# Gonadectomy – Rethinking Long-Held Beliefs

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Those of us with responsibility for the health of dogs need to continually read and evaluate new studies to ensure that we are taking the most appropriate care of our canine companions. This article reviews scientific evidence that, taken together, suggests that veterinarians and dog owners should revisit the current common recommendation that all dogs not intended for breeding have their gonads removed at or before 6 months of age. The results of a number of studies on the effects of removal of the ovary or testicles (gonadectomy) on orthopedics, cancer, behavior, and other health issues are briefly summarized, and alternatives to gonadectomy for preventing procreation are presented.

**Orthopedic Considerations**

- Bitches spayed at 7 weeks had significantly delayed closure of growth plates as compared to those spayed at 7 months; those spayed at 7 months had significantly delayed closure of growth plates as compared to those left intact.(1)
- In a study of 1444 Golden Retrievers, bitches and dogs spayed or neutered at less than a year of age were significantly taller than those spayed or neutered after a year of age.(2)
- In a study of 203 agility dogs, the author demonstrated that the tibia and the radius & ulna were significantly longer than the femur and humerus, respectively, in dogs that were spayed or neutered at or prior to 8 months of age as compared to intact dogs.(C. Zink, unpublished data)
- Spayed and neutered dogs have a significantly higher prevalence of CCL rupture (3–7), even when controlling for body size.(3)
- In a study of 759 male and female Golden Retrievers neutered or spayed before 6 months of age, the incidences of CCL rupture were 5 and 8 percent for males and females, respectively, compared to no CCL rupture diagnosed in intact dogs.(8)
- Dogs that were neutered at least 6 months prior to a diagnosis of hip dysplasia were 1.5 times more likely to develop hip dysplasia than sexually intact dogs.(9)
- Spayed/neutered dogs had 3.1 times higher incidence of patellar luxation.(10)
- Neutering Labrador Retrievers and Golden Retrievers before 6 months of age increased the incidence of one or more joint disorders by 2x and 4 to 5x, respectively.(11)
- In a study of 1170 German Shepherd Dogs, followed through 8 years of age, 21% of neutered males and 16% of spayed females were diagnosed with one or more joint disorders compared with 7% of intact males and 5% of intact females (12).

***Discussion***: Dogs that have been spayed or neutered at or before puberty can often be identified by their longer limbs, lighter bone structure, narrower chests and narrower skulls than intact dogs of the same breed. This differential growth frequently results in significant alterations in body proportions and particularly the lengths (and therefore weights) of certain bones relative to others. For example, if the femur has achieved its genetically determined normal length at 8 months, prior to a dog being spayed or neutered, but the tibia (which normally stops growing at 12 to 14 months of age) continues to elongate for several months because of the removal of the sex hormones (which contribute to growth plate closure), then the relationship between the femur and tibia will be different than what was genetically intended. This may result in an abnormal angle at the stifle and a longer (and therefore heavier) tibia placing increased stress on the cranial cruciate ligament (of the knee or stifle joint). It is well known that spayed and neutered dogs are more likely to be overweight or obese than sexually intact dogs (13, 14), and this can be an additional contributing factor to orthopedic diseases. Thus, keeping spayed/neutered dogs lean can help mitigate the increased risk of orthopedic conditions.

**Cancer Considerations**

- Spayed females had more than 5 times greater risk of developing cardiac hemangiosarcoma than intact bitches. Neutered males had 1.6 times higher risk than intact males had of developing cardiac hemangiosarcoma.(15)
- Spayed females had 2.2 times increased risk for developing splenic hemangiosarcoma than intact females.(16)
- Male and female Rottweilers that were neutered or spayed before a year of age had 3.8 and 3.1 times greater risk, respectively, of developing bone cancer than intact dogs.(17)
- Spayed/neutered dogs had a 2.2 times higher risk of developing bone cancer than intact dogs.(18)
- Neutered dogs had a 2.8 times higher risk for developing prostate cancer than intact dogs.(19)
- Neutered dogs had a 4.3 times higher risk of developing prostate carcinoma than intact dogs.(20, 21)
- Neutered dogs had a 3.6 higher risk for developing transitional cell carcinoma of the bladder than intact dogs, and a 3 times greater risk of developing any bladder tumor.(19)
- Spayed/neutered dogs had more than 4 times greater risk for developing transitional cell carcinoma of the bladder than intact dogs.(22)
- Early neutered male Golden Retrievers were 3x more likely to be diagnosed with lymphoscarcoma than intact males, and late-spayed females were significantly more likely to develop hemangiosarcoma and mast cell tumor than intact females.(8)
- In a survey of 2505 Vizslas, dogs spayed or neutered dogs at any age were found to have a significantly higher risk of mast cell cancer, hemangiosarcoma, lymphoma and all cancers together than intact dogs.(23) In this study, the risk of gonadectomized dogs developing one of the above cancers was significantly higher than the risk of an intact female developing mammary cancer. Further, the younger the age at gonadectomy, the earlier the mean age at diagnosis of mast cell cancer, hemangiosarcoma, lymphoma, and all cancers combined.
- Female Labrador Retrievers spayed between 2 and 8 years of age had a significantly increased prevalence of mast cell cancer, hemangiosarcoma, and lymphoma.(11)

- ***Discussion***: The risk of dogs developing mammary cancer is classically listed as 0.5%, 8%, and 26% higher depending on whether ovariohysterectomy is performed before the first, second or any estrus thereafter, respectively.(24) However, a metastudy that examined peer-reviewed journal articles addressing the subject of whether there was evidence of an effect of neutering or age of neutering on the risk of mammary tumors concluded that the evidence that neutering reduces the risk of mammary cancer is weak and does not constitute a sound basis for firm recommendations.(25) At the time when many of the studies of gonadectomy and mammary tumor risk were conducted (late 1960s), incidence rates for all malignant neoplasms were 453.4/100,000 female dogs. Mammary tumors accounted for half of these tumors, or 198.8/100,000. Thus, the actual overall risk at that time of any bitch getting a mammary tumor was only 0.2%.(26) These figures for increased risk of mammary cancer must be compared with the 200 to 400% increased risk of other cancers in spayed females. While about 30% of mammary cancers are malignant (27), as in humans, when caught and surgically removed early, the prognosis is very good.(28) This is in comparison to the other cancers listed, such as hemangiosarcoma, lymphosarcoma and bladder cancer, which are usually fatal. Given the balance of cancer risks listed above, owners of bitches should strongly consider having a hysterectomy (ovary-sparing spay) performed rather than an ovariohysterectomy, thus precluding the possibility of pyometra while retaining the benefits of the female hormones. In addition, the veterinary field should be developing programs for regular mammary examinations, including imaging, to facilitate early diagnosis of mammary cancer in all intact female dogs, as has been performed in women for decades.

**Behavior Considerations**

- Early age gonadectomy was associated with an increased incidence of noise phobias and undesirable sexual behaviors, such as mounting.(29)
- Vizslas gonadectomized at ≤ 6 months, between 7 and 12 months, or at > 12 months of age had significantly increased odds of developing fear of storms, compared with the odds for sexually intact dogs. Those gonadectomized at ≤ 6 months of age had significantly increased odds of developing a behavioral disorder, and the younger the age at gonadectomy, the earlier the mean age at diagnosis of a behavioral disorder or fear of storms.(23)
- Significantly more behavioral problems were seen in spayed and neutered bitches and dogs, with fearful behavior being most common in spayed bitches and aggression in neutered dogs.(30,31)
- In a prospective study, German Shepherd Dogs spayed between 5-10 months of age had significantly increased reactivity.(32)
- A recent study of more than 13,500 dogs showed no association between gonadectomy and aggression of dogs towards familiar people and other dogs. However, there was a significant increase in the odds of

moderate or severe aggression toward strangers for dogs gonadectomized at 7 to 12 months of age.(33)

**Discussion**: A number of the early studies claiming to show positive behavioral effects of spay/neuter were significantly flawed. For example, one of the most often quoted publications to support improvements in behavior, particularly aggression, after gonadectomy does not actually provide any statistical analysis (34) and in another the difference was not statistically significant.(35) Another study performed a statistical analysis but showed that the age when the dog was neutered was not correlated with the degree of behavior improvement.(36) Most critically, none of the above studies included control groups of intact dogs. One of the more important undesirable behavioral effects of spay/neuter for canine athletes was a finding of a significantly lowered energy level. This was shown in a well-controlled study that examined over 3500 dogs.(31)

**Other Health Considerations**

- Female, and sometimes male, dogs that are spayed/neutered before puberty have an increased risk of urinary incontinence and it is more severe in bitches spayed earlier.(37-40)
- Spayed female dogs displayed a significantly higher risk of hypothyroidism when compared to intact females.(41) A health survey of several thousand Golden Retrievers showed that spayed or neutered dogs were more likely to develop hypothyroidism.(2) Neutered male and spayed female dogs had higher relative risks of developing hypothyroidism than intact females.(42)
- Neutered females had a 22 times increased risk of developing fatal acute pancreatitis as compared to intact females.(43)
- Risk of adverse reactions to vaccines is 27 to 38% greater in neutered dogs as compared to intact.(44)
- In a study of female Rottweilers there was a strong positive association between retention of the ovaries and longevity.(45)
- A study of 90,090 dogs revealed that neutered and spayed dogs had a significantly increased risk of atopic dermatitis, autoimmune hemolytic anemia, hypoadrenocorticism, hypothyroidism, immune-mediated thrombocytopenia, and inflammatory bowel disease than intact dogs.(46)

**Summary**

Clearly, the veterinary practice of recommending that every dog not meant for breeding have its gonads removed at or before the age of 6 months is not a black-and-white issue. More studies need to be undertaken to evaluate the broader health effects of spaying and neutering, and in particular to investigate non-gonadectomy alternatives to prevent procreation such as vasectomy and hysterectomy. It is clear that the gonads are not just important for reproduction, but the hormones that they produce play a critical role in growth, development and long-term health. One study showed that spayed bitches had 30x higher levels of luteinizing hormone than intact bitches (47), and given that this hormone has receptors on diverse tissues throughout the body, and that binding of LH to its receptors can induce inflammatory cascades and cell division (48), it is possible that the lack of a feedback loop for this hormone might contribute to some of the negative effects of gonadectomy, at least in females.

**Preventing Procreation**

***Males***

If we leave the gonads intact, how can we prevent the production of unwanted dogs? For males, it is relatively easy to perform a vasectomy. One possible disadvantage is that vasectomy does not prevent some unwanted behaviors associated with males such as marking, humping and roaming. On the other hand, females and neutered males frequently mark and hump as well. Training is an effective solution to these behaviors. Appropriate containment is a solution to roaming. One potential issue is finding a veterinarian who can perform the procedure. Veterinary schools do not currently teach students how to perform vasectomies. However, the methodology has been described (49) and any veterinary surgeon can learn the technique.

***Females***

In females, the issues are more complex, because having a bitch in heat is inconvenient and leaving the uterus intact substantially increases the risk of pyometra, which can be serious and potentially fatal. One solution is to perform a hysterectomy (removal of the uterus), leaving the ovaries intact. As yet, however, the effects of this technique on female dogs have not been carefully studied. There is some suggestion that hysterectomized dogs continue to ovulate and may show behavioral changes, vulvar swelling and in some cases a minor discharge. Further, dogs that have this surgery will have intact ovaries, so veterinarians would need to establish an effective monitoring system for early detection of mammary cancer in intact bitches, as is available for women. In addition, there is the possibility of the dog developing a stump pyometra if small amounts of uterine tissue are left behind during the hysterectomy. This potential issue can be prevented, however, by careful removal of the entire uterus. It is to be hoped that the effects of this technique will be appropriately studied in the future.

**Retained Testicles**

For males with retained testicles, there is a logical solution, based on fact. A large prospective study showed that the incidence of testicular cancer in cryptorchid dogs was 12.7/1000 dog-years at risk.(50) In other words, if 100 dogs with retained testicles live to be 10 years old, approximately 13 of them will develop cancer in the retained testicle. The average age at which tumors develop in an undescended testes is 8.7 years.(51) These tumors are commonly benign, though they can grow quite large. Based on this study, it is recommended that dogs with retained testicles undergo abdominal ultrasound examination every two years to determine whether a tumor is developing in the retained testicle(s). If a tumor is detected, which will happen in a minority of dogs, it can be removed at that time. In addition, dogs with just one descended testicle should undergo a vasectomy on that spermatic cord. This solution allows the dog to have the benefit of its sex hormones, but prevents passing this likely genetic condition on to offspring.

**Individualized Medicine**

Most children in the decades after World War II had their tonsils removed when they suffered sore throats. Today this procedure is performed much less commonly because numerous studies have shown that removal of this immune organ imposes both short term and long term risks on the patient and provided questionable benefits (52). Likewise, in consideration of the evidence presented here, it is apparent that removal of the gonads presents significant risks to dogs. This is particularly true given that the procedure is not required to prevent procreation, the predominant reason for which gonadectomy is considered. Therefore, before performing gonadectomy, it is important that we assess each dog and its living situation individually, weighing the risks and benefits of removal of the gonads. It is also critical that we discuss the pros and cons of the procedures and their alternatives with our clients. There is no single solution that fits every dog.

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