


**The Optimal Time for Spay / Neuter:  
An Analysis of Critical Spay Neuter Literature**

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## Introduction

- ▣ To Spay or Not to Spay
  - ▣ That is the question
- ▣ If to Spay
  - ▣ When to spay
- ▣ Do we know the answers?

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## Primary objective

- ▣ To look at the issues and help sort out the benefit versus risk of ovariohysterectomy and castration in dogs and cats.
- ▣ Goal is for you to have a better understanding of some of the important research in order to make more informed decisions related to spay / neuter issues.

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## The Ugly Truth

- ❑ Millions of animals are euthanized in shelters each year.
- ❑ Millions more are killed on highways, die of disease, die of starvation.

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## Stray Dogs / Feral cats

- ❑ Are a public health hazard
  - ❑ Spread of disease
  - ❑ Bite wounds
  - ❑ Cause accidents on the highways
- ❑ Are a risk to the health of pets
  - ❑ Spread of heartworms
  - ❑ Spread of internal and external parasites
  - ❑ Spread of viral disease



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## The Facts

- ❑ There is an overpopulation of unwanted dogs & cats
- ❑ Euthanasia of homeless dogs and cats occurs every day in shelters across the U.S.
- ❑ In the U.S. it is estimated that 3 to 4 billion dollars are spent each year catching, holding, caring for and eventually killing homeless dogs and cats
- ❑ The number 1 cause of death of dogs and cats in the U.S. is homelessness due to overpopulation

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## Spay Neuter

- ▣ After one litter
- ▣ After the first heat
- ▣ At or after 6 months
- ▣ At 4 to 5 months
- ▣ Now many are promoting pediatric spay neuter
  - ▣ As young as 6 – 8 weeks
- ▣ While others recommend
  - ▣ No spay or neuter, or
  - ▣ Delayed spay neuter

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## Research – (supporting delay / or don't)

- ▣ UC Davis: Golden Retriever study (February 2013)
- ▣ UC Davis: Comparison of Labrador Retrievers with Golden Retrievers (2014)
- ▣ UC Davis: Neutering of German Shepherd Dogs (2015)
- ▣ UC Davis: Gonadectomy effects on the risk of immune disorders... (2016)

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## Golden Retriever Study

OPEN ACCESS Freely available online PLOS ONE

### Neutering Dogs: Effects on Joint Disorders and Cancers in Golden Retrievers

Gretel Torres de la Riva<sup>1</sup>, Benjamin L. Hart<sup>2\*</sup>, Thomas B. Farver<sup>1</sup>, Anita M. Oberbauer<sup>3</sup>, Locksley L. McV Messam<sup>4</sup>, Neil Willits<sup>5</sup>, Lynette A. Hart<sup>1</sup>

1 Department of Population Health and Reproduction, School of Veterinary Medicine, University of California-Davis, Davis, California, United States of America, 2 Department of Anatomy, Physiology and Cell Biology, School of Veterinary Medicine, University of California-Davis, Davis, California, United States of America, 3 Department of Animal Science, College of Agriculture and Environmental Sciences, University of California-Davis, Davis, California, United States of America, 4 Department of Public Health Sciences, School of Medicine, University of California-Davis, Davis, California, United States of America, 5 Statistics Laboratory, Department of Statistics, University of California-Davis, Davis, California, United States of America

**Abstract**

In contrast to European countries, the overwhelming majority of dogs in the U.S. are neutered (including spaying), usually done before one year of age. Given the importance of gonadal hormones in growth and development, this cultural contrast invites an analysis of the multiple organ systems that may be adversely affected by neutering. Using a single breed-specific dataset, the objective was to examine the variables of gender and age at the time of neutering versus leaving dogs gonadally intact, on all diseases occurring with sufficient frequency for statistical analyses. Given its popularity and vulnerability to various cancers and joint disorders, the Golden Retriever was chosen for this study. Veterinary hospital records of 759 client-owned, intact and neutered female and male dogs, 1–8 years old, were examined for diagnoses of hip dysplasia (HD), cranial cruciate ligament tear (CCL), lymphosarcoma (LSA), hemangiosarcoma (HSA), and mast cell tumor (MCT). Patients were classified as intact, or neutered early (<12 mo) or late (≥12 mo). Statistical analyses involved survival

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### All 4 articles

- ▣ Looked at incidence of joint problems (CCL rupture, hip dysplasia) various cancers (lymphoma, hemangiosarcoma, osteosarcoma, mast cell tumors) and immune disorders
- ▣ Showed varying degrees of increase in incidence of certain orthopedic conditions, neoplastic conditions and immune disorders in sterilized dogs

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### On Closer Examination

- ▣ In retrospective studies medical record data is often incomplete and variables are not controlled
- ▣ Cases at a referral institution not necessarily representative of general population
- ▣ Association does not prove cause and effect
- ▣ Conclusions based on small numbers of cases.
- ▣ 3 of the articles focused on one or two breeds

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### Value

- ▣ Point to the need for more research
- ▣ Preferably PROSPECTIVE studies in which Case criteria and Data collection standards are defined in advance

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## Research – (supporting spay / neuter)

- University of Georgia longevity study (April 2013)
- Banfield State of Pet Health Report (2013)
- Howe's Long Term Outcome of Gonadectomy at Early Age (2000 / 2001)
- Spain's Long Term Risks and Benefits of Pediatric spay Neuter (2004)

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## University of Georgia

OPEN ACCESS Freely available online

PLOS ONE

### Reproductive Capability Is Associated with Lifespan and Cause of Death in Companion Dogs

Jessica M. Hoffman<sup>1</sup>, Kate E. Creevy<sup>2\*</sup>, Daniel E.L. Promislow<sup>1\*</sup>

1 Department of Genetics, University of Georgia, Athens, Georgia, United States of America, 2 Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, Athens, Georgia, United States of America

**Abstract**

Reproduction is a risky affair; a lifespan cost of maintaining reproductive capability, and of reproduction itself, has been demonstrated in a wide range of animal species. However, little is understood about the mechanisms underlying this relationship. Most cost-of-reproduction studies simply ask how reproduction influences age at death, but are blind to the subjects' actual causes of death. Lifespan is a composite variable of myriad causes of death and it has not been clear whether the consequences of reproduction or of reproductive capability influence all causes of death equally. To address this gap in understanding, we compared causes of death among over 40,000 sterilized and reproductively intact domestic dogs, *Canis lupus familiaris*. We found that sterilization was strongly associated with an increase in lifespan, and while it decreased risk of death from some causes, such as infectious disease, it actually increased risk of death from others, such as cancer. These findings suggest that to understand how reproduction affects lifespan, a shift in research focus is needed.

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## Study design

- Evaluated data for 80,958 dogs
- Looked at age of death
- In those that a specific cause of death was determined, categorized cause of death
- Compared age of death
  - with gender
  - with sterilization status
- Compared cause of death with sterilization status

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## Results

- ▣ Mean age of death of intact dogs - 7.9 years
- ▣ Mean age of death of sterilized dogs - 9.4 years
- ▣ Sterilization increased life expectancy of males by 13.8%
- ▣ Sterilization increased life expectancy in females by 26.3%

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## Results

- ▣ Intact dogs were “dramatically” **more** likely to die from
  - ▣ Infectious disease
  - ▣ Trauma
  - ▣ Vascular disease
  - ▣ Degenerative disease
- ▣ Sterilized dogs were **more** likely to die from
  - ▣ Neoplasia
  - ▣ Immune mediated disease

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## Sterilization

- ▣ Significantly increased:
  - ▣ Transitional cell carcinoma
  - ▣ Osteosarcoma
  - ▣ Lymphoma
  - ▣ Mast cell tumors
- ▣ Significantly decreased
  - ▣ Mammary cancer

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## On Closer Examination

- ❑ Retrospective study at a referral institution
- ❑ Did not have access
  - ❑ to data on age of sterilization
  - ❑ to data indicating whether or not sterilized dogs had reproduced or the number of times they had reproduced prior to sterilization
  - ❑ to data indicating whether or not intact dogs had reproduced or the number of times they had reproduced.

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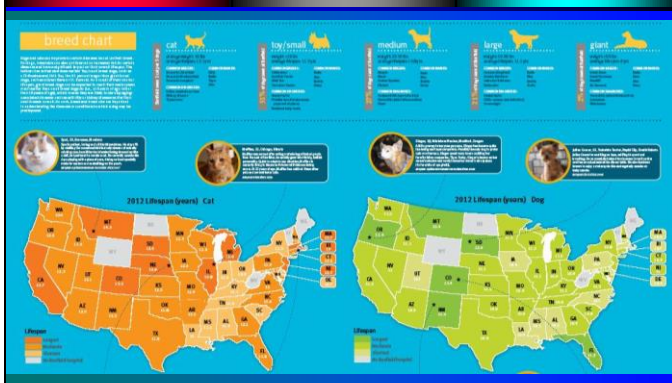
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## Banfield State of Pet Health Report



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## Longevity

- ❑ Dogs
  - ❑ Sterilized females 11.6 yrs   Intact females 9.5 yrs
  - ❑ Sterilized males 11.1 yrs   Intact males 9.5 yrs
- ❑ Cats
  - ❑ Sterilized females 13.1 yrs   Intact females 9.5 yrs
  - ❑ Sterilized males 11.8 yrs   Intact males 7.5 yrs

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## Pause to reflect

- ❑ Sterilized dogs and cats live longer
- ❑ Sterilized dogs have a higher incidence of certain cancers
- ❑ Sterilized dogs a lower incidence of other cancers
- ❑ Sterilized dogs may have higher incidence of some immune diseases.
- ❑ Intact dogs are more likely to die of infections and trauma
- ❑ In some breeds sterilized dogs appear to have greater incidence of certain orthopedic conditions

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## Pediatric Spay Neuter

- ❑ 2000 Howe and 2001 Howe
  - ❑ Prospective study
  - ❑ 4 year follow up on dogs
  - ❑ 3 year follow up on cats
- ❑ 2004 Spain
  - ❑ Retrospective cohort studies
  - ❑ 1500 cats and 1800 dogs
- ❑ No serious long term medical or behavioral effects associated with early age sterilization in cats and dogs



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## Kustritz – Optimal Age for Gonadectomy – Good & Bad

### Reference Point

#### Determining the optimal age for gonadectomy of dogs and cats

Margaret V. Root Kustritz, DVM, PhD, DACT

Elective gonadectomy of dogs and cats, most commonly performed as an OHE of females and castration of males, is one of the most common veterinary procedures performed in the United States.<sup>1</sup> Increasingly, dog owners and members of the veterinary profession throughout the world have questioned the optimal age for performance of these surgeries or whether they should even be performed as elective surgeries. The objective for the information reported here was to provide a review of the scientific evidence, which could be used by veterinarians to counsel clients appropriately on this issue.

#### ABBREVIATIONS

OHE	Ovariohysterectomy
TCC	Transitional cell carcinoma
CCL	Cranial cruciate ligament
FLUTD	Feline lower urinary tract disease
BPH	Benign prostatic hypertrophy-hyperplasia

is decried as "the tool of despots and tyrants throughout history," and the author of that article claims that gonadectomized dogs are "canine eunuchs, condemned to live their lives in a physical and mental twilight."

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### Summary of Kustritz article

Condition	Frequency	Seriousness	Impact
Mammary neoplasia	High	High	Decrease
Prostatic tumors	Low	High	Increases
Testicular tumors	Moderate	Low	Decreases
Transitional Cell	Rare	High	Increases
Osteosarcoma	Low	High	Increases
Hemangiosarc	Low	High	Increases
Urinary incontinence	Moderate	Low	Increases
Pyometra	High	High	Decreases
BPH	High	Low	Decreases
Diabetes	Low (cats)	Moderate	Increases
Hypothyroidism	Low (dogs)	Low	Increases
CCL	Low	Moderate	Increases

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### Summary of Kustritz article

Condition	Incidence	Seriousness	Impact
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Prostatic tumors	Low	High	Increases
Osteosarcoma	Low	High	Increases
Hemangiosarc	Low	High	Increases
CCL	Low	Moderate	Increases
Diabetes	Low (cats)	Moderate	Increases
Hypothyroidism	Low (dogs)	Low	Increases
Urinary incontinence	Moderate	Low	Increases

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### Key Point

- ❑ **Can not make spay/neuter decisions based on the impact of spay/neuter on a small handful of diseases.**
  
- ❑ **Must take into consideration the impact on the overall health and longevity of the animal.**

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## Kustritz – Optimal Age for Gonadectomy 2017

### Determining optimal age for gonadectomy in the dog: a critical review of the literature to guide decision making

Margaret V. Root Kustritz,<sup>a</sup> Margaret R. Slater,<sup>b</sup> G. Robert Weedon,<sup>c</sup> Philip A. Bushby<sup>d</sup>  
<sup>a</sup>College of Veterinary Medicine, University of Minnesota, St. Paul, MN; <sup>b</sup>American Society for the Prevention of Cruelty to Animals, Northampton, MA; <sup>c</sup>College of Veterinary Medicine, University of Illinois, Urbana, IL; <sup>d</sup>College of Veterinary Medicine, Mississippi State University, Starkville, MS

#### Abstract

Gonadectomy is the most common elective surgery performed on dogs in the United States. Concerns have been expressed by veterinarians, dog breeders, and pet owners or guardians about the need to better understand effects of gonadectomy on individual animal health. Many studies to date on this topic have been performed on small or unique populations of dogs and data from those studies may or may not readily be extrapolated to dogs seen by veterinarians in private practice. Veterinarians should be careful to read manuscripts in their entirety whenever possible rather than to rely on brief summaries that do not permit the reader to make their own decisions regarding value of the data as presented to their clinical practice.

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## Key Point

- ❑ To determine cause and affect
  - ❑ Randomized clinical trials
  - ❑ Unbiased subject selection
  - ❑ Adequate same size
  - ❑ Accurate and precise measurement of the factors of interest
  - ❑ Adequate control of confounding factors
  - ❑ Cautious & critical assessment of results

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## A few years ago

- ❑ Veterinary Task Force on Feline Sterilization
- ❑ Cats spayed before their first heat cycle
  - ❑ Decreased risk for mammary carcinoma
  - ❑ Elimination of reproductive emergencies such as pyometra and dystocia
  - ❑ Prevents unintended pregnancies that may occur as early as 4 months of age
  - ❑ Potential decrease in behavioral problems linked with cat relinquishment.
- ❑ No evidence of adverse effects of pediatric or juvenile spay / neuter

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## In June 2017

- AVMA officially endorsed the recommendations in the report of the Veterinary Task Force on Feline Sterilization

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## Are there medical benefits in cats?

Hayes HM, Milne KL, Mandell CP: Epidemiological features of feline mammary carcinoma, *Vet Rec* 108:476, 1981.

Overley B, Shofer FS, Goldschmidt MH, et al: Association between ovariectomy and feline mammary carcinoma, *J Vet Intern Med* 19:560, 2005.

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## Early age in cats

### Long-term outcome of gonadectomy performed at an early age or traditional age in cats

Lisa M. Howe, DVM, PhD, DACVS; Margaret R. Slater, DVM, PhD;  
Harry W. Boothe, DVM, MS, DACVS; H. Phil Hobson, DVM, MS, DACVS;  
Theresa W. Fossum, DVM, PhD, DACVS; Angela C. Spann, BS; W. Scott Wilkie, BS

**Objective**—To determine long-term results and complications of gonadectomy performed at an early age (prepubertal) or at the traditional age in cats.

**Design**—Cohort study.

**Animals**—263 cats from animal shelters.

**Procedure**—Cats that underwent gonadectomy were allotted to 2 groups on the basis of estimated age at surgery (traditional age, ≥ 24 weeks old; prepubertal, < 24 weeks old). Adoptive owner information was obtained from shelter records, and telephone inter-

gonadectomy of humane shelter animals may result in nearly 100% neutering compliance rates, fewer returned animals, and improved staff morale.<sup>3</sup>

In 1993, the AVMA House of Delegates approved Resolution 6, which stated: "Resolved, that AVMA supports the concept of early (8 to 16 weeks of age) ovariectomies/gonadectomies in dogs and cats in an effort to stem the overpopulation problem in these species."<sup>19</sup> Despite the passage of this resolution, acceptance of prepubertal gonadectomy by veterinarians has been slow, in part, because of concerns about anesthesia, urethral obstruction in male cats, potential behav-

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## Early age in cats

### Long-term risks and benefits of early-age gonadectomy in cats

C. Victor Spain, DVM, PhD; Janet M. Scarlett, DVM, PhD; Katherine A. Houpt, VMD, PhD, DACVP

**Objective**—To evaluate the long-term risks and benefits of early-age gonadectomy, compared with traditional-age gonadectomy, among cats adopted from a large animal shelter.

**Design**—Retrospective cohort study.

**Animals**—1,660 cats.

**Procedure**—Cats underwent gonadectomy and were adopted from an animal shelter before 1 year of age; follow-up was available for up to 11 years after

and the rate is estimated at 4.3 to 15.4 million cats/yr.<sup>1</sup> These numbers represent cats that were never adopted from shelters because of insufficient adopters and cats that were adopted but subsequently relinquished back to the shelters, frequently when the cat developed behaviors that were unacceptable to the new owner. Typically, more than half of cats relinquished to shelters are subsequently euthanized by the shelter, and in some shelters, the rate is > 90%.<sup>2,3</sup> Many people with humane concerns consider rou-

## What about short term complications?

### Short-term results and complications of prepubertal gonadectomy in cats and dogs

Lisa M. Howe, DVM, PhD

**Objective**—To determine short-term results and complications of prepubertal gonadectomy in cats and dogs.

**Design**—Prospective randomized study.

**Animals**—775 cats and 1,213 dogs.

**Procedure**—Animals undergoing gonadectomy were allotted into 3 groups on the basis of estimated age (group 1, < 12 weeks old; group 2, 12 to 23 weeks old; group 3, ≥ 24 weeks old). Complications during anesthesia, surgery, and the immediate postoperative period (7 days) were recorded. Complications were classified as major (required treatment and resulted in an increase in morbidity or mortality) or minor (required little or no treatment and caused a minimal increase in morbidity). An ANOVA was used

to compare the groups. Compliance with these programs is estimated to be < 60%.<sup>3,4</sup> To increase effectiveness of population control measures, many humane organizations and veterinarians have promoted prepubertal gonadectomy, whereby animals are neutered before the onset of puberty and before adoption.<sup>5-11</sup> Prepubertal gonadectomy of animals in humane shelters can result in compliance rates of nearly 100% for neutering, fewer animals returned, and improved staff morale.<sup>12</sup>

In 1993, the AVMA House of Delegates approved the following resolution:

Resolved, that AVMA supports the concept of early (8-16 weeks of age) ovariobysterectomies/gonadectomies in dogs and cats, as an effort to stem the overpopulation problem in these species.

## What about urethral obstruction in cats?

Root MV, Johnston SD, Johnston GR, et al: The effect of prepubertal and postpubertal gonadectomy on penile extrusion and urethral diameter in the domestic cat. *Vet Radiol Ultrasound* 37:363, 1996

## What about orthopedic issues in cats?

- UC Davis: Golden Retriever study (February 2013)
- UC Davis: Comparison of Labrador Retrievers with Golden Retrievers (2014)
- UC Davis: Neutering of German Shepherd Dogs (2015)

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## Behavioral Effects



Journal of Veterinary Behavior: Clinical Applications and Research  
Volume 9, Issue 5, September–October 2014, Pages 196-206

Research  
Development of behavior in adopted shelter kittens after gonadectomy performed at an early age or at a traditional age  
Nathalie Portiers <sup>a</sup>, Hilde de Rooster <sup>a</sup>, Katrien Verschueren <sup>b</sup>, Ingeborgh Polis <sup>a</sup>, Christel P.H. Moons <sup>c, d, e</sup>

Abstract  
Prepubertal gonadectomy (PPG) is promoted for population control in cats, but concerns related to health and behavior still exist. From a behavioral point of view, in order for PPG to

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## Behavioral Effects

- Inappropriate elimination
- Fearful behavior (people/animals)
- Fearful behavior (movement/noise)
- Non-play related aggression (people)
- Non-play related aggression (animals)
- Play-related aggression (people)
- Play-related aggression (animal)
- Destruction
- Excessive vocalization
- Pica
- Sucking on fabric

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## Mississippi State Shelter Program



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## Humane Alliance



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## So How Do You Decide

- ▣ Decisions on whether or not to spay / neuter a dog or cat must be based :
  - ▣ First - The life situation of the animal – is the animal in a home or homeless.
  - ▣ Second on an assessment of ALL known relationships between reproductive status and health and longevity not just a few.

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## Key Point

- ❑ When making decisions related to increase or decrease in incidence of a condition
- ❑ **Must consider what the overall incidence is and what is the change**

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## What do we KNOW - shelters

- ❑ Sterilization
  - ❑ Increases adoptions
  - ❑ Reduces shelter intake
  - ❑ Reduces shelter euthanasia

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## What do we KNOW - overall

- ❑ Sterilization is associated with an increased in incidence of several conditions that have low incidence
  - ❑ Prostatic cancer
  - ❑ Transitional cell carcinoma
  - ❑ Osteosarcoma
  - ❑ Diabetes mellitus
  - ❑ Hypothyroidism

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**What do we KNOW - overall**

- ▣ Sterilization is associated with a decrease in incidence or elimination of several conditions that have high incidence
  - ▣ Mammary cancer
  - ▣ Testicular cancer
  - ▣ Pyometra
  - ▣ Benign prostatic hypertrophy

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**What do we KNOW - overall**

- ▣ Sterilization is associated with an increased incidence of
  - ▣ CCL
  - ▣ Hip dysplasia
- ▣ In some breeds

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**What do we KNOW - overall**

- ▣ Sterilization is associated with significant increases in life expectancy in dogs and cats

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### Putting it all together - shelters

- ▣ Spay or neuter prior to adoption
- ▣ Regardless of age

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### Putting it all together - cats

- ▣ **For individually owned cats**
  - ▣ There are few documented adverse effects of spay neuter in cats
  - ▣ And many documented positive effects
  - ▣ Cats can come into heat by 4 ½ to 5 months
  - ▣ Spay or castrate cats before 5 months of age

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### Putting it all together -dogs

- ▣ **For individually owned dogs, it gets much more complex.**
  - ▣ Individual decision based on many factors.
  - ▣ Requires clear communication with owners regarding risk / benefit
  - ▣ Owners must make decisions based on personal concerns

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## Putting it all together – female dogs

- ▣ For individually owned female dogs,
- ▣ The mammary, pyometra and life expectancy data outweighs other factors
- ▣ Spay prior to first heat cycle

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## Putting it all together – male dogs

- ▣ For individually owned male dogs
- ▣ Small dogs – no evidence at this time for orthopedic issues – castrate prior to sexual maturity – 5 months
- ▣ Large dog – responsible owner– orthopedic concerns may outweigh all others – spay / neuter after growth stops 15 – 18 months
- ▣ Large dog – irresponsible owner– population concerns may outweigh all others – spay / neuter by 5 months.

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## Putting it all together – as we move forward

- ▣ There is still much we don't know about the positive and negative effects of spay / neuter
- ▣ We must remain open to new information as research continues
- ▣ We must, however, always be willing to look critically at new information to determine if conclusions are valid based on the research data

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## Questions



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