Association Between Functional Detection of HPG-Axis Disturbance and Reduced Cranial Cruciate Ligament Disease in Desexed Dogs: A Longitudinal Study

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Abstract

Cranial cruciate ligament (CCr) disease is a common orthopaedic condition in dogs, particularly following desexing. This study evaluates the association between hypothalamic–pituitary–gonadal (HPG) axis disturbance, specifically luteinising hormone receptor (LHR) signalling, and CCr disease using a functional screening approach.

A longitudinal, practice-based observational study was conducted from 2014–2025. Desexed dogs were monitored using a functional screening system (DAMNIT-V). A structured three-week post-desexing HPG-axis monitoring protocol was implemented. Identified imbalances were managed with targeted interventions. Annual incidence of CCr disease was recorded.

A total of 191 dogs were monitored. Incidence of CCr disease decreased from 15.00 to 0.07 cases per monitored desexed dog-year (~99.5% reduction). Log-transformed analysis demonstrated an exponential decline in incidence over time, with a negative linear regression trend ($R^2 = 0.398$).

Longitudinal data demonstrate a strong association between early functional detection and reduced incidence of CCr disease. Findings support a time-based, functional model of disease development. Further controlled studies are required to establish causation.

Introduction

Cranial cruciate ligament (CCr) disease represents one of the most common orthopaedic conditions in canine practice and is strongly associated with desexing status. While traditionally considered a structural and biomechanical disorder, increasing evidence suggests that endocrine and metabolic factors may contribute to ligament degeneration.

Desexing results in persistent alterations in the hypothalamic–pituitary–gonadal (HPG) axis, including sustained elevation of luteinising hormone (LH). The presence of luteinising hormone receptors (LHR) in non-gonadal tissues raises the possibility that endocrine signalling may influence connective tissue integrity.

This study provides a longitudinal clinical dataset evaluating whether early functional detection of HPG-axis disturbance is associated with later orthopaedic outcome, specifically long-term reduction in incidence of CCr disease.

Materials and Methods

Study Design

A longitudinal observational study was conducted between 2014 and 2025 within a single veterinary practice.

Animals

A total of 191 desexed dogs were monitored. Dogs had no prior history of cranial cruciate ligament disease at baseline.

HPG-Axis Monitoring Protocol

Dogs underwent functional screening at Week 1 post-desexing, Week 2 post-desexing, and Week 3 post-desexing.

Signals assessed included luteinising hormone (LH) and luteinising hormone receptor (LHR). HPG-axis disturbance was defined as reproducible elevated responses, particularly if persistent across multiple time points. Dogs identified with disturbance underwent targeted intervention and serial reassessment.

Device and Functional Screening System

Functional screening was performed using proprietary bioenergetic devices developed by the author: the TC Diagnostic Laser (screening device) and the TC Laser (therapeutic device).

The TC Diagnostic Laser is a low-power, visible light Class 3R laser system operating at dual wavelengths (approximately 405 nm and 605 nm, <5 mW output), used as a stimulus reference during functional testing.

The system delivers predefined signal constructs (for example molecular, receptor, and biochemical targets) via modulated light exposure. Physiological responses are detected as transient autonomic events (RAC-type responses) during a defined exposure window.

Testing was conducted using a standardised protocol with signal exposure duration of approximately 5 seconds per test, responses quantified as event counts within the exposure window, and threshold interpretation applied to classify response magnitude.

The TC Laser was used for therapeutic intervention, applying frequency-based modulation aligned with identified functional disturbances. This system was used as an adjunctive clinical tool and does not replace conventional diagnostic methods.

Outcome Measure

The outcome measure was development of cranial cruciate ligament (CCr) disease over time. Incidence was defined as the number of dogs developing CCr disease per monitored desexed dog-year. This represents disease occurrence within a desexed cohort, not comparison with entire or non-desexed populations.

Statistical Analysis

Linear regression demonstrated a negative temporal trend ($R^2 = 0.398$), indicating a moderate association between time and decreasing incidence. Log-transformed data demonstrated exponential decline.

Results

Cohort Overview

A total of 191 dogs were monitored over the study period. Incidence refers to occurrence of CCr disease within the monitored desexed cohort. Early-year values reflect aggregated disease events and should be interpreted as high-variance baseline estimates.

Dataset

Year	Dogs monitored	Dogs developing CCr disease	Incidence
2014	1	15	15.00

2015	3	10	3.33
2016	4	7	1.75
2017	5	7	1.40
2018	10	7	0.70
2019	20	4	0.20
2020	19	5	0.26
2021	17	8	0.47
2022	27	7	0.26
2023	43	5	0.12
2024	32	4	0.13
2025	14	1	0.07

Overall incidence of CCr disease decreased from 15.00 to 0.07 (~99.5% reduction).

Phase-Based Analysis

Phase 1 (2014–2017): small cohorts (n = 1–5), high variability, and inflated incidence values.

Phase 2 (2018–2020): increasing cohort size (n = 10–20), rapid decline in incidence, and transition toward stability.

Phase 3 (2021–2025): larger cohorts (n = 14–43), sustained low incidence (0.07–0.47), and reduced variability.

Trend Behaviour

The dataset demonstrates a strong negative temporal trend. Log-linear behaviour is consistent with exponential decline, and the reduction persists despite increasing cohort size.

As shown in Figure 1, incidence of CCr disease declines over time.

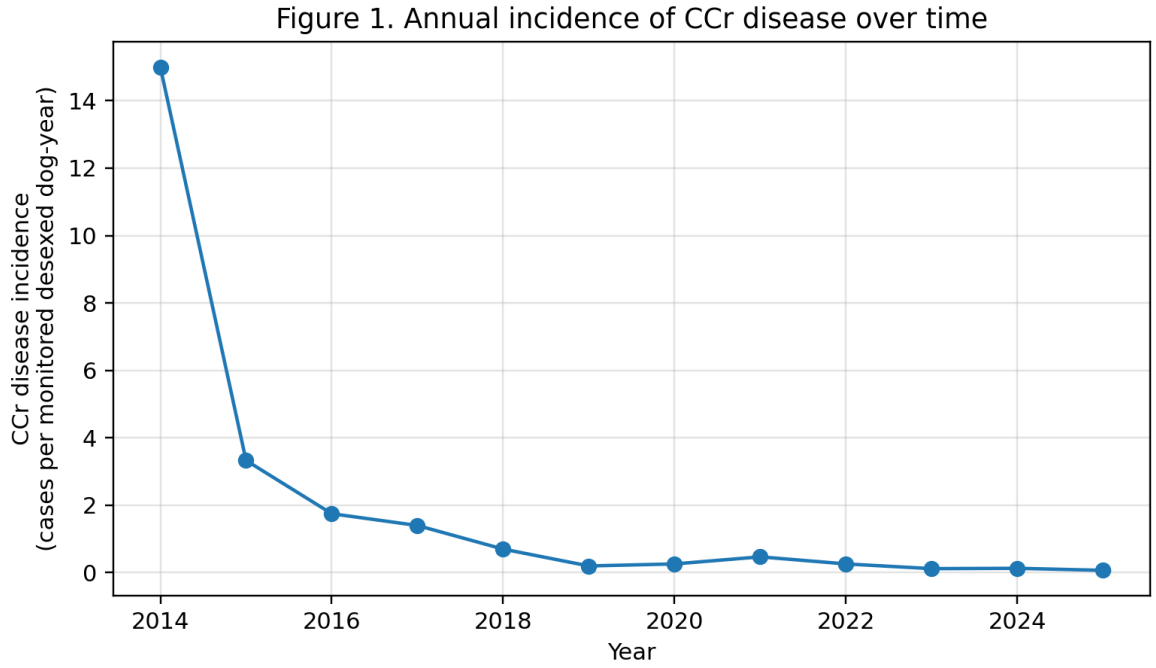

Figure 1. Annual incidence of CCr disease over time. The data demonstrate a marked and sustained reduction in incidence across the study period, with progressive stabilisation as cohort size increased.

Figure 2 demonstrates a consistent temporal decline.

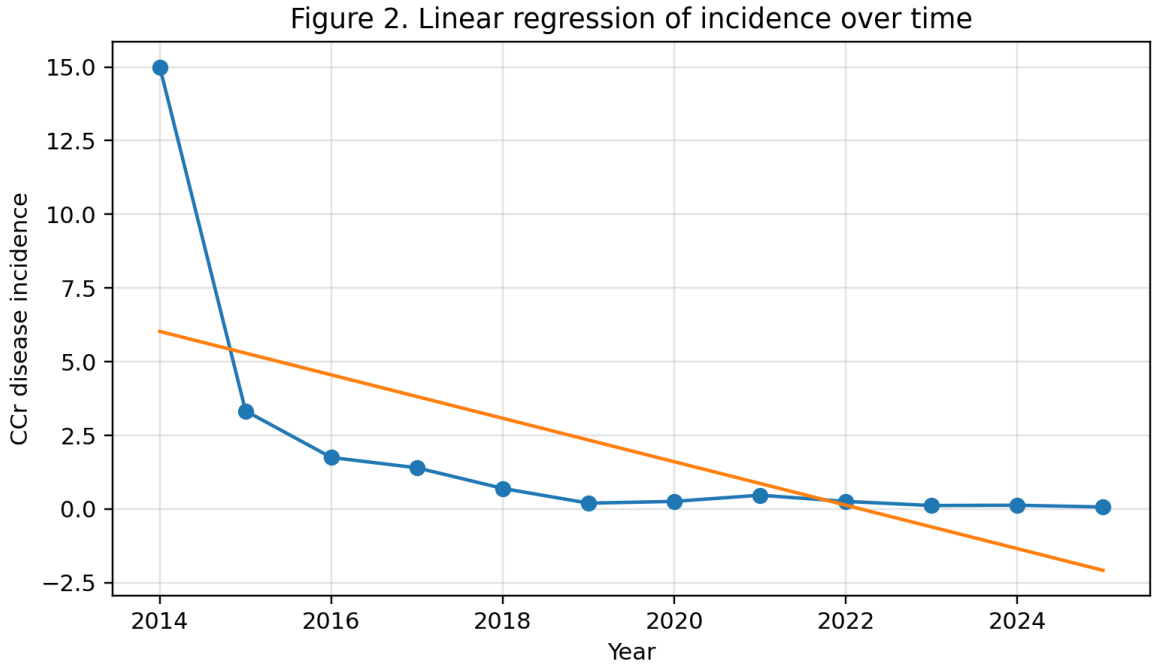

Figure 2. Linear regression of incidence over time ($R^2 = 0.398$). The negative slope indicates a consistent temporal decline. The R^2 value demonstrates a meaningful proportion of variance explained by time, supporting a non-random trend.

Figure 3 demonstrates exponential decay of disease incidence.

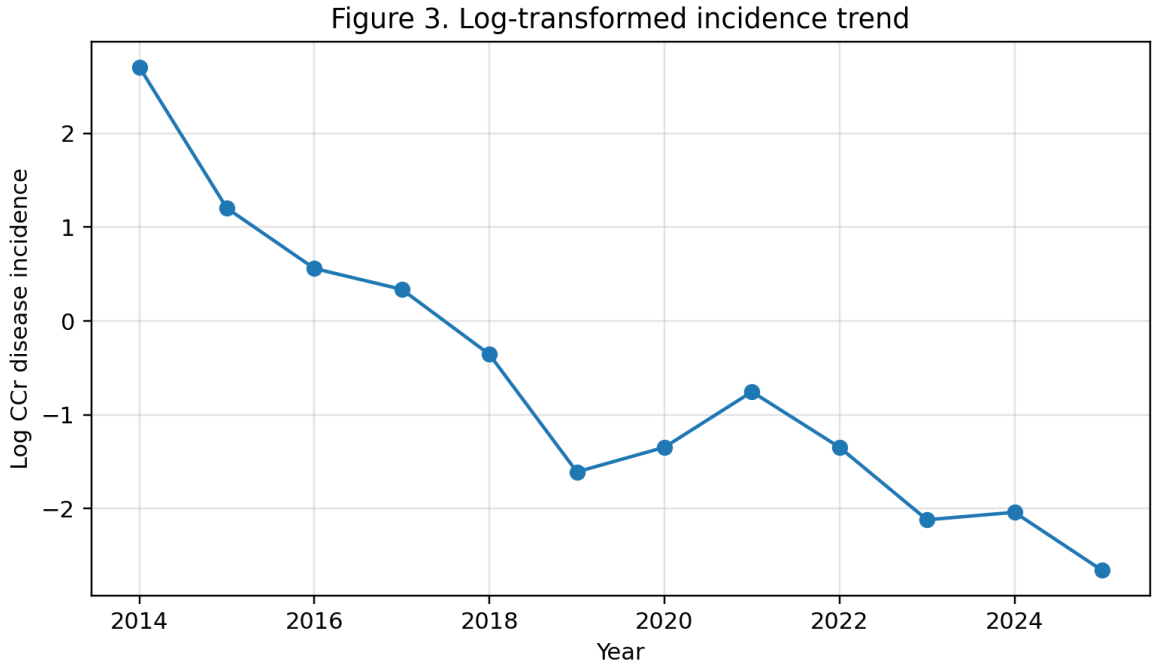

Figure 3. Log-transformed incidence values. The approximately linear relationship on log scale indicates exponential decay, suggesting a progressive system-level effect rather than random fluctuation.

Discussion

Principal Findings

This study demonstrates a large-magnitude, sustained reduction in the incidence of CCr disease within a cohort of desexed dogs. This should be interpreted as a reduction in disease occurrence over time within the monitored population, not as a comparison between desexed and non-desexed populations.

The magnitude, persistence, and temporal structure of the reduction strongly suggest a non-random effect. While the R^2 value (0.398) indicates moderate variance explained by time alone, the consistent exponential trend supports biological relevance.

Interpretation of Effect

The observed reduction is unlikely to represent simple temporal drift because the effect size is large, the trend persists with increasing sample size, and there is no reversion to baseline incidence.

HPG-Axis Hypothesis

Findings align with hypotheses linking HPG signalling to ligament integrity. The data support a functional model in which desexing induces persistent LH elevation and LHR-mediated signalling may influence ligament integrity.

Functional vs Structural Model

Model	Detection Point
Structural	Late (rupture)
Functional	Early (physiological disturbance)

Functional disturbance appears to precede structural failure.

Temporal Validation

A key contribution of this work is methodological: early detection systems require longitudinal validation. The shift from histopathology (spatial) to longitudinal observation (temporal) resolves this limitation.

Clinical Implications

CCr disease may be modifiable.

Early endocrine disturbance may represent a risk state.

Preventive screening may reduce disease incidence.

Limitations

Observational design, single-centre dataset, lack of control group, early cohort variability, and non-standardised interventions. Association rather than causation is demonstrated.

The functional screening system utilised is proprietary and requires further independent validation.

References

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Conflict of Interest

The author is the inventor and developer of the TC Diagnostic Laser, TC Laser, and DAMNIT-V screening system used in this study. The study reflects clinical application of these technologies within routine practice. No external commercial funding was received for this work.