



Vet Q&A: Neutering and behaviour in companion animals

Caroline Warnes BVSc MSc CCAB MRCVS

Fellowship of Animal Behaviour Clinicians





Proportion of pet animals neutered in the UK

According to the most recent PDSA Animal Welfare (PAW) Report 2021:
(<https://www.pdsa.org.uk/get-involved/our-campaigns/pdsa-animal-wellbeing-report/paw-report-2021>):

Species	No living in UK	% neutered	% not neutered
Dog	9.6 million	71% (6.8 million)	29% (2.8 million)
Cat	10.7 million	90% (9.7 million)	10% (1 million)
Rabbit	900,000	63% (560,000)	37% (340,000)



Why do we routinely neuter pet animals?

- Population control
- Perceived health benefits
- Perceived behavioural benefits: current or future
- Owner preference



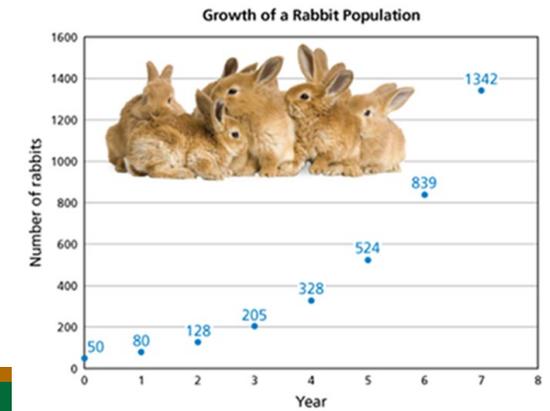
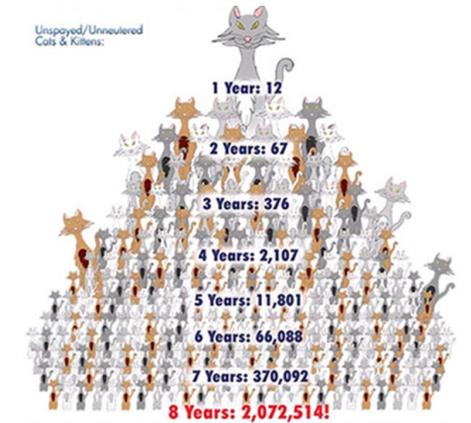
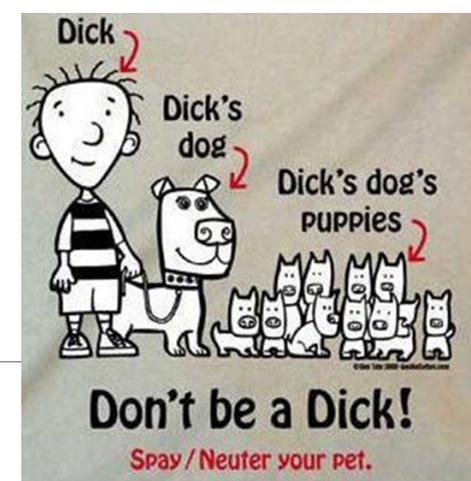
Neutering and population control

Surgical neutering is currently the most reliable means of population control in dogs, cats and rabbits.

While dog owners have some ability to control unwanted breeding this is not always the case for cats or rabbits.

Neutering enables welfare-friendly practices, such as access to the outdoors for cats, and living in mixed-sex pairs in rabbits, without adding to the significant over-population problem for both species

Neutering animals before they reach puberty will be most effective at preventing unwanted breeding.





Neutering and Health

Neutering was traditionally associated only with health benefits, particularly reducing the risk of diseases directly relating to the reproductive tract such as testicular and prostatic disease in males, and uterine and mammary disease in females.

Recent research suggests that:

- neutering is not always as effective at reducing disease associated with the reproductive tract as was previously thought e.g. mammary tumours in dogs (see Beauvais et al, 2012a), prostatic tumours in cats and dogs.
- neutering may be associated with an increased risk of diseases not directly related to the reproductive system including obesity and related diseases, orthopaedic problems, endocrine diseases such as diabetes mellitus and a range of neoplastic conditions including osteosarcoma, lymphoma, mast cell tumours and haemangiosarcoma.

Hoffman et al (2018): entire male dogs lived longer than neutered males, neutered bitches lived longer than entire bitches.



Neutering and Behaviour



Neutering has traditionally been used to reduce undesirable behaviours directly associated with sex hormones:

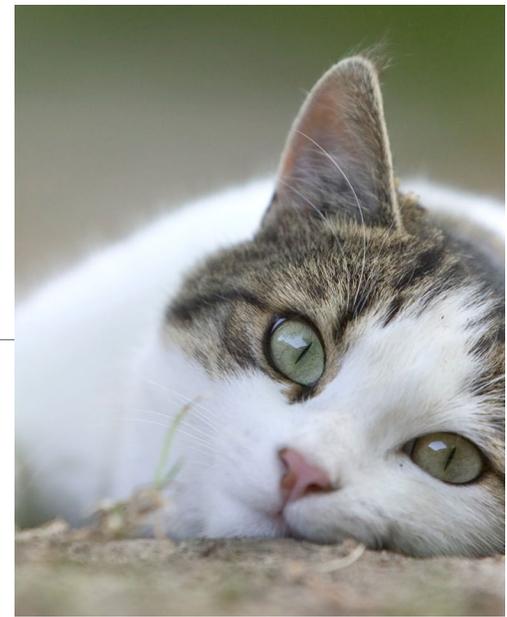
- **Males:** roaming in search of mates, urine marking, mounting and fighting with other males
- **Females:**
 - oestrous-related behaviours including mood changes, fighting with other females, urine marking and roaming in search of mates
 - Pregnancy or pseudopregnancy-related behaviours such as nesting and resource-guarding

However:

- neutering does not always reliably reduce these behaviours
- in some cases neutering may increase the risk of other undesirable behaviours not directly related to sex hormones.



Neutering and behaviour in cats



Spaying or castration appear to fairly reliably reduce or eliminate sex-hormone-related problem behaviours:

- **males:** fighting with other male cats; indoor urine spraying; roaming
- **females:**
 - oestrous behaviours including restlessness, rolling, calling, roaming, urine marking, attracting males
 - Maternal aggression

Neutering kittens early (8-12 weeks) not associated with any increase in incidence of non-sex hormone-related problematic or undesirable behaviours including inappropriate elimination, fearfulness, aggression and destructiveness compared to neutering at 6-8 months (Porters et al, 2014; Moons et al, 2018)



Neutering and behaviour in rabbits



The most common undesirable behaviours seen in entire male rabbits are:

- fighting with other males
- urine spraying: directed at other rabbits/owners
- inappetence

Castration will reduce but not necessarily totally eliminate these behaviours

The most common undesirable behaviours in entire female rabbits are:

- Serious fighting with other female rabbits: reduced but not necessarily eliminated by neutering
- Behaviour changes associated with pregnancy or pseudopregnancy: prevented by neutering
 - Temperament changes: increased aggression
 - Pulling fur from dewlap to line nest
 - Nest-making behaviour



Neutering and behaviour in dogs

The most common undesirable behaviours in entire male dogs include:

- Mounting
- Urine marking
- Roaming in search of bitches
- Aggressive behaviour directed specifically at other male dogs

And also potentially:

- ↑ Distraction by other dogs
- ↑ Frustration/arousal
- ?? Aggressive behaviour in other contexts

Castration will generally reduce these behaviours but not always.



The most common undesirable behaviours in entire bitches are:

- Behaviours associated with seasons:
 - Mood changes/irritability
 - Urine marking
 - Aggression to other bitches esp in the home
 - Roaming in search of male dogs

Spaying will generally reduce undesirable behaviours associated with seasons as long as they don't continue outside of the season.

However while aggression between bitches in a home often starts when one or both come into season, this may not resolve after the season. If so spaying unlikely to significantly improve it.

- Behaviours associated with pseudopregnancy:
 - Aggressive behaviours directed towards owners/strangers/other dogs
 - Nesting behaviours including digging
 - ↑ fear/anxiety

Spaying will generally prevent future pseudopregnancies, but:

- If bitch is spayed during a pseudopregnancy this can persist long-term
- If bitch is spayed during metoestrous when progesterone is high, this can trigger a pseudopregnancy that persists long-term.



Neutering and non-sexual behaviours in dogs

Whilst various studies demonstrate an effect of neutering on behaviours that are not directly linked to sex hormones, their findings are not always consistent.

- **Frustration:** neutering can potentially reduce frustration, particularly in male dogs.
- **Fearfulness:** several studies suggest that neutering can be associated with increased fearfulness in both male and female dogs (e.g. Starling et al, 2013; Zink et al, 2014) and that this risk increases with earlier neutering/lower PLGH (McGreevey et al, 2018; Starling et al, 2019)
- **Aggressive behaviour:** while some studies suggest that neutering is associated with reduced aggressive behaviour (e.g. Neilson et al, 1997), others suggest that neutering does not prevent aggressive behaviours developing (Podberscek & Serpell, 2005; Farhooody et al, 2018) and that in some cases the risk of aggressive behaviours in some contexts may be increased after neutering in male dogs (Guy et al, 2001; Reisner et al, 2005; McGreevey et al, 2018) and bitches (O'Farrell & Peachey, 1990; Guy et al, 2001; Reisner et al, 2005; Kim et al, 2006; Starling et al, 2019).

- **Separation anxiety:** lower PLGH associated with reduced risk of dogs howling when left alone (McGreevey et al, 2018; Starling et al, 2019)
- **Excitability:** lower PLGH associated with increased excitability and reactivity to stimuli such as doorbell ringing (McGreevey et al 2018; Starling et al, 2019)
- **Trainability:** neutered male dogs found to be more trainable than entire males (Serpell & Hsu, 2005; lower PLGH associated with increased trainability (McGreevey et al, 2018; Starling et al, 2019)
- **Cognitive function:** Hart (2001) suggested that castration increases risk of cognitive dysfunction in older male dogs. Scandurra et al, 2018; Scandurra et al, 2019: neutering associated with reduced performance in both social and spatially-related cognitive tasks, particularly in bitches

Possible contributing factors to effects of neutering on non-sexually dimorphic behaviours:

- Increased circulating LH after neutering
- Direct effects of reduced levels of sex hormones after neutering
- Adverse effects associated with process of surgical neutering:
 - Learning: being hospitalised and handled by unfamiliar people may increase fear in animals that are generally nervous/unused to being handled/separated from owners
 - Impact of stress during adolescent period (Eiland & Romeo, 2013; Lupien et al, 2009)
 - Farhody et al 2018: dogs and bitches neutered between 7 and 12 months of age significantly more likely to show aggressive behaviour to strangers



So what does this mean?

Neutering is associated with risks as well as benefits

Based on our current understanding:

- in cats and rabbits the advantages of neutering before puberty strongly outweigh the disadvantages (? except if female rabbits kept alone)
- in dogs the risks and benefits are a little less clear, and need to be assessed for each individual animal, including:
 - risk of unwanted mating: exposure to entire animals of opposite sex?
 - risk of development of health problems: sex, size, breed, activity?
 - risk of development of undesirable problem behaviours: nervous vs bold/confident; ? poor frustration tolerance
 - Likelihood of current undesirable problem behaviours being influenced by sex hormones



Behavioural pros and cons of pre-pubertal neutering in dogs

Males	Pros	Cons
	May reduce (but not totally prevent) development of sexually-dimorphic behaviours such as mounting, urine marking, roaming and aggression directed towards other male dogs	May increase risk of problem behaviours associated with fearfulness and excitability (McGreevey et al, 2018)
Females	Prevents any season-related problem behaviours	May increase aggression in bitches especially in those already showing aggressive behaviour before they are neutered (O'Farrell & Peachey, 1990)
	Prevents any risk of problem behaviours associated with pseudopregnancy	May increase risk of problem behaviours associated with fearfulness and excitability (Starling et al, 2018)
	Reduces (but will not totally eliminate) the risk of aggressive behaviour between bitches living together	



Decision-making with regard to neutering and behaviour in dogs

For dogs with no current undesirable problem behaviours decisions regarding whether to neuter, and at what age will be based on:

- risks of unwanted mating
- risks of development of future health problems
- Risks of development of future behaviour problems: influenced by general temperament of dog (e.g. bold v fearful, easily frustrated), other animals in household, presence of other entire animals nearby etc
- Owner preferences and lifestyle: day care, kennels etc.

Essential to minimise stress associated with neutering as this is a potential cause of future behaviour problems.

Avoid performing major procedures such as neutering during adolescent fear periods if possible

Ideally wait until dog skeletally mature and near end of adolescence: i.e. > 1 yr for most dogs, later for larger breeds.

For dogs already showing undesirable behaviours decisions regarding neutering must consider whether neutering likely to have a positive or negative impact on that behaviour. Neutering is most likely to reduce problem behaviours that are directly influenced by circulating sex hormones i.e.:

Male dogs:

- Mounting
- Urine marking
- Roaming in search of in-season bitches
- Confident aggressive behaviour directed specifically to other male dogs
- Dogs that live with or near entire bitches and become very frustrated when they are in season

Bitches: problem behaviours specifically associated with seasons and/or pseudopregnancy

However neutering alone may not resolve these problem behaviours:

- learning
- behaviours may have other causes

Neutering will neither improve or exacerbate problem behaviours that are not directly influenced by circulating sex hormones including:

- **Unruly, over-excitabile adolescent behaviours:** these will respond better to reward-based training and provision of appropriate outlets for mental and physical stimulation
- **Inappropriate predatory, hunting or herding behaviours** e.g. chasing inappropriate targets, digging etc.: will respond better to management, reward-based training and providing more appropriate outlets for these behaviours.

For fearful dogs that do not also show aggressive behaviours or any other problematic sexually-dimorphic behaviours, neutering could potentially increase their fearfulness. Some dogs may benefit from remaining entire (? males) but if neutering is undertaken, needs to be done with great care in order to minimise adverse behavioural effects.

In other cases the role of sex hormones, and the potential impact of neutering, is less clear.

- In male dogs testosterone can potentially increase impulsivity and the intensity of aggressive behaviour shown in other contexts, e.g. confident dogs showing aggressive behaviours directed towards owners or other dogs in the contexts of resource-guarding, control or redirected frustration. Castration may have a small beneficial effect, but not necessarily, and not without additional behavioural support.
- aggressive behaviour between entire bitches may start when one or both come into season, but continue after the season finishes. Behaviour that continues through the anoestrus period is not directly influenced by sex hormones, and spaying is unlikely to improve it.
- Dogs showing fear-related problem behaviours including defensive aggression: neutering can increase fearfulness in dogs and bitches. Unless aggressive behaviour appears to be influenced by sex hormones (e.g. frustration in male dogs, or aggressive behaviour that worsens with a season or pseudopregnancy in bitches) neutering is unlikely to improve the behaviour and could potentially exacerbate it.

Suggested approach to entire dogs with problem behaviours:

- Ideally all dogs should have a behavioural assessment before neutering is undertaken:
 - Is the problem behaviour being influenced by circulating sex hormones?
 - could the behaviour have other causes?
 - how strong is the learned component?
- If the behaviour is likely to be influenced by circulating sex hormones, neutering may well be part of the behavioural treatment plan
- Behaviour modification may be needed to address other potential causes and any learned component of behaviour

For dogs where likely behavioural effect of neutering is not clear, and particularly where there is a risk that neutering might exacerbate the problem behaviour:

- Management and behavioural modification first
- In males can trial testosterone-reducing drugs e.g. delmadinone (Tardak) or deslorelin (Suprelorin) as effects not permanent



Deslorelin (Suprelorin, Virbac)



Deslorelin = a GnRH agonist

Continuous low-dose release of GnRH suppresses FSH and LH production from anterior pituitary

=> suppresses reproductive function in dogs (but **NB after initially increasing it**):

- ↓ testosterone
- ↓ spermatogenesis

Implant injected under skin along back:

- onset of effect @ 6 weeks
- lasts @ 6m
- effect fully reversible once implant runs out





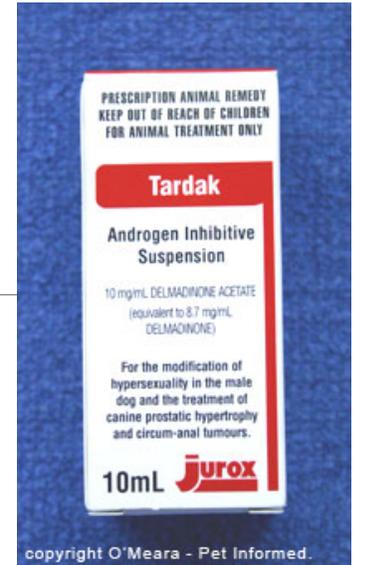
Tardak (Delmadinone acetate)

A progestin with anti-androgen and anti-oestrogen effects

Indicated for treatment of:

- hypersexuality (male dog and cat)
- prostatic hypertrophy
- anal adenomas
- hormonally-driven canine aggression.

Not reliable indicator of potential effect of castration because also enhances effect of GABA
=> general calming/ sedative effect





Minimising adverse effects associated with surgical neutering

- accustom animals to the vet surgery environment and to being handled here from an early age
- minimise negative experiences associated with surgery e.g. waiting room, weighing scales as well as in the consulting room
- handling should always be gentle and respectful of animal's physical and mental welfare
- Identify nervous individuals early (Godbout et al, 2007) and take extra care to accustom these to the surgery environment and to handling: will also benefit from additional behavioural support

- use pre-event medication to reduce anxiety and potentially cause mild sedation if any chance animal might be frightened/ distressed: as neutering likely to be elective should have time to trial drugs/doses
- If pre-event medication not given, give pre-med as soon as animal arrives at surgery and if feasible allow owner to stay with them until they are drowsy
- Minimise stress associated with hospitalisation:
 - Ensure hospital environment is as low-stress as possible:
 - separate dog, cat, rabbit wards if possible
 - minimise noise, bright lights, strong smells
 - cover cages
 - provide raised hiding places for cats, low hiding places for rabbits
 - Ask owner to bring familiar items e.g. blankets, bedding etc and place into cage to ensure animal surrounded by familiar smells both before and after surgery

- Bonded cats and rabbits: to minimise risk of relationship breakdown either bring to surgery together, and house together before surgery/after recovery or do scent swapping before reintroduction at home.
- Effective pain relief during surgery and post-op period essential
- Minimise stress in post-op period:
 - Use surgical suits or comfy collars/doughnut collars rather than Elizabethan collars (see Shenoda et al, 2020)
 - Reduce boredom and stress for animals on restricted exercise using environmental enrichment, food puzzles, sniffing, search games etc
- Care with post-op checks, suture removal etc.



In summary

Based on our current understanding of the impact of neutering on behaviour in companion animals:

- **for cats and rabbits** the behaviour-related benefits of neutering far outweigh the risks and pre-pubertal neutering is preferred for population control.
- For **dogs** the relationship between behaviour-related risks and benefits of neutering will vary according to:
 - **temperament:** bold/confident vs fearful; impulsive/easily frustrated
 - **Social situation:** inc living with other dogs, close to entire animals of opposite sex etc
 - Any **specific problem behaviours** being shown

Decisions about when and whether to neuter dogs should be made on an individual basis
For all animals the process of neutering should be managed in a way that does not cause or exacerbate fearfulness.



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Any Questions?

