BVA British Veterinary Association | Policy statement

BSAVA BRITISH SMALL ANIMAL VETERINARY ASSOCIATION

BVA and BSAVA policy position on Neutering of Cats and Dogs

Introduction

Although commonly performed, neutering is not a trivial procedure and there are multiple clinical and contextual factors to consider before deciding when, how, and whether to neuter a cat or dog. The evidence base has changed since BVA previously considered this issue in 2019 and will continue to change as new research is published. This policy draws together the current key research, and includes guidance for vets in practice, to support decision making in relation to neutering.

This policy does not attempt to discuss ethical questions of neutering as individuals will have differing views. The policy concentrates on the impact of neutering on the health and welfare of the animal in question, their potential offspring, and on the population to which they belong. It attempts to contextualise decision-making, considering the animal and the owner, the environment in which they live, and broader societal factors.

Methods of neutering

For the purposes of this policy, neutering refers to veterinary intervention to prevent reproduction in dogs and cats of either sex. Neutering may be medical or surgical, temporary or permanent. Various methods of neutering are set out in detail below, and summarised at Annex A, including some options which are not currently available in the UK.

Surgical neutering

There are various surgical procedures used to prevent fertility in male and female cats and dogs, involving full or partial removal of the reproductive organs. There are risks to neutering procedures, as with any surgical procedure, although these are generally accepted to be low for both males and females[1]. The risks of surgical complications are considered in more detail below.

Males

Castration

In male animals, surgical castration is generally understood to refer to the removal of the testicles (orchiectomy) from the scrotum or, in cryptorchid males where testicle(s) have failed to descend into the scrotum, removal of the retained testicle(s) from either the inguinal canal or the abdomen. This surgical technique is commonly performed to prevent unwanted breeding, and to prevent or treat testosterone-associated disorders and behaviours in male dogs and cats.

Removal of the testicles results in loss of testosterone production, which prevents the feedback of this hormone on the pituitary gland and hypothalamus. This means that luteinising hormone (LH) levels are continuously raised above normal, in gonadectomised dogs. LH receptors have been found in the thyroid and adrenal glands, gastrointestinal tract, cranial cruciate ligament, and lymphocytes[2], leading to the hypothesis that persistently raised LH levels may be related to the increased incidence of some diseases such as lymphoma and cruciate ligament rupture in neutered dogs.

[1] "NASAN Benchmark Report," *RCVS Knowledge* https://knowledge.rcvs.org.uk/quality-improvement/tools-and-resources/vetaudit/nasan/nasan-report/

[2] Kutzler, Michelle A. "Possible relationship between long-term adverse health effects of gonad-removing surgical sterilization and luteinizing hormone in dogs." Animals 10, no. 4 (2020): 599

Vasectomy

Research into the health benefits of sex hormones in recent years has led to interest in the use of other methods to prevent breeding in dogs. Vasectomy (vas deferens ligation, sealing or tying) can be used to render an animal infertile and prevent unwanted breeding by physically preventing the release of the sperm from the testicles, without the accompanying (positive or negative) hormonal impact of medical or surgical castration. Studies are limited, but it appears that longer exposure to testosterone may have health benefits, such as lowering the risk of specific cancers and orthopaedic conditions[3]. However, vasectomy will not have the potential behavioural benefits of castration, or the health benefits of preventing testosterone-dependent conditions such as prostatic hyperplasia and perianal adenomas. This procedure is rarely performed in cats.

For most surgeons, vasectomy can be a lengthier, more complex surgery than castration. Furthermore, vasectomy maintains the appearance of an intact male, which some owners may perceive as an aesthetic benefit, but could cause issues encountering other dogs (females in heat for example). Vasectomy is rarely performed in the UK[4], and may only be an option to avoid unwanted breeding, where there is a clinical reason or ethical preference to avoid castration. Although potentially reversible, this has only been shown in experimental and small clinical studies in dogs and other canids[5,6], with variable outcomes - reversal cannot be guaranteed because vasectomy may cause epididymal or testicular changes that prevent return to fertility[7].

Females

In female animals, surgical procedures to prevent fertility (spaying) can consist of the removal of:

- the ovaries alone (ovariectomy - OE)
- the ovaries and part, or all, of the uterus (ovariohysterectomy - OHE)
- the uterus alone (hysterectomy, also known as 'ovary-sparing spay' - OSS)
- fallopian tube ligation or removal (salpingectomy)

The partial or full removal of the uterus is dependent on surgical technique and for the purpose of this policy is treated as one in terms of removal of the uterus in an OHE procedure. These procedures can be done through open laparotomy, where OHE is usually performed, or minimally invasive laparoscopy, where OE is usually performed. It can also be done alongside other procedures, including caesarean section. Laparoscopic surgery is generally less painful, induces less surgical stress, and is associated with quicker recovery and fewer wound complications[8]. However, the surgical method used will very much depend on other factors, including costs, and may not be appropriate for some veterinary care contexts.

Ovariohysterectomy and Ovariectomy

Removal of the ovaries, with or without the uterus, results in the loss of ovarian hormones, which prevents the feedback of these hormones on the pituitary gland and hypothalamus. As with gonadectomy of males, this means that for female dogs who have their ovaries removed, LH levels are continuously raised above normal and do not fluctuate in line with the normal seasonal reproductive cycle.

The limited evidence available indicates that ovariectomy alone does not increase risk for uterine pathology e.g. neoplasia or endometritis/pyometra provided the ovaries are completely removed[9]. As it is usually performed laparoscopically, it may be associated with quicker recovery and fewer wound complications.

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[3] Zink, Chris, Mikel M. Delgado, and Judith L. Stella. "Vasectomy and ovary-sparing spay in dogs: comparison of health and behavior outcomes with gonadectomized and sexually intact dogs." *Journal of the American Veterinary Medical Association* 261, no. 3 (2023): 366-374.

[4] "Vasectomy," Vetlexicon Canis, https://www.vetlexicon.com/canis/surgery-soft-tissue/articles/vasectomy/.

[5] Urry, Ronald L., John Thompson, and Abraham TK Cockett. "Vasectomy and vasovasostomy. II. A comparison of two methods of vasovasostomy: silastic versus chromic stents." *Fertility and sterility* 27, no. 8 (1976): 945-950..

[6] DeMatteo, Karen, Sherman Silber, Ingrid Porton, Kathy Lenahan, Randall Junge, and Cheryl Asa. "Preliminary tests of a new reversible male contraceptive in bush dog, Speothos venaticus: open-ended vasectomy and microscopic reversal." *Journal of Zoo and Wildlife Medicine* (2006): 313-317.

[7] Sarrat, R., J. Whyte, A. Torres, F. Lostale, and Mª Díaz. "Experimental vasectomy and testicular structure." *Histology and histopathology* (1996).

[8] Moxon, R., E. Yarwood, H. Hawkins, J. Came, and G. C. W. England. "Laparoscopic ovariectomy provides favourable peri-and postoperative outcomes compared with ovariohysterectomy via celiotomy in bitches." *Journal of Small Animal Practice* (2025). Pract. https://doi.org/10.1111/jsap.70013

[9] Candetoft, Maria Norell. "The incidence of uterine pathology in ovariectomised bitches." *Veterinary Evidence* 5, no. 3 (2020).

Ovarian Sparing Spay (OSS) and Fallopian tube surgery
OSS may be chosen for similar reasons to vasectomy in a male, i.e. to prevent unwanted breeding while retaining the health benefits of the sex hormones produced by the ovaries. Alternatively, although currently rarely performed in the UK, fallopian tube surgery will prevent unwanted breeding by physically preventing the release of the ovum from the ovaries. OSS and fallopian tube surgery are rarely performed, in cats in particular, but research into the health benefits of sex hormones in recent years has led to interest in its use to control breeding in dogs.

Preserving the ovaries avoids the persistent supraphysiological levels of LH seen in female dogs who have had their ovaries removed which, as discussed above, has been hypothesised to increase incidence of some health conditions in gonadectomised dogs. Fallopian tube surgery or OSS will prevent pregnancy and allow continued exposure to gonadal hormones but will not prevent the development of hormone-dependent conditions such as pyometra and mammary tumours, although OSS will prevent pyometra provided the uterus is fully removed.

In addition, female dogs who have undergone OSS or fallopian tube ligation/salpingectomy will still undergo oestrus cycles and related fluctuating levels of hormones, which could cause issues such as unwanted attention when encountering other dogs, particularly intact males.

Temporary medical neutering

Unlike most surgical neutering, medical neutering can be reversible, and therefore can be used if a return to fertility is required, for example in breeding populations. Hormonally influenced behaviours may be altered by medical neutering, however the permanence and reversibility of the effects are not predictable. That said, medical neutering should not be considered a definitive predictor of the behavioural outcomes of surgical castration, as the effects may not be identical. It can, however, assist decision-making when owners are uncertain about permanent neutering. Medical neutering is generally lower cost (although it needs to be repeated to maintain infertility so there is a long-term financial impact), and a less invasive procedure that requires no anaesthetic.

GnRH Agonist Implants

Male Dogs
The only medicine licensed for suppressing fertility in male dogs in the UK is a gonadotropin-releasing hormone (GnRH) agonist (deslorelin), available as a slow-release implant which reversibly shuts down the hypothalamic-pituitary-gonadal axis. Deslorelin implants[10] were licensed for male dogs in the UK in 2007.

The GnRH agonist implant gradually releases a synthetic hormone which reduces testosterone levels circulating in the blood, causing the dog to stop producing sperm, suppressing fertility, and reducing libido[11]. The implant takes effect within 6 weeks, lasts 6-12 months (depending on the dose used), and can be repeated if necessary[12]. It can be removed if the animal has any adverse reaction but otherwise can be left in place as the effects ultimately wear off.[13]

A deslorelin implant is not a permanent solution. Fertility (based on sperm production and morphology) and testosterone levels usually return to normal[14] within a few months (the timeframe is variable)[15] if the implant is not repeated every 6 – 12 months. It may have some side effects which will need to be monitored. One commonly recognised side effect is a short-lived ‘flare-up’ phase during which exposure to the GnRH agonist has stimulatory effects on the pituitary gonadal axis, causing an increase in serum testosterone and resulting in transitory changes in behaviour such as an increase in sexual behaviour or increased aggression towards male

[10]Virbac Limited, Summary of Product Characteristics (datasheet). Suprelorin 4.7mg. Available at https://www.noahcompendium.co.uk/?id=-484967 and Suprelorin 9.4mg. Available at https://www.noahcompendium.co.uk/?id=-460783
[11] Driancourt, Marc Antoine, and Joyce R. Briggs. "Gonadotropin-releasing hormone (GnRH) agonist implants for male dog fertility suppression: a review of mode of action, efficacy, safety, and uses." *Frontiers in Veterinary Science* 7 (2020): 483.
[12] Virbac Limited, datasheet op cit
[13] Stempel, Sabrina, Hanna Körber, Larena Reifarth, Gerhard Schuler, and Sandra Goericke-Pesch. "What happens in male dogs after treatment with a 4.7 mg Deslorelin implant? II. Recovery of testicular function after implant removal." *Animals* 12, no. 19 (2022): 2545.
[14] Virbac datasheet, op cit
[15] Lucas, X. "Clinical use of deslorelin (GnRH agonist) in companion animals: a review." *Reproduction in domestic animals* 49 (2014): 64-71.

dogs[16]. Testicular shrinkage is another common side effect. It may cause a reduction in a dog's activity levels[17], which could lead to weight gain. However, this can also be a side effect of surgical neutering and is not therefore a reason to favour one method over the other.

There is, as yet, limited evidence to show the long-term impact of medical castration on preventing testosterone-related diseases, a proven effect of surgical castration, although there are potential benefits as adjunct therapy in pathologies exacerbated by reproductive hormones[18]. Limited studies involving small numbers of dogs have shown that GnRH agonists such as deslorelin may be effective as treatment for benign prostatic hyperplasia (BPH) and perianal adenomas[19]. Deslorelin is not licensed for this use in the UK, though it can be used under the veterinary cascade if clinically justified[20]. This is discussed further in the section on medical benefits below.

Male cats
GnRH agonist implants are also licensed in the UK for the induction of temporary infertility and suppression of sexual behaviours and urine marking in male cats but are less commonly used. The case for surgical castration of cats is more clearcut, and is less dependent on size and breed, and therefore there is less demand for medical castration. Furthermore, the need for repeated treatments and monitoring is more difficult to manage in cats, unless they are indoor cats. The implant takes effect within 6 weeks and lasts for up to 12 months[21].

Female dogs
In the UK, GnRH agonist implants are authorised for use in female prepubertal dogs, to delay the first oestrus and to prevent pregnancy at a young age. When administered at 12-16 weeks of age, the implant delays the first oestrus by 6-24 months[22]. Small studies have shown a normal return to heat cycles and fertility once the effects of the implant have ended[23]. The use of deslorelin in sexually mature female dogs to supress reproductive function and oestrus cycling has been studied[24], but this use is not currently authorised, and is not recommended, due to the risk of inducing an oestrus. This may result in an unwanted pregnancy or exacerbate pre-existing uterine and ovarian pathology (metropathy, cysts)[25]. There is only limited evidence[26] on the long-term impact of delaying puberty through the use of deslorelin on e.g.skeletal development or cancer risk, and it is not clear whether delaying oestrus in this way has less impact on long-term health than early surgical neutering. This is discussed in more detail under "when to medically neuter" below.

Female cats
Although not currently licensed in the UK, GnRH agonist implants have been shown to cause temporary infertility and delay oestrus in female cats. However, the duration of effect is extremely variable, over 3 years in some female cats, and may induce persistent oestrus after implantation[27]. The same monitoring concerns apply as for male cats.

Reproductive steroid hormones

Temporary medical neutering can also be achieved by using reproductive steroid hormones (progestogens or anti-androgens such as megestrol, medroxyprogesterone and delmadinone) and the human contraceptive progestogen, norethisterone. These exert their effects within the endocrine system through negative feedback

[16] Driancourt et al op cit
[17] Driancourt and Briggs, op cit
[18] Koilpillai, Joanna Nandita, Emily Nunan, Landon Butler, Fabio Pinaffi, and Joshua T. Butcher. "Reversible Contraception in Males: An Obtainable Target?." *Biology* 13, no. 5 (2024): 291.
[19] Fontbonne, Alain, and Cindy Maenhoudt. "Medical control of reproduction in the male dog with deslorelin subcutaneous implants." *Clinical Theriogenology* 13, no. 3 (2021): 151-155.
[20] The cascade: prescribing unauthorised medicines: https://www.gov.uk/guidance/the-cascade-prescribing-unauthorised-medicines
[21] Virbac Ltd datasheet op cit
[22] ibid
[23] Gontier, Aymeric, Myriam Youala, Christelle Fontaine, Elsa Raibon, Sandrine Fournel, Philippe Briantais, and Delphine Rigaut. "Efficacy and safety of 4.7 mg deslorelin acetate implants in suppressing oestrus cycle in prepubertal female dogs." *Animals* 12, no. 24 (2022): 3504.
[24] Brändli SP, Palm J, Kowalewski MP, Reichler IM, Long-term effect of repeated deslorelin acetate treatment in bitches for reproduction control, Theriogenology, Volume 173, 2021, Pages 73-82, https://doi.org/10.1016/j.theriogenology.2021.07.015.
[25] Romagnoli, S., Krekeler, N., De Cramer, K., Kutzler, M., McCarthy, R., & Schaefer-Somi, S. (2024). WSAVA guidelines for the control of reproduction in dogs and cats. *J Small Anim Pract*, *65*(7), 424-559. pp 60-61
[26] Brändli et al, op cit
[27] Furthner, Etienne, Juliette Roos, Zuzanna Niewiadomska, Cindy Maenhoudt, and Alain Fontbonne. "Contraceptive implants used by cat breeders in France: a study of 140 purebred cats." *Journal of feline medicine and surgery* 22, no. 10 (2020): 984-992.

on the hypothalamic-pituitary-gonadal axis and other endocrine effects. They are usually used for the short-term postponement of oestrus in female dogs and cats, but repeated use can achieve a longer-term effect. There are currently no reproductive steroid hormones licensed for medical neutering in dogs and cats in the UK, though they may still be used under the veterinary cascade where clinically justified[28].

Male dogs
Delmadinone has historically been used to treat androgen-dependent conditions, including behavioural concerns in male dogs, but is no longer available in the UK.

Female dogs
Progestogens are a very effective method of oestrus suppression in female dogs. Given 1-2 months before expected oestrus, they will delay the onset of oestrus for 9-12 months[29]. Several side effects have been reported, including weight gain, lethargy and coat changes including hair loss. In addition, their use, particularly long-term or at higher doses, increases the risk of cystic endometrial hyperplasia-endometritis, pyometra, mammary tumours and diabetes mellitus[30]. The incidence of side effects may be higher if administered during stages of the oestrous cycle other than anoestrus.

The Greyhound Board of Great Britain (GBGB) permits the use of norethisterone to suppress oestrus in racing greyhounds, if prescribed by a veterinary surgeon under the cascade[31].

Female cats
Progestogens can be administered to female cats suppress oestrus signs, with varying duration of effects depending on the formulation used. Side effects include weight gain and lethargy, as well as increased risk of uterine pathology, mammary tumours and diabetes mellitus after repeated use, though medroxyprogesterone is less diabetogenic[32]. The risk of side effects is dose-related, and some studies suggest that low doses can be used relatively safely in cats[33].

GnRH vaccines

Globally, injectable GnRH vaccines have been studied, however no commercial companion animal GnRH vaccine is available and there have been concerns with both safety and efficacy in trials. Two GnRH vaccines exist, one licensed for use in pigs in the UK and elsewhere, and one authorised in the USA for use in wildlife[34].

Permanent medical castration

Intratesticular or intra-epididymal injections

Permanent medical castration or ‘chemical castration’ of male dogs and cats can also be carried out by administering intratesticular or intra-epididymal injections of zinc gluconate or calcium chlorate to induce azoospermia as well as a variable reduction in testosterone concentrations, depending on which chemical agent is injected. Although not technically challenging, it may require general anaesthesia or ultrasound guidance, especially when performed in cats. There are no long-term safety and efficacy studies, and this method is still subject to research. Some zinc gluconate injections have been licensed for use in the USA, although there is currently no product commercially available[23]. No such treatment is licensed for use in the UK.

Gene Therapy

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[28] The cascade, op cit
[29] Romagnoli, Stefano, and Hasan Sontas. "Prevention of breeding in the female." In *BSAVA manual of canine and feline reproduction and neonatology*, pp. 23-33. BSAVA Library, 2010.
[30] Kutzler, Michelle Anne. "Estrus suppression in dogs." *Veterinary Clinics: Small Animal Practice* 48, no. 4 (2018): 595-603.
[31] Norethisterone Guidance Notes (GBGB), https://gbgb-prod-assets.s3.eu-west-1.amazonaws.com/wp-content/uploads/2019/05/16183840/Norethisterone-Guidance-Notes.pdf.
[32] Romagnoli et al, WSAVA Guidelines op cit pp 63
[33] Romagnoli, Stefano. "Progestins to control feline reproduction: historical abuse of high doses and potentially safe use of low doses." *Journal of feline medicine and surgery* 17, no. 9 (2015): 743-752.
[34] Romagnoli et al, WSAVA Guidelines op cit pp 64-68

Gene therapy is another method of permanent medical neutering. Research is being undertaken as to whether it could potentially be used to silence or induce the overexpression of certain genes, to induce infertility. However, the technique is in its infancy and has largely been tested only in cells and in rodents. While the Precision Breeding Act 2023[35] laid the foundation for eventually introducing such procedures in the UK, legislation is not yet in place to permit the use of any gene editing procedure in animals.

Reasons to neuter

Neutering of cats and dogs is commonly advised by vets and welfare organisations in the UK. In addition to controlling populations and reducing cases of abuse or abandonment of unwanted puppies and kittens, there are health and welfare benefits for the animal itself[36]. The BSAVA Scientific Position Statement on the neutering of dogs, cats, rabbits and ferrets[37] recommends that the neutering of companion animals should be considered for reasons of population control, prevention of unwanted litters, and reduction of disease.

Population Benefits

One of the primary benefits of neutering is avoiding unwanted pregnancies and controlling populations. This can reduce the impacts on owners associated with rearing young animals (female cats can have up to eighteen kittens in a year[38]) and reduces the number of stray animals or those ultimately ending up in shelters.

The factors around population control and unwanted litters will be most important in relation to animals in shelters and stray/feral populations. In such instances the cost of the procedure, and managing the necessary aftercare, will be more important in deciding whether or how to neuter than they may be with owned animals. For animals in close quarters with other animals, consideration should also be given to the impact on the rest of the population of an individual female going into heat. These issues mean that many rescue and rehoming charities neuter animals, particularly cats, as a matter of course, and trap and neuter programmes are used to control feral populations of cats. However, unwanted litters are still a risk for owned animals, particularly cats, due to their greater freedom to roam.

Welfare and Legal Considerations

There are also welfare considerations around animals which are not fit to breed due to extreme conformation or health factors, especially when detrimental traits may be passed to offspring. The Animal Welfare Act 2006 Section 4[39] states it is an offence to cause an animal to suffer unnecessarily. This can, in principle, include breeding practices if a person knowingly causes suffering to animals or their offspring. In addition, the Animal Welfare (Licensing of Activities Involving Animals) (England) Regulations 2018[40] state no dog may be kept for breeding if it can reasonably be expected, based on its genotype, phenotype or state of health, that breeding from it could have a detrimental effect on its health or welfare or that of its offspring. Scotland has similar legislation for both cats and dogs[41]. The welfare benefit to future generations is also relevant in such cases.

In some breeds, neutering is mandatory under the Dangerous Dogs Act 1991[42], in order to control the population, but also perhaps also for the perceived benefit in reducing aggression, since the initial purpose of the act was to prevent dog attacks. However, new research is weakening the case for this, as explained below.

Medical benefits

For both cats and dogs, surgical neutering eliminates the possibility of cancers of the uterus (if OHE or OSS is performed), ovaries (if OE or OHE is performed), or testicles (if castration is performed), and reduces the

[35] Precision Breeding Act (2023): https://www.legislation.gov.uk/ukpga/2023/6/contents
[36] "Neutering Your Pet," RSPCA, https://www.rspca.org.uk/adviceandwelfare/pets/general/neutering.
[37] "Position Statement of Neutering of Dogs, Cats, and Ferrets, BSAVA, https://bsava.com/position-statement/neutering-of-dogs-cats-rabbits-and-ferrets/
[38] "Neutering your Cat", Cats Protection, https://www.cats.org.uk/help-and-advice/neutering-and-vaccinations/neutering-your-cat#benefits
[39] Animal Welfare Act 2006, https://www.legislation.gov.uk/ukpga/2006/45/section/4
[40] The Animal Welfare (Licensing of Activities Involving Animals) (England) Regulations 2018, https://www.legislation.gov.uk/uksi/2018/486/schedule/6/paragraph/6/made
[41] The Animal Welfare (Licensing of Activities Involving Animals) (Scotland) Regulations 2021 https://www.legislation.gov.uk/ssi/2021/84/contents/made
[42] Dangerous Dogs Act 1991, https://www.legislation.gov.uk/ukpga/1991/65/contents

likelihood of pyometra, mammary disease and specific prostate conditions if the gonads are removed[43]. It prevents breeding-related injuries, such as bites, and health issues that can arise from pregnancies and births.

Cats

For **male cats**, castration reduces the risk of infectious diseases such as FIV and FeLV[44] which are transmitted by fighting and mating. In **female cats**, surgical spaying under the age of 1 year significantly reduces the risk of mammary tumours, which are primarily malignant in cats[45]. Surgical neutering can also prevent false pregnancies, although these are uncommon in cats.

Dogs

For **male dogs**, additional medical benefits to surgical castration include a lower risk of testosterone-dependent perianal adenomas and reduction in the size of the prostate and benign prostatic hyperplasia (BPH). GnRH agonists have also been shown to produce similar results, although studies are limited[46]. As well as preventing these conditions, castration (medical or surgical) can be an effective treatment for these conditions. However, the evidence for GnRH agonists is anecdotal for perianal adenomas, and the flare-up signs following administration can be problematic in dogs with BPH, depending on prostatic size at the time of treatment[47]. Deslorelin is not licensed for the treatment or prevention of these conditions in the UK, though it can be used under the veterinary cascade if clinically justified[48]. Gonadectomy may also be beneficial in cases of perineal hernias associated with BPH, and urethral prolapse.[49]

For **female dogs**, current evidence suggests a net benefit in neutering, more so than for male dogs. Unspayed female dogs can develop pyometra later in life, which can require life-saving surgery. Spaying a healthy female does not involve the risks of spaying an older dog with toxaemia arising from the pyometra.

Intact female dogs have an increased incidence of mammary tumours compared to spayed female dogs, although tumours occurring in spayed females may be more likely to be malignant[50,51]. There is some evidence that surgically spaying female dogs before 2.5 years of age reduces risk of mammary gland tumours, though this evidence is weakened by the risk of bias in the published studies and limited peer-reviewed evidence .[52] This risk may be further reduced when spaying is performed before the first oestrus[53], but the risk of other health conditions may be higher with prepubertal spaying (see risks of neutering below). Furthermore, the relative risk of mammary tumours may increase progressively with successive seasons, as extending exposure to gonadal hormones may have a significant and proliferative effect on the development of mammary tissue, and thus the potential for mammary tumour development but the evidence for this is mixed[54], with breed also a significant predisposing factor. WSAVA Guidelines for the Control of Reproduction in Dogs and Cats state that “the decision whether to gonadectomise a female dog and at what age this should be done, should not only rest upon the consideration of preventing mammary tumours alone. The age at which such gonadectomy should be done will depend on the inherent risk of the specific breed to develop other conditions due to gonadectomy. While paediatric gonadectomy (6 to 16 weeks) is known to reduce the prevalence of mammary

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[43] Lannoo, Joke, Guillaume Domain, Ann Van Soom, and Eline Wydooghe. "Gonadectomy 2.0: novel insights into the long-term effects in dogs." *Vlaams Diergeneeskundig Tijdschrift* 90, no. 2 (2021): 87-96.

[44] Chhetri, B.K., Berke, O., Pearl, D.L. *et al.* Comparison of risk factors for seropositivity to feline immunodeficiency virus and feline leukemia virus among cats: a case-case study. *BMC Vet Res* **11**, 30 (2015). https://doi.org/10.1186/s12917-015-0339-3

[45] Morris, Joanna. "Mammary tumours in the cat: size matters, so early intervention saves lives." Journal of feline medicine and surgery 15, no. 5 (2013): 391-400.

[46] Romagnoli et al, WSAVA Guidelines op cit pp 82-86

[47] Driancourt et al, op cit

[48] The cascade, op cit

[49] Lima, C. B., Daniel Souza Ramos Angrimani, R. B. Flores, and Camila Infantosi Vannucchi. "Endocrine, prostatic vascular, and proapoptotic changes in dogs with benign prostatic hyperplasia treated medically or surgically." *Domestic Animal Endocrinology* 75 (2021): 106601.

[50] Gedon, Julia, Axel Wehrend, and Martin Kessler. "Ovariectomy reduces the risk of tumour development and influences the histologic continuum in canine mammary tumours." *Veterinary and comparative oncology* 20, no. 2 (2022): 476-483.

[51] Varney D, O'Neill D, O'Neill M, Church D, Stell A, Beck S, et al. Epidemiology of mammary tumours in bitches under veterinary care in the UK in 2016. *Vet Rec*. 2023;e3054. https://doi.org/10.1002/vetr.3054

[52] Beauvais, W.; Cardwell, J.M.; Brodbelt, D.C. The effect of neutering on the risk of mammary tumours in dogs—A systematic review. *J. Small Anim. Pract.* **2012**, *53*, 314–322

[53] ibid

[54] Guirguis, Phillip, and David S. Beggs. 2025. "Systematic Review: Does Pre-Pubertal Spaying Reduce the Risk of Canine Mammary Tumours?" *Animals* 15, no. 3: 436. https://doi.org/10.3390/ani15030436

carcinoma, this reduction is likely smaller than was previously believed and therefore the practice of paediatric gonadectomy can no longer be routinely recommended in most cases"[55].

False pregnancy is particularly common in female dogs (estimated to be between 50-75%[56]) and can result in distress to the animal and anguish to the owner, as well as potentially increasing the risk of mammary tumours. The hormonal changes following oestrus are essentially the same, whether or not pregnancy occurs, with progesterone levels remaining elevated for a prolonged period and then declining sharply, stimulating prolactin release. This means that all female dogs experience the endocrine conditions necessary for pregnancy, and in some individuals, this manifests clinically as overt or "false" pseudopregnancy. It is most commonly recognised in entire female dogs, however it can also develop as a result of spaying, particularly if susceptible female dogs are spayed during dioestrus[57]. A female dog undergoing a false pregnancy may produce milk, lose her appetite and exhibit adverse behavioural problems, including aggression.

Removal of the ovaries through spaying is also an integral part of the treatment of diabetes mellitus in female dogs suffering from altered progesterone-induced glucose metabolism during pregnancy and dioestrus[58], and the treatment of vaginal hyperplasia and prolapse[59].

Behavioural benefits

Dogs

The behavioural impact of neutering on dogs is incredibly complex. Behaviour is influenced by multiple factors including genetics, past experiences, the environment, and the physiological and emotional state of the animal. The interaction between the various hormones, and therefore the impact of gonadectomy is improperly understood, and this gives rise to conflicting evidence[60]. If behavioural considerations are a prominent factor in neutering, it may be appropriate to consider non-permanent alternatives such as the deslorelin implant (in male dogs), or to refer the animal to a certified behaviourist[61] for an assessment before proceeding.

Males

As previously mentioned, castration has an impact on behaviour, but its impact can be unpredictable. Some studies suggest that neutering may be effective at reducing aggressive behaviour in some dogs[62] and this is one of the reasons why castration is mandated in breeds banned under the Dangerous Dogs Act. However, this is not universally the case and more recent studies have found that castration, especially pre-pubertal, can exacerbate fear-based aggression in some dogs[63] [64]. This must be considered carefully before recommending castration for behavioural reasons. A behavioural assessment by a certified behaviourist[65] may be appropriate before recommending treatment

There is evidence to support that castration of male dogs is helpful in limiting straying, particularly in response to female dogs in season, which causes nuisance and unwanted litters. It can also reduce excessive and unacceptable sexual behaviour such as mounting[66], people and inanimate objects as well as undesirable behaviours such as urine marking[67].

Females

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[55] Romagnoli et al, WSAVA Guidelines op cit pp73-75
[56] Gobello, Cristina. "Revisiting canine pseudocyesis." *Theriogenology* 167 (2021): 94-98.
[57] Root, A.L., Parkin, T.D., Hutchison, P. *et al.* Canine pseudopregnancy: an evaluation of prevalence and current treatment protocols in the UK. *BMC Vet Res* **14**, 170 (2018). https://doi.org/10.1186/s12917-018-1493-1
[58] Vendriami et al, op cit
[59] Romagnoli et al, WSAVA Guidelines, pp76
[60] Arroube, Ana, and Alfredo F. Pereira. "Dog Neuter, Yes or No? A Summary of the Motivations, Benefits, and Harms, with Special Emphasis on the Behavioral Aspect." *Animals* 15, no. 7 (2025): 1063
[61] Animal Behaviour & Training Council (ABTC), Fellowship of Animal Behaviour Clinicians (FAB), Association of Pet Behaviour Counsellors (APBC)
[62] Neilson, Jacqueline C., Robert A. Eckstein, and Benjamin L. Hart. "Effects of castration on problem behaviors in male dogs with reference to age and duration of behavior." *Journal of the American Veterinary Medical Association* 211, no. 2 (1997): 180-182.
[63] McGreevy, Paul D., Bethany Wilson, Melissa J. Starling, and James A. Serpell. "Behavioural risks in male dogs with minimal lifetime exposure to gonadal hormones may complicate population-control benefits of desexing." *PloS one* 13, no. 5 (2018): e0196284.
[64] Arroube and Pereira op cit
[65] Animal Behaviour and Training Council et al, Op cit
[66] Arroube and Pereira, op cit
[67] Roulaux, Pascalle EM, Ineke R. van Herwijnen, and Bonne Beerda. "Desexing dogs as a means of decreasing the generally regarded sexually dimorphic behaviors of urine marking, mounting, and roaming." *Journal of Veterinary Behavior* 62 (2023): 47-52.

Spaying female dogs prevents them from coming into heat, with the consequent difficulties of keeping them under close supervision and away from males. As with male dogs, the impact of gonadectomy on behaviour is not fully understood and behavioural issues are often multifactorial. Spaying will generally reduce undesirable behaviours associated with oestrus, if they are only present at the oestrus stage of the cycle. However, there is insufficient reliable evidence to predict that spaying will reduce aggressive or fearful behaviours[68]. WSAVA Guidelines for the Control of Reproduction in Dogs and Cats state that gonadectomy can be beneficial in addressing behavioural problems in female dogs with overt pseudopregnancy, or maternal aggression[69].

Cats

For **male cats,** castration, particularly at a young age, reduces urine marking and spraying[70], and the tendency to roam in search of a mate. In addition, as mentioned above, castration reduces the tendency to fight with other cats and therefore reduces the risk of injuries and viral diseases such as FeLV and FIV.

For **female cats**, spaying reduces harassment from male cats and the need to be kept indoors during oestrus, which can cause significant stress. It also prevents oestrus-associated behaviours such as calling and maternal aggression[71] which can be problematic for some owners. As in male cats, spaying female cats can also reduce urine spraying.

Risks of neutering

There are risks to neutering, as with any procedure. The most common methods of neutering, whether surgical or medical, induce hormonal changes, which can have an impact on behaviour, metabolism, and the likelihood of developing various health conditions associated with testosterone and oestrogen. The BSAVA Scientific Position Statement on neutering[72] recommends that the decision to neuter an individual animal, for medical or behavioural reasons, needs to consider factors such as species, sex, breed and age of the animal as well as current and future health status. Veterinary advice should always be sought in individual cases.

In dogs, various studies show links to specific conditions (e.g. cranial cruciate ligament disease, neoplastic disease), but most sample a specific breed, whereas mixed breed studies appear to be less conclusive[73]. In these cases, the relative risk must also be considered. If a study shows that neutering doubles the risk of developing a certain condition, that sounds significant, but if the breed's baseline risk of developing that condition is only 0.5% then doubling that is still only 1%, or very low risk.

Such a risk must also, of course, be balanced against the benefits of neutering, and set in the context of the individual animal. This can be difficult for the practicing vet, as studies tend to be single issue/single breed and therefore a lot of collating is required to get an overall picture, even for one breed. In addition, many studies have focused on prepubertal or paediatric neutering, which may increase the risk compared to neutering at an older age. There is a need for a literature review, or other resource to collate the available evidence for the most common breeds. Hart et al is one of the more comprehensive sources available,[74] and Arroube and Pereira[75] give a good overview of the evidence for behavioural changes.

Medical and Behavioural Risks

Dogs

In dogs, neutering increases the risk of weight gain and obesity and may bring an increased risk of lymph and bone-related cancers and skeletal/orthopaedic problems in certain breeds, with genetics and size also being

[68] Arroube and Pereira op cit
[69] Romagnoli et al, WSAVA Guidelines op cit pp78
[70] Howe, Lisa M. "Current perspectives on the optimal age to spay/castrate dogs and cats." *Veterinary Medicine: Research and Reports* (2015): 171-180.
[71] Finkler, Hilit, Idit Gunther, and Joseph Terkel. "Behavioral differences between urban feeding groups of neutered and sexually intact free-roaming cats following a trap-neuter-return procedure." *Journal of the American Veterinary Medical Association* 238, no. 9 (2011): 1141-1149.
[72] BSAVA Position Statement on Neutering op cit
[73] McKenzie, Brennen. "Neutering: The risks and benefits in the context of breed, sex, and age." (2021): 26-27.
[74] Hart, Benjamin L., Lynette A. Hart, Abigail P. Thigpen, and Neil H. Willits. "Assisting decision-making on age of neutering for 35 breeds of dogs: associated joint disorders, cancers, and urinary incontinence." *Frontiers in Veterinary Science* 7 (2020): 548304.
[75] Arroube and Pereira op cit

important factors[76]. “Recent research reveals that for some dog breeds, neutering may be associated with increased risks of debilitating joint disorders and some cancers, complicating pet owners' decisions on neutering. The joint disorders include hip dysplasia, cranial cruciate ligament tear or rupture, and elbow dysplasia. The cancers include lymphoma, mast cell tumour, hemangiosarcoma, and osteosarcoma.”[77] Neutering may also be a risk factor for intervertebral disc herniation in dachshunds[78]. The overall picture however is complicated, as most of these diseases are multifactorial and many of the studies fail to take into consideration all the potential factors involved.[79]

In female dogs, spaying increases the risk of urinary incontinence[80], particularly in medium to large sized breeds with some evidence that the risk is higher in female dogs spayed before six months of age[81].

There is reasonable evidence for neutering increasing the risk of[82]:

a. lymphosarcoma and haemangiosarcoma in female golden retrievers;
b. cranial cruciate ligament in male and female golden retrievers as well as in many large breeds;
c. osteosarcoma in Rottweilers, in male golden retrievers and in large breeds in general;
d. urinary incontinence in medium to large size female dogs.

As previously mentioned, the presence of LH receptors in many of the tissues affected has led to the hypothesis that the increased incidence of these conditions may be related to persistently elevated supraphysiological LH levels post neutering[83]. This has led to suggestions that some of these risks could be reduced with the use of deslorelin implants as an alternative to surgical neutering, as this avoids the elevated LH levels, though evidence and long-term studies for this are lacking.

Weight gain is a well-recognised risk of neutering for both male and female dogs, although this may be breed-dependent to some degree[84], and can impact severely on an animal’s quality and quantity of life as well as potentially on the risk of some of the conditions reported to be increased in neutered dogs. It is linked to metabolic changes triggered by hormonal changes, motivated primarily by decreased energy demand and decreased activity, as well as increased energy intake. However, weight gain is not an inevitable consequence of neutering[85]. Calorie intake should be reduced after neutering, and adjusted according to individual animal’s requirements as assessed by regular monitoring of Body Condition Score (BCS) and weight. Diets specifically formulated for neutered dogs may be helpful for some owners.

Castration of **male dogs** is the most difficult area in which to draw a clear conclusion. The health and behavioural outcomes vary, depending on breed, size and multiple other lifestyle and genetic factors. Despite being previously held to have a beneficial impact on aggressive behaviour, more recent studies show castration can increase fear-based aggression in some male dogs[86] and this risk may be increased with prepubertal castration, alongside increased excitability and reactivity to stimuli[87]. Medical neutering may be of assistance in assessing this, although the behavioural changes it induces are not necessarily identical to surgical neutering. An appropriate behavioural assessment may help to reach a decision on neutering. Spaying

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[76] Yates, David, and Rosa Leedham. "Prepubertal neutering in cats and dogs." *In Practice* 41, no. 7 (2019): 285-298.
[77] Hart et al. op cit
[78] Dorn, Marianne, and Ian J. Seath. "Neuter status as a risk factor for canine intervertebral disc herniation (IVDH) in dachshunds: a retrospective cohort study." *Canine genetics and epidemiology* 5, no. 1 (2018): 11.
[79] Vendramini, Thiago HA, Andressa R. Amaral, Vivian Pedrinelli, Rafael VA Zafalon, Roberta BA Rodrigues, and Marcio A. Brunetto. "Neutering in dogs and cats: current scientific evidence and importance of adequate nutritional management." *Nutrition research reviews* 33, no. 1 (2020): 134-144.
[80] Pegram, Camilla, D. G. O'Neill, D. B. Church, J. Hall, Laura Owen, and D. C. Brodbelt. "Spaying and urinary incontinence in bitches under UK primary veterinary care: a case–control study." *Journal of Small Animal Practice* 60, no. 7 (2019): 395-403.
[81] O'Neill, D. G., Alex Riddell, D. B. Church, L. Owen, David C. Brodbelt, and J. L. Hall. "Urinary incontinence in bitches under primary veterinary care in England: prevalence and risk factors." *Journal of Small Animal Practice* 58, no. 12 (2017): 685-693.
[82] Romagnoli, S. "When–and whether–should we spay/neuter companion dogs." *Journal of Small Animal Practice* (2025).
[83] Kutzler op cit
[84] Benka, Valerie A., John M. Sahrmann, Katherine Rieke, Joyce R. Briggs, Nathaniel Spofford, Stephen Zawistowski, Audrey Ruple, Stefano Romagnoli, and Jo Ann Morrison. "Gonadectomy status and age are associated with variable risk of overweight or obese outcomes in 15 dog breeds: a retrospective cohort study using data from primary care veterinary clinics." *Journal of the American Veterinary Medical Association* 1, no. aop (2025): 1-11.
[85] Hart et al, op cit
[86] Arroube and Pereira, op cit
[87] McGreevy, Paul D., Bethany Wilson, Melissa J. Starling, and James A. Serpell. "Behavioural risks in male dogs with minimal lifetime exposure to gonadal hormones may complicate population-control benefits of desexing." *PloS one* 13, no. 5 (2018): e0196284.

(removal of ovaries), particularly prepubertal, may have similar effects on fear-based aggression and excitability in female dogs[88].

Cats

For cats, there is limited evidence to show negative impacts of neutering. This is attributable, at least in part, to inherent bias in many studies, as most owned cats are neutered. That said, the negative impacts of multiple unwanted pregnancies, on the mother and kittens, is apparent. There is also evidence the risks of obesity and related conditions in neutered cats[89], especially males. This can impact severely on an animal's quality and quantity of life[90]. However, weight gain is not an inevitable consequence of neutering and can be managed by careful diet control. Neutering has been highlighted as a risk factor for the development of feline lower urinary tract disease (FLUTD), but this may correlate to the increased incidence of obesity in neutered cats[84].

Summary

On balance health risks and benefits are about even for both species, but unintended reproduction and behaviour should be considered as well as individual risk factors. The balance may be finer for male dogs, when the risks of unwanted reproduction may have little impact on the health and welfare of the dog itself, although there are still societal considerations, and breed and age-related factors are stronger. The effects of neutering on health should always be considered alongside the effects on weight gain, which will itself have a negative effect on health.

Life expectancy

Dogs

Neutering has been reported to increase life expectancy in both males and females[91]. Conversely, some studies have found a reduction in life expectancy for neutered dogs in some breeds, notably Rottweilers. Inherent biases within data sources complicate the picture, such as referral case load, age at neutering and pet insurance data. WSAVA Guidelines state that, for both males and females: "[in dogs] life expectancy is multifactorial and not only dependent on gonadal steroids."

Cats

Neutered female and male cats are reported to live on average 1 to 4 years longer than intact cats[92]. However, since owned cats are mostly neutered and live at least part of their time indoors, longer life expectancy may result from better medical care and safer standards of living, compared to intact free-roaming cats.

However, for both dogs and cats, influence of neutering on life expectancy cannot be considered alone, given that weight gain, which is more likely to occur post neutering, can also affect life expectancy.

Surgical Risks

As with any surgical procedure, there are risks associated with neutering, particularly for spaying females, where the procedure can be more invasive (although cryptorchid castration is a more invasive procedure and therefore can increase the risk of complications in males)[93]. However, reported complication rates for routine neutering are low[94]. Evidence suggests the risk of surgical complications are similar if neutering is carried out before puberty, with several studies showing a similar risk of general surgical complications being associated

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[88] Starling, Melissa, Anne Fawcett, Bethany Wilson, James Serpell, and Paul McGreevy. "Behavioural risks in female dogs with minimal lifetime exposure to gonadal hormones." *PLoS One* 14, no. 12 (2019): e0223709.
[89] Vendraminii et al, op cit
[90] **Danks, Laura.** "*Neutering and Weight Gain in Cats: What's the Evidence?*" *Veterinary Practice*, April 1, 2016. https://www.veterinary-practice.com/article/neutering-and-weight-gain-in-cats-whats-the-evidence.
[91] Romagnoli et al, WSAVA Guidelines op cit, pp81 & 88
[92] Ibid pp92
[93] Faulkner, Emma B., Anne Kimmerlein, JoAnn Morrison, Tricia Beal, Marie Kerl, and Emi K. Saito. "Serious surgical complications of canine cryptorchid castration are associated with surgical approach: a case-control study of 202 dogs." *Journal of the American Veterinary Medical Association* 263, no. 1 (2025): 100-105.
[94] RCVS Knowledge (2025). *National Audit for Small Animal Neutering Report 2024,* Op cit

with prepubertal animals[95,96]. Similar evidence for the risk of neutering geriatric animals is lacking, but co-morbidities are more likely to impact on the risk of complications in older animals. In female dogs, the risk of surgical complications may be reduced further by using laparoscopic procedures. A recent study of 519 female dog spays, found that postoperative complications were reduced for those performed through laparoscopic ovariectomy, compared to open ovariohysterectomy[97]. However, this may not always be available or appropriate, particularly for stray and feral animals. Context should always be considered when recommending a procedure, including capacity for proper aftercare, lifestyle of animal and owner, and cost.

There are also risks to anaesthesia, particularly with brachycephalic breeds of dogs[98] and their associated breathing issues, which must always be considered against the risks of not neutering (these increased risks may also apply for brachycephalic breeds of cats although specific evidence is lacking). Young age does not appear to be an increased risk factor for anaesthetic related death in dogs and cats, although small body weight may be[99,100].The technique used can of course exacerbate or mitigate the risk.

Pain is also a risk of any surgery, and consideration must be given to managing this appropriately. Cats in particular do not always readily show signs of pain, and this must be taken into account in post-operative care. Pain is perhaps a more significant factor for neutering, than for other surgeries, as it is an elective procedure on an otherwise healthy animal and therefore the pain caused is avoidable.

It must be remembered that, although routine for the vet, neutering is not routine for the patient. An unnecessarily stressful or painful experience early in life could have a potential impact on welfare, triggering an aversive reaction to future vet visits, which is stressful for the animal and owner, and more difficult for the vet.

When to surgically neuter

Cats

Evidence supports BVA's previous view that both male and female cats should be neutered at around four months old, before they reach sexual maturity, in order to prevent accidental litters and reduce the number of unowned cats. This view is also held by the major cat welfare organisations, such as Cats Protection[101] and PDSA[102]. The BSAVA Scientific Position Statement on neutering[103] also supports the policy of pre-pubertal neutering (i.e. at 4 months of age or older rather than at the traditional 6 months of age or older) in cats. Data shows that neutering age has a profound impact on the number of unowned cats within the UK, even when neutering rates are constant[104] and a reported 4% of owned cats have their first litter before 6 months of age[105].

Long-term data on the impact of age of neutering on the health and welfare of cats is limited. However, a recent longitudinal cohort study found that cats neutered prepubertally are at no greater risk of developing obesity than those neutered at around 6 months old, though cats neutered at 7–12 months experienced a less

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[95] Howe, Lisa M. "Short-term results and complications of prepubertal gonadectomy in cats and dogs." *Journal of the American Veterinary Medical Association* 211, no. 1 (1997): 57-62.
[96] Roberts, Madeleine L., Julia A. Beatty, Navneet K. Dhand, and Vanessa R. Barrs. "Effect of age and surgical approach on perioperative wound complication following ovariohysterectomy in shelter-housed cats in Australia." *Journal of Feline Medicine and Surgery Open Reports* 1, no. 2 (2015): 2055116915613358.
[97] Moxon, R., E. Yarwood, H. Hawkins, J. Came, and G. C. W. England. "Laparoscopic ovariectomy provides favourable peri-and postoperative outcomes compared with ovariohysterectomy via celiotomy in bitches." *Journal of Small Animal Practice* (2025).
[98] Gruenheid, Michaela, Turi K. Aarnes, Mary A. McLoughlin, Elaine M. Simpson, Dimitria A. Mathys, Dixie F. Mollenkopf, and Thomas E. Wittum. "Risk of anesthesia-related complications in brachycephalic dogs." *Journal of the American Veterinary Medical Association* 253, no. 3 (2018): 301-306.
[99] Brodbelt DC, Pfeiffer DU, Young LE, Wood JL. Risk factors for anaesthetic-related death in cats: results from the confidential enquiry into perioperative small animal fatalities (CEPSAF). *Br J Anaesth*. 2007;99(5):617–623
[100] Brodbelt, David C., Dirk U. Pfeiffer, Lesley E. Young, and James LN Wood. "Results of the confidential enquiry into perioperative small animal fatalities regarding risk factors for anesthetic-related death in dogs." *Journal of the American Veterinary Medical Association* 233, no. 7 (2008): 1096-1104..
[101] Cats protection Neutering Guidance: https://www.cats.org.uk/help-and-advice/neutering-and-vaccinations/neutering-your-cat
[102] PDSA Neutering Gudance, https://www.pdsa.org.uk/pet-help-and-advice/pet-health-hub/other-veterinary-advice/cat-neutering-a-guide-to-castration-and-spaying
[103] BSAVA Position Statement op cit
[104] McDonald, Jenni, Lauren Finka, Rae Foreman-Worsley, Elizabeth Skillings, and Dave Hodgson. "Cat: Empirical modelling of Felis catus population dynamics in the UK." *PLoS One* 18, no. 7 (2023): e0287841.
[105] PDSA, *Animal Wellbeing (PAW) Report 2024*. https://www.pdsa.org.uk/what-we-do/pdsa-animal-wellbeing-report/paw-report-2024

rapid age-related increase in bodyweight and BCS [106]. Other studies have not demonstrated a difference in health problems up to 24 months of age between cats neutered at 2-3 months, and those neutered at 6-8 months[107]. In addition, neutering at around 4 months compared to 7 months may support weight management as acute changes in eating behaviour are less likely[108]. Neutering in general is a known risk factor for weight gain/obesity, but there is no consistent evidence that age at neuter (when comparing 4 months to 6 months) strongly changes that risk, i.e. the act of neutering appears to matter more than the age[109]. As discussed above, other than obesity, there is limited evidence for long term risks of neutering in cats, irrespective of age.

Unlike female dogs, female cats are not known to experience any problems in relation to the stage of the oestrous cycle in which they are spayed[110].

Dogs

The age at which to neuter dogs is more complex, and there is no universal timing that is right for every dog. As discussed previously, several studies have looked at the risk of orthopaedic disorders and cancers in neutered dogs, and for some breeds the risk appears to be increased if neutered before 6-12 months of age. However, this finding is not consistent between breeds or between sexes within some breeds. In addition, as neutering is associated with altered metabolism and a predisposition for weight gain, this may also influence the incidence of certain conditions in neutered dogs.

Gonadal steroids affect musculoskeletal development, and therefore neutering can impact bone elongation in dogs and in turn conditions related to bone maturation such as hip dysplasia, with large and giant breeds most at risk due to their later age at maturity, although this has not been evidenced in every breed studied[111]. The hormonal regulation of longitudinal bone growth is complex, involving growth hormone (GH), thyroid hormone and sex steroids[112].

In the UK, the general consensus[113] seems to be that male and female dogs are now neutered at around 12 months, an age when many breeds of dogs are considered to have reached skeletal maturity (i.e. growth plate closure), which reduces the risk of developing orthopaedic conditions[114]. However, the age at which skeletal maturity is reached will depend on breed - although 12-18 months is generally cited as the age of maturity for both female and male dogs, there is considerable variance between breeds, depending on size. Larger breeds, particularly giant breeds, are slower to mature, therefore for these breeds there are benefits to neutering later, and the evidence shows that for many larger breeds, pre-pubertal neutering increases the health risks[115]. It is important to look at the evidence for individual breed risks where available[116],[117],[118] to assist with making a personalised decision for each dog's neutering age[119]. For mixed breeds, neutering before 1 year (male and female) may be associated with increased risks of one or more joint disorders for those dogs over 20kg[120]. The majority of small dog breeds studied do not appear to have an increased risk in joint disorders related to neutering, apart from IVDD in Dachshunds[109]. A table covering 35 common breeds of dog can be found in

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[106] Foreman-Worsley, Rae, Emily Blackwell, Lauren R. Finka, Elizabeth Skillings, and Jenni L. McDonald. "Long-term effect of neutering age on body condition score and bodyweight in domestic cats." *Veterinary Record* (2025): e5433.
[107] Porters, Nathalie, Ingeborgh Polis, C. P. H. Moons, Isabel Van de Maele, Richard Ducatelle, Klara Goethals, Luc Duchateau, and Hilde De Rooster. "Relationship between age at gonadectomy and health problems in kittens adopted from shelters." *Veterinary Record* 176, no. 22 (2015): 572-572..
108 Allaway, David, Matthew Gilham, Alison Colyer, and Penelope J. Morris. "The impact of time of neutering on weight gain and energy intake in female kittens." *Journal of nutritional science* 6 (2017): e19..
[109] Larsen, J. A. (2017). Risk of obesity in the neutered cat. *Journal of feline medicine and surgery*, *19*(8), 779-783.
[110] Romagnoli, S., & Sontas, H. (2010). Prevention of breeding in the female. In *BSAVA manual of canine and feline reproduction and neonatology* (pp. 23-33). BSAVA Library.
[111] Oberbauer, Anita M., Janelle M. Belanger, and Thomas R. Famula. "A review of the impact of neuter status on expression of inherited conditions in dogs." *Frontiers in Veterinary Science* 6 (2019): 397.
[112] Nilsson A, Ohlsson C, Isaksson OG, Lindahl A, Isgaard J. Hormonal regulation of longitudinal bone growth. Eur J Clin Nutr. 1994 Feb;48 Suppl 1:S150-8; discussion S158-60. doi: 10.1007/BF02558817.
[113]Laura Danks, "Neutering and Weight Gain in Cats: What's the Evidence?" *Veterinary Practice*, April 1, 2016, https://doi.org/10.1002/vetr.1265.
[114] Nilsson et al op cit
[115] Romagnoli, S. (2025), When – and whether – should we spay/neuter companion dogs, op cit
[116] Hart, Benjamin L., Lynette A. Hart, Abigail P. Thigpen, and Neil H. Willits. "Long-term health effects of neutering dogs: comparison of Labrador Retrievers with Golden Retrievers." *PloS one* 9, no. 7 (2014): e102241.
[117] Hart, Benjamin L., Lynette A. Hart, Abigail P. Thigpen, and Neil H. Willits. "Neutering of German Shepherd Dogs: associated joint disorders, cancers and urinary incontinence." *Veterinary Medicine and Science* 2, no. 3 (2016): 191-199.
[118] Hart et al,. Assisting Decision-Making op cit.
[119] ibid
[120] ibid

"Assisting Decision-Making on Age of Neutering for 35 Breeds of Dogs: Associated Joint Disorders, Cancers, and Urinary Incontinence" by Hart et al[112].

Delaying neutering or leaving animals intact will raise some risks while reducing others, and the optimal outcome for any individual will never be completely predictable. The BSAVA's Scientific Position Statement on neutering[121] recommends that a thorough benefit/risk assessment on an individual basis should be discussed with clients when deciding if and when to neuter individual dogs, incorporating both physical and behavioural considerations. If there are specific circumstances where neutering a dog less than 12 months of age is considered desirable, then sufficient and due regard should be paid to the physiological immaturity of the dog and, also the specific breed.

Males

For larger dogs particularly, post-pubertal neutering seems to reduce health risks in male dogs[122]. Later castration (from 12-18 months or later depending on breed) aligns with skeletal maturity in many breeds, which, as stated above, may be a factor in reducing instances of orthopaedic conditions. Nevertheless, there may be a limited number of circumstances where a veterinary professional may need to consider neutering at an earlier age than might be considered ideal, for example for legal reasons[123], where an uncastrated male may cause distress to other dogs (both male and female) and therefore management issues within the household, or where other methods are not working to correct aggressive behaviour that has been assessed to be driven by testosterone. The exception to this may be giant breeds, where the risks to the individual of earlier neutering may outweigh any situational benefits (other than legal requirements). However, in any larger breeds, alternatives should be considered and the potential impacts on the health of the individual carefully assessed[124]. To minimise the potential adverse impact on the long-term health of an animal and to account for uncertainties around effectiveness, particularly with behavioural concerns, medical castration could be considered in these circumstances until the dog reaches the appropriate age for surgical castration, or is moved to an environment where it is not necessary. However, the long-term effects of pre-pubertal medical castration on developmental orthopaedic conditions and cancers has not been studied.

Females

As with male dogs, the consensus of opinion is moving away from early neutering in female dogs. In addition to the orthopaedic concerns already discussed, spaying before six months has been linked to an increased risk of urinary incontinence in some breeds[125] and is therefore no longer recommended. Conversely, although it was previously a commonly-held belief, there is no known benefit to letting a female dog have a litter before neutering[126]. While there is evidence that early spaying reduces the development of mammary tumours, studies into the optimal age at which spaying should occur have yielded conflicting findings[127], with a systematic review finding the relationship between age at spay and the development of mammary tumours to be weak due to the risk of bias and limited peer-reviewed evidence[128].

The timing of spaying is perhaps more challenging to determine for female dogs, balancing the risks of pregnancies and managing them in heat, with the health benefits of delaying spaying until skeletal maturity which, as with male dogs, occurs later in larger breeds and the potential for the risk of other conditions such as mammary tumours to increase with successive seasons. Pregnancy and whelping have their own impact on health and welfare and may bring complications. These risks are magnified for brachycephalic breeds, where extreme conformation has led to them struggling to whelp naturally[129], requiring caesarean section for them to

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[121] BSAVA Position Statement op cit
[122] McKenzie, Brennen, Neutering: The risks and benefits in the context of breed, sex, and age, Veterinary practice News December 2020 https://www.veterinarypracticenews.com/neutering-january-2021/
[123] Dangerous Dogs Act 1991 https://www.legislation.gov.uk/ukpga/1991/65/contents
[124] Romagnoli et al, WSAVA Guidelines op cit, pp102
[125] Pegram, C., D. C. Brodbelt, D. B. Church, Jon Hall, L. Owen, Y-M. Chang, and D. G. O'Neill. "Associations between neutering and early-onset urinary incontinence in UK bitches under primary veterinary care." *Journal of Small Animal Practice* 60, no. 12 (2019): 723-733.
[126] The Kennel Club neutering guidance: https://www.thekennelclub.org.uk/health-and-dog-care/health/health-and-care/a-z-of-health-and-care-issues/neutering-a-dog-castrating-and-spaying/
[127] Guirguis and Beggs op cit
[128] Beauvais, W., J. M. Cardwell, and D. C. Brodbelt. "The effect of neutering on the risk of mammary tumours in dogs–a systematic review." *Journal of Small Animal Practice* 53, no. 6 (2012): 314-322.
[126]O'Neill, D. G., A. M. O'sullivan, E. A. Manson, D. B. Church, A. K. Boag, P. D. McGreevy, and D. C. Brodbelt. "Canine dystocia in 50 UK first-opinion emergency-care veterinary practices: prevalence and risk factors." *Veterinary Record* 181, no. 4 (2017): 88-88.

deliver safely. This of course brings the associated risks of anaesthetic, exacerbated by the breathing issues also associated with brachycephaly, and of surgery.

That said, there may be a limited number of circumstances where a veterinary professional may need to consider spaying at an earlier age than might be considered ideal, for example for legal reasons[130], where an entire female may cause distress to other dogs or where it is important to completely rule out the risk of pregnancy or oestrus – for example where there is an intact male dog which may cause management issues in the household. The exception to this may be Giant breeds, where the risks to the individual of earlier neutering may outweigh any situational benefits (other than legal requirements). However, in any larger breeds, alternatives should be considered and the potential impacts on the health of the individual carefully assessed[131].

It may also be appropriate to consider spaying later on, even if the decision is made to breed from a female dog first, as this can still have a significant impact in reducing pyometra and mammary tumours in later life. Spaying a healthy, younger female dog is lower risk than ovariohysterectomy in an older female dog which has already developed pyometra or other complications.

The ideal stage of the oestrus cycle at which to perform gonadectomy in female dogs is anoestrus. If a female dog is spayed in pro-oestrus or oestrus, there is an increased risk of short-term postsurgical complications, whilst when it is performed in dioestrus there is an increased risk of false pregnancy. In female dogs gonadectomy is best performed 2.5 – 5.5 months following the onset of pro-oestrus[132].

When to medically neuter (dogs)

Unlike surgical neutering, the long-term effects of medically delaying puberty have not been evidenced, with few studies and low patient numbers available. There is evidence that deslorelin administered to female dogs between 12-16 weeks of age to delay puberty does not cause abnormalities of body development[133]. As previously mentioned, use in sexually mature female dogs to supress reproductive function and oestrus cycling is not recommended. Similarly, postponement of puberty with GnRH agonists did not cause developmental problems in male dogs, though there is limited data on the use of deslorelin in dogs weighing over 40kg[134]. However, the use of deslorelin in pre-pubertal male dogs has not been investigated and it is therefore recommended that male dogs should be allowed to reach puberty before treatment with the veterinary medicinal product is initiated. In both males and female dogs, prepubertal use of deslorelin was associated with delayed epiphyseal closure of long bones, so there may be further long-term effects on joint health and long bone growth not yet identified[135].

Contextualising neutering

As outlined above, there are multiple factors which must be considered when recommending for or against neutering a particular animal. The case is generally more clearcut for cats than for dogs, due largely to the greater homogeneity between breeds, however, there is also much more limited research into the health and behavioural impacts of neutering cats. In the case of stray or feral animals, with a few exceptions, the benefits tend to outweigh the risks, and cost and availability of aftercare will be limiting factors in which procedure to use. Neutering decisions should take into account whether an owner is realistically able to keep entire animals separated to prevent accidental mating and unwanted litters. Consideration should also be given to whether an owner, however capable of caring for an individual animal, feels they could manage the financial and practical responsibilities of raising an unexpected litter.

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[130] Dangerous Dogs Act 1991 op cit
[131] Romagnoli et al, WSAVA Guidelines op cit pp102
[132] Romagnoli and Sontas op cit
[133] Schäfer-Somi, S.; Kaya, D.; Aslan, S. Prepubertal Use of Long-Term GnRH Agonists in Dogs: Current Knowledge and Recommendations. *Animals* **2022**, *12*, 2267. https://doi.org/10.3390/ani12172267
[134] Virbac Limited, datasheet op cit
[135] Schäfer-Somi op cit

Factors that should be considered and discussed with the owner, many of which have been discussed in more detail above, include:

- Age
- Breed
- Medical and behavioural reasons
- The lifestyle of the animal
- The lifestyle of the owner
- Other context (charity, stray, multi pet household, breed specific legislation)
- Overall impacts on life expectancy and disease risk, including those influenced by weight gain (balance of positive and negative effects)

This amounts to the need for a full discussion with the owner, to ensure fully informed consent is obtained before neutering. Standard practice should be a separate appointment with a vet or RVN before the procedure is booked in, to discuss the factors of the case and ensure the client understands the implications of both proceeding and not proceeding, as well as the various alternative methods that may be available (e.g. surgical, medical, etc). It may also be advisable to include the specifics of the procedure agreed with the client within the consent form. However, this more detailed approach may not be necessary or possible for stray or shelter animals.

Conclusions

Cats

The picture is relatively straightforward for cats, albeit largely due to limited evidence. The standard remains to neuter both males and females at 16 weeks unless the owner wishes to breed the animal, or there is some other compelling reason not to.

Dogs

There have been considerably more studies on the impacts of neutering in dogs, however this amounts to a complex picture with no definitive answer. The one point of consensus seems to be that neutering should wait until after puberty, at around 12 months, or later for larger breeds. The balance of opinion tends to favour spaying female dogs, largely due to the negative health and welfare impacts of pregnancy and whelping, and the risk of pyometra, false pregnancy and mammary tumours. With these factors absent for male dogs, it appears to come down to a case-by-case assessment of whether neutering would benefit an individual male dog, based on breed alongside other factors. There is clearly a need for more overarching literature reviews, and perhaps some guidance for the most common breeds to assist vets in practice with this decision-making.

Recommendations

Recommendation 1: Male and female cats should be neutered at around 16 weeks unless they are intended for breeding, or there are clinical reasons not to neuter.

Recommendation 2: Castration of male dogs, either medical or surgical, should be considered in the context of the breed and lifestyle of the dog.

Recommendation 3: Castration of male dogs, either medical or surgical, should not be carried out before physical maturity for the breed, unless there is a compelling contextual reason for doing so.

Recommendation 4: Medical castration of post-pubertal male dogs may be considered in circumstances where surgical castration is not desirable.

Recommendation 5: Depending on the breed and expected age at maturity, female dogs should be spayed between twelve and twenty-three months of age unless they are intended for breeding

Recommendation 6: Spaying should be considered for female dogs after breeding is finished to reduce the risk of health problems in later life.

Recommendation 7: Careful discussion with the owner should take place to ensure the implications of neutering are fully understood before a decision is taken to proceed.

Recommendation 8: A comprehensive resource is needed summarising the current evidence, evidence gaps, and risk factors of neutering for common dog breeds, to further assist vets in advising owners.

Recommendation 9: More research is needed into the impacts of neutering on male and female cats.

Annex A – Summary of Neutering Methods

Procedure	Definition	Suppresses fertility	Suppresses gonadal hormones
Medical or non-surgical neutering			
Temporary medical neutering	Reversible, temporary suppression of fertility • GnRH agonists, • reproductive steroid hormones, • GnRH vaccines	Yes	Yes
Permanent medical (chemical) castration **not licensed in the UK*	Irreversible suppression of fertility. • intratesticular injection of zinc gluconate or calcium chlorate • gene therapy	Yes	Yes
Surgical neutering			
Surgical castration	Removal of both testicles	Yes	Yes
Vasectomy	Ligation or cutting of the vas deferens	Yes	No
Spay - ovariohysterectomy (OHE)	Removal of the ovaries and part, or all, of the uterus	Yes	Yes
Spay - ovariectomy (OE	Removal of the ovaries only	Yes	Yes
Ovary-sparing spay (OSS) - hysterectomy	Removal of the uterus only	Yes	No
Fallopian tube ligation or salpingectomy* *Referred to as fallopian tube surgery within this Policy	Ligation or cutting of fallopian tubes	Yes	No