were detected between groups prior to treatment. Mean scores for questions in CBPI and VAS owner questionnaires typically improved at each evaluation time for dogs in both groups. Of the various CBPI assessment scores (pain severity, pain interference, and overall quality of life scores), pain severity and interference scores improved significantly (ie, scores decreased) for dogs in both treatment groups between each evaluation time; the greatest improvement in scores was detected between the initial (day 0) and 6-week evaluation times (Figure 1). A significant difference in pain interference and severity scores was detected between treatment groups only for the 52-week evaluation time; at that time, dogs in the surgical treatment group had significantly lower (ie, lower scores than dogs in the nonsurgical treatment group. Overall, 90% of owners indicated that their dog had a good to excellent quality of life 52 weeks after enrollment in the study, but the surgical management group had a higher

![Figure 1](image-url)
proportion of dogs with an indicated good to excellent quality of life (63%), compared with the nonsurgical management group (35%).

Significant improvements over time were detected for dogs in both groups during the study for 7 movement assessment VAS measures. Significant differences were detected between treatment groups during the 12-month study for 4 movement assessment VAS measures; dogs in the surgical treatment group had greater improvements in VAS measures during the study versus dogs in the nonsurgical treatment group. Significant differences in time by group interactions were detected between treatment groups for 5 VAS measures; dogs in the surgical treatment group had greater improvements in these measures during the study versus dogs in the nonsurgical treatment group.

Investigator-assigned lameness and pain scores (determined by use of a VAS and a numeric grading scale) significantly decreased during the study for dogs in both treatment groups, but no significant differences were detected between groups. No significant differences in cranial drawer motion were found during the study between treatment groups. Additionally, no significant differences in preoperative lameness grades that did or did not have a meniscal tear.

Objective outcome measures—Dogs in the nonsurgical treatment group had a mean ± SD initial body weight of 39.10 ± 3.96 kg (86.02 ± 7.61 lb; range, 20.1 to 70.4 kg [44.2 to 154.9 lb]) and a 12-week evaluation mean ± SD body weight of 35.72 ± 3.26 kg (78.58 ± 7.17 lb; range, 17.2 to 67.3 kg [37.8 to 148.1 lb]). Dogs in the surgical treatment group had a mean ± SD initial body weight of 36.18 ± 2.31 kg (79.60 ± 5.08 lb; range, 16.7 to 52.5 kg [36.7 to 115.5 lb]) and a mean ± SD 12-week evaluation body weight of 32.08 ± 2.11 kg (70.58 ± 4.64 lb; range, 14.0 to 47.3 kg [30.8 to 104.5 lb]; Figure 2). The mean weekly decrease in body weight during the study, which was planned to be 0.5% to 2% of a dog's body weight/wk, was 0.83% of body weight/wk for all dogs in the study. Although the mean percentage of body weight lost by dogs during the first 12 weeks of the study was >10%, the decrease in body weight was not significant for dogs in either treatment group and no significant differences were detected between treatment groups. Although the dogs were not fed a prescription diet for weight loss after the 12-week evaluation time, dogs in the nonsurgical treatment group had a lower mean ± SD body weight at the 24- and 52-week evaluations (32.37 ± 2.80 kg [71.21 ± 6.16 lb] and 33.18 ± 2.72 kg [73.00 ± 5.98 lb], respectively) than they did at the 12-week evaluation; however, these values were not significantly different. Dogs in the surgical treatment group seemed to maintain their weights at 24- and 52-week evaluations (31.91 ± 2.44 kg [70.20 ± 5.37 lb] and 31.16 ± 2.74 kg [68.55 ± 6.03 lb], respectively). Dogs in the nonsurgical treatment group had mean ± SD BCSs of 6.74 ± 0.16 (range, 6 to 8; initial [day 0] evaluation), 5.59 ± 0.18 (range, 4.5 to 7.0; 12-week evaluation), 5.43 ± 0.19 (range, 5.0 to 7.0; 24-week evaluation), and 6.21 ± 0.29 (range, 5.5 to 8.0; 52-week evaluation). Dogs in the surgical treatment group had mean ± SD BCSs of 6.97 ± 0.14 (range, 6 to 8; initial evaluation), 5.5 ± 0.2 (range, 5 to 8; 12-week evaluation), 5.54 ± 0.20 (range, 4.5 to 7.0; 24-week evaluation), and 6.0 ± 0.27 (range, 5.0 to 8.0; 52-week evaluation). Body condition scores were not significantly different between groups at any time; however, the mean BCS score for each group of dogs was significantly lower at the time of the 12-week evaluation than it was at the time of the initial evaluation.

A significant decrease in body fat percentage (measured via DEXA) was detected for dogs in both groups between the initial and 12-week evaluations (6.21% and 5.95% decrease in body fat percentage for dogs in the nonsurgical and surgical treatment groups, respectively) and between the initial and 24-week evaluations (8.45% and 8.61% decrease in body fat percentage for dogs in the nonsurgical and surgical treatment groups, respectively; Figure 3). However, no significant differences in percentage body fat reduction were detected between treatment groups at any time. No significant changes in whole-body lean tissue mass were detected for dogs in either treatment group during the study, and no significant differences in that variable were detected between groups at any evaluation time. The overall decreases in percentage lean tissue mass for dogs in the surgical and nonsurgical treatment groups during the study were 2.67% and 0.38%, respectively.
No significant differences were detected between treatment groups during the study for either mean hind limb length or velocity and acceleration (as measured during gait analysis). Peak vertical force increased during the study for dogs in both treatment groups, but results were not significant. Dogs in the surgical treatment group had a significantly higher mean PVF at 24 and 52 weeks after the start of the study, compared with dogs in the nonsurgical treatment group (Figure 4). Vertical impulse significantly increased during the study for dogs in both treatment groups; no significant differences in mean VI were detected between treatment groups at any time during the study (Figure 5). Net GRF of CCLR-affected limbs significantly increased during the study for dogs in both treatment groups (Figure 6); no significant differences were detected in mean net GRF between treatment groups at any time during the study. The ratio of the net GRF of the CCLR-affected limb to the net GRF of the contralateral (unaffected) limb significantly increased during the study for dogs in both treatment groups. For dogs in the nonsurgical treatment group, the ratio of the net GRF of the CCLR-affected hind limb to the net GRF of the unaffected contralateral hind limb increased from 55.7% at the time of the initial evaluation to 84.5% at the time of the 52-week evaluation; for dogs in the surgical treatment group, the value of that variable increased from 55.6% at the time of the initial evaluation to 87.7% at the time of the 52-week evaluation (Figure 7).

Successful outcomes—A successful outcome for a dog was defined as a net GRF that was >85% of the value for a clinically normal dog (ie, >1.70) with owner questionnaire responses that indicated an improvement of ≥10% in lameness and quality of life scores between pre- and postintervention questionnaires. This evaluation was performed at each evaluation time; thus, a dog could change from a status of having a successful outcome to a status of having an unsuccessful outcome or vice versa. At each evaluation time, a higher percentage of dogs in the surgical treatment group had a successful outcome, compared with dogs in the nonsurgical treatment group; this difference was significant only at the 24-week evaluation time. The percentage of dogs in the nonsurgical treatment group with a successful outcome was 47.1%, 33.3%, and 63.6% at 12, 24, and 52 weeks after enrollment in the study, respectively. The percentage of dogs in the surgical treatment group with a successful outcome was 74.7%, 66.7%, and 88.5% at 12, 24, and 52 weeks after enrollment in the study, respectively.
outcome was 67.7%, 92.6%, and 75.0% at 12, 24, and 52 weeks after enrollment in the study, respectively.

**Discussion**

In the present study, overweight medium- and large-breed dogs with unilateral CCLR treated via surgical (TPLO) and nonsurgical (feeding of a weight loss diet, administration of NSAIDs, and performance of physical therapy) methods had better overall outcomes, compared with dogs that were treated via nonsurgical methods alone. This conclusion was supported by our findings that dogs in the surgical treatment group had greater improvements in owner questionnaire responses and PVF values and higher probabilities of successful outcomes versus dogs in the nonsurgical treatment group. Thus, we accepted our hypothesis that CCLR-affected dogs treated via surgical and nonsurgical methods had better outcomes, compared with dogs treated via nonsurgical methods alone.

However, dogs in the surgical treatment group did not have better outcomes for all variables versus dogs in the nonsurgical treatment group. Dogs in the nonsurgical treatment group had better outcomes than has been reported for other CCLR-affected dogs managed nonsurgically. These differences between results of the present study and results of those other studies were not surprising because those other studies had a retrospective design and dogs that did not undergo surgery in those studies were not actively treated. Dogs in the nonsurgical treatment group had improvements in owner survey scores, veterinary examination scores, and GRF concentrations in the present study; such data may influence of adipose tissue on inflammation of cartilage is likely multifactorial, and adipokines likely have a role in progression of osteoarthritis. For example, adipokines such as leptin may influence chondrocyte responsiveness to inflammation and upregulate matrix metalloprotease expression in human chondrocytes. We did not measure serum or synovial fluid adipokine concentrations in the present study; such data may have supported results of the study.

We did not detect an unexpected number of dogs with complications after surgery in the present study. Osteotomy sites in dogs seemed to heal within an expected time frame, and the complication rate of dogs in this study was similar to the complication rates of dogs after TPLO in other studies. A torn medial meniscus was found at the time of surgery in 7 of the 20 (35%) dogs in the surgical treatment group, which was similar to findings of another study. Arthroscopy was performed for only 50% of the dogs in the surgical treatment group of the present study; arthroscopy is more sensitive than arthrotomy for the diagnosis of meniscal injury. We did not control the surgical methods (eg, arthrotomy vs arthroscopy and meniscal release vs no meniscal release) performed by clinicians other than the method used for stifle joint stabilization (TPLO) because we did not want surgeons to perform procedures with which they were uncomfortable; decisions regarding the correct surgical methods for treatment of CCLR typically involve consultation with owners and are controversial. We wanted management of dogs with CCLR in the present study to be consistent with our typical management of such dogs. In addition, no adverse events attributable to administration of deracoxib for 12 consecutive weeks were detected in dogs of this study, including complications associated with healing of osteotomy sites. Although we did not statistically evaluate healing times of dogs in the surgical management group of this study, data suggested TPLO osteoarthritis.
otomies sites healed within a typical period, even though dogs were treated daily with NSAIDs. This finding of the present study was different from findings of another study30 that indicate NSAID administration to dogs delays healing of tibial osteotomies. Owners of dogs in the present study were aware that adverse events should be reported to the investigators; however, we did not provide a daily diary in which owners were asked to record observations regarding clinical signs potentially attributable to adverse events. Dogs received NSAIDs perioperatively in this study because use of such drugs is common, and dogs recovering from cranial cruciate ligament surgery benefit from early use of NSAIDs.31

Results of other studies31,32 indicate the benefits of physical therapy for dogs after surgery for treatment of CCLR. It seemed reasonable that CCLR-affected dogs would benefit from physical therapy whether they did or did not undergo surgery. However, physical therapy may have greater benefits for some CCLR-affected dogs than it has for others; such dogs might be better candidates for nonsurgical treatment alone. Furthermore, although we tried to limit variability in physical therapy by having the same person treat all dogs in the study, rehabilitation procedures were not standardized. Because the CCLR recovery rate differs among dogs, we believed standardization of physical therapy procedures was contraindicated. Dogs were assigned to treatment groups in the present study by use of a randomization procedure. This method was used so that investigators could not bias groups by trying to identify copers of instability (ie, patients with CCLR that overcome or tolerate passive laxity [measured by use of a cranial drawer test] and successfully resume preinjury amounts of activity without surgical intervention) and allocate such dogs to the nonsurgical treatment group.30

Other authors30 have suggested results of tests to determine muscle strength can be used to identify humans with ACL injury who are copers of instability prior to surgical intervention. If similar tests were available for dogs, identification of such dogs might be possible; nonsurgical treatment of such dogs with CCLR might be indicated. An objective of the physical therapy program for dogs of the present study was to increase caudal thigh muscle (biceps femoris, semitendinosus, and semimembranosus muscles) strength because those muscles are secondary stabilizers of ACL-deficient knee joints in humans.30 Results of another study31 indicate that 56% of maximal caudal thigh muscle force can eliminate abnormal amounts of anterior tibial translation in a human with an ACL-deficient knee joint.

Results of the present study suggested that overweight dogs with CCLR have better outcomes when treated via surgical and nonsurgical methods, compared with dogs treated via nonsurgical methods alone. However, overweight medium- and large-breed dogs with CCLR treated via nonsurgical methods alone in this study typically had improvements in limb function, and almost two-thirds of such dogs had a successful outcome 1 year after the start of the study.

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**From this month’s AJVR**

**Fecal calprotectin concentrations in adult dogs with chronic diarrhea**

Aurélien Grellet et al

**Objective**—To evaluate fecal calprotectin concentrations in healthy dogs and dogs with chronic diarrhea, to identify cutoff values for fecal calprotectin concentrations for use in differentiating dogs with chronic diarrhea and a canine chronic enteropathy clinical activity index (CCECAI) < 12 from dogs with chronic diarrhea and a CCECAI ≥ 12, and to evaluate the association between histologic evidence of intestinal mucosal changes and fecal calprotectin concentrations in dogs with chronic diarrhea.

**Sample**—Fecal samples from 96 adult dogs (27 dogs with chronic diarrhea and 69 healthy control dogs).

**Procedures**—Severity of clinical signs was evaluated on the basis of the CCECAI scoring system. Endoscopy was performed in all dogs with chronic diarrhea, and mucosal biopsy specimens were evaluated histologically. Fecal calprotectin concentration was quantified via radioimmunoassay.

**Results**—Fecal calprotectin concentrations were significantly higher in dogs with chronic diarrhea than in healthy control dogs. Fecal calprotectin concentrations were also significantly higher in dogs with a CCECAI ≥ 12, compared with concentrations for dogs with a CCECAI between 4 and 11. Fecal calprotectin concentrations were significantly higher in dogs with chronic diarrhea associated with histologic lesions, compared with concentrations in control dogs, and were significantly correlated with the severity of histologic intestinal lesions. Among dogs with chronic diarrhea, the best cutoff fecal calprotectin concentration for predicting a CCECAI ≥ 12 was 48.9 mg/g (sensitivity, 53.3%; specificity, 91.7%).

**Conclusions and Clinical Relevance**—Fecal calprotectin may be a useful biomarker in dogs with chronic diarrhea, especially dogs with histologic lesions. ([Am J Vet Res 2013;74:706–711])

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