Surgical Site Infection Rate after Hemilaminectomy and Laminectomy in Dogs without Perioperative Antibiotic Therapy

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Abstract

Objective The aim of this study was to retrospectively review the surgical site infection (SSI) rate in dogs undergoing laminectomies without perioperative antibiotics, and compare those data with the expected infection rate for clean surgical wounds in dogs undergoing similar procedures.

Methods This was a retrospective single-centre study composed of dogs that underwent hemilaminectomies or laminectomies for thoracolumbar disc herniation or lumbosacral disease during a 2-year period (during 2015 and 2016). All incisional complications within 30 days were recorded and divided into superficial, deep or organ/space infections. Those dogs that received perioperative or postoperative antibiotics due to non-related comorbidities and those with incomplete medical records during the study period were excluded.

Results Of 221 consecutive hemilaminectomy and laminectomy procedures, 154 were included in this research study. One superficial wound infection was recorded and treated with antimicrobials. Overall, the SSI rate was 0.6%, while the expected SSI rate in clean operative wounds in dogs and cats is 2.0 to 4.8%. The SSI rate in human spinal surgery is 0.7 to 4.3%.

Clinical Significance Considering the low incidence of SSI in our study group, the routine use of perioperative antibiotic prophylaxis in dogs undergoing laminectomy procedures should be reconsidered to help address the global problem of bacterial resistance.

Keywords
- infection rate
- laminectomy
- perioperative antibiotic therapy
- surgical site infection
- hemilaminectomy

Introduction

Perioperative prophylactic antibiotic treatment has been suggested to decrease infection rates in human patients undergoing spinal surgery.[1] In human spinal surgery, the expected surgical site infection (SSI) rate for patients without comorbidities ranges from 0.7 to 4.3%.[1] Therefore, for uncomplicated spinal procedures in humans, the current consensus is to administer a single dose of preoperative prophylactic antibiotics with intraoperative re-dosing as needed.[1] A similar consensus is lacking for spinal surgery in veterinary patients. However, it is often considered to be standard practice to use antimicrobial prophylaxis in clean surgical orthopaedic procedures, because the development of an SSI can have devastating consequences.[2–4] The expected SSI rate in clean operative wounds in dogs and cats is 2.0 to 4.8%;[2,5–8] more specifically, 5.2 to 7.1% for clean orthopaedic surgeries in dogs.[5,9]

The development of antibiotic resistance is a growing worldwide problem that is considered to be one of the biggest threats to global health, food security and development today, according to the World Health Organization (WHO).[10] All government, industrial, agricultural and individual healthcare workers are urged to help prevent and control the spread of antibiotic resistance.[10]

The objective of this study was to retrospectively review the SSI rate in dogs undergoing hemilaminectomies and

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laminectomies without perioperative antibiotic treatment, and compare the data with the expected SSI rate for clean surgical wounds in dogs undergoing similar procedures. The aim of our study was to determine if dogs undergoing laminectomy without perioperative antibiotic medications have a higher SSI rate than dogs undergoing clean surgical procedures.

Materials and Methods

This research consisted of a retrospective single-centre study that comprised all consecutive canine cases (from 2014 to 2016) undergoing hemilaminectomy or laminectomy for thoracolumbar disc herniation and lumbosacral disease (degenerative lumbosacral stenosis syndrome). The breed, gender, surgical site, duration of anaesthesia, treatments, culture results and postoperative developments were documented for all the dogs. Definitions of SSI followed the Centers for Disease Control and Prevention (CDC) guidelines (►**Table 1**). According to these guidelines, minimal inflammatory discharge from surgical wounds confined to the points of suture penetration and sterile seroma were classified as minor incisional complications, not SSI. Those cases with suspected or confirmed SSI were defined as having major complications. Any cases with comorbidities requiring perioperative antibiotic therapy were excluded from the study, as were those patients that developed non-incisional problems requiring postoperative antibiotic medications. Finally, any patients that were lost to follow-up because of incomplete information about the surgical incision before reaching 30 postoperative days were also excluded from this study.

Computed tomography or magnetic resonance imaging, or both for the confirmation of the diagnosis and for surgical planning, preceded the majority of the surgeries during the same anaesthetic event.

Surgical Preparation

The same aseptic preparation protocol was used in all the patients, and the overall duration of anaesthesia was recorded. After induction, the surgical sites were clipped and scrubbed for 2 minutes with a 4% chlorhexidine detergent (Descutan; Fresenius Kabi, Uppsala, Sweden). The patient was moved into the surgical suite where the clipped incisional area was disinfected for at least a 3-minute contact

Table 1 Centers for Disease Control and Prevention's criteria for defining a SSI[11]

Superficial incisional SSI
Date of event for infection occurs within 30 days after any operative procedure (where day 1 = the procedure date)
SSI involves only skin and subcutaneous tissue of the incision and patient has at least one of the following:
a. Purulent drainage from the superficial incision
b. Organisms identified from an aseptically obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture–based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment
The patient has at least one of the following signs: pain or tenderness, localized swelling, erythema or heat
Diagnosis/treatment of cellulitis (redness/warmth/swelling) and sterile seroma, by itself, does not meet criterion for superficial incisional SSI. A stitch abscess alone (minimal inflammation and discharge confined to the points of suture penetration).
Deep incisional SSI
Date of event for infection occurs within 30 or 90 days after any operative procedure (where day 1 = the procedure date)
SSI involves deep soft tissues of the incision (e.g. fascial and muscle layers) and the patient has at least one of the following:
a. Purulent drainage from the deep incision
b. A deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon, attending physician
The patient has at least one of the following signs: fever, localized pain or tenderness. A culture or non-culture–based test that has a negative finding does not meet this criterion
An abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathological examination, or imaging test
Organ/Space SSI
Date of event for infection occurs within 30 or 90 days after any operative procedure (where day 1 = the procedure date)
SSI involves infection in any part of the body deeper than the fascial/muscle layers that is opened or manipulated during the operative procedure and the patient has at least one of the following:
a. Purulent drainage from a drain that is placed into the organ/space (e.g. closed suction drainage system, open drain, T-tube drain, CT-guided drainage)
b. Organisms are identified from an aseptically obtained fluid or tissue in the organ/space by a culture or non-culture–based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment
c. An abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathological examination, or imaging test evidence suggestive of infection

Abbreviation: CT, computed tomography; SSI, surgical site infection.

time with 5 mg/mL of chlorhexidine (Klorhexidinsprit; Fresenius Kabi, Uppsala, Sweden). The surgical area was then framed with four small adhesive drapes (Hartmann Foliodrape; Hartmann ScandiCare, Anderstorp, Sweden), followed by a large surgical drape (Medline Optima; Medline International, Arnhem, the Netherlands). A window was cut in the drape over the surgical area and covered with an adhesive incisional drape (3M Ioban 2; 3M, St. Paul, Minnesota, United States). Perioperative antibiotic medications or corticosteroids were not administered. Two or three people were present in the surgical suite during the procedure. The hand and arm preparation of the surgeon and assistant consisted of soap with a 1-minute contact time, followed by 80% alcohol with a 3-minute contact time.

The procedures were performed by the European College of Veterinary Surgeons (ECVS) specialists, ECVS residents or a national surgical specialist. The surgeons were double gloved and wore standard single-use sterile gowns. After the surgery, an adhesive bandage (Sorbact; ABIGO Medical AB, Askim, Sweden) was applied over the surgical wound and, if dysuria was expected postoperatively, a Foley silicone urinary catheter (Economy ClearView Foley Catheter; SurgiVet, Smith Medical, St. Paul, Minnesota, United States) was aseptically placed after clipping, cleaning and flushing the preputial area with a 0.5-mg/mL chlorhexidine solution (Klorhexidin, Fresenius Kabi, Uppsala, Sweden). During hospitalization, the surgical wards were divided according to the patients' wound classifications.

The adhesive bandage was removed 2 to 3 days postoperatively, and all the dogs were discharged when their bladder function was under control. The wounds were protected from licking and scratching postoperatively with collars, protective clothing or bandages. During hospitalization, the incisional wounds were examined daily by a surgical specialist or resident. The pet owners were informed both orally and in writing about how to check, clean and protect the wounds daily, and to contact us if there were any problems. All the wounds were checked by healthcare professionals, in our hospital or at our referral clinics, at the time of suture removal, and at the follow-up examinations in our hospital, approximately 4 weeks postoperatively. Owners were also interviewed following a list of questions regarding postoperative problems at the latter follow-up. All incisional complications within 30 days were recorded. All descriptions of wounds were reviewed by one author (B.D.). Suspected SSI was classified as superficial, deep or organ/space infections according to the CDC wound classification.[12]

Results

The medical records of 221 consecutive laminectomy cases were reviewed; 26% (58/221) were performed in the lumbosacral area and 74% in the thoracolumbar area (163/221). The mean age of the patients was 5.7 years.

Sixty-eight cases were excluded from our study: Four dogs were euthanatized before the end of the study period due to neurological deterioration and dysuria ($n = 3$), or at the owners' request ($n = 1$). Four cases were treated with perioperative antibiotic therapy due to comorbidities (endocardial disease, pyodermatitis, haemorrhagic gastroenteritis and severe periodontitis). Thirty-three cases were treated with postoperative antibiotic medications for indications other than SSI: suspected or confirmed urinary tract infections ($n = 28$), scrotal and preputial dermatitis ($n = 1$), and suspected aspiration pneumonia ($n = 4$). Furthermore, 27 dogs were lost to follow-up before the end of the study period and were therefore excluded (►**Table 1**). None of the excluded dogs developed SSI during the available follow-up times.

The mean duration of anaesthesia was 144 (60–295) minutes. Wound complications were diagnosed in 9.1% of the cases (14/154): one suspected superficial SSI that was treated successfully with cephalexin and 13 (8%) minor incisional problems (five seromas and eight cases of mild incisional swelling) that healed without specific treatment (►**Table 1**). The overall SSI rate was 0.6% (1/154), and no cases of deep incisional or organ space infections were reported (►**Appendix A**, available in online version only).

Discussion

The infection rate depends on many pre-, peri- and postoperative factors. Hygiene protocols are different from clinic to clinic. Orthopaedic surgical procedures have a great variation in necessary soft-tissue trauma, length of anaesthesia, implants and other factors. This could explain the different results and recommendations regarding SSI rates. We have chosen the hemilaminectomy and laminectomy procedures for this study because they are very standardized and do not require implants. The current recommendation for uncomplicated spinal procedures is a single dose of preoperative prophylactic antibiotic medication with intraoperative re-dosing as needed.[1] After reviewing 14 studies of spinal surgery in dogs, only 1 specifically reported not using perioperative antibiotic medication for the study procedure. Five of the studies described the usage of perioperative antibiotic medication, but no information was given in the other eight studies. Only three of the studies mentioned the use of perioperative corticosteroids.[13–26] To our knowledge, the only study that specifically investigated wound complications in canine spinal surgery dated back to 1992, with a surgical site complication rate of 14% in 264 laminectomies.[13] The authors of that study were under the impression that laminectomies carry a higher wound complication rate than other clean surgical procedures. However, 17% of the patients were treated preoperatively with antimicrobial drugs, 50% treated postoperatively and neither influenced the wound complication rate. The complication rate also included those cases not treated with antimicrobial drugs, but the specific SSI rate could not be determined.[13] There is a possibility that some of their minor complications were mild infections that resolved without antimicrobial drug therapy. In our hospital, the total wound complication rate of 9.1% was lower, when compared with the above-mentioned study.

Despite appropriate prophylaxis use, the rate of SSI in spinal surgery in human patients without comorbidities ranges from

0.7 to 4.3%.[1] Our SSI rate without prophylactic antibiotic therapy was lower when compared with human spinal surgery patients with prophylactic antibiotic therapy, and when compared with clean operative wounds in dogs and cats (2.0–4.8%).[1,2,6–8] The long duration of anaesthesia in our study was due to the patients undergoing both diagnostic imaging procedures and surgery during the same anaesthetic event. This is important because a prolonged duration of anaesthesia has been recognized as a significant risk factor for SSI, independent of the duration of surgery, with a 30% greater risk of wound infection for each additional hour of anaesthesia.[6] Prophylactic antibiotic therapy has been recommended for clean spinal surgeries in dogs, at least for surgeries lasting over 90 minutes.[8,13,27] However, the actual duration of anaesthesia in our study group was not associated with a higher SSI rate than that expected for clean surgeries.[2,6–8]

A leading publication on antimicrobial management has recommended only perioperative antibiotics in orthopaedic surgeries in dogs with extensive internal fracture fixation, open fracture repair, total hip prosthesis, extensive neurosurgery or prolonged (> 2 hours) surgery with a large amount of tissue manipulation.[28] Other publications recommended antimicrobial prophylaxis in clean surgical orthopaedic procedures in general, because SSI can have devastating consequences.[2–4] One prospective study concluded that there was a clear benefit from using perioperative antibiotic medications with orthopaedic surgery; however, another study concluded the opposite, demonstrating that additional larger studies are necessary to refine the use of antibiotic therapy in veterinary surgery.[9,10,29] According to a British survey performed in 2012 with small animal surgeons, 25.3 to 32.1% always used perioperative antimicrobial drugs for clean surgeries versus 21.1 to 31.1% who never did. Furthermore, 31% of the surgeons agreed that antimicrobial drugs decreased wound infections in clean surgical procedures, while 22.7% agreed that all animals undergoing surgery benefit from perioperative antibiotic drug administration.[30] Interestingly, this survey also identified suboptimal management with respect to the timing, duration and choice of antimicrobials.[30]

In our study, 12.7% of the cases were excluded due to the development of postoperative urinary tract infections, compared with 27 to 42% postoperative urinary tract infections in other published reports.[31,32] One study has shown that antimicrobial drug administration significantly increases the risk of urinary tract infections, in combination with indwelling urinary catheters.[33]

Our study did have some limitations; for example, the retrospective nature, without standardized methods, increased the number of variables and increased the risk for incomplete data. Due to the retrospective nature of the study, we could not control the SSI criteria for evaluating wounds after discharge from hospital in all patients. Surgical wounds are carefully monitored at our hospital, and SSI infections are reported to the hospital company's medical director. We have reviewed the description of the surgical incisions from records in our hospital and from referring colleagues, and compared these to the CDC guidelines. Another consequence of the retrospective nature of the study was the exclusion of patients because of incomplete datasets. If the information was not sufficient to classify the incisional wound according to the CDC criteria, the patient was excluded from the study. Dogs lost to follow-up may have developed complications that would have affected the outcome if included in this research. In addition, some of the minor complications in our study may represent mild infections that resolved without antimicrobial treatment despite the wounds not meeting the SSI criteria of the CDC. If so, they did not challenge global bacterial resistance, which was the background for the objective of this study.

Strict hygienic measures are implemented in our hospital, as well as a surveillance programme with dedicated personnel. The staff are regularly educated and updated regarding the hygiene programme and routines. Without these precautions, the SSI rate may have been higher. With the low SSI rate in our study, a larger number of cases would have been necessary to be able to compare the different variables and identify the risk factors for SSI (e.g. age and duration of anaesthesia, hemilaminectomies versus lumbosacral laminectomies). Moreover, the results from our study may differ from those in other clinical settings with other perioperative procedures and hygiene protocols.

Conclusion

Dogs undergoing hemilaminectomy and laminectomy without perioperative antibiotic therapy did not have a higher SSI rate when compared with similar procedures in humans or clean surgical procedures in dogs. These data support other studies showing that there are no significant benefits from perioperative prophylactic antibiotic therapy.[13,29,34]

Considering the low incidence of SSIs in our study group, the routine use of perioperative antibiotic medications in hemilaminectomy and laminectomy procedures in dogs should be reconsidered to help address the global problem of bacterial resistance.

Conflict of Interest
None.

Author contributions
Barbara A.R. Dyall and Hugo G. Schmökel contributed to the conception of the study, study design, acquisition of data, and data analysis and interpretation. Both authors drafted and revised and approved the submitted manuscript.

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Appendix A Laminectomies

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
1	German Shepherd	L7S1		
2	Bichon Havanais	Lami		
3	Dachshund	Lami		
4	Mixed breed	Lami		Perioperative antibiosis/Pyodermatitis
5	Mixed breed	Lami		Postoperative antibiosis/Urinary tract infection
6	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
7	Dachshund	Lami		Perioperative antibiosis/Haemorrhagic gastroenteritis
8	Dachshund	Lami		
9	Mixed breed	Lami		
10	French Bulldog	Lami		
11	French Bulldog	Lami		
12	Dachshund	Lami		Lost to follow-up
13	Mixed breed	Lami		Lost to follow-up
14	Chinese Crested Dog	Lami		
15	Mixed breed	Lami		Postoperative antibiosis/Urinary tract infection
16	Dachshund	Lami		
17	Dachshund	Lami		
18	Dachshund	Lami		
19	Dachshund	Lami		
20	Jämthund	L7S1		
21	Chinese Crested Dog	Lami	Minor/No treatment	
22	Dachshund	Lami		
23	Mixed breed	Lami		
24	Drever	Lami		Postoperative antibiosis/Urinary tract infection
25	French Bulldog	Lami		Postoperative antibiosis/Aspiration pneumonia
26	French Bulldog	Lami		
27	Dachshund	Lami		
28	Dachshund	Lami		Lost to follow-up
29	Dachshund	Lami		
30	Dachshund	Lami		
31	Dachshund	Lami		
32	Cavalier King Charles Spaniel	Lami		
33	French Bulldog	Lami		
34	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
35	Dachshund	Lami		
36	Mixed breed	Lami		

(*Continued*)

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
37	French Bulldog	Lami		
38	Dachshund	Lami		Euthanatized /Dysuria
39	Miniature Poodle	Lami		
40	Dachshund	Lami	Minor/No treatment	
41	Cavalier King Charles Spaniel	Lami		
42	Welsh Corgi	Lami	Minor/No treatment	
43	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
44	Mixed breed	Lami		
45	Mixed breed	Lami		
46	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
47	French Bulldog	Lami		Postoperative antibiosis/Aspiration pneumonia
48	Dachshund	Lami		
49	Miniature Poodle	Lami		
50	Dachshund	Lami		
51	Cocker Spaniel	Lami		
52	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
53	Nova Scotia Duck Tolling Retriever	L7S1		
54	Dachshund	Lami		Lost to follow-up
55	Chinese Crested Dog	Lami		
56	Mixed breed	Lami		Lost to follow-up
57	Chinese Crested Dog	Lami		Perioperative antibiosis/Severe periodontitis
58	Miniature Poodle	Lami		
59	Dachshund	Lami		
60	French Bulldog	Lami		Lost to follow-up
61	Dachshund	Lami		
62	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
63	Pug	Lami		
64	Papillon	Lami		
65	Drever	Lami		
66	Mixed breed	Lami		Lost to follow-up
67	Chihuahua	Lami		
68	Cocker Spaniel	Lami		
69	German Shepherd	Lami		Lost to follow-up

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
70	Dachshund	Lami		
71	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
72	Chinese Crested Dog	Lami		Lost to follow-up
73	Dachshund	Lami		
74	Drever	Lami		
75	Mixed breed	Lami		Euthanatized /Neurologic deterioration
76	Mixed breed	Lami		
77	Mixed breed	Lami		
78	Shihtzu	Lami		Postoperative antibiosis/Urinary tract infection
79	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
80	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
81	French Bulldog	Lami		
82	Dachshund	Lami		
83	Mixed breed	Lami		Lost to follow-up
84	Mixed breed	Lami		
85	Mixed breed	Lami		
86	Dachshund	Lami		Lost to follow-up
87	Cavalier King Charles Spaniel	Lami		Lost to follow-up
88	French bulldog	Lami	Minor/No treatment	
89	Dachshund	Lami		Lost to follow-up
90	French Bulldog	Lami	Minor/No treatment	
91	Mixed breed	Lami		Postoperative antibiosis/Urinary tract infection
92	Mixed breed	Lami		
93	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
94	Dachshund	Lami		
95	Dachshund	Lami		
96	Dachshund	Lami		Lost to follow-up
97	French Bulldog	Lami		Postoperative antibiosis/Aspiration pneumonia
98	Mixed breed	Lami		
99	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
100	Dachshund	Lami		
101	French Bulldog	Lami		
102	Chinese Crested Dog	Lami		
103	Airedale Terrier	L7S1		Perioperative antibiosis/Cardiac valve disease
104	Cocker Spaniel	L7S1		

(*Continued*)

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
105	Chinese Crested Dog	Lami		
106	Rhodesian Ridgeback	L7S1		
107	Australian Kelpie	Lami	Minor/No treatment	
108	Dachshund	Lami	Minor/No treatment	
109	Welsh Corgi	Lami		
110	Dachshund	Lami		
111	Cavalier King Charles Spaniel	L7S1		
112	Miniature Dachshund	Lami		
113	Dachshund	Lami		
114	Mixed breed	Lami		Lost to follow-up
115	Whippet	Lami		
116	Whippet	L7S1		
117	Dachshund	L7S1		Lost to follow-up
118	Bichon Havanais	Lami		
119	Mixed breed	Lami		Lost to follow-up
120	Miniature Poodle	Lami		
121	Drever	Lami		Lost to follow-up
122	Welsh Corgi	Lami		Postoperative antibiosis/Urinary tract infection
123	Mixed breed	Lami		
124	Miniature Poodle	Lami		
125	Coton de Tulear	Lami		Postoperative antibiosis/Urinary tract infection
126	Whippet	L7S1		
127	Mixed breed	Lami		Postoperative antibiosis/Urinary tract infection
128	Dachshund	Lami		
129	Dachshund	Lami		Lost to follow-up
130	American Cocker Spaniel	Lami		
131	Chinese Crested Dog	Lami		
132	Coton de Tulear	Lami		
133	German Shepherd	Lami	Major/SSI	
134	German Shepherd	Lami	Minor/No treatment	
135	Mixed breed	L7S1		
136	French Bulldog	Lami		
137	Dachshund	Lami		
138	Mixed breed	Lami		

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
139	Dachshund	Lami		
140	Griffon Belge	Lami		
141	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
142	Dachshund	Lami		
143	Dachshund	Lami		
144	French Bulldog	Lami		
145	Welsh Corgi	Lami		
146	Dachshund	Lami		
147	Dachshund	Lami		
148	Berner Sennen	L7S1		
149	Dachshund	Lami		Lost to follow-up
150	Bichon Havanais	Lami		Postoperative antibiosis/Urinary tract infection
151	Dachshund	Lami		
152	Mixed breed	Lami		
153	Mixed breed	Lami		Lost to follow-up
154	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
155	French Bulldog	Lami		
156	Mixed breed	Lami		
157	Miniature Dachshund	Lami		Lost to follow-up
158	Basset Hound	Lami		
159	French Bulldog	Lami		Postoperative antibiosis/Confirmed aspiration pneumonia
160	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
161	French Bulldog	Lami		
162	Welsh Springer Spaniel	L7S1		
163	Pekingese	Lami		
164	Chinese Crested Dog	Lami		
165	Rhodesian Ridgeback	Lami		
166	Dachshund	Lami		
167	French Bulldog	Lami		Postoperative antibiosis/Urinary tract infection
168	Dachshund	Lami		
169	Dachshund	Lami		Postoperative antibiosis/Urinary tract infection
170	Mixed breed	Lami		Lost to follow-up
171	Cavalier King Charles Spaniel	Lami		
172	French Bulldog	Lami		
173		Lami		

(*Continued*)

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
	Nova Scotia Duck Tolling Retriever			Postoperative antibiosis/Dermatitis scrotum and preputium
174	Miniature Poodle	Lami		
175	Mixed breed	Lami		Postoperative antibiosis/Urinary tract infection
176	Chinese Crested Dog	Lami	Minor/No treatment	
177	Dachshund	Lami		
178	Pug	Lami		Lost to follow-up
179	Mixed breed	Lami		
180	Welsh Corgi	Lami		
181	Lhasa Apso	Lami		
182	Field Spaniel	Lami		Postoperative antibiosis/Urinary tract infection
183	Rhodesian Ridgeback	L7S1		
184	Welsh Corgi	Lami		Euthanazized /On owners' request
185	Cocker Spaniel	Lami		Lost to follow-up
186	German Shepherd	L7S1		
187	Mixed breed	L7S1		
188	Border Collie	L7S1		
189	German Shepherd	L7S1		Postoperative antibiosis/Urinary tract infection
190	Mixed breed	L7S1		
191	Border Collie	L7S1		
192	Australian Shepherd	L7S1		Lost to follow-up
193	German Shepherd	L7S1		
194	German Shepherd	L7S1		
195	German Shepherd	L7S1		
196	Golden Retriever	L7S1		
197	Staffordshire Bull Terrier	L7S1		
198	Malinois	L7S1		
199	Rottweiler	L7S1		
200	Leonberger	L7S1	Minor/No treatment	
201	Rottweiler	L7S1		
202	Mixed breed	L7S1		
203	Golden Retriever	L7S1		
204	German Shepherd	L7S1		

Appendix A (*Continued*)

	Breed	L7S1	Wound complication/ comment	Indication for exclusion
205	German Shepherd	L7S1		
206	Kromfohrländer	L7S1		
207	Cane Corso	L7S1		
208	Rottweiler	L7S1		
209	German Shepherd	L7S1		
210	Nova Scotia Duck Tolling Retriever	L7S1	Minor/No treatment	
211	German Shepherd	L7S1		
212	Mixed breed	L7S1		
213	Mixed breed	L7S1	Minor/No treatment	
214	German Shepherd	L7S1		
215	Rhodesian Ridgeback	L7S1		
216	German Shepherd	L7S1		Lost to follow-up
217	Mixed breed	L7S1		
218	German Shepherd	L7S1		
219	Golden Retriever	L7S1	Minor/No treatment	
220	English Setter	L7S1		
221	Golden Retriever	L7S1		

Abbreviations: L7S1, lumbosacral laminectomy; lami, thoracolumbar laminectomy.