Up in Arms: The Sterilization Debate

Written By: Crystalyn Steubing

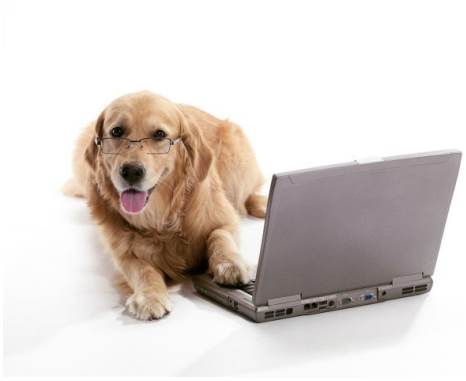
The spaying and neutering of pets is an important topic. Reading this entire article is not for the faint of heart or for those who just want someone to give them an answer. This article is not a "quick read." However, it has been set it up so that the biggest questions are answered in the beginning. A person must have the answers to their questions to make a truly informed decision. This is why the research has been done and all of the facts have been provided for those who are interested in reviewing them.

One of the most common questions for puppy owners is when their puppy should be spayed/neutered. For decades, the answer was, "between four and six months." This was the answer because this is "how it was done." If a dog was not going to be used for breeding, the best time to spay/neuter was before they reached sexual maturity. This was primarily so the owner would not have to deal with the hassles associated with their dog reaching sexual maturity (between six and nine months).

Times Have Changed

With the technological age, the "age of the internet," and the reality that more dogs are becoming family members and not just pets, owners tend to be doing more research as to what is best for their pets.

As a result, "How it is done" is no longer an answer that many responsible pet parents are comfortable with. They want to know the "why" associated with the question. Consequently, more veterinary studies are being made available to the public. However, just because they are available does not make them easy to find.



A Heightened Debate

Within the last couple of years, the debate concerning spaying/neutering has become heightened. Some of the information that can be found on the more "popular" sites is exaggerated, downright ridiculous, or clearly bias. I feel it is important to give all of the information and allow owners to make their own choice.

Additionally, since it is a requirement of Regency Ranch that all dogs are spayed/ neutered by the age of 36 months, it is important that my puppy owners have the most significant information at hand. Reviewing all of the provided information will show that there is a "best time" to spay/neuter. However, when it comes down to it, you need to do what you believe is best for your dog and your family.

Quick Summary

Many of the issues associated with spaying/neutering are correlated to a juvenile or early surgery. According to the research, some studies define juvenile spay/neuter as those pups that have surgery before the age of 5.5 months[32][8] and others define it as sterilization before one year of age.[28] Many of the issues associated with spaying/neutering revolve around doing so before the age of six months.

The Short of It

Most male dogs that are not going to be used for breeding should be neutered between 14 and 36 months of age. Females that are not going to be used for breeding should be spayed between 14 and 36 months depending on when they have their first heat. If the first heat is late (at 10-11 months of age) then 16 months is preferred.

There are a few health issues that recommend early sterilization for females, but the statistical differences in the health risk only differs by approximately 1% to 2%.

General Consensus for Spay/Neuter

Choosing to **never** spay/neuter your pet is, in most cases, not the right idea. However, having the surgery performed after the age of 6 months and by the age of 36 months seems to be the consensus at to when it is the safest, health-wise, to have the surgery performed. The best time within this window depends on what "bad habits" you, as the dog's family, are willing to deal with.

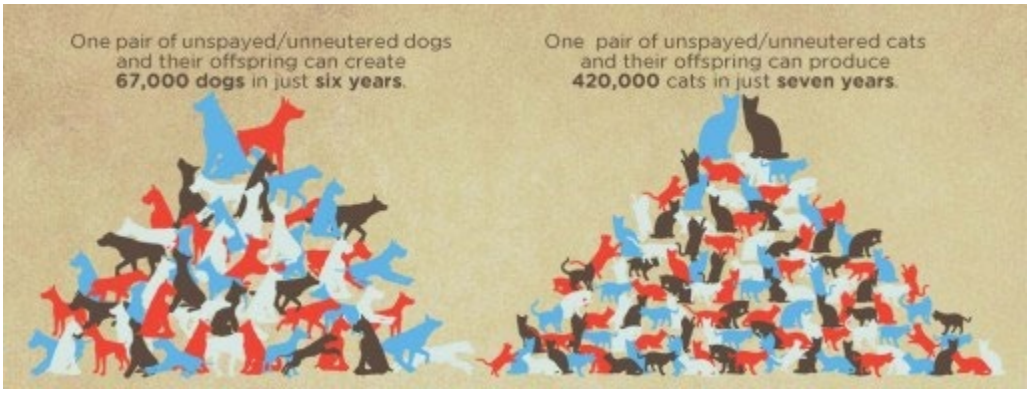
Additional Information

If you would like additional information and details concerning why to spay and neuter and the potential health risks, read on. After reading the rest of the information, if still confused concerning if/when your dog should be sexually altered, consult your vet. On another note, if dog has any pre-existing health problems, talking to the vet about what is best is of utmost importance. Only a vet is truly qualified to help you make this decision.

Why Spay/Neuter

One of the most obvious and commonly used reasons for spaying and neutering your dog is to help control over population. According to the research, "widespread recommendation for [spay/neuter] is based on advocating for the welfare of the animal as well as the general canine population by reducing the incidence of certain medical problems and minimizing contributions to the homeless animal population."[23] Dogs in shelters are primarily from a litter that was an "accident, or was the result of intact dogs that were "lost" or "ran away."

Reduction of Overpopulation



Sadly, there are thousands of animals in shelters around the United States. Multiple generational mixed breed dogs make up the majority of dogs in shelters. These pups are caused by the lack of spay/neuter. This could be due to lack of funds, misinformation, or general irresponsibility. Unfortunately, dogs are more driven to reproduce than some owners understand. It only takes the choice to spay/neuter to eliminate this issue. An accidental litter conceived by two purebred dogs (of different breeds) result in approximately 1/3 of the "unplanned litter" puppies found in a shelter. This is the result of one or two owners that did not spay/neuter. Additionally, 90% of the purebred dogs that are in shelters are often from backyard breeders, but that is another topic.

Unfortunately, many of the puppies that are from "oops" litters are not able to find quality homes. These "unwanted" pups are left at shelters, left to run the streets, or taken into families that allow other liters to be born in the same manner. Although there are many owners of mixed breed dogs that are loving and responsible, there are just as many that are not.

Most importantly, if inexperienced with trying to keep an intact male in the yard when there is a female in heat, it is much harder than many think.

Spaying/Neutering *IS* the Right Answer

According to Statistics, many of the dogs found roaming or are relinquished to shelters are intact. They could be roaming because they got out to chase another dog, because they were born on the street, because the owner dumped them, or because the owner let them go because they were too much of a hassle. Sadly, another common instance is that these puppies often come from homes that got their puppy for free or for an

extremely low adoption fee when they are young pups. Spaying/neutering is strongly suggested for any dog that is not going to be used for breeding.

Overall Happiness

Overall, the happiness of the family and the dog can be higher with spaying/neutering. Less "stress" is associated with owning a dog that is spayed/neutered. Spaying/Neutering is beneficial as it correlates with dogs not wandering as much, getting into fights as often, or having changes in personality depending on the time of the year.

Another positive aspect is that spaying and neutering can greatly reduce and/or eliminate the chance of certain deadly health issues. Studies say that spaying/ neutering can lengthen the life of your dog. Additionally, you are able to take your pet more places if he/she is neutered/spayed.

Some studies have even declared that spaying/neutering allows dogs a longer life is because when people invest in an animal, they tend to take better care of it.

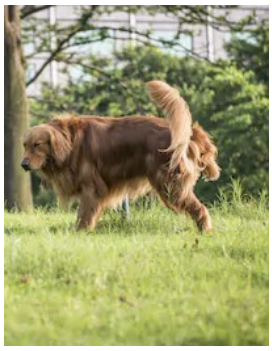
If the pet is monetarily important, it is "worth" protecting. I am not sure how much weight this holds, but it is an interesting psychological concept.

Spay/Neuter Behavioral Considerations

There are multiple aspects to consider when deciding when (or in some cases whether) to spay/neuter. Health is always important aspect to consider. Nonetheless, behavior can be just as important.

If a dog is consistently "misbehaving" it can "disrupt the human-animal bond [and is] one of the most common reasons for relinquishment or rehoming of dogs."(17) These "misbehaviors" include habits and personality traits that are associated with intact dogs.

With this in mind, if a dog is already disruptive, there is a good chance that his/her behavior may take a turn for the worse once puberty hits. It is better to spay/neuter then it is to give the dog away because you chose to wait to spay/neuter and can no longer handle the dog's personality



Male Behavior

Once a dog has reached sexual maturity, there are some behavioral changes that commonly correlate. For males this is roaming, hormonal aggression (fighting with other dogs), hyperactivity, and urine marking. In fact, studies show that "sexually intact dogs were more than twice as likely as [altered] dogs to be hit by a car or bitten by another animal."(3)

Neutering a dog can often help with the onset and/or help curb this behavior. Multiple

studies have shown that neutering can help with this behavior, but it is never a guarantee. Nonetheless, many of them show that after neutering and the "resulting decrease in gonadal steroid hormones typically result in a marked reduction or elimination of sexually dimorphic behaviors."[27]

Still, one study that said the age of neuter does not seem to "change the likelihood that surgery will alter these unwanted behaviors"[20]

Female Behavior

For females, one of the most common changes is dominance related aggression. For those females who started to show this personality trait during their first heat, the spay can have an affect on them for the better.

However, those females that showed dominant aggression before their first heat were "at risk for an increase of dominance aggression after surgery."[22] For female dogs that had not already displayed aggressive behavior, there was little risk for increased aggression.[22]

Additional Behaviors concerning spay/neuter

Another form of behavioral issues is those associated with phobias or hypersensitivity. A study conducted in 2004 showed that male dogs neutered before 5.5 months of age "were more likely to display noise phobias and sexual behaviors" in addition to "increased aggression toward family members" and excessive barking.[30]

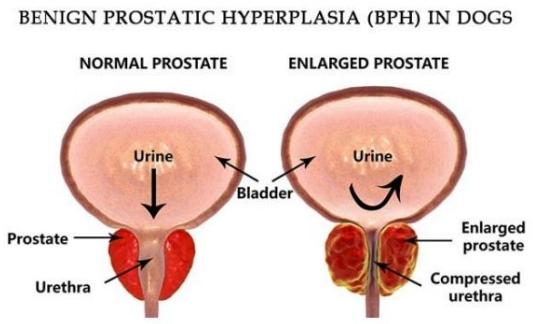
The older a dog is when spayed/neutered, the more "set" these behavioral issues will be. As a result, the chance of your dog changing these patterns after the surgery may lessen as they age. Nonetheless, it seems that with females, there is less of a variable. A study done on female dogs found "no behavioral differences" between spayed females and the "intact control group."[13]

Spay/Neuter and Life Expectancy

An increased life expectancy is correlated with spaying/neutering. For spayed females, the "life expectancy was increased by 23% to 26.3% and that of [neutered] males [were] increased by 13.8% to 18%"[23], [3]

Neuter and the Male Reproductive Tract

BPH

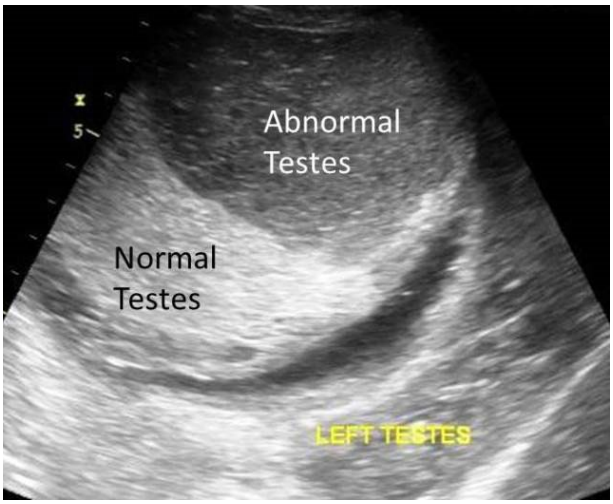


One benefit of neutering is that it helps prevent androgen-related diseases including BPH (Benign Prostatic Hypoplasia). Those dogs that are castrated only account for 6.7% of dogs with a prostatic disorder.[15]

It is found that "BPH is the most common prostatic disorder among sexually intact males dogs, potentially affecting 50% of sexually intact dogs by 5 years of age and 95% to 100% [… after] 9 years old"[15] Male dogs with BPH are predisposed to

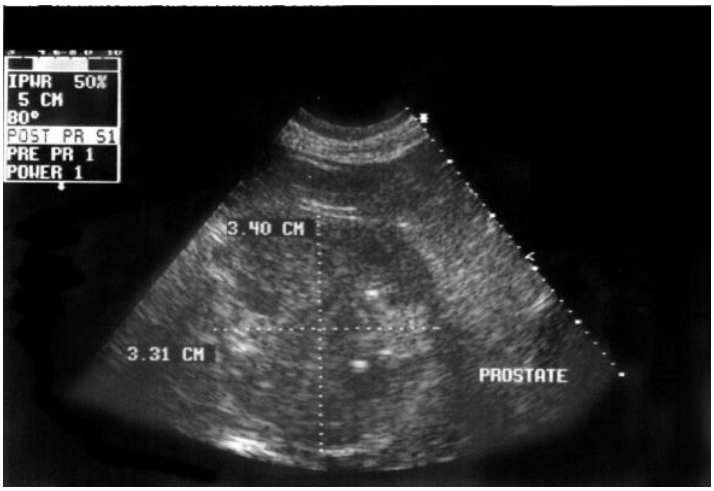
other issues which include “prostatic cysts, prostatitis, and prostatic abscesses.”[15]

Testicular Tumors



Testicular tumors are tumors that grow within the testicle or scrotal area. In males that are neutered, the chance for testicular cancer is eradicated. For males that are intact, testicular tumors are common and account for “up to 16% to 27% of sexually intact male dogs and approximately 90% of all tumors in the male reproductive tract.”[16]

Prostate Neoplasia



Prostate Neoplasia is cancer of the prostate. A study completed in 2007, it states that “castration [is shown] to be a risk factor for development of prostate neoplasia in dogs.”[7] Conversely, another study conducted in 2009 shows that the “age at which prostate neoplasia was diagnosed […] did not differ significantly between sexually intact and neutered dogs.”[25]

In this case, it is important to realize that the statistical analysis for these tumors show they are rare and have an “estimated prevalence of 0.29% to 0.6%.[7] Due to the rarity of this tumor, it is not a reason not to neuter your dog.

Spay and the Female Reproductive System

Spaying allows prevention of “disorders of the reproductive tract, including pyometra, metritis, and ovarian cysts”[18] The most severe of these disorders is the pyometra which is a potentially life-threatening condition.

Mammary Tumors

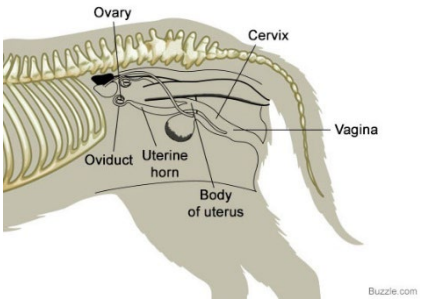
Mammary gland tumors in female dogs represent “the most common malignant tumors in dogs.”[6] According to a recent study, it is believed that breed influences the incidence of these tumors due to heredity. It has been proven that these tumors are also connected to hormones.

In **Golden Retrievers,** “few dogs had mammary gland neoplasia.”[19] However, this study only consisted of dogs up to eight years of age. In much of the research surrounding these types of tumors, it is believed that “intact females have a higher incidence (3 to 7 times as high).”[24]

Spaying a female before her first estrus shows the greatest benefit for prevention of these tumors. However, the probability of the development of these tumors does not raise substantially if you choose to wait until after the first heat.

Pyometra

This is an infection of the uterus. This infection is deadly if not caught immediately. The more heats a female has without pregnancy, the higher chance of a pyometra. This infection is not possible if a female has been spayed.



Reproductive Tumors

Ovarian tumors and transmissible venereal tumors are not possible in spayed females. The overall prevalence of ovarian tumors is "potentially as high as 6.25%"[9] and venereal tumors at "5% to 17%"[10]

Incontinence

Acquired Urinary Incontinence (involuntary leakage of urine) is a risk for spayed females. It is common in "2% to 20% of spayed females" and "typically develops 3 to 5 years" after spay.[31] Those females that are spayed before 3 months of age are at an even higher risk of developing incontinence.[11]

However, although incontinence can be a bother, it is often successfully treated with medication. Although the correlation between spay and incontinence is a common belief, a recent review "categorized the causal relationship between [spay] and urinary incontinence as weak"[6]

Spay/Neuter and Other Cancers

Hemangiosarcoma

A hemangiosarcoma is a rapidly growing, highly invasive variety of cancer that occurs almost exclusively in dogs, and is a sarcoma arising from the lining of blood vessels. One study stated that females spayed after "one year of age or later that developed hemangiosarcoma (about 7%) was more than four times the percentages of sexually intact and early age – [spayed] females that developed hemangiosarcoma."[21]

In a comparative study that focused on specific breeds, it was determined that the spay or "neuter status of golden retrievers […] of both sexes was not associated with a significantly increased risk"[6] when it came to the development of hemangiosarcoma.

*When focusing on the studies including **Golden Retrievers** there is no confirmed answer. Even if the study with the highest results is correct, it states that 7% of dogs that end up with a hemangiosarcoma have a correlation with spay/neuter. This is an extremely low occurrence if you consider the number of dogs within the population.*

Osteosarcoma

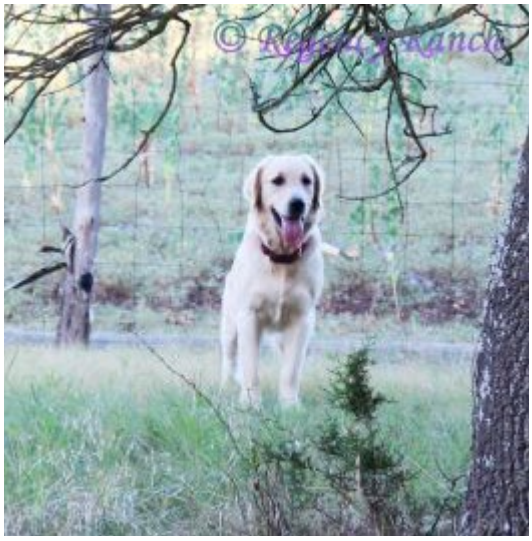
The prevalence among all dogs was 0.35 percent."[21] When looking at the actual numbers, less than 0.5 percent and as high as 8% is a large variance. If you consider the average at approximately 3.75%, then the overall risk is less likely than the possibility of getting hit by a vehicle.

An osteosarcoma is a cancerous tumor in a bone. Additionally, this is the most common primary malignant bone tumor in dogs. A multiple breed study found that when dogs were spayed/neutered before one year, they were "twice as likely to develop osteosarcoma."[28] Another study showed that for Rottweilers spayed/neutered before one year of age, "1 in 4 would develop osteosarcoma in their lifetime."[8] Of those dogs that have been diagnosed with bone tumors, 85% to 95% of them have been osteosarcomas.

According to an article published on the AVMA website, the prevalence of the disease within breeds are as follows:" Irish Wolfhound, with a 7.31 percent prevalence of the disease; Greyhound, 5.56 percent; Akbash, 4.76 percent; St. Bernard, 4.12 percent; and Leonberger, 4.04 percent.

Lymphoma

One of the most common cancers found in dogs in Lymphoma. The factors that have been associated with the development of lymphoma are "breed […], environmental, immunologic, and hormonal factors."[5] One comparative study showed that "sexually intact male dogs and neutered male and female dogs were twice as likely as sexually intact female dogs to develop lymphoma."[14]



However, multiple breed related studies have inconsistent findings and are not able to replicate this study. In a study that specifically included **Golden Retrievers,** it was found that "there was not a significant risk of developing lymphoma associated with spaying females at any age.

Additionally, studies showed that **Golden Retriever** males neutered after 1 year of age, had no increased risk of Lymphoma. However, "male **Golden Retrievers** neutered before 1 year of age were 3 times as likely as sexually intact males to develop lymphoma"[32]

Mast Cell Neoplasia

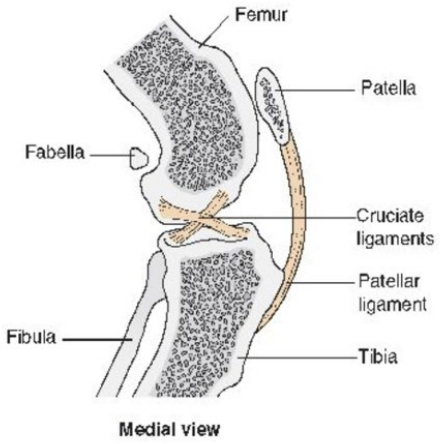
A Mast Cell Tumor is a growth or lump of mast cells (a type of white blood cell). Mast cell tumors (mastocytomas) can involve the skin, subcutaneous tissue, and muscle tissue. Studies have shown that for some breeds, spaying can cause an increase in the occurrence of mast cell tumors. Unfortunately, there is no research concerning multiple breeds and male dogs.

However, studies done on **Golden Retrievers** showed that "there was not a significant difference between the incidence of mast cell tumors in males and females regardless of [spay/] neuter status" or when the surgery was performed.[32] The study then goes on to state that there are several breeds that are at an increased risk for these tumors.

These breeds include Weimaraner, Staffordshire Bull Terrier, Boxer, Golden Retriever, Labrador Retriever and the Bulldog.[12] As a result, this states that these breeds are more likely to get mast cell tumors whether or not they are neutered/spayed.

Spay/Neuter and Joint Issues

CCL

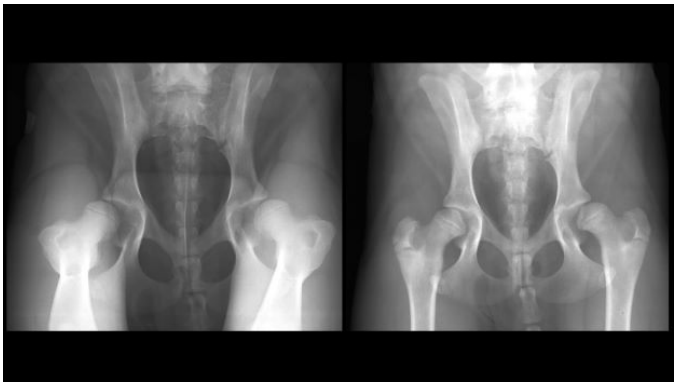


Cranial Cruciate Ligament (CCL) disease is an injury-based disease as a result of the damage, rupture, or tear of the cruciate ligament. Additionally, this issue has shown a link to specific breeds and genetics. **Golden Retrievers** are not one of the listed breeds.

The "overall prevalence for CCL disease is 3.38%, with [spayed/neutered] dogs having a significantly higher prevalence then their sexually intact counterparts and neutered females having the highest prevalence"[33] Alternately, another study showed the incidence of CCL disease at 1.7%.[26] Just as with the other mentioned issues, there is a wide variance concerning the outcome of each study.

Hip and Elbow Dysplasia

This is an abnormality of the joint where the socket portion does not fully cover the ball portion, resulting in an increased risk for joint dislocation. Just as with CCL, hip dysplasia connection to genetics. One study conducted in 2008 found that "hip dysplasia was more prevalent among neutered male dogs and less common among female dogs regardless of their neuter status."[34]

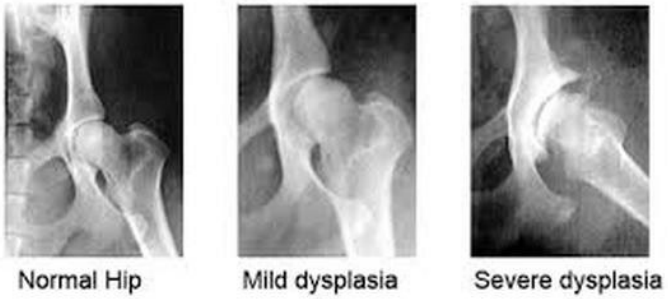


In a longer study that followed the dogs for up to 11 years after spay/neuter, it was shown that there was a "significant increase in the incidence of hip dysplasia among dogs [spayed/neutered] before 5.5 months of age, compared with the incidence for those [spayed/neutered] after 5.5 months of age.[30]

Golden Studies

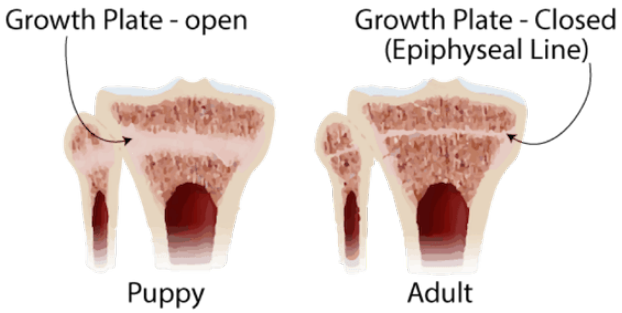
Reviewing breed specific studies shows a wide difference in incidence between breeds. The results from these studies concerning **Golden Retrievers** state that the "prepubertal [spay/neuter] (usually before 9 months of

age) of Golden Retrievers resulted in an increased incidence of joint disorders (3 to 5 times as high as the incidence for sexually intact dogs).[25]



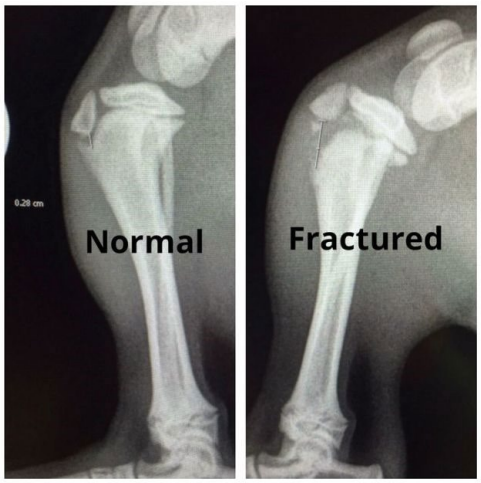
It goes on to state that the "incidence of hip dysplasia increased significantly only in male **Golden Retrievers** neutered before 1 year of age"[26] Lastly, the study showed that, in Golden Retrievers, the risk of elbow dysplasia did not waiver based on spay/neuter status.

Growth Plates



Growth Plates, also known as the epiphyseal plate or physis, is the area of growing tissue near the ends of the long bones. The closure of these plates corresponds with puberty in the way that "puberty initiates a release of hormones that help close the [growth] plates on long bones. The closure of these plates 'tells" the long bones to stop growing.

Absent this signal, the long bones grow beyond their intended length and interfere with the normal size and mechanical relationship between the bone and joint."[33] It has been speculated that this increased bone length attributes to the development of orthopedic diseases.



Consequently, in a study associated with prepubertal spay/neuter, it was found that early spay/neuter "is associated with increased bone length attributed to delayed closure of growth plates."[29]

Age of Closure

Although the closing of these plates depends on the size and breed of the dog, for **Golden Retrievers**, the growth plates close between the ages of 14 and 24 months. All breeds will have closed growth plates by 36 months. Radiographs of a joints is the only way to be sure the growth plates are closed before 36 months.

Conclusion

Overall, spaying/neutering is the best course of action for your dog. The most important aspect to consider is the timing in which the surgery takes place. One aspect of consideration is how long an owner can handle traits associated with an intact animal. None of the above information supports a complete lack of sterilization. Yes, there are some increased risks with spaying and neutering. Nonetheless, by the time the dog reaches three years of age, the majority of these risks are less substantial.

There are medical and responsibility arguments associated with choosing to keep a dog intact for life. The increased health risks associated spaying and neutering are not significant enough when weighed against the benefits. In all instances, the health risk increase is shown to be between 0.02% and 3%. However, it does state, that in most cases, for females, the best time to spay is between 12 and 36 months, and for males, between 14 and 36 months. If you need additional assistance to make your decision, contact you veterinarian. They, too, want to do what is best for your dog.

Disclaimer:

I am not a veterinarian or a certified animal nutritionist. I am a breeder who cares for my dogs and I am willing to share my information with you. Nevertheless, you have to make your own decisions. If you choose to follow my recommendations, then that is your choice. I take no responsibility if it does not work as you had hoped. Information on this site is not meant to diagnose or prescribe. If your pet has a medical problem, you should consult your veterinarian. The FDA has not endorsed or approved this information. In no event shall the owners of this website be liable for any damages.

References

(1) "Analyses Delve into Osteosarcoma Prevalence, Veterinary Pricing." *American Veterinary Medical Association*, 29 Mar. 2017, www.avma.org/javma-news/2017-04-15/analyses-delve-osteosarcoma-prevalence-veterinary-pricing. Accessed 22 Jan 2020

(2) AVMA. "Policy on dog and cat population control." *American Veterinary Medical Association,* 01 Jan.2005, www.avma.org/KB/Policies/Pages/Dog-And-Cat-Population-Control.aspx. Accessed 27 July 2016.

(3) Banfield Applied Research and Knowledge Team. "Banfield Pet Hospital State of Pet Health 2013 Report." *Banfield* 2013, www.stateofpethealth.com. Accessed Apr 28, 2015.

(4) Beauvais W, Cardwell JM, Brodbelt DC. The effect of neutering on the risk of urinary incontinence in bitches—a systematic review. *Journal of Small Animal Practice* 21 Feb 2012; 53: 198–204.

(5) Bienzle, Dorothee, and William Vernau. "The Diagnostic Assessment of Canine Lymphoma: Implications for Treatment." *Clinics in Laboratory Medicine*, Elsevier, 3 Feb. 2011, www.sciencedirect.com/science/article/pii/S0272271210001435?via%3Dihub. Accessed 20 Jan. 2020

(6) Brodey RS, Goldschmidt MH, Roszel JR. "Canine mammary neoplasm." *Journal of American Animal Hospital Association* 1983; 19: 61–90.

(7) Bryan JN, Keeler MR, Henry CJ, et al. "A population study of neutering status as a risk factor for canine prostate cancer." *The Prostate* 21 May 2007; 67: 1174–1181.

(8) Cooley DM, Beranek BC, Schlittler DL, et al. "Endogenous gonadal hormone exposure and bone sarcoma risk." *Cancer Epidemiol Biomarkers Prev* 11 Nov. 2002; 11: 1434–1440.

(9) Cotchin E. "Canine ovarian neoplasms." *Research in Veterinary Science.* Vol 2, Issue 2, April 1961, 133–142.

(10) Das, Utpal, and Arup Kumar Das. "Review of Canine Transmissible Venereal Sarcoma." *Veterinary Research Communications*, Kluwer Academic Publishers, 1 Jan. 1967, link.springer.com/article/10.1023%2FA%3A1006491918910. Accessed 22 Jan. 2020

(11) de Bleser B, Brodbelt DC, Gregory NG, et al. "The association between acquired urinary sphincter mechanism incompetence in bitches and early spaying: a case-control study." *The Veterinary Journal.* Vol 187, Issue 1, January 2011: 42–47.

(12) Dobson JM. Breed-predispositions to cancer in pedigree dogs. *ISRN Veterinary Science* 17 Jan. 2013; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3658424/. Accessed 27 Dec 2019

[13] Fazio E, Medica P, Cravana C, et al. “Effects of ovariohysterectomy in dogs and cats on adrenocortical, haematological and behavioural parameters”. *Acta Scientiae Veterinariae* 2015; Vol 43: Pub. 1339. https://pdfs.semanticscholar.org/7a39/9a594bf6f4ead4355817ecb46c1c5906172f.pdf Accessed 3 Jan 2020.

[14] Henry, Carolyn J., et al. “Hormonal and Sex Impact on the Epidemiology of Canine Lymphoma.” *Journal of Cancer Epidemiology*, Hindawi, 14 Mar. 2010, www.hindawi.com/journals/jce/2009/591753/. Accessed 1 Jan 2020.

[15] Kutzler MA, Yeager A. “Prostatic diseases”. Eds. Ettinger SJ, Feldman EC. *Textbook of Veterinary Internal Medicine*. Vol 2. 6th ed. St Louis: Elsevier, 2005; 1809–1819.

[16] Lawrence, Jessica A., and Corey F. Saba. “Tumors of the Male Reproductive System.” *Withrow and MacEwen’s Small Animal Clinical Oncology (Fifth Edition)*, W.B. Saunders, 28 Nov. 2012, www.sciencedirect.com/science/article/pii/B9781437723625000281?via%3Dihub. Accessed 5 Jan 2020

[17] Luescher A. “Behavioral disorders”. Eds. Ettinger SJ, Feldman EC. *Textbook of Veterinary Internal Medicine*. Vol 1. 6th ed. St Louis: Elsevier, 2005; 183–189.

[18] MacPhail CM. “Surgery of the reproductive and genital systems.” Ed. Fossum, TW. *Small Animal Surgery*. 4th ed. St Louis: Elsevier, 2013; 780–855.

[19] Moe L. “Population-based incidence of mammary tumours in some dog breeds.” *Journal of Reproductive Fertility Supply* 2001; Vol 57: 439–443.

[20] Neilson JC, Eckstein RA, Hart BL. “Effects of castration on problem behaviors in male dogs with reference to age and duration of behavior.” *Journal of the American Veterinary Medical Association* 15 July 1997; Vol 211: 180–182.

[21] Nolen, R. Scott. “Study Shines Spotlight on Neutering.” *American Veterinary Medical Association*, 1 Nov. 2013, www.avma.org/javma-news/2013-11-01/study-shines-spotlight-neutering.Accessed 15 Jan. 2019

[22] O’Farrell V, Peachey E. “Behavioural effects of ovariohysterectomy on bitches.” *Journal of Small Animal Practice.* Dec. 1990; Vol 31, Issue 12: 595–598.

[23] Petty, Michael, and Mark Goldstein. “Reexamining the Early Spay-Neuter Paradigm in Dogs.” *DVM 360*, 1 Mar. 2019, www.dvm360.com/view/reexamining-early-spay-neuter-paradigm-dogs. Accessed 15 Jan. 2020

[24] Priester WA. “Occurrence of mammary neoplasms in bitches in relation to breed, age, tumour type, and geographical region from which reported.” *Journal of Small Animal Practice* Jan 1979; Vol 20, Issue 1: 1–11. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-5827.1979.tb07014.x. Accessed 29 Dec 2019

[25] Reichler IM. “Gonadectomy in cats and dogs: a review of risks and benefits.” *Reproduction in Domestic Animals* 7 Jul 2009; Vol 44, Issue s2: 29–35. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1439-0531.2009.01437.x Accessed 10 Dec 2020

[26] Root Kustritz MV. “Determining the optimal age for gonadectomy of dogs and cats.” *Journal of the American Veterinary Medical Association* 1 Dec. 2007. Vol 231, No. 11: 1665–1675. https://avmajournals.avma.org/doi/10.2460/javma.231.11.1665 Accessed 2 Jan 2020

[27] Root Kustritz MV. “Effects of surgical sterilization on canine and feline health and society.” *Reproduction in Domestic Animals* 25 Jul 2012. Vol 47, Issue s4: 214–222. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1439-0531.2012.02078.x Accessed 2 Jan 2020

[28] Ru G, Terracini B, Glickman LT. “Host related risk factors for canine osteosarcoma.” *The Veterinary Journal.* Jul 1998; Vol 156, Issue 1: 31–39.

[29] Salmeri KR, Bloomberg MS, Scruggs SL, et al. “Gonadectomy in immature dogs: effects on skeletal, physical, and behavioral development.” *Journal of the American Veterinary Medical Association* 1 Apr. 1991. Vol 198, Issue 7: 1193–1203.

[30] Spain CV, Scarlett JM, Houpt KA. “Long-term risks and benefits of early-age gonadectomy in dogs.” *Journal of the American Veterinary Medical Association* 1 Feb. 2004. Vol 244, Issue 3: 380–387.

[31] Thrusfield MV, Holt PE, Muirhead RH. "Acquired urinary incontinence in bitches: its incidences and relationship to neutering practices." *Journal of Small Animal Practice* 28 June 2008. Vol 39, Issue 12: 559–566.

[32] Torres de la Riva G, Hart BL, Farver TB, et al. "Neutering dogs: effects on joint disorders and cancers in Golden Retrievers." *PLoS ONE* 13 Feb. 2013. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0055937. Accessed 11 Jan 2020.

[33] Whitehair JG, Vasseur PB, Willits NH. "Epidemiology of cranial cruciate ligament rupture in dogs." *Journal of the American Veterinary Medical Association.* 1 Oct. 1993. Vol 203, Issue 7: 1016–1019.

[34] Witsberger TH, Villamil JA, Schultz LG, et al. "Prevalence of and risk factors for hip dysplasia and cranial cruciate ligament deficiency in dogs." *Journal of the American Veterinary Medical Association.* 15 Jun 2008. Vol 232, Issue 12: 1818–1824.

[35] Zink MC, Farhoody P, Elser SE, et al. "Evaluation of the risk and age of onset of cancer and behavioral disorders in gonadectomized Vizslas." *Journal of the American Veterinary Medical Association.* 1 Feb 2014. Vol 244, Issue 3: 309–319.