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In female dogs undergoing elective neutering is ovariectomy or ovariohysterectomy superior?

A Knowledge Summary by

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KNOWLEDGE SUMMARY

PICO question

In female dogs undergoing elective neutering via midline coeliotomy is ovariectomy superior to ovariohysterectomy in terms of anaesthetic duration, incision length, complications and postoperative pain?

Clinical bottom line

Category of research question
Treatment

The number and type of study designs reviewed
The number and type of study designs that were critically appraised were four prospective clinical trials (Peeters et al., 2011; Lee at al., 2013; Harris et al., 2013; and Tallant et al., 2016) and a retrospective cohort study (Okkens et al., 1997)

Strength of evidence
Critical appraisal of the selected papers meeting the inclusion criteria collectively provide weak evidence in terms of their experimental design and implementation

Outcomes reported
Okkens et al. (1997) found no occurrence of pyometra/endometritis in 135 dogs receiving ovariectomy (OVE) or ovariohysterectomy (OVH) over an 8–11 year follow-up period. This study also reported no significant difference in long-term postoperative complications in either group.
Of the four prospective clinical trials one (Harris et al., 2013) had final year vet students perform the surgeries. This study found no difference in incision length, surgical time or incidence of intra-operative complications between techniques. However the relevance of this study to procedures performed by qualified veterinary surgeons is questionable.
The remaining papers all evaluated incision length, surgical time and postoperative pain after surgeries performed by experienced vets. All three found mean incision length was shorter in the OVE group and two (Lee et al., 2013; and Tallant et al., 2016) found that surgical duration was shorter in the OVE group. Only one paper (Lee et al., 2013) revealed a significant difference in pain scoring between groups, with the OVE group having lower scores at 1, 2, 4 and 6 hours post-surgery. Lee at al. (2013) and Tallant et al. (2016) also recorded intra-operative complications, however none were noted in either group

Conclusion
In view of the strength of evidence and the outcomes from the studies the following conclusion is made; whilst the evidence does suggest OVE may be associated with some modest improvement in surgical time and incision length, due to the small sample sizes and varying techniques used, further studies are required before definitive conclusions can be made.
There is currently insufficient evidence to determine if there is a difference in complication rates or postoperative pain between procedures.

How to apply this evidence in practice
The application of evidence into practice should take into account multiple factors, not limited to: individual clinical expertise, patient's circumstances and owners' values, country, location or clinic where you work, the individual case in front of you, the availability of therapies and resources.
Knowledge Summaries are a resource to help reinforce or inform decision-making. They do not override the responsibility or judgement of the practitioner to do what is best for the animal in their care.

Clinical Scenario

An 11-month-old, female entire crossbreed dog presents for elective neutering. You discuss surgical techniques with the client. You are confident at performing both ovariectomy and ovariohysterectomy via midline coeliotomy. Other techniques, including minimally invasive surgery and surgery through a flank incision, are not locally available or financially feasible and so are not considered.

When considering anaesthetic duration, incision length, complication rate and postoperative pain, what evidence is there to suggest OVE is superior to OVH or vice versa?

The evidence

From the literature reviewed here there is some evidence to suggest that when performed by an experienced veterinary surgeon OVE is associated with a shorter incision length and reduced surgical time compared to OVH. However the studies reviewed differ markedly in case selection, technique and study objectives. The sample sizes are typically small and the experience of the operating veterinary surgeons may not accurately reflect an 'average' general practitioner. Additionally the differences in between procedures reported may not be clinically significant.

There is convincing evidence that, when properly performed, OVE is not associated with a risk of pyometra. There is currently insufficient evidence to determine if there is a difference in postoperative pain following OVH compared to OVE. No papers reported an improvement in any outcome with OVH compared to OVE.

In conclusion, whilst the evidence does suggest OVE may be associated with some modest improvement in surgical time and incision length, further studies are required before definitive conclusions can be made.

Summary of the evidence

Harris et al. (2013)	
Population:	Female dogs of various breeds presented to a British veterinary teaching hospital for elective neutering. Age range 6–120 months. Weight range 2.9–51.5 kg. Dogs were excluded from recruitment if there were signs of pregnancy, oestrus, pseudopregnancy or ill health on clinical examination. Dogs were excluded at the time of surgery if pregnancy or abnormalities of the reproductive system were visualised or palpated.
Sample size:	108 dogs
Intervention details:	• Dogs were randomly allocated to undergo OVE (n=54) or OVH (n=54) via midline coeliotomy. • A final year student was allocated to each case and given written instructions of the procedure to be performed based on a standard open protocol. • The procedures were performed by the final year student assigned to the case with a qualified veterinary surgeon assisting, this assistant would complete the procedure if the total surgical duration exceeded 2 hours or major complications occurred.

Study design:	Prospective, single centre, randomised, controlled, clinical trial

Outcome studied:	• Intra-operative complication rates.
	• Time of surgery:
	  ○ from first incision to start of closure
	  ○ from start to end of closure
	  ○ total surgical time.
	• Incision length.

Main findings: (relevant to PICO question):	• Two dogs in the OVH group experienced major complications (one bladder laceration, one pedicle rupture prior to ligation) which required the assistant veterinary surgeon to complete the procedure, these were not included in the final analysis. • 11/108 cases exceeded the 2 hour time limit, 8/51 of the OVH group and 3/53 of the OVE group – this was not statistically significant. • Mean total surgical time was 88.7 +/- 20.6 minutes in the OVE group and 92.0 +/- 27.6 minutes in the OVH group. This was not significantly different. • Mean incision length was 8.7 +/- 2.6 cm in the OVE group and 9.6 +/- 3.4 cm in the OVH group. This was not significantly different. • No significant difference was observed in time from first incision to start of closure or time of closure between groups. • Minor intra-operative complication rates occurred in 12/52 (23%) of the OVH group and 21/54 (39%) of the OVE group – this did not differ significantly between groups.
Limitations:	• This is a single centre study which may limit application to other centres. • Surgeries were performed by final year students and so results may not be applicable to experienced veterinarians. • Students may have been more familiar with OVH from time in general practice where OVH is more commonly performed. • An assistant veterinary surgeon more experienced in OVH was scrubbed in to procedures. • Analgesia used is not recorded. • The text instructions supplied recommended a set incision length with extension at the discretion of supervising veterinary surgeon. • Incision length was recorded as an absolute length rather than as a proportion of the dog's length. • Different supervising veterinary surgeons of different skill levels were assisting and this was not controlled between groups. • There was no assessment of difference in skill levels of students, this was likely to be variable and was not controlled between groups.

Peeters et al. (2011)	
Population:	Client-owned, female entire, healthy dogs admitted to a Dutch veterinary teaching hospital for elective neutering. 12 mixed breed, 30 pedigree dogs of unspecified breed. Dogs excluded if they were not classified as ASA I (a normal healthy patient) on the American Society of Anaesthesiologists' (ASA) classification of Physical Health, or had shown signs of oestrus within the previous 6 weeks. Two dogs were later excluded due to receiving medical management for epilepsy. Mean age and weight were 2.8 years (standard error of mean +/- 3 years) and 26 kg (standard error of mean +/- 6 kg) in the OVH group and 1.9 years (standard error of mean +/- 1.2 years) and 24.4 kg (standard error of mean +/- 7.3 kg) in the OVE group.
Sample size:	40 dogs
Intervention details:	• Recruited dogs were randomly assigned to undergo OVH (20) or OVE (20). • Induction and maintenance of anaesthesia was performed as per a set protocol with carprofen (4 mg/kg) given once intravenously prior to surgery. • Surgical procedure was standardised for both techniques. Both OVE and OVH were performed via an open approach midline coeliotomy. All surgeries were performed by the same veterinary surgeon with an assistant. • Buprenorphine (10 µg/kg) was administered subcutaneously every 6 hours for 24 hours after surgery. Dogs hospitalised for > 24 hours received carprofen subcutaneously at a dose of 2 mg/kg. • Blood samples were collected immediately prior to and at 1 and 6, hours post-surgery via a preplaced jugular catheter. A final blood sample was collected at 24 hours post-surgery via venipuncture of the contralateral jugular vein. • Assessors were blinded to the type of procedure performed.
Study design:	Prospective, single centre, randomised, blinded, controlled, clinical trial

Outcome studied:	• Body condition score.
	• Blood loss estimated by weight of surgical sponges and swabs.
	• Time of surgery:
	  ○ from skin incision until completion of closure
	  ○ from start of incision to counting of used swabs
	  ○ from start of closure until end of closure.
	• Incision length (both of skin and of fascia) relative to the length of the area from manubrium to cranial rim of the pubis.
	• Pain scores:
	  ○ determined by the Glasgow Composite Measure Pain Scale (Reid et al., 2007) long form (CMPS-LF) and short form (CMPS-SF)

	○ recorded at 2, 6, 12 and 24 hours post-surgery. • Postoperative wound characteristics: ○ determined by subjective assessment of swelling, redness, dehiscence, discharge and pain on palpation ○ performed by four senior veterinary students blinded to surgical technique ○ assessed at 2, 6, 12 and 24 hours post-surgery ○ scored from 0–4 with 0 indicating feature not detected and 4 being severe ○ scores added to give total.
Main findings: (relevant to PICO question):	• The mean relative length of both the fascia and skin incisions were significantly shorter in the OVE group (17.7 +/- 1.8% and 19.8 +/- 2.0% respectively) than in the OVH group (21.3 +/- 3.1% and 23.8 +/- 3.6% respectively). • Surgical time (any component), postoperative pain and wound scores at any time point were not significantly different between groups.
Limitations:	• This is a single centre study which may limit application to other centres. • All procedures were performed by a single board certified veterinary surgeon which may limit application to general practice. • Wound appearance was assessed by subjective methods. • Collection of blood via a jugular catheter was performed at 1 and 6 hours post-surgery, and by venipuncture at 24 hours post-surgery, this may have affected pain scores. • Incision length was determined by the operating veterinary surgeon and may not reflect the required minimum incision length for each procedure. • Dogs received buprenorphine analgesia at 6 hourly intervals for 24 hours post-surgery. This is unlikely to reflect general practice and may have hindered ability to detect differences in pain scores between groups.

Tallant et al. (2016)	
Population:	Adult, female entire dogs obtained from local humane society shelters (country of origin not specified). Weight ranged from 3.3–30.1 kg. Dogs were excluded if there were signs of illness or cardiovascular abnormalities, evidence of oestrus or pregnancy on physical examination.
Sample size:	20 dogs
Intervention details:	• Dogs were individually kenneled a minimum of 24 hours prior to surgery. • Dogs were randomly assigned to receive either OVE or OVH. • Anaesthetic protocol was standardised with carprofen (4 mg/kg) given once subcutaneously prior to surgery.

	• Surgery was performed as per a standardised technique via a median coeliotomy. Haemostasis was achieved via a vessel sealing device, this was also used to seal and divide the uterine body where this was under 9 mm, where the uterine body exceeded 9 mm a single circumferential ligature was applied prior to transection. • Aftercare was standardised. Rescue analgesia (buprenorphine) was administered to dogs with pain scores of 5/24 or greater.
Study design:	Prospective, single centre, randomised, blinded clinical trial

Outcome studied:	• Total incision length.
	• Duration of each phase of surgery:
	  ○ Phase 0: From induction to first incision
	  ○ Phase 1: From first incision to grasping the first ovary
	  ○ Phase 2: From manipulation of the first ovary to initiation of body wall closure
	  ○ Phase 3: From initiation of body wall closure to completion of skin closure.
	• Heart rate, end-tidal isoflurane, systolic, mean and diastolic blood pressure measured at each phase.
	• Pain:
	  ○ assessed at 1, 2, 4, 6, 8, 12, 18 and 24 hours after surgery
	  ○ performed by single blinded assessor
	  ○ using the CMPS-SF and a 10 cm visual analog scale
	  ○ wound sensitivity was measured using an algometer with readings given in Newtons;
	  ▪ for each time point three readings were obtained from a point 1 cm cranial to the cranial edge of the incision.
	• Complication rate up to 24 hours.

Main findings: (relevant to PICO question):	• The change in mean arterial pressure between phase 1 and 2 was greater in the OVH group (increase of 25 +/- 14 mmHg) than the OVE group (increase of 9 +/- 15 mmHg). • The change in diastolic pressure between phase 1 and 2 was greater in the OVH group (increase of 27 +/- 13 mmHg) than the OVE group (increase of 6 +/- 14 mmHg). • There were no significant differences between groups in blood pressure between other phases, or heart rate and systolic pressure changes between any phases. • The mean heart rate of the OVE group was significantly greater than that of the OVH group during phase 0 and during phase 3. • The end-tidal isoflurane was significantly lower for the OVH group compared to the OVE group during phase 1 and phase 2. There was no difference during phase 3 or between the phases. • Mean procedure time was significantly greater for the OVH group (17.5 +/- 2.4 minutes) compared to the OVE group (15.4 +/- 1.7 minutes). There were no significant differences

	between groups in the duration of phases 0–2, however, the duration of phase 3 was longer in the OVH group than the OVE group. • Mean skin incision length was significantly greater in the OVH group (6.4 +/- 0.7 cm) compared to the OVE group (5.3 +/- 1.1 cm). • One dog from each group required rescue analgesia – this was not significantly different. • Neither visual analog scores nor algometer readings were significantly different between groups. • There were no complications in any of the dogs intra-operatively or up to 24 hours postoperatively.
Limitations:	• This was a single centre study, which may limit the application of results to other centres. • All procedures were performed by the same veterinary surgeon which may limit application to other veterinary surgeons. • The operating veterinary surgeon was board certified which may not reflect general practice. • Incision length was reported as an absolute value rather than percentage of body length. • Pre-operative overnight kenneling is not reflective of a typical general practice setting. • The sample size was small, limiting power to detect differences between groups and increasing the effect of any individual variation. • Incision length was determined by the operating veterinary surgeon and may not reflect the required minimum incision length for each procedure. • A vessel sealing device was used during the procedure and so results may not be applicable to procedures using ligatures.

Lee et al. (2013)	
Population:	Female entire, purpose-bred, crossbreed dogs (country of origin not specified). Dogs were excluded if abnormalities were found on clinical examination or serum biochemical profile/complete blood count 24 hours prior to surgery.
Sample size:	13 dogs
Intervention details:	• Dogs were kenneled 24 hours prior to surgery. • Anaesthetic protocol was standardised. • All surgeries were performed in the morning by a single experienced veterinary surgeon. OVE (6 dogs) or OVH (7 dogs) were performed as per a standardised technique via midline celiotomy.

	• Butorphanol (0.4 mg/kg) was administered intravenously prior to extubation, no further analgesia was given. • Blood sampling was performed by jugular venipuncture prior to surgery then at 1, 2, 4, 6, 12 and 24 hours post-surgery. • Aftercare was standardised.
Study design:	Prospective, single centre clinical trial

Outcome studied:	• Pain assessment:
	  ○ performed by blinded assessor
	  ○ using short form of the Glasgow Composite Measure Pain Scale (CMPS-SF) (Reid et al., 2007)
	  ○ assessed prior to surgery then at 1, 2, 4, 6, 12 and 24 hours post-surgery.
	• Serum cortisol and glucose
	  ○ assessed prior to surgery then at 1, 2, 4, 6, 12 and 24 hours post-surgery.
	• Incision length.
	• Surgical duration.
	• Anaesthetic duration.
	• Intra and postoperative complications.

Main findings: (relevant to PICO question):	• No complications were observed intra or postoperatively in either group. • Incision length was significantly shorter in the OVE group. Mean incision length was 10.1 +/- 2.2 cm in the OVH group and 4.4 +/- 0.3 cm in the OVE group. • Surgical duration was significantly shorter in the OVE group. Mean surgical time was 52.3 +/- 2.1 minutes in the OVH group and 35.8 +/- 2.8 minutes in the OVE group. • Anaesthetic duration was significantly shorter in the OVE group. Mean anaesthetic time was 66.1 +/- 4.4 minutes in the OVH group and 47.1 +/- 4.0 minutes in the OVE group. • The OVE group had a significantly lower CMPS-SF score than the OVH group at 1, 2, 4 and 6 hours postoperatively. • Serum cortisol and glucose values did not differ significantly between groups.
Limitations:	• This was a single centre study which may limit application of results to other centres. • All procedures were performed by the same veterinary surgeon which may limit application to other veterinary surgeons. • Venipuncture was performed regularly throughout the study which may have affected pain scores. • Incision length was reported as an absolute value rather than percentage of body length. • The study population were purpose bred crossbreeds which may limit application to other breeds. • Pre-operative overnight kenneling is not reflective of a typical general practice setting. • The sample size was small, limiting power to detect differences between groups and increasing the effect of any individual variation.

	• Incision length was determined by the operating veterinary surgeon and may not reflect the required minimum incision length for each procedure. • Dogs received one injection of butorphanol analgesia postoperatively only. This was in contrast to other studies where a non-steroidal anti-inflammatory drug (NSAID) was administered which may be more typical of general practice. This may account for the differences in pain score noted.

Okkens et al. (1997)	
Population:	Female dogs of various breeds which had undergone either an OVE or OVH procedure at a Dutch, teaching hospital 8–11 years prior to the study. Weight range at time of surgery 1.6–37.5 kg, age range at time of surgery 9.6 months to 9 years.
Sample size:	135 dogs
Intervention details:	• Dogs had been randomly selected to receive either OVH (n=66) or OVE (n=69). Anaesthesia and surgical technique were standardised. • A questionnaire was sent to owners 8–11 years post-surgery. Questions included whether the dog had experienced abdominal pain, vaginal discharge, endometritis/pyometra attractiveness to male dogs and urinary incontinence post-surgery. If any of the questions were answered positively a follow-up phone call was carried out.
Study design:	Retrospective single centre, cohort study
Outcome studied:	Incidence of urinary incontinence, ovarian remnant syndrome, attractiveness to male dogs, abdominal pain, vaginal discharge, endometritis/pyometra post-surgery.
Main findings: (relevant to PICO question):	• No attractiveness to male dogs or abdominal pain as a consequence of elective neutering was reported in any dog. • Asymptomatic vaginal discharge was observed in two dogs from either group. • Six dogs in the OVE group and nine in the OVH group developed urinary incontinence. • There was no incidence of endometritis/pyometra in either group. • There was no significant difference between groups in the incidence of any of the urogenital problems studied during the follow-up period.
Limitations:	• The method of randomisation was not reported and thus cannot be critiqued. • The questions asked were not reported and it is not clear if these may have biased client answers. • The study is retrospective and follow-up was performed. • Group matching (of age, weight etc.) was not possible and therefore confounding factors may have influenced results.

	• The study may be underpowered to detect differences in the rate of urinary incontinence between groups due to the relatively uncommon nature of the condition. • Due to the long follow-up time, accuracy of client recollection would be expected to have reduced. • The level of experience of the veterinary surgeons performing the procedures is not reported. • Bias may have been introduced by cases with negative outcomes being less likely to have complete case records and therefore being more likely to be excluded.

Appraisal, application and reflection

Five papers were found to be relevant to this knowledge summary, four prospective clinical trials (Peeters et al., 2011; Lee at al., 2013, Harris et al., 2013; and Tallant et al., 2016) and a retrospective cohort study (Okkens et al., 1997).

The retrospective cohort study (Okkens et al., 1997) reviewed long-term complications post OVE and OVH and found no occurrence of pyometra/endometritis in 135 dogs 8–11 year post-surgery. This finding is anticipated as pyometra is known to occur secondary to cystic endometrial hyperplasia; a disorder which requires the presence of progesterone and would not be expected to occur in the absence of functional ovarian tissue or administration of exogenous hormones (De Tora & McCarthy, 2011). Likewise the group reported there was no significant difference in urinary incontinence between groups. The findings of this study must be considered with caution however, as there may be some inherent bias with dissatisfied owners less likely to provide follow-up and therefore to be included.

Harris et al. (2013), a prospective, randomised clinical trial, prospectively monitored OVE and OVH surgeries performed by final year vet students. This study found no difference in incision length, surgical time or incidence of intra-operative complications between techniques; however the relevance of this study to procedures performed by qualified veterinarians experienced in routine neutering is disputable.

The remaining papers all evaluated surgeries performed by experienced veterinarians. These studies all compared incision length, surgical time and postoperative pain between groups. All found mean incision length was shorter in the OVE group and two (Lee et al., 2013; and Tallant et al., 2016) found that surgical duration was shorter in the OVE group; however the clinical impact of these findings is not clear as the reduction in both parameters was small. Additionally it should be noted that the surgeries reported by Tallant et al. (2016) were performed with the aid of a vessel sealing device, therefore results may not be applicable to procedures performed with suture ligation.

Differences in pain scores reported by these papers are harder to interpret. Only one paper (Lee et al., 2013), found a significant difference in pain scoring between groups; with the OVE group having lower scores at 1, 2, 4 and 6 hours post-surgery. However this was a small study (n=13) with purpose-bred dogs and procedures performed by a single veterinary surgeon. Equally two of the three groups (Peeters et al., 2011; and Lee et al., 2013) also performed postoperative blood sampling at regular intervals which may have affected pain score accuracy. Finally analgesia protocol varied between papers. Pre-operative NSAID administration was performed by Tallant et al. (2016) and Peeters et al. (2011), but not by Lee et al. (2013). Tallant et al. (2016) administered buprenorphine at 6 hourly intervals for 24 hours post-surgery, whilst Peeters et al. (2011) only included this as a rescue protocol and Lee et al. (2013) administered a single butorphanol injection only. Administration of additional analgesia beyond what is commonly used in general practice may hinder ability to detect differences in pain scores between groups, however withholding analgesia that is commonly used, may artificially increase differences in groups beyond what would be anticipated.

Lee et al. (2013) and Tallant et al. (2016) also recorded intra-operative complications, however none were noted in either group.

Gonadectomy in female dogs is generally performed to prevent misalliance and pyometra, for behavioural reasons and to reduce the risk of mammary and uterine neoplasia. Removal of the ovaries alone would be expected to prevent unwanted pregnancy, pyometra and to have an equal impact on the risk of mammary neoplasia as OVH, due to the cessation of ovarian hormone production. The effect of leaving the uterus *in situ* on the development of uterine neoplasia has not been evaluated, however as this disease is rare - the incidence of canine malignant uterine neoplasia is approximately 0.003% (Van Goetham et al., 2006) - and anticipated to be at least in part hormonally mediated, the impact of a change in practice from OVE to OVH on the uterine neoplasia related morbidity/mortality is likely to be negligible.

Of the studies reviewed here only two major complications were reported, both by Harris et al. (2013). Of these complications one, bladder laceration, would be expected to occur more commonly in OVH procedures due to the more caudal placement of the distal ligature. However, this study did not find a significant difference in complications between groups overall. It has also been proposed that OVE may be associated with a reduced risk of ureteral ligation; as the distal ureter is located caudal to the placement of the distal ovarian ligatures in OVE, but in the vicinity of the uterine ligature when an OVH is performed (De Tora & McCarthy, 2011). However serious complications secondary to neutering are rare and there is currently no evidence showing a difference in perioperative complications between techniques.

This knowledge summary reviewed surgery performed via a midline coeliotomy incision only, surgery performed via flank incision was not considered as part of this knowledge summary and data may not necessarily be extrapolated to other approaches.

In conclusion though the evidence reviewed within this knowledge summary suggests that OVE may be associated with shorter surgical duration and incision length than OVH there are several major weaknesses which prevent definitive conclusions. Firstly, where significant results are reported actual differences are not large and may be clinically insignificant. Secondly, all but two of the papers (Okkens et al. 1997; and Harris et al., 2013) used sample sizes of 40 or fewer animals, thus confounding factors are more likely to affect results and extrapolation to a general population becomes more challenging. Of the two papers which did use larger sample sizes, one (Harris et al. 2016) reviewed surgeries performed by final year students; consequently the implication of results from unqualified vets is not clear; and the second was a retrospective study reviewing owner reported long-term complications only. Finally, the population and techniques used between studies varied markedly and were often not representative of UK general practice; for example Lee et al. (2013) used only purpose-bred cross breed dogs, Tallant et al. (2016) used vessel-sealing devices rather than suture ligation, and Peeters et al. (2011) regularly blood sampled patients to collect data for a separate study.

No difference in complication rates between groups has been shown and differences in postoperative pain scores between procedures have not been convincingly demonstrated. No papers identified an advantage of performing OVH over OVE. These results apply only to animals with grossly normal uteri at coeliotomy, and hysterectomy is still recommended when uterine pathology is present.

Further indicated research includes large scale studies allowing identification of differences in rare intra-operative complications and randomised, clinical trials in larger numbers of animals in a setting more reflective of general practice, to determine if a significant difference between procedures is found when power is increased.

Methodology Section

Search Strategy	
Databases searched and dates covered:	CAB Abstracts on OVID Platform 1973 to 2019 Week 08 PubMed accessed via the NCBI website (1910–2019)
Search terms:	**CAB Abstracts:** 1. (dog or dogs or canine or canines or canis or bitch or bitches).mp. or exp dogs/ or exp bitches/ or exp canis/ [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] 2. (spey* or spay* or ovariohysterectom* or ovario-hysterectom*).mp. or exp hysterectomy/ [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] 3. ovariectom*.mp. or exp ovariectomy/ [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] 4. 1 and 2 and 3 **PubMed:** (canine OR bitch OR dog OR bitches OR dogs OR canis) AND (ovariectomy OR ovariohysterectomy OR spey OR spay)
Dates searches performed:	CAB Abstracts: 07/03/19 PubMed: 12/03/19

Exclusion / Inclusion Criteria	
Exclusion:	• Single case reports • Duplicates • Laparoscopic surgeries
Inclusion:	• English language • Peer reviewed publication • Original data • In vivo study • Canine patients • Comparative papers including both ovariectomy and ovariohysterectomy performed through a median coeliotomy • Reporting one or more of the following outcomes; complication rates, surgical time, post-operative pain

Search Outcome											
Database	**Number of results**	**Excluded – Non-canine patients**	**Excluded – Not OVH/OVE**	**Excluded – Duplicate**	**Excluded – No original data**	**Excluded – Non-surgical**	**Excluded – Laparascopic approach**	**Excluded – Not median coeliotomy**	**Excluded – Non-comparative**	**Excluded – Not comparing specified criteria**	**Total relevant papers**
CAB Abstracts	477	9	4	10	96	83	44	1	222	3	5
PubMed	1226	54	12	181	123	427	61	1	360	2	5
Total relevant papers when duplicates removed											**5**

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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