Cranial cruciate ligament disease (CCLD) is one of the most prevalent orthopedic problems in dogs, affecting 3% to 5% of dogs, causing stifle instability, mobility dysfunction, and pain. The objective of this study was to evaluate the American Kennel Club field trial community's knowledge of CCLD and estimate its perceived prevalence within this population.

**SAMPLE**
401 field trial participants responded, with 701 field trial canines reported.

**METHODS**
A survey instrument was emailed to a population of Retriever field trial participants to collect information on perceptions and experience with CCLD and current canine participants. Analyses included descriptive statistics, multiple logistic regression, and $\chi^2$ tests (significant at $P < .05$).

**RESULTS**
The majority of respondents appropriately identified the connection between genetics and CCLD (69%). There was under-recognition (6%) of the degenerative nature of the disease, with 61% inappropriately identifying trauma as the major cause. Respondents also indicated that a CCLD diagnosis in a dog's sibling or offspring affected their breeding decisions less than a diagnosis in their parents, indicating a misunderstanding of genetics. More than half of respondents indicated prior experiences with CCLD. The reported occurrence of CCLD was found to be 12% (72/610) in field trial Labrador Retrievers.

**CLINICAL RELEVANCE**
There is a lack of knowledge in the field trial community regarding CCLD. This population showed a higher owner-perceived occurrence of CCLD compared to data collected from medical records. Further investigation is warranted to validate the true prevalence of CCLD in field trial Retrievers.
researchers agreeing that an increased body condition score leads to added weight putting more strain on the ligament and that the excess adipose with its proinflammatory nature may increase the rate of inflammation and degeneration.\textsuperscript{9,11,12} In addition, spay/neuter status has been noted to have a correlation with an increased incidence of CCLD, with castrated dogs more often affected, though the precise mechanisms are unknown at this time.\textsuperscript{5,11,12} Another potentially significant cause of CCLD is a genetic factor. Prevalence of this condition has been reported to be 2.6% in the US, from a study\textsuperscript{13} looking at over 1,000,000 dogs between 1964 and 2003. Various studies have demonstrated an increased incidence of CCLD in breeds such as the Newfoundland, Labrador Retriever, and Rottweiler, especially when compared to other breeds such as the Greyhound that seem to be less affected.\textsuperscript{7,11} In Labrador Retrievers, the prevalence of CCLD has been shown to be 5.8%.\textsuperscript{11} The number of affected dogs appears to be on the rise, either because of increasing awareness or prevalence.\textsuperscript{5,11,13,14}

Labrador Retrievers make up the majority of the competitor base of field trials, though other breeds do participate, making them a perfect group to examine to determine the effects of CCLD on a more genetically limited population of dogs. Labs have higher instances of bilateral CCL rupture than other breeds of dogs (up to 50%) as well, making them a good population to examine.\textsuperscript{9,15} Therefore, the aim of this study was to look at a large population of primarily working field trial Labrador Retrievers and determine the perceived prevalence and impact of this disease in this community. We hypothesized that there would be a higher reported occurrence of CCLD in field trial Retrievers than what has been reported in the medical record data of the general population of Labrador Retrievers. In addition, we predicted that field trial participants would inappropriately identify causes for CCLD. Finally, we hypothesized that field trial participants would decide to breed a dog even if they have CCLD in their pedigree. Understanding the impact of this condition on the dogs in the field trial community can help guide prevention and treatment.

Methods

This study was reviewed and approved by the Michigan State University Institutional Review Board for human subjects (STUDY0004778). The protocol was submitted to the animal care and use committee and given exempt status indicating that no review was needed because animals were not directly tested in this survey study.

Study design

A survey instrument was written (Supplementary Material S1), with some guidance from a previous study\textsuperscript{16} developed to examine the rate of return to sport postinjury in agility dogs. The purpose of the survey was to examine the knowledge and attitudes surrounding CCLD in field trial Retrievers as well as its reported occurrence.\textsuperscript{16} As part of the validation process, the survey was sent out to a small group of people involved in the sport of field trials, as well as a few fellow researchers, to test for any errors within the program and gather suggested changes to question wording. The survey was refined on the basis of their feedback and submitted to our Institutional Review Board for approval before being sent out to the target population. The survey opened on July 20, 2020, and closed on September 12, 2020. Reminders were sent out at the 2- and 4-week marks.

Survey audience

Retriever News, a popular publication among field sport participants, co-owns the Entry Express database, which is used for competition entry by Retriever field trial participants as well as other field sports. The survey was sent to this database, which contains individuals who are involved in the many different field sports and are handlers, judges, owners, breeders, and trainers. Our inclusion criteria limited analysis to participants involved in Retriever field trials, with no exclusion if dogs participated in other dog sports. The inclusion criteria for specific dog information (diagnosis with CCLD, age, breed, sex, etc) was limited to those who currently own an AKC-registered Retriever intended for field trial training and/or competition. All responses were collected from participants within the US. There was no exclusion included for multiple people answering the survey regarding the same dog.

Survey details

This instrument was developed using the Qualtrics survey system (Qualtrics XM; Qualtrics International Inc), with access granted by our institution. The survey was kept completely anonymous, and respondents were allowed to skip questions by choice to encourage participation. The program settings were enabled to prevent a single respondent from completing the survey more than once, and the survey was organized so that the questions were tailored to each respondent, only asking them questions that applied to their background based on their responses to initial questions. All questions were multiple choice, with some questions allowing multiple answers.

The number of questions in the survey varied on the basis of the respondent’s involvement in field sports and whether they currently owned an AKC-registered Retriever intended for field trial training and trialing. The survey was organized into 3 blocks of questions, the first being field trial participant demographics. This was used to collect information on the participants’ background and their involvement in Retriever field trials, prompting them to select in what capacity they participated in the sport (were they trainers, judges, owners, etc) and for how many years they had been involved. The second section was used to determine their background with CCLD by asking questions such as what they thought may cause the disease and how it may have affected their choices when breeding and purchasing Retrievers, as well as their opinions on its impact on the sport. The third part of the survey was used to collect information about their individual dogs to determine the reported occurrence and impact of this disease on the
population. Some examples of the questions asked included age, weight, sex, and whether they had been diagnosed with CCLD. The survey was designed so that they could enter information about multiple dogs without having to exit the survey program.

Data analysis
After the survey data were collected, descriptive statistics were performed and data were organized using the Qualtrics analysis software (Qualtrics International Inc). All results were included, even if participants did not elect to complete every question prompted, in which case the percentage is given as well as the number of respondents in terms of total respondents as part of the descriptive statistics. Multiple logistic regression was performed looking at variables of breed, sex, age (continuous), and presence of offspring (yes or no; CCLD - intercept + gender + age + has offspring). Other analyses included χ² tests for evaluating return to sport given the leg(s) affected and severity of rupture. The significance for all statistical tests performed was set at a P value of < .05.

Results

Respondent demographics
Information was collected from a total of 407 Retriever field trial participants, with respondents able to skip questions as they desired, and results were calculated individually for each question on the basis of the number of responses to the question, not to the survey as a whole.

Involvement in the sport—There were 401 of 407 (99%) responses; 371 of 401 (93%) considered themselves amateur handlers/trainers, 246 of 401 (61%) owned field trial Retrievers, 229 of 401 (57%) were licensed judges, 24 of 401 (6%) were professional handlers/trainers, and 11 of 401 (3%) were veterinarians. For this question, respondents were allowed to choose > 1 answer (Figure 1).

Years of involvement—There were 396 of 407 (97%) responses; 16 of 396 (4%) had been involved for 3 years or less, 70 of 396 (18%) had been involved for 4 to 8 years, and 310 of 396 (78%) had been involved for 9 years or more.

CCLD perceptions
Causes of CCLD—Out of the total 407 respondents, 360 of 407 (88%) chose to respond to this question. Of that number, 280 of 360 (78%) indicated that genetics were a cause of CCLD, 170 of 360 (48%) noted that weight was a cause, and 148 of 360 (41%) indicated that conformation was a cause. In addition, 34 of 360 (9%) respondents noted a relationship between spay and neuter status and CCLD diagnosis. Finally, 247 of 360 (69%) respondents chose trauma as a cause of CCLD and 93 of 360 (6%) noted it was a degenerative disease. For this question, all respondents were permitted to choose > 1 answer (Figure 2).

Breeding decisions—Out of the total 407 potential respondents, 323 of 407 (79%) responded to this question; 285 of 323 (88%) were less likely to breed their dog if it had been diagnosed with CCLD in both legs, and 260 of 323 (81%) were less likely to breed their dog if they only had CCLD in 1 leg. In addition, 179 of 323 (55%) indicated they would be less inclined to breed a dog if it had produced offspring that were affected, 159 of 323 (49%) indicated they would be less likely to breed their dog if a parent was affected, and 132 of 323 (41%) indicated that they would be less likely to breed their dog if it had a sibling affected. Finally, 37 of 323 (11%) participants noted they would not breed their dog if it had a relative that was not a parent or sibling diagnosed with CCLD. For this question, all respondents were permitted to choose > 1 answer.

Impact on training and trialing—Out of the total 407 respondents, 354 of 407 (87%) responded to this question. Of those that responded, 220 of 354 (62%) indicated that they believe CCLD has a negative impact on a Retriever’s training or trialing ability,
102 of 354 (29%) indicated they believed this was a possibility, and 32 of 354 (9%) indicated that CCLD does not have a negative impact on the Retriever’s training and trialing ability (Figure 3).

![Figure 3](distribution_of_answers.png)

**Figure 3**—Distribution of the answers to the question, “Would you be less likely to breed your dog if ...” with 323 responses out of a total 407 possible.

**Is CCLD an issue in field trials?**—Out of the 407 total respondents, 352 of 407 (87%) chose to respond to this question. Of the respondents, 334 of 352 (95%) believed CCLD to be an issue in this population, and 18 of 352 (5%) believed it was not an issue. Of those who believed CCLD to be an issue, 262 of 334 (78%) agreed that it was a moderate issue, whereas 72 of 334 (22%) believed it is a severe problem. Of the 321 respondents who believed CCLD to be an issue, 154 of 321 (48%) saw CCLD as a worsening problem, 129 of 321 (40%) believed it was of static prevalence in the sport, and 38 of 321 (11%) believed it was starting to become less of an issue.

**Individual dog information**

**General questions**

Individual dog information was collected on 701 dogs, with some respondents not completing every question asked about the dog. Signalment data and presence of offspring are provided (Table 1).

**CCLD-specific questions**

**Diagnosis as reported by client**—The total number of responses was 697 of 701 (99%); 77 (11%) had a positive diagnosis of CCLD, and 620 of 701 (89%) were normal. Data on leg(s) affected, severity of rupture, type of surgery performed, and return to surgery are provided (Table 2). Overall return to sport was 44 of 74 (60%). This number does not account for duration of injury or recovery, or whether their return was successful, just if they had returned at the time of this survey.

**Reported occurrence**

**Breed**—After compiling the collected data on individual dogs, the total reported occurrence of CCLD in this population was found to be 76 of 693 (11%; Table 1). Due to the large portion of data being related to Labrador Retrievers, we calculated the reported occurrence in just Labradors to be 72 of 610 (12%). There was not a significant association between breed and CCLD diagnosis ($P = .99$; 95% CI, 0.8 to 1.2).

**Sex**—Though not significant in the model (all $P > .2$), altered female and male dogs had a higher reported occurrence of CCLD than their intact counterparts (Table 1).

**Age**—When evaluating the dog’s age at the time of a CCLD diagnosis, we found 8 of 233 (3%) were affected in the age range < 1 to 3 years, 24 of 201 (12%) affected from 4 to 6 years of age, and 44 of 259 (17%) affected in the dogs 7 years and older. When

<table>
<thead>
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<th>No CCLD</th>
<th>Row totals</th>
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<tbody>
<tr>
<td>Black Labrador Retriever</td>
<td>59</td>
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<td>536</td>
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<tr>
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<td>4</td>
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<td>16</td>
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<td>62</td>
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<tr>
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</tr>
<tr>
<td>Male intact</td>
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<td>335</td>
<td>370</td>
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<tr>
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<tr>
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<tr>
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<td>177</td>
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</tr>
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<table>
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<tbody>
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<tr>
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<table>
<thead>
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<tr>
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<td>Both limbs</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td></td>
<td></td>
</tr>
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</tr>
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</table>

**Table 1**—Comparison of breed, sex, age, and presence of offspring to cranial cruciate ligament deficiency (CCLD) diagnosis. Age data were a continuous variable, whereas presence or absence of offspring was a categorical variable.

**Table 2**—Comparison of leg affected, severity, and treatment on successful return to sport.

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ES = Extracapsular stabilization. TPLO = Tibial plateau-leveling osteotomy. TTA = Tibial tuberosity advancement.
evaluated as a continuous variable, increasing age was statistically significant in relation to CCLD diagnosis (Table 1; \( P < .001 \); 95% CI, 0.74 to 0.9).

**Offspring**—Of the 71 dogs affected for which the question of whether the dog had offspring was answered (yes or no), 22 of 71 (31%) were found to have offspring, 1 (5%) dog was altered, and the rest remained intact (Table 1). There was not a significant relationship between having offspring and a CCLD diagnosis (\( P = .6; \) 95% CI, 0.6 to 2.1).

**Return to competition**

**Number of legs affected**—Dogs with only 1 leg affected had a significantly decreased chance of returning to competition (Table 2; \( \chi^2 \) statistic of 4.51; \( P \) value of .03).

**Severity of rupture**—The comparison of rupture severity to return to competition was not statistically significant (Table 2; \( \chi^2 \) statistic of 1.02; \( P \) value of .31).

**Type of surgery**—We compared the type of surgery performed as a treatment with return to sport and noted that of the 66 that underwent surgery, 42 of 66 (64%) had returned to the sport at this time. Of those dogs, 39 of 42 (93%) had undergone a tibial plateau leveling osteotomy (Table 2).

**Discussion**

We accepted our hypotheses that there would be a high owner-reported occurrence of CCLD within this population of AKC filed trial Retrievers and that there would be a lack of knowledge within the community regarding CCLD.

The reported occurrence of CCLD in AKC-filed trial Retrievers in our survey was approximately 12%. Though this finding was based on an owner-reported value rather than clinical analysis of medical records like previous studies, it is still much higher than the 2.8% to 4.8% looking at the national population of dogs as a whole. Given that the owner-reported value is so high, it indicates that there may be good reason to conduct a medical record analysis to determine the validity of this value and eliminate the bias of an owner-reported value.

There are studies showing a correlation with Labradors and CCLD-induced ligament rupture, which is consistent with our findings. The reported occurrence of CCLD in this subset of Labrador Retrievers from our study (12%) was much higher than the 5.8% prevalence found in a previous study of Labrador Retrievers. Given that the previous study was conducted using medical records and our data were collected by owner submission, our values are not directly comparable. However, this shows the potential for a vast difference between these athletic Labradors and a population that includes nonworking companion dogs, warranting further confirmation of this value. In addition, a recent study demonstrated a high rate of heritability of cruciate ligament rupture in Labradors, validating a genetic component to CCLD. It is reasonable to suspect that the reported occurrence in this population of Labradors is higher compared to the general population because this is a more limited genetic community. These dogs are bred for a specific purpose with a focus on certain traits, with popular pedigrees being frequently used, which can limit the genetic pool. This was reinforced, as less than half of respondents indicated that they would be less inclined to breed their dog if it had offspring, a parent, or a sibling diagnosed with CCLD, and only a small number considered it a problem if a more distant relative of the dog was diagnosed.

Even though 67% of respondents agreed that CCLD had a genetic component, it was found that 31% of CCLD-affected dogs reported in this survey had contributed offspring to the population at some point in their career. CCLD is often not diagnosed until later in life, so it important to note that we do not know whether these dogs were bred before or after diagnosis, as this was not reported in the survey.

Another difficulty when it comes to managing CCLD within this population is the confusion surrounding what causes CCLD and how it is different from a traumatic CCL rupture. This confusion is highlighted by the fact that out of the total 360 participants that responded to the question on the causes of CCLD, only approximately 25% noted that CCLD is a degenerative disease that occurs over time, while close to 70% attributed the cause of CCLD to trauma. It is possible that the mixed responses are due to issues surrounding the terminology used to describe the disease and how it is distinct from a CCL rupture due to trauma. Moreover, the confusion may occur due to the fact that CCLD occurs slowly over time and people often misinterpret the inciting cause as trauma, as the final rupture may occur during a perceived traumatic event. In addition, other minor contributors to CCLD that are currently under investigation (weight, conformation, and spay/neuter status) were not considered components of the disease by over half of the total respondents. These findings indicate that there is uncertainty and confusion within the community regarding what causes CCLD, which may lead to complications for the future of the sport. There is a consensus within the community that CCLD is an issue within this population, which is promising, as it opens an opportunity for educating the community on the details of CCLD and how to better manage it moving forward.

Another important finding was that a larger portion of dogs that had 1 leg affected had not yet returned to the sport (75%), when compared to dogs with both legs affected (50%). Dogs that have torn 1 ligament are likely to have a contralateral ligament rupture within a year of the first tear. This is likely to be the case in this instance as well, and the increased rate of return to sport following treatment of dogs with bilateral tears is potentially due to different management for a single tear versus a bilateral tear. It is also possible that, because we did not receive information on the timing of the rupture compared to the return to sport, those with a single tear simply hadn’t had the same recovery time as those with a bilateral tear.
Our study in field trial dogs was consistent with previous studies noting age to be positively correlated with CCLD. The connection between sex and CCLD diagnosis has been noted in the past. Although not statistically significant in this study, our client-reported results remain consistent with previous findings, which indicated that altered dogs have a higher reported occurrence of CCLD than those left intact. It is unclear why sex was not significant in the present study.

Limitations for this study included survey bias, as interested individuals may have been more prone to complete the survey; some questions were not able to parse out the timeline of events (eg, were animals bred before or after the CCLD diagnosis); inability to follow up with respondents; no access to medical records; no confirmed veterinary diagnosis of CCLD; and this survey was specific to 1 type of sporting dog. There was potential for owners, trainers, breeders, and judges to have referenced the same dog within the survey and the same dog to be accounted for multiple times, thereby skewing the statistical results.

This survey found a high owner-reported occurrence of CCLD within the field trial community. We also confirmed that there are misconceptions being passed throughout the community surrounding the topic, leading to uninformed decision-making. The results of this study can be used to educate the community on CCLD, as well as spur the interest for more research into this disease and its effects on these canine athletes. Finally, the results of this study should be validated with a prospective study or retrospective analysis of medical records of field trial dogs with CCLD.

Acknowledgments

The open access fee for this manuscript was provided by the Peter J. and Freda M. Babich Fund.

The authors thank Retriever News for disseminating the survey to their database.

References


Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org