Desexing - Pros and Cons of desexing, age to desex, procedures and conversations with clients

The decision whether to desex a dog and the ethics surrounding the decision are complex. There is a lack of evidence that desexing reduces the population of shelter dogs, and in some countries where desexing is not performed, there are lower rates of shelter surrender. This likely means that vets and owners need to make decisions based on the individual dog and the owner circumstances (e.g. do they have a fenced yard etc), versus a simple calculation of 'desexing is the responsible pet ownership decision'.

In one owner survey, 61% of male dog owners and 47% of female dog owners reported that they would not make the same decision, if given the choice again to desex. This highlights the importance of giving pet owners all the available information to make the decision. This may also provide a huge opportunity to build a more loyal client base with pet owners.

This pros and cons list should be interpreted in light of the disease prevalence, which can vary based on breed and region. For example, although desexing females reduces the risk of ovarian tumours, these tumours are uncommon. Some breeds are more prone to orthopaedic disease or various cancers, and it may be more important to delay desexing or find an alternative, in these breeds.

Therefore, although this information gives an overview, more detailed information may be required. The information should also be combined with the recommendation from a dog's own veterinarian, who will have knowledge of the region and pet owner base.

A **printable handout**, that may help assist to give some of the information to pet owners, can be found at this link. Warn owners that this information may change over time.
https://www.vss.net.au/desexing-your-dog.html

A much more detailed outline can be found in the 2024 WSAVA guidelines published in JSAP.
https://onlinelibrary.wiley.com/doi/10.1111/jsap.13724

In regards to desexing, there are some generally accepted trends based on the literature. The literature is a constantly changing entity, however there are some useful summary papers that have been published in the last two years and these references can be found within these notes. Three useful references are;

“Assisting Decision-Making on Age of Neutering for 35 Breeds of Dogs: Associated Joint Disorders, Cancers, and Urinary Incontinence”
https://www.frontiersin.org/articles/10.3389/fvets.2020.00388/full

“Assisting Decision-Making on Age of Neutering for Mixed Breed Dogs of Five Weight Categories: Associated Joint Disorders and Cancers”
https://www.frontiersin.org/articles/10.3389/fvets.2020.00472/full

"Decision-Making on Recommended Age of Spay/Neuter for a Specific Dog: General Principles and Cultural Complexities"
https://pubmed.ncbi.nlm.nih.gov/37330274/

“An Ancient Practice but a New Paradigm: Personal Choice for the Age to Spay or Neuter a Dog”
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8017224/

The generally accepted trends are as follows;

1 - Desexing at greater than 12-18 months will result in less influence on developmental diseases e.g. orthopaedic disease
2 - Desexing at a later age, can still have effects on degenerative disease. Preserving the hormones for longer, may reduce these diseases – e.g. neoplasia
3 - Hormones have an effect on growth plate closure, ligament and muscle formation, relaxin and Luteinizing Hormone (LH).
4 – There is literature bias. Literature bias is often the result of studies being retrospective in nature. When interpreting the literature, we need to look at why a patient is desexed or kept entire. For example, desexing in many countries is often coupled with better general husbandry and more compliant owners. Therefore any paper that shows a lifespan advantage with desexing is likely to be affected by bias. Some dogs are screened for orthopaedic disease because they are breeding dogs. These dogs will be intact. In some regions where a study is performed, there are greater numbers of various breeds, which can effect results. These are just three sources of bias, but there are many.

One other factor involved in decision making, is you have your pros and cons list - but also consider relative risk. An example, is that there is an increased risk of prostate cancer, however this is a low cause of overall dog mortality.

Below, is an overall summary of the Pros and Cons of desexing, with a few comments.

PROS OF DESEXING IN FEMALES

Mammary Cancer reduction of risk

There is likely a reduction in risk of mammary neoplasia. The evidence is conflicting and a meta-analysis found overall the evidence showed only a weak association. Prevalence of mammary cancer varies by breed, so taking a look at the breed related studies is advised.

You can monitor a dog for mammary neoplasia via palpation, so mammary cancer can be diagnosed early by dedicated owners (versus for example hemangiosarcoma). Around 50% of mammary tumours diagnosed in dogs are malignant.

Age, hormonal control and breed are the main influencing factors when it comes to mammary cancer. A recent 2021 summary paper by Hart, expressed that the dangers of not desexing, in regards to mammary neoplasia, *may* be overrated. Mammary cancer in dog is often treatable. (note - mammary cancer in cats is generally much more malignant).

"An Ancient Practice but a New Paradigm: Personal Choice for the Age to Spay or Neuter a Dog" https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8017224/

"Epidemiology of canine mammary tumours on the Canary Archipelago in Spain" https://bmcvetres.biomedcentral.com/articles/10.1186/s12917-022-03363-9 supports the trend towards neutering being protective, and identified at risk breeds.

The breeds most at risk – Samoyed, Schnauzer, Poodle, German Pinsher, Cocker Spaniel, Dobermann, West Highland White Terrier, Dalmation, Dachshund, Yorkshire Terrier and Boxer. Lower risk – Chihuahua, English Pointer, Labrador Retriever.

"Ovariectomy reduces the risk of tumour development and influences the histologic continuum in canine mammary tumours" VCOT 2021.

This paper found that desexing at adulthood still reduces the risk of mammary tumour development, so again brings into question the '6 month' for desexing dogma.

Intact dogs were more likely to have multiple tumours and were more likely to have benign tumours (2/3rds were benign). Neutered dogs were more likely to have malignant tumours

(>1/2 were malignant). Neutered dogs also had tumours of significantly greater aggressive subtypes. Bigger tumours were more malignant, which concurs with other papers. They noted however, that smaller tumours should not be ignored especially if the dog was desexed.

"Risk factor analysis and clinicopathological characteristics of female dogs with mammary tumours from a single-centre retrospective study in Poland"

This paper found that > 2/3rds of tumours were malignant. Benign tumours were more common in younger dogs and they were smaller.

Breeds found to be prone – dachshund, Yorkshire terrier, GSD, Boxer, English cocker spaniel.

Breeds more likely to have benign tumours – Chihuahua, Jack Russel Terrier, Labrador
Breeds more likely to have malignant tumours – German Shepherd Dogs, Standard Schnauzer.

My conclusion re mammary neoplasia:
When taking all the literature to date into account, there is little evidence to suggest dogs should be desexed prior to skeletal maturity to reduce the risk of mammary tumours. Post-adulthood, the decision to desex in regards to mammary tumours should take breed into account.
A further note, is that for all dogs (desexed and entire), most small mammary tumours are treatable. Early surgical resection is advised and is often curative.

<u>Ovarian tumours, uterine neoplasia, vaginal and vulval tumors.</u>

These tumours are uncommon.

Uterine neoplasia is often benign so ovariohysterectomy is curative.

Ovarian tumours are uncommon. Ovariectomy and ovariohysterectomy are protective. Mortality rate for ovarian tumours is overall fairly low.

Desexing is likely to be protective against vaginal and vulval tumours, which are commonly leiomyomas. In dogs with confirmed leiomyoma, desexing is often part of the treatment.

Pyometra, metritis and ovarian cysts

Ovariohysterectomy, ovariectomy and ovary-sparing hysterectomy prevent and treat pyometra and metritis. Ovariohysterectomy and ovariectomy prevent ovarian cysts. They all prevent problems associated with pregnancy and parturition.

Incidence in intact dogs has been reported to be between 2 and 25% by 10 years. The incidence also seems to vary based on breed, so referral to breed related studies as above is recommended. Pyometra can result in septic shock and renal failure and mortality rates between 4 and 17% have been reported.

It is important to note, that in regards to ovary sparing hysterectomy, it is important to remove the entire uterus.

PROS OF DESEXING IN MALES

Testicular tumour reduction

Testicular tumours are common, but they have a low rate of metastasis. Castration is preventative and generally curative. Cryptorchid testicles may be more prone to testicular tumours. This condition is also heritable so it is recommended that cryptorchid dogs are castrated for both these reasons.

Reduction in benign prostatic hyperplasia, chronic prostatitis, perianal adenomas and perianal hernias.

Benign prostatic hyperplasia (BPH) affects around 50% of intact dogs by 5 years of age and 95-100% by 9 years. Dogs with BPH are prone to prostatic cysts, prostatitis and prostatic abscesses.

PROS OF DESEXING IN MALES AND FEMALES

Reduction in transmissible venereal tumours

Transmissible venereal tumours are fairly common in regions where there are lots of intact dogs. Maybe if we start advocating against desexing we may see a greater prevalence of these. They are sexually transmitted and metastasis occurs in 5-17%.

Overall lifespan advantage?

One study found that lifespan was increased in dogs that were desexed. They found that although the risk of death by neoplasia increased, the risk of death by trauma and infectious disease increased. There are biases in this type of research, in that in some regions desexing is often associated with better husbandry and compliant owners. It does highlight however, that it is

important for dogs that are kept entire, to be kept in a secure yard to avoid escape episodes that can result in vehicular trauma.

Lifespan studies also do not take age at desex into account, so some dogs may have been exposed to hormones for longer than others. Also, the finding of increased lifespan seems more consistent in desexed females and the association is less for desexed males.
Lifespan studies also do not take into account quality of life. Is it better to live for a shorter period of time in less pain? This is an ethical dilemma.

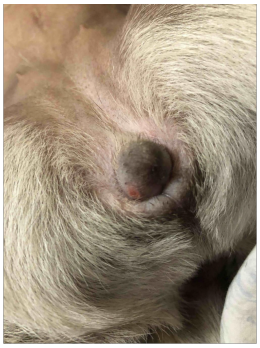
CONS FEMALES

Urinary incontinence

This problem affects around 6-9% of neutered females and larger breeds are more prone to this. There is some evidence to suggest that those dogs spey prior to 3 months of age have the highest risk. Desexed females in general, have a much higher prevalence compared to intact females. Prevalence also varies by breed, so checking breed specific studies is recommended (see examples above). Dogs greater than 10kg, as especially dogs greater than 30kg, are at the greatest risk.

It can be medically managed, however this can be an expense to owners.

Female vulval development



Development of the female vulvar is dependent on sex steroids. There is an increased risk of recessed vulva when females are desexed before development.

CONS OF DESEXING IN THE MALE

Increased risk of prostatic carcinoma

Prostatic carcinoma is potentially more prevalent in desexed dogs. Prostatic carcinoma is an aggressive neoplasia with a high metastatic rate.
There is a low prevalence of this disease. Risk varies by breed.

CONS OF DESEXING IN MALES AND FEMALES

Cancer
The prevalence of various cancers, and whether or not the risk is increased or not with desexing, varies by breed. It may also vary depending on the age the patient is desexed i.e. period of time they were exposed to hormones.

Briefly, these are the cancers that evidence suggests are increased with desexing. All of these cancers have multiple factors affecting their development, prevalence and prognosis and cancer is a complex disease. For further information on these neoplasias an excellent resource is vsso.org, specifically the webpage https://vsso.org/home/#homecancercatsdogs
I also highly recommend The Pet Oncologist. https://www.thepetoncologist.com/

This below reference looks at 35 common dog breeds and the prevalence of joint disorders, cancers and urinary incontinence.
https://www.frontiersin.org/articles/10.3389/fvets.2020.00388/full

It is important to note, that this article does not take into consideration the potential decreased risk of trauma and infectious disease in the desexed population.

In this further paper, by the same authors (Hart et al), in 2023, 5 additional breeds were examined.
https://pubmed.ncbi.nlm.nih.gov/37330274/

The 5 breeds, and the recommendations (in brief) were;

German Shorthaired Pointer, Newfoundland, Mastiff
– Recommendation to wait until 1 year of age to desex in both ages.

Ridgeback and Siberian Husky – Wait until after 6 months (overall low prevalence of joint disorders and cancer)

In a similar article examining mixed breed dogs, no increased risk of cancer was found in any weight group with desexing. They examined lymphoma, mast cell tumour, hemangiosarcoma and osteosarcoma.

Transitional cell carcinomas

Transitional cell carcinomas account for around 2% of cancer. Desexing increases the risk. It is also an aggressive cancer with a high metastatic rate. Risk also varies by breed.

Lymphoma

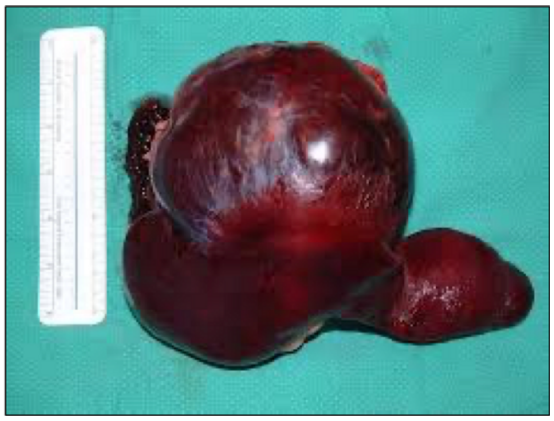
Lymphoma is a fairly common tumour. There is an increased prevalence in desexed dogs. It has fairly high remission rates with chemotherapy (60-90%). Risk varies by breed.

Mast cell tumours

These are common tumours and account for around 20% of cutaneous tumours. The prognosis is variable depending on the grade and stage of mast cell tumour. Risk varies with breed.

Hemangiosarcoma

Hemangiosarcoma accounts for around 5-7% of non-cutaneous neoplasia. It has a poor prognosis and only 10% of dogs survive greater than 12 months even with surgery and chemotherapy. Risk of splenic and cardiac hemangiosarcoma is increased in desexed dogs. Risk varies by breed.



Osteosarcoma

Osteosarcoma is a malignant bone tumour. It is malignant in nature with local aggressiveness and a high rate of metastasis often to the lungs. Around 90% of patients die of metastatic disease within a year if amputation is the only treatment. There is an increased risk in desexed dogs. Risk varies by breed, and larger breeds are more prone. Of important note, is the Rottweiler, 25% of which will develop an osteosarcoma. The earlier the Rottweiler is desexed, the higher the risk of osteosarcoma. This trend is seen in some other breeds, and desexing after a year of age may reduce the risk, some studies have shown.

Orthopaedic disease

There have been a number of breed specific studies and the finding is generally that some breeds, when desexed prior to skeletal maturity, have an increased risk of joint diseases. The finding is not always consistent among males and females.

A few examples of breeds at increased risk of orthopaedic disease are Golden Retrievers, Labrador Retrievers, German Shepherds, Rottweilers, male Beagles and female Australian cattle dogs. This is evidence that for these patients, we should consider desexing at skeletal maturity.

This below reference looks at 35 common dog breeds and the prevalence of joint disorders, cancers and urinary incontinence.
https://www.frontiersin.org/articles/10.3389/fvets.2020.00388/full

A similar article examined mixed breeds of various weight ranges.
"Assisting Decision-Making on Age of Neutering for Mixed Breed Dogs of Five Weight Categories: Associated Joint Disorders and Cancers"
https://www.frontiersin.org/articles/10.3389/fvets.2020.00472/full

In this further paper, by the same authors (Hart et al), in 2023, 5 additional breeds were examined.
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The 5 breeds, and the recommendations (in brief) were;

German Shorthaired Pointer, Newfoundland, Mastiff
– Recommendation to wait until 1 year of age to desex in both ages.

Ridgeback and Siberian Husky – Wait until after 6 months (overall low prevalence of joint disorders and cancer)

It is important to note, that these articles do not take into consideration the potential decreased risk of trauma and infectious disease in the desexed population.

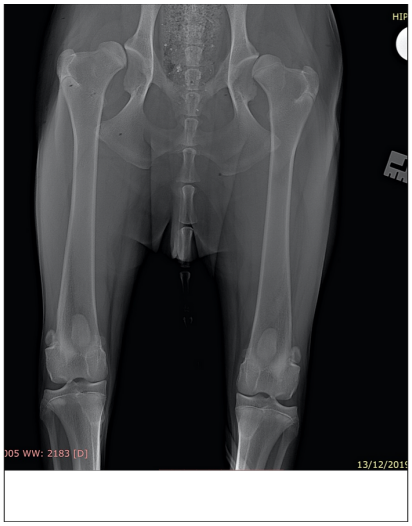
Orthopaedic disease is also complex, with many different proposed etiological contributors. Further information beyond the scope of this post, should be obtained as there are other factors that can reduce the incidence of orthopaedic disease (namely, weight control and core strengthening activities).

Briefly, specific orthopaedic diseases, that may have an increased prevalence in the desexed population are;

Cruciate ligament disease

2-4% of dogs get cruciate disease
Desexing is a risk factor for some breeds and larger mixed breeds.
One study found dogs desexed prior to skeletal maturity had a 3 fold increase in tibial plateau angle

Hip dysplasia



Some breeds and mixed breeds >20kg desexed prior to skeletal maturity, have an increased risk of hip dysplasia.
Golden Retrievers have an increased risk in males desexed prior to 1 year of age.
Boxers de-sexed at least 6 months prior to diagnosis were 1.5x more likely to develop hip dysplasia.

Elbow dysplasia
The link between elbow dysplasia and desexing is less well defined. Desexed mixed breed dogs over 20kg had a higher risk of elbow dysplasia if desexed <12 months.

Other cons of desexing (not related to cancer or orthopaedic disaese)

Obesity
Desexing results in increased appetite and slowed metabolism. It results in a 30% less energy requirement.

Diabetes
There is an increased risk in the desexed population

Autoimmune disease
There is a possible increase in risk of immune-mediated disease, addisons, hypothyroidism, IBD, cushings and epilepsy – the effect tends to be stronger in females.

Intervertebral disc disease
There is an increased risk in desexed females and an increased risk in males and females desexed prior to 12 months of age. Consider desexing dachshunds >12 months of age.

Other
There is a possibly an increased risk of GDV and cardiomyopathy but the literature is inconclusive and one study doesn't always reproduce another.

Surgery and anaesthetic risk

The anaesthetic mortality rate in cats is around 0.11% cats and in dogs around 0.05%.

Other anaesthetic complications include hypotension, hypoventilation, bradycardia, arrhythmias and hypothermia.

Surgical complications occur in roughly 10% of patients. These include hemorrhage, wound infection, stump pyometra, ovarian remnant syndrome, seroma, iatrogenic ureteral ligation, pain, splenic laceration, iatrogenic urethral trauma.

Older, larger dogs may have an increased risk and this may need to be considered if we are recommending a delay in desexing.

BEHAVIOUR - MIXED RESULTS - PROS AND CONS

The effects on behaviour are less straightforward than it was once believed. This is especially true for aggressive and nuisance behaviours, where there are multiple factors involved.

<u>A summary of the pros of desexing are;</u>

- It decreases urine marking, mounting and roaming in some studies of dogs (one study reported around a 40% reduction in these behaviours). One study revealed that the effect of reducing urine marking was lost as the age of desexing increased. This seemed specific to males. A recent paper (link below) found an increase in problem behaviours however in the desexed population.
- It can reduce hormonally based inter-dog aggression (one study reported around a 20% reduction only however)
- The most serious human bite injuries involve intact dogs. This could be related to the desexed population being tied to better husbandry and owner compliance however. There are many factors involved in dog bite behaviour. Overall, a recent human systematic review was in favour of desexing to reduce dog bites. It did however note many limitations to the observational studies included in the review.
- Intact dogs were significantly more likely to be referred for aggression and reactivity in one study (the same bias as above may apply)

WSAVA reproduction guidelines table summaries below.

Table 2. Health benefits of sterilisation with loss of gonadal steroid hormones in female dogs

Condition	Occurrence (%)	Substantial morbidity*	Breed at risk†	Influencing factors
Ovarian tumours	0.5 to 6.3 (GCT: 50% among ovarian tumours)	Yes	No	Age
Pyometra, CEH	>20 to >50 until >10 years of age	Yes	Yes‡	Age, breed/genetics geographic location
Vaginal tumours	1.9 to 3 (of all tumours)	No	No	Age, steroid hormones
Uterine tumours	0.03 to 0.4 (of all tumours)	Yes	No	Age
Mammary tumours	8.4 to 52	Yes	Yes§	Age, age at gonadectomy, gestagens, obesity, epigenetics …
Transmissible venereal tumour (TVT)	<1 (reported incidence)	No	No	Mating
Vaginal prolapse	–	No	No	Large breeds, familiar disposition
Progesterone dependent diabetes mellitus	Assumed to be low	No	Yes¶	Age, increased body condition score, exogenous hormones (gestagens)
Behaviour: Overt pseudopregnancy	>50 to 75	No	Yes‖	Nutrition, another lactating female dog

*Can be life-threatening
†According to literature (see chapter 4. health benefits of gonadectomy)
‡Golden retriever; Leonberger, Irish wolfhound, Bernese mountain dog, great dane, Staffordshire bull terrier, Rottweiler, Bullterrier, Doberman, Bouvier des Flandres, Airdaleterrier (Jitpean et al., 2012)
§English springer spaniel, English cocker spaniel, Brittany spaniel, Doberman, boxer, English setter, Pointer, German shepherd dog, poodle, dachshund; Staffordshire bull terrier, Lhasa apso, Yorkshire terrier, Maltese
¶Elkhounds, Nordic spitz breeds
‖Afghan hound, beagle, boxer, dachshund, Dalmatian, Basset hound, Pointer

Table 5. Health benefits of sterilisation with loss of gonadal steroid hormones in male dogs

Condition	Occurrence (%)	Substantial morbidity*	Breed at risk†	Influencing factors
Testicular tumours	16 to 27% among all tumours	Yes	No	Age, cryptorchidism, environmental factors
Benign prostate gland hyperplasia (BPH)	32.8% in dogs aged 7 to 10 years, 50% of all canine diseases	Yes	Yes‡	Age
Prostatitis	Dependent on population	Yes	No	Other prostatic diseases
Perianal gland adenomas	–	No	Yes§	Androgens, oestrogens
Transmissible venereal tumour (TVT)	<1	Yes	No	Demography, mating
Perineal hernia	–	Yes	No	Age, enlarged and dislocated prostate gland

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†According to literature
‡Large breeds; Doberman, Rottweiler, German shepherd dog, Rhodesian ridgeback and Labrador retriever
§Cocker spaniels

A summary of the cons of desexing are;

- Intact german shepherds were found to be more trainable in one study - it is unknown if this applies to other breeds
- In one recent paper, there was an increased number of dogs that were fearful of unfamiliar dogs/humans and had increased sound phobia in the desexed population
- Potential negative effect on aggressive behaviours - see below.
- A recent 2023 paper, found that the longer the dog was exposed to hormones, the less nuisance and problematic behaviours were exhibited. This paper defined problematic behaviour as aggression, anxiety-based behaviors, and extreme fears, and nuisance behaviors as urine marking and mounting behavior.

Aggression

The effect on aggression is conflicting. Aggressive behaviours in ENTIRE dogs may decrease as dogs age.

There is potentially an increased dominance aggression towards family members. Females and puppies that had already shown signs of aggression had the highest risk. The risk reduced the older they were de-sexed. This finding of increased aggression towards family members is not replicated in all studies and one study found a 30% reduced risk.

Age to desex, in regards to behaviour

In terms of the age to desex. In one study they compared groups desexed prior to around 6 months versus post 6 months of age. Those desexed early were more likely to display noise phobias and sexual behaviours and males were more likely to show aggression towards family members and bark at visitors, but the post 6 month group were more likely to develop separation anxiety, urination due to fear and escape behaviour.
In a further study however, there was no difference before and after the 6 month mark in these behaviours.

A 2022 paper, based on owner questionnaire, found that desexing reduced aggressive behaviours towards other dogs, roaming, mounting, urine marking and decreased dogs overall activity.

In 2023, a paper found a decrease in nusiance and problematic behaviours, in dogs with longer exposure to hormones.
https://avmajournals.avma.org/view/journals/javma/261/3/javma.22.08.0382.xml

Summary - there are very conflicting results on the evidence of desexing on behavoiur.

WSAVA reproduction guideline table summary on behaviour.

Behavioural problem	Improvement (n)	No change (n)	Deterioration (n)
Fear reaction to • Loud noises • Unfamiliar objects • Jumping, barking, growing dogs	–	–	All spayed bitches had higher numerical rating scores than intact bitches
Aggression, mostly fear and possessive and female–female	–	–	68% of spayed *versus* 32% of intacts
Excitability Unsecurity Aggression Separation anxiety	–	–	Anxiety score in PPN group sign. higher than in controls

• Aggression	53% (25/47)	21 (10/47)	21% (10/47)
• Aggression towards other dogs	3.1% (12/382)	–	7% (28/382)
• Anxiety	48% (20/41)	41 (17/41)	9.7% (4/41)
• Restlessness, nervousness	87.1% (25/32)	15.6 (5/32)	6.2% (2/32)
Overt pseudopregnancy	100%	0	0
Approach of an unfamiliar human with a dog unknown	–	–	Offensive reactivity scores higher than in intact dogs
Aggression towards other dogs	55.2% (from 58)	–	–
Aggression towards persons	55.9% (from 39)		
Escaping	52.5% (from 40)		
Aggression Fear and anxiety Excitability Attachment and attention seeking Social behaviour	Decrease in aggression scores between 1 and 3 years in 8 PPN and 8 controls	No sign. differences between groups	Increase in aggression score between 1 and 3 years in 20 PPN and 9 controls (more likely for golden retriever cross Labradors)
Aggressive dominance towards owners	8.9% 11.9%	62.2% 73.8	28.9% 14.3% ⇨Detrimental mainly when aggression was present before gonadectomy in bitches <12 months (50%)

GENERAL SUMMARY

WSAVA reproduction guidelines table summaries below.

Table 2. Health benefits of sterilisation with loss of gonadal steroid hormones in female dogs

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‡Large breeds; Doberman, Rottweiler, German shepherd dog, Rhodesian ridgeback and Labrador retriever
§Cocker spaniels

Table 8. Health detriments of sterilisation with loss of gonadal steroid hormones in female dogs

Condition	Occurrence (%)	Further influencing factors	Breeds at risk*
Mast cell tumour	0.24 to 0.29 Among skin tumours: 20	BW, age, age at gonadectomy	Yes†
TCC	1	Age	No
Osteosarcoma	0.2 to 8.9	BW, age, size, sex, age at gonadectomy	Yes‡
Lymphoma	0.02 to 0.1	Age at gonadectomy	Yes§
Haemangiosarcoma	5% of all non-dermal primary malignant tumours	Age at gonadectomy	Yes¶
Urinary sphincter mechanism incompetence	5 to 20	BW, age, size, sex, age at gonadectomy, short urethra	Yes‖
Orthopaedic diseases	0 to 22; dependent on disease and influencing factors	BW, age, age at gonadectomy	Yes††
Hypothyroidism	2.05	Environment, age	Yes‡‡
Hypoadrenocorticism	0.4	Age	Yes§§
Obesity	Increasing with age	Feeding, physical activity, sexual status, age and breed size	Yes¶¶
Behaviour: Increased reactivity in some breeds, increasing fear/shyness depending on age at gonadectomy	Dependent on influencing factors	Age at gonadectomy, housing, training, experiences…	Not proven
Life expectancy: questionable, some indication in female Rottweilers	Dependent on influencing factors	Diseases, especially cancer	Not proven

Table 9. Health detriments of sterilisation with loss of gonadal steroid hormones in male dogs

Condition	Occurrence (%)	Further influencing factors	Breeds at risk*
Prostate gland tumour	<1	Age, chronic inflammations	Yes†
Mast cell tumour	0.24 to 0.29 (10 to 21% among all skin tumours)	Age, BW (>20 kg)	Yes‡
TCC	<1 (less in males than in females)	Age, sexual status	No
Osteosarcoma	0.2 to 8.9 (more in males than in females)	Age, BW, sexual status, age at gonadectomy	Yes§
Lymphoma	0.02 to 0.1 (less in males than in females)	Age at gonadectomy, sexual status	Yes¶
Haemangiosarcoma	5% of all non-dermal primary malignant tumours, 50% of all splenic tumours	Age, age at gonadectomy, light skin and short hair	Yes‖
Urinary sphincter mechanism incompetence (USMI)	0.94	Age, short urethral length, caudal bladder position	Not proven
Orthopaedic diseases	0 to 22; dependent on disease and influencing factors	BW, age, age at gonadectomy	Yes††
Obesity	Increasing with age	Feeding, physical activity, sexual status, age and breed size	Yes‡‡
Hypothyroidism	2.05 (less in males than in females)	Environment, age	Yes§§
Hypoadrenocorticism	0.4 (less in males than in females)	Age, sexual status	Yes¶¶
Immune disorders	Less in males than in females	Age, sexual status	No
Behaviour: Increase in aggression in some cases, also dependent on age at gonadectomy	Dependent on influencing factors	Age at gonadectomy, housing, training, experiences…	Not proven

PROCEDURE OPTIONS

Females:
Ovariohysterectomy – traditional approach.
Ovariectomy – spares the uterus. This is the traditional method for laparoscopic spey. Because you remove the hormonal effect on the uterus this procedure will not result in pyometra etc. It is essentially the same procedure as above in most respects.

Ovary-sparing hysterectomy – this procedure renders a dog sterile, however the hormones are maintained. You can leave one or both ovaries and it should be outlined in the records which ovary is left. The dog has a heat cycle and there may be a small amount of bloody discharge and they will be attractive to male dogs. They may have the behavioural side effects of being on heat such as yowling etc. Theoretically they cannot get a pyometra, however if you leave any uterine endometrial tissue, then this can result in a stump pyometra. You need to aim to remove the uterus beyond the cervix.
There is a new paper reporting on the outcomes and complications of this procedure, that was published in 2023.
https://avmajournals.avma.org/view/journals/javma/261/3/javma.22.08.0382.xml

Salpingectomy - Tubal ligation – in every way this dog is intact, but just can't become pregnant. The exact technique and complication rate has not been well-reported in the literature, it can be technically challenging and one complication is iatrogenic uterine ligation instead, which leads to fluid building up in the uterus and problems. It is not my preferred technique for hormone-sparing sterilisation for these reasons.
Males:

Traditional castration - removes the hormones

Vasectomy - preserves the hormones.
The outcomes of vasectomy were also looked at in the 2023 paper
https://avmajournals.avma.org/view/journals/javma/261/3/javma.22.08.0382.xml

In summary, the new paradigm, is for the vet and pet owner to use the available data-based information to decide on the best age and procedure for the dog dependent on owner situation and dog breed. If there is no data available on a certain breed, extrapolation from similar breeds may be possible.

Description of vasectomy and OSS can be found by following the link to this paper
https://www.frontiersin.org/articles/10.3389/fvets.2020.00342/full

AVA statement
https://www.ava.com.au/policy-advocacy/policies/companion-animals-health/desexing-surgical-sterilisation-of-companion-animals

American College of Theriogenology Statement
https://cdn.ymaws.com/www.theriogenology.org/resource/resmgr/Docs/spay-neuter_basis.pdf