Outcomes of dogs undergoing limb amputation, owner satisfaction with limb amputation procedures, and owner perceptions regarding postsurgical adaptation: 64 cases (2005–2012)

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Objective—To evaluate outcomes of dogs and owner satisfaction and perception of their dogs' adaptation following amputation of a thoracic or pelvic limb.

Design—Retrospective case series.

Animals—64 client-owned dogs.

Procedures—Medical records of dogs that underwent limb amputation at a veterinary teaching hospital between 2005 and 2012 were reviewed. Signalment, body weight, and body condition scores at the time of amputation, dates of amputation and discharge from the hospital, whether a thoracic or pelvic limb was amputated, and reason for amputation were recorded. Histologic diagnosis and date of death were recorded if applicable. Owners were interviewed by telephone about their experience and interpretation of the dog's adaptation after surgery. Associations between perioperative variables and postoperative quality of life scores were investigated.

Results—58 of 64 (91%) owners perceived no change in their dog's attitude after amputation; 56 (88%) reported complete or nearly complete return to preamputation quality of life, 50 (78%) indicated the dog's recovery and adaptation were better than expected, and 47 (73%) reported no change in the dog's recreational activities. Body condition scores and body weight at the time of amputation were negatively correlated with quality of life scores after surgery. Taking all factors into account, most (55/64 [86%]) respondents reported they would make the same decision regarding amputation again, and 4 (6%) indicated they would not; 5 (8%) were unsure.

Conclusions and Clinical Relevance—This information may aid veterinarians in educating clients about adaptation potential of dogs following limb amputation and the need for postoperative weight control in such patients. (*J Am Vet Med Assoc* 2015;247:786–792)

Amputation of a limb is frequently recommended in veterinary medicine as a component of treatment for neoplasia, traumatic injury, peripheral neuropathies, vascular compromise, infection, or disability resulting from degenerative or congenital processes.[1] Anecdotally, most veterinarians believe dogs adapt quickly to ambulation after limb amputation; however, many dog owners are reluctant to pursue surgery. Owner anxiety exists even though limb amputation frequently represents the safest, least demanding, and most cost-effective treatment option for a variety of pathological changes affecting limbs. In a survey conducted in 1999, the most common owner concerns about limb amputation included cosmetic appearance and reduced mobility after surgery.[2] Other issues include owners' guilt associated with limb amputation, perception of reduced QOL, perception that an older dog may not tolerate surgery or anesthesia, concern about the dog's inability to tolerate concurrent osteoarthritis in the remaining limbs, and perception of a substantial degree of pain associated with the surgery. Many owner concerns may be amplified by disease processes such as osteosarcoma, which may be associated with a short survival time following amputation.

Abbreviations

BCS	Body condition score
QOL	Quality of life

Many factors should be considered in predicting a given patient's satisfactory adaptation following limb amputation. Previous studies[2] have demonstrated that dog age or size, which factor into common owner concerns, are not associated with delayed recovery. Adaptation following amputation of a thoracic limb was shown to be similar to that following pelvic limb amputation in dogs[2,3] and cats.[3] The contraindications to

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limb amputations most commonly cited among veterinarians include extreme obesity or coexisting orthopedic or neurologic disease.[1,2]

Studies evaluating owner satisfaction and patient outcome after limb amputation in dogs and cats were reported in 1999[2] and 2010,[4] respectively. Both of these studies were performed in Europe. To the authors' knowledge, the most recent report of a study[3] evaluating these measures in the United States was published in 1987. Prior to these investigations, results of a small survey in Canada evaluating owner satisfaction after limb amputation in dogs were published in 1979.[5] In each of these reports, investigators concluded that most owners were satisfied with the postsurgical outcome for their pet. Given that more therapeutic options for various conditions affecting the limbs of dogs have become available since some of these studies were published, and that owners' opinions on the subject of amputation may vary over time and among countries, updating information regarding patient adaptation and owner satisfaction following limb amputation is important to facilitate informed decision making.

The objectives of the study reported here were to evaluate outcomes of dogs undergoing amputation of a thoracic or pelvic limb and to assess owner expectations, satisfaction with the procedure, and perception of their dogs' adaptation following amputation. We also sought to evaluate the impact of various perioperative factors on postoperative QOL in these patients. We hypothesized that most owners would report a positive outcome, even if their initial reactions regarding amputation were negative, and that patient adaptation following amputation would exceed owners' expectations.

Materials and Methods

Case selection—The medical records database at the University of Georgia Veterinary Teaching Hospital was searched to identify dogs that had undergone limb amputation between January 1, 2005, and June 30, 2012. Inclusion criteria were as follows: amputation of a thoracic or pelvic limb during the study period, availability of a complete medical record (including age, sex, breed, body weight, BCS, surgery date, reason for amputation, ability to walk at the time of hospital discharge, medications supplied or prescribed at discharge, and discharge date), a follow-up time of ≥ 6 months from the date of surgery to the date of the owner interviews, and owner agreement to complete an interview by telephone.

Medical records review—Patient data obtained from the medical record included signalment, body weight, and BCS (scale of 1 to 9, where 1 = emaciated and 9 = grossly obese) at the time of amputation. The BCS was assigned by a fourth-year veterinary student under the direct supervision of a surgical resident or board-certified surgeon. The date of amputation, date of discharge from the hospital, whether a thoracic or pelvic limb was amputated, reason for amputation, and histologic diagnosis (if applicable) were also recorded. When applicable, date of death was recorded; if date of death was not available in the medical record, it was obtained by follow-up with the owner.

Procedures—A 22-question telephone survey was used.[a] The survey was modified from previous veterinary investigations of QOL[2,3,6] and included questions with multiple-choice and yes-or-no answers, as well as open-ended questions. Interviews were conducted by a third-year surgical resident (KDC) or a fourth-year veterinary student (MO) between January 7, 2013, and March 4, 2013. The interview was intended to semiquantitatively score the owner's preoperative concerns, perception of how the dog adapted after amputation, and satisfaction with the amputation procedure and outcome.

Owners were asked to provide information on medications, supplements, and treatments provided to the dog after surgery; this information was cross-referenced with the medical record. Additional questions asked included whether they recalled when the dog was able to walk without support and what the time frame was, as well as whether they thought the dog had returned to a normal QOL after the amputation and if so, how long it took for the dog to return to normal. Owners who did not think the dog had returned to a normal QOL were asked to indicate how long it took for the dog to stop improving.

Owners were then asked to indicate how they would score their dog's QOL (on a scale of 1 to 5, where 1 = very poor and 5 = full recovery to preamputation QOL) after its limb amputation and to provide the reason they thought the dog's QOL was not normal if the score was < 5. They were also asked whether they had noticed signs of pain in the dog after it had returned home from the hospital and, if present, what signs of pain were observed. Several questions were asked to ascertain the dog's behavioral and activity changes following amputation, including the degree to which amputation had affected its comfort or sociability; any changes (increase or decrease) in interaction with familiar and unfamiliar pets, recreational pastimes, ability to maneuver on stairs, walking or hiking routines, stamina during exercise, general attitude, and attitude toward receiving human affection; and whether the dog walked better with or without a leash after surgery or if this was unchanged. If the dog swam prior to surgery, the owner was asked whether it had returned to swimming afterward. Any complications after discharge from the hospital that required veterinary treatment were noted.

Near the end of the survey, owners were asked to rank how reluctant or willing they had been to have the amputation performed initially (on a scale of 1 to 5, where 1 = almost did not go through with it and 5 = no second thoughts about it), what their biggest concern had been if they were reluctant, and whether they would make the decision to have amputation performed if they were faced with it again, both when taking all factors into account (survival, adaptation after surgery, and chemotherapy if applicable) and when considering adaptation to amputation only. Finally, they were asked to rate how their dog's recovery and adaptation compared with their expectations (better, the same, or worse than expected), whether they thought their veterinarian had adequately prepared them for the dog's overall experience, and to provide any other comments regarding the amputation.

Statistical analysis—Continuous data were evaluated for normality by means of a Kolmogorov-Smirnov test. Data with normal distribution were described as mean ± SEM, and nonnormally distributed data were summarized as median and range. Categorical or ordinal data were described as percentages of the total. Median survival time was estimated with Kaplan-Meier analysis; dogs still alive at the time of the owner's telephone survey interview were censored on that date.

A 2-tailed Student *t* test or Mann-Whitney test (for data that did and did not meet normality assumptions, respectively) was used to compare preoperative age, body weight, and BCS of dogs able versus unable to walk at the time of discharge from the hospital; time to achievement of best QOL after surgery (ie, time to return to preamputation QOL or until the dog stopped improving) for patients that underwent thoracic limb versus pelvic limb amputation; BCS, body weight, and postoperative QOL scores of dogs that underwent amputation for neoplasia versus other reasons; time to discharge from the hospital in dogs that had thoracic limb versus pelvic limb amputation; and postoperative QOL score in dogs that had thoracic limb versus pelvic limb amputation. The χ^2 test was used to compare the following results for patients that underwent thoracic limb versus pelvic limb amputation: ability to walk at discharge from the hospital, whether dogs that previously swam returned to swimming after surgery, and whether dogs walked better with or better without a leash after surgery, compared with before surgery (or if this was unchanged). The χ^2 test was also used to assess perceived postsurgical pain (present vs absent) for dogs that were prescribed various types of analgesic medication at hospital discharge; analgesic medications dispensed at discharge were grouped into NSAID only, NSAID in combination with an opioid, opioid only, or none for statistical analysis.

The Spearman correlation test was used to quantify associations of time to best QOL after surgery with BCS, age, and body weight and with postoperative QOL score. The same test was used to evaluate correlations of BCS, age, and body weight with postoperative QOL score and of body weight with BCS.

Statistical analysis was performed with the aid of commercially available software.[b] Values of $P < 0.05$ were considered significant.

Results

Medical records of 118 dogs that underwent a limb amputation between January 1, 2005, and June 30, 2012, and would have ≥ 6 months between the date of surgery and date of a possible interview were identified. Owners of 64 dogs that could be contacted by telephone consented to participate in the telephone survey. None of the owners who were contacted directly declined to be interviewed; in the remaining 54 cases, contact information was invalid or the owners did not respond to a voice message.

The 64 dogs included in the study had a median survival time of 592 days; 25 dogs were still alive at the time the telephone survey was completed with the owner and were censored on that date. The median follow-up time was 38.5 months (range, 8 to 84 months). Median age at the time of amputation was 7.7 years (range, 1.2 to 14.2 years); median body weight and BCS of the dogs at the time of surgery were 33.3 kg (73.3 lb; range, 2.3 to 77.2 kg [5.1 to 169.8 lb]) and 6 of 9 (range, 3/9 to 9/9), respectively. Thirty-one male dogs (2 sexually intact and 29 castrated) and 33 female dogs (1 sexually intact and 32 spayed) were included in the study. The most common breed was Labrador Retriever (n = 14); followed by Golden Retriever (8); mixed (6); Rottweiler (5); Boston Terrier (4); 2 each of American Bulldog, Boxer, German Shepherd Dog, and Rhodesian Ridgeback; and 1 each of Akita, Australian Shepherd, Beagle, Cane Corso, Chihuahua, English Bulldog, Flat-Coated Retriever, German Short-Haired Pointer, Greyhound, Irish Setter, Jack Russell Terrier, Leonberger, Maltese, American Pit Bull Terrier, Pomeranian, Saint Bernard, Siberian Husky, English Springer Spaniel, and Whippet. The most common reason for amputation was neoplasia (n = 53 dogs), including osteosarcoma (32), soft-tissue sarcoma (15), mast cell tumor (3), chondrosarcoma (2), and malignant neoplasm of mesenchymal origin (1). Seven dogs underwent amputation because of traumatic injury. Other causes included infection, necrotizing fasciitis, a failed fracture repair, and chronic elbow joint luxation (1 dog each). Of the 64 dogs, 32 (50%) underwent thoracic limb amputation, and 32 (50%) underwent pelvic limb amputation.

Postoperative complications were identified in 8 of 64 (13%) dogs; 5 (8%) dogs developed a surgical site infection, and 3 (5%) developed a seroma. Seven of the 8 dogs that had complications were still alive at the time of the follow-up survey. The remaining dog had undergone amputation following a diagnosis of osteosarcoma and was euthanized 5 months after surgery.

When owners were asked about their initial willingness or reluctance to have the amputation performed on a scale of 1 (almost did not go through with it) to 5 (no second thoughts about it), 28 of 64 (44%) reported a score of 5, 10 (16%) reported a score of 4, 12 (19%) reported a score of 3, 6 (9%) reported a score of 2, and 8 (13%) reported a score of 1. One of the owners who reported an initial score of 1 stated that after a pathological fracture developed in the dog, the score changed to a 5. Concerns about general postoperative QOL (n = 13) and postoperative mobility (8) were the most common reasons given when owners were asked to state their biggest concern if they had been reluctant; for others, the concern was financial (n = 5), related to the dog's postoperative survival time (3) or surviving surgery (2), need for postoperative care (2), psychological impact on the pet (2), the pet's age (2), or cosmetic (1). Two owners reported > 1 primary concern.

Fifty-eight of 64 (91%) owners thought their veterinarian had adequately prepared them for their dog's overall experience, 4 (6%) thought they had not been adequately prepared (including 1 owner who indicated having had adequate information about the surgery itself but not having been emotionally prepared), and 2 (3%) were unsure.

The median time from surgery to discharge from the hospital was 3 days (range, 1 to 17 days). Twenty of 64 (31%) owners perceived their dog as having signs of pain at the time of discharge from the hospital, including evidence of sensitivity at the incision site, behavior-

al signs of depression, and unwillingness to move. Of the 64 dogs, 35 (55%) were discharged from the hospital with medications for multimodal analgesia (NSAID in combination with an opioid), 19 (30%) with an opioid medication only, 6 (9%) with an NSAID only, and 4 (6%) with no analgesic medications. There were no significant differences in the proportions of dogs reported to have signs of pain (12/35, 5/19, 2/6, and 1/4, respectively) when grouped according to these treatments.

Forty-seven of 64 (73%) owners reported that their dogs were able to walk without support at the time of discharge from the hospital. Of the remaining 17 dogs, 11 were walking without support within 1 week, 3 required < 2 weeks, and 3 required ≥ 2 weeks. Comparison between groups that could or could not walk without support at the time of hospital discharge revealed no significant difference in age (7.4 years [range, 1.2 to 13.3 years] vs 8.1 years [range, 1.3 to 14.2 years], respectively), body weight (33.4 kg [73.5 lb; range, 4.4 to 77.2 kg {9.7 to 169.8 lb}] vs 30.0 kg [66.0 lb; range, 2.3 to 74.8 kg {5.1 to 164.6 lb}], respectively), or BCS (6/9 [range, 3/9 to 8/9] vs 6/9 [range, 4/9 to 9/9], respectively). There was no significant difference in the proportion of dogs able to walk without assistance at hospital discharge after undergoing thoracic limb (22/32) versus pelvic limb amputation (25/32). There was also no significant difference in time to discharge from the hospital for dogs that underwent thoracic (3.2 ± 0.5 days) versus pelvic (3.2 ± 0.3 days) limb amputation.

Forty-four of 64 (69%) owners reported that their dog's walking was unchanged with regard to being on or off leash after amputation, compared with before surgery. Sixteen (25%) reported that the dog walked better without a leash and 2 (3%) reported that the dog walked better with a leash after surgery. Two (3%) owners indicated that the question was not applicable; in 1 case, the dog did not walk again following its pelvic limb amputation (the other owner did not specify a reason). Of 32 dogs that underwent thoracic limb amputation, 2 (6%) walked better with a leash, 6 (19%) walked better without a leash, 23 (72%) had no change as compared with before surgery, and 1 (3%) reported this was not applicable for unspecified reasons; proportions did not differ significantly from those of the 32 dogs that underwent pelvic limb amputation (0 [0%] better with a leash, 10 [31%] better without, 21 [66%] unchanged, and 1 [3%] not applicable). Forty-seven (73%) owners reported no change in their dog's recreational activities, 13 (20%) said there was a slight decrease, and 4 (6%) reported a substantial decrease. Of 22 dogs that previously swam, 13 (59%) were able to return to swimming after amputation and 9 (41%) were not. There was no significant difference in the proportion of dogs that returned to swimming after thoracic (4/10) versus pelvic (9/12) limb amputation. Other activities that some dogs were able to return to (not specifically asked but mentioned by the owners) included agility, flyball, hiking, and playing in the park (1 dog each). Of the 64 owners, 39 (61%) reported no change in the dog's stamina during exercise, 24 (38%) reported a slight decrease, and 1 (2%) reported a substantial decrease. Thirty-seven (58%) owners reported no change in the dog's ability to maneuver on stairs, 21 (33%) reported a slight decrease, 5 (8%) reported a substantial decrease, and 1 (2%) was unsure. Forty-nine of 64 (77%) dogs were able to return to normal walking or hiking routines after amputation, 13 (20%) had a moderate decrease in ability to perform normal walking, and 1 (2%) had a severe decrease; 1 (2%) owner was undecided as to this outcome.

When asked to rank their dog's QOL after amputation on a scale of 1 to 5, with 1 being a very poor QOL and 5 being full recovery to preamputation QOL, 43 of 64 (67%) owners reported a score of 5, 13 (20%) reported a score of 4, 5 (8%) reported a score of 3, 1 (2%) reported a score of 4, and 2 (3%) reported a score of 1. Each of the 3 dogs whose owners reported a score of 1 or 2 was euthanized ≤ 3 months after surgery; 2 were euthanized because of metastatic neoplasia, and the third was euthanized for unspecified reasons. The most frequently reported reasons for lack of a full recovery were difficulty with mobility (n = 11) and decreased stamina (6). The time to best postamputation QOL was < 1 week in 13 (20%) dogs, < 4 weeks in 33 (52%), < 6 months in 15 (23%), and not reached (ie, QOL was poor and did not improve) in 3 (5%). Shorter time to reach best QOL was significantly (P = 0.004) correlated (r = –0.356; r^2 = 0.13) with a higher QOL score. The time to best QOL after surgery was not correlated with body weight, BCS, or age at the time of surgery. Of 32 dogs that underwent thoracic limb amputation, 7 (22%) reached their best QOL in < 1 week, 16 (50%) in < 4 weeks, and 9 (28%) in < 6 months, and no dogs failed to reach an acceptable QOL; these proportions did not differ significantly from those of the 32 dogs that underwent pelvic limb amputation (6 [19%], 17 [53%], 6 [19%], and 3 [9%], respectively)

The study population included 8 small- and toy-breed dogs that weighed < 10 kg (22 lb). As for the overall study population, neoplasia remained the most common reason for amputation in this group (n = 5), followed by trauma (2); the remaining dog underwent amputation because of a failed fracture repair. Most (6/8) of these small dogs underwent pelvic limb amputation, and all had a BCS between 4 and 6. None of the owners of small- or toy-breed dogs reported QOL scores < 4; 1 owner reported a score of 4, and the remaining 7 reported a score of 5. Time to reach the dog's best postamputation QOL was < 1 week for 3 of 8 small- or toy-breed dogs, < 4 weeks for 4 dogs, and < 6 months for 1 dog.

Three of 21 owners who scored their dog's postoperative QOL as < 5 reported obesity was a possible contributing factor in failure for their dog to fully recover its normal preamputation QOL. The median BCS of dogs with a QOL score of 1 or 2 was 8 of 9 (n = 3; range, 5/9 to 8/9), and that of dogs with a QOL score of 4 or 5 was 6/9 (n = 56; range, 3/9 to 9/9). Higher BCS was significantly (P = 0.001) correlated (r = –0.400; r^2 = 0.16) with lower QOL score. Median body weight of dogs with a QOL score of 1 or 2 was 36.5 kg (80.3 lb; range, 29.3 to 43.3 kg [64.5 to 95.3 lb]), and that of dogs with a QOL score of 4 or 5 was 33.05 kg (72.71 lb). Lower QOL scores were significantly (P = 0.005) correlated (r = –0.342; r^2 = 0.12) with higher body weight, and higher body weight was

correlated ($r = 0.400$; $r^2 = 0.16$; $P = 0.001$) with higher BCS. Dogs that underwent amputation for neoplasia had significantly ($P = 0.002$) higher body weights (median, 33.5 kg [73.7 lb]; range, 6.7 to 77.2 kg [14.7 to 169.8 lb]) than those undergoing amputation for other reasons (median, 21 kg [46.2 lb]; range, 2.3 to 37.8 kg [5.1 to 83.2 lb]); there was no significant difference in BCS between these groups. No correlation was found between age at the time of surgery and QOL score. There was no significant difference in median QOL score between dogs that had thoracic (5/5; range, 3/5 to 1/5) versus pelvic (5/5; range, 1/5 to 5/5) limb amputation or between dogs that underwent amputation because of neoplasia (5/5; range, 1/5 to 5/5) versus other reasons (4/4; range, 4/5 to 5/5).

In response to questions about behavior-related changes in their dogs after limb amputation, 58 of 64 (91%) owners reported no change in their dog's general attitude, 4 (6%) reported a slight change, and 2 (3%) reported a substantial change. Similarly, 62 of 64 (97%) owners reported no change in their dog's attitude toward receiving affection, 1 (2%) reported an increase, and 1 (2%) reported a decrease in this variable. Fifty-two owners reported having other family pets in their home, and 12 owners reported the question was not applicable; within multipet households, 45 (87%) reported no change in how their dog interacted with familiar pets and 7 (13%) reported a decrease in such interaction. Of 46 dogs that were allowed to interact with unfamiliar pets, 43 (93%) had no change in these interactions and 3 (7%) had decreased interactions.

Fifty of 64 (78%) owners indicated their dog's surgical recovery and adaptation had been better than they expected, 11 (17%) reported it was the same as expected, and 3 (5%) indicated it was worse than expected. Taking all factors into account (survival after surgery, adaptation to the amputation, and chemotherapy treatment if applicable), if faced with the same decision again, 55 of 64 (86%) owners indicated they would have amputation performed, 4 (6%) said they would not, and 5 (8%) were not sure. Taking into account only the dog's adaptation to the amputation, 60 of 64 (94%) indicated they would have the amputation done, 3 (5%) said they would not, and 1 (2%) was undecided. The 3 owners who reported they would not pursue amputation again on the basis of adaptation alone were included among the 4 owners who reported they would not pursue amputation again when taking all factors into account; each of these 3 individuals had dogs that underwent amputation because of neoplasia. The 2 dogs reported to have a very poor QOL after surgery (score of 1) were included in this group; both were euthanized ≤ 2 months after surgery and were obese (BCS, 8/9).

Discussion

The results of the telephone survey in the present study were consistent with previous studies[2,3,5] of general owner satisfaction following limb amputation in dogs. Fifty-eight of 64 (91%) perceived no change in their dog's general attitude following amputation; 56 (88%) reported that the dog had a complete or near complete recovery to preamputation QOL, 50 (78%) indicated that their dog's surgical recovery and adaptation were better than they expected, and 47 (73%) reported no change in their dog's recreational activities following the surgery. These data indicated that overall outcomes for dogs after amputation were good. Although this is a common perception among veterinary caregivers, the quantification of these tendencies may be a useful tool when advising owners contemplating this type of surgery in dogs. These results may be lifesaving, inasmuch as some owners may consider euthanasia more humane than amputation.

Owner-assigned postoperative QOL scores had significant negative correlations with preoperative BCS and body weight. Considering that dogs with neoplasia had a significantly higher body weight than those that underwent amputation for other reasons, the possibility that factors related to dogs' underlying medical conditions contributed more to the QOL score than did body weight cannot be excluded. However, there was no significant difference in QOL score between dogs that underwent amputation for neoplasia and dogs that had the surgery for other reasons. Obesity has been discussed in the literature as a possible concern when considering whether a particular patient is a good candidate for limb amputation.[1] Although this information should not be used to exclude overweight patients as candidates for amputation, it should be taken into consideration when discussing each individual dog's likely outcome following surgery with owners. Unfortunately, limb amputation is typically a time-sensitive surgery, so instituting weight-reduction programs prior to surgery would not likely be feasible in most cases. However, the authors consider it possible that improving BCS in an obese patient after amputation could help to optimize its QOL.

The positive correlation between body weight and BCS could suggest that overweight patients in the study population were overall larger dogs, and therefore the results for correlation testing between BCS and QOL may be biased. The same BCS scale was used for the duration of the study period; however, because this was a retrospective study, training for BCS scoring was not standardized, and the procedure was performed by different individuals. In other studies, body weight, but not BCS, has been evaluated in light of canine and feline patients' adaptation following amputation. Investigators of 1 study[3] indicated that functional status after amputation was influenced slightly by body weight; however, no statistical evidence was provided. Another study[2] found no correlation between body weight and rapidity of adaptation in dogs following limb amputation. Anecdotally, most veterinarians do not consider the size of a patient to be a negative factor when deciding whether limb amputation is appropriate.

Kirpensteijn et al[2] showed a relationship between the owner-reported time for a dog to adapt to walking on 3 legs after amputation and how successfully it was reported to adapt. We found that shorter time to reach the dog's best QOL after surgery was correlated with a higher QOL score. Time to reach best QOL is likely multifactorial, potentially involving overall health and concurrent conditions, the reason for amputation, and

adjunctive treatments. Owner commitment and ability to rehabilitate their pet are also likely to be important factors. Our study did not find an association between the time to reach best QOL and any other patient-related variable that was tested, including age, body weight, and BCS at surgery and whether a thoracic or pelvic limb was amputated.

It is a common misconception that adaptation to thoracic limb amputation will be more difficult than pelvic limb amputation in dogs and cats. In clinically normal dogs, approximately 30% of the total body weight is distributed on each thoracic limb and approximately 20% on each pelvic limb.[7] Additionally, thoracic limb amputation has been associated with greater stress on the remaining contralateral limb, compared with pelvic limb amputation.[8] Despite this information, results of several studies,[2,3] including the present study, have shown that there is no significant difference in owner-perceived recovery of dogs after thoracic limb amputation, compared with pelvic limb amputation. Many of the dogs in our study that underwent thoracic limb amputation were able to return to a variety of recreational activities, including swimming.

Fourteen of 64 (22%) dog owners in our study reported strong initial reluctance (ie, scored as 1 or 2 on a 5-point scale) to have the amputation performed. Twenty-two of 54 (41%) dog owners in the study by Kirpensteijn et al[2] in 1999 reported initial reluctance to have surgery performed. This may be a function of differences in the scale used in the 2 studies or the populations of owners referred to the study institutions, or it may reflect a shift in the public view toward limb amputation in dogs. Many owners expressed that their initial hesitations about amputation were related to uncertainty about their dog's general QOL after amputation and its mobility on 3 legs. More than three-quarters of owners reported that their dog's surgical recovery and adaptation to amputation were better than they expected. This suggests that some owners reluctant to have the surgery performed may not have had a reference for the return to function of canine amputees, which is typically successful. The rapid acclimation of most dogs in this study, who had surgery performed in Georgia, may not be comparable to that in dogs living in northern climates, where snow and ice may inhibit ambulation, especially in winter.

Anthropomorphism may be an important factor for owners making decisions regarding their pets. There are certainly profound differences in social and emotional factors involving perception of QOL in human amputees, compared with canine amputees; however, it may be worth considering factors that negatively affect QOL in humans because these likely influence owner concerns prior to amputation in dogs. A systematic literature review of QOL in human amputees was published in 2011.[9] That study[9] reported QOL of amputees in people was lower than that of the general population, and that increased age, female gender, decreased mobility, phantom limb pain, and depression were consistently associated with lower QOL. Age and sex have been shown not to be associated with differences in QOL following limb amputation in dogs.[2] Further, evidence in this and other studies[2,3,5] suggest that overall mobility can be unchanged in dogs after limb amputation. To our knowledge, the prevalence of phantom limb pain in dogs has not been reported, and behavioral signs of depression have not been specifically evaluated in dogs after amputation; however, behavioral changes in dogs after limb amputation have been reported, including signs of aggression, anxiety, decreased dominance, and lack of interest in other dogs.[2] Most patients in our study had no changes noted in general attitude, attitude toward receiving affection, or interactions with other pets following amputation. One change that was commonly noted by owners in a previous study[2] was that dogs had difficulty walking when leashed and reportedly preferred to walk or trot off leash following limb amputation. Sixteen of 64 (25%) owners in the present study reported that their dogs walked better without a leash after surgery, but most (44 [69%]) indicated the dog's walking was unchanged with regard to being on or off leash after amputation, compared with observations before surgery. Evaluation of behavioral changes following amputation versus other types of surgery may be warranted[10]; it is possible that the previously described behavioral changes can be found in canine patients recovering from any type of surgery.

The present study had several limitations, including its retrospective nature. Owners were interviewed by telephone, and the data relied on owners' ability to recall details of their dog's surgery and recovery and their own feelings and emotions during that time. Follow-up times ranged from < 1 year to 7 years; owner ability to recall details likely decreased over time. Studies[11,12] comparing survey methods when evaluating QOL in humans have found that telephone surveys typically yield higher QOL scores than surveys administered by mail. Dog owners in this study had already made the decision to consent to the pet's limb amputation; thus, those who declined surgery were excluded. Further, some owners who were strongly opposed to the concept or may have had negative experiences may not have agreed to participate (although none of the owners who were directly contacted declined, some did not return the call when a message was left inviting them to complete a survey). It is not possible to determine what proportion of the nonparticipants thought this way and therefore is unknown how this may have affected our data. Information from owners that ultimately declined the surgery would be valuable and could be considered in future studies. The small proportion of dogs (3/64 [5%]) whose owners perceived a poor QOL after surgery (score of 1 or 2 on the 5-point scale) and of owners who would not consent to have their dog undergo limb amputation if faced with the same decision again (3/64) made it impossible to evaluate all factors potentially associated with these outcomes. Similarly, the small proportion of dogs undergoing amputation for reasons other than neoplasia (11/64 [17%]) relative to the proportion of dogs undergoing amputation for neoplasia (53/64 [83%]) may have influenced the ability to detect significant differences in variables between these groups.

Assisting owners in making an appropriate but timely decision regarding amputation is important; delay in time to amputation sometimes negatively impacts

survival time or increases the risk of development of complications, such as pathological fractures or infection. The information provided in our study may aid veterinarians in educating and reassuring clients on various facets of amputation in dogs, helping to better inform their decisions in the face of often difficult circumstances. Considering that most clients perceived positive outcomes following amputation, client-to-client support before surgery may also be helpful for owners with QOL concerns.

a. Copies of the questionnaire are available from the corresponding author on request.
b. Prism, version 6, GraphPad Software Inc, La Jolla, Calif.

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