Lifetime cost of surgical treatment for canine hip osteoarthritis is less than conservative management in dogs under eight years of age

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OBJECTIVE
To determine the lifetime cost of 3 treatments for canine hip osteoarthritis: (1) conservative management, (2) femoral head and neck excision (FHNE), or (3) total hip replacement. We hypothesized that FHNE would be the least expensive treatment at all ages.

SAMPLE
Cost estimates from 11 private and academic referral centers from 8 randomly chosen cities across the US.

METHODS
Costs of surgeries were collected from practices in 8 US cities. The literature was used to determine expected post-operative costs. For conservative management, costs of pain medications and diet were obtained by use of online pharmacies. A 4.5% inflation adjustment was used for costs in subsequent years.

RESULTS
For a dog aged 1 to 7 years, FHNE had the lowest lifetime cost. Total hip replacement had the second lowest cost until age 4, after which conservative management was lower. For dogs > 8 years, conservative management was the most cost-effective.

CLINICAL RELEVANCE
For dogs presenting with clinical signs at or under 1 year of age, the perceived benefits of total hip replacement may not be financially prohibitive if lifetime cost of care is considered. Femoral head and neck excision was also less expensive than long-term conservative management. This can help veterinarians inform owners on costs of treatments over the lifetime of their pet. This type of analysis is limited to financial costs alone and does not account for differences in outcomes, as these are not well established. It should be expanded in the future as better data on outcomes and impacts of care become available.

Keywords: total hip replacement, osteoarthritis, femoral head and neck excision, hip dysplasia, cost analysis

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determined whether a surgical procedure could consistently return dogs with CHD to normal function. However, 2 level III studies included in that review found that THR would allow a consistent return to clinical function.24,25 Femoral head and neck excision has multiple studies documenting reduced hip range of motion and hind limb muscle mass asymmetry in dogs. However, owner satisfaction following FHNE is often good to excellent despite these findings.15-17

Evidence-based practice must take into consideration client values and preferences.18 This includes the financial aspects of treatment choice. Although pet insurance is becoming more popular, there is often still a financial component in many plans.

As treatment becomes more specialized and expensive in veterinary medicine, lifetime cost estimates may help guide owners in making decisions for their pets. The purpose of this study was to determine the lifetime cost of 3 treatment options for canine hip OA: (1) multimodal conservative management, (2) FHNE, or (3) THR based on patient age at presentation with clinical signs requiring treatment. Our hypothesis was that FHNE would be the least expensive treatment at all ages.

Methods

A random city generator was used to create a list of cities across the US with populations in the top 100 nationwide.19 Two cities in each US census region (northeast, midwest, south, and west) were selected in the order they were generated.20 Private practices in these cities advertising THR were identified via internet search. The nearest academic teaching hospital to each city was also included. Each practice or hospital was contacted via telephone to obtain oral estimates for FHNE and THR. Costs for the surgery and any required follow-up at that facility were combined. If high and low estimates were given, the average of the two was used for subsequent calculations. All facilities were then averaged to determine the cost for FHNE and THR.

The costs of revision, explantation, and continued conservative management were included by increasing the cost for that treatment as a function of risk as reported in the literature.21-23 All calculations were made for a unilateral procedure, as publications that included bilaterally affected dogs conventionally treated each THR surgery as a staged procedure rather than a discounted procedure performed under the same anesthetic episode. We treated FHNE as if staged to remain consistent. Because all revision procedures are individualized for the patient, the surveyed clinics were unwilling to give cost estimates for revision or explantation. Therefore, costs for these procedures at the authors’ institution were used in calculations. An 11.1% revision rate for THR at an estimated cost of $4,500 was added to the overall cost of THR.21 FHNE explantation of THR hardware was estimated to cost $2,000 with a rate of 0.8%.23 For the percentage of dogs requiring explantation, costs in subsequent years were calculated as if they had undergone FHNE. For FHNE, additional costs of continued conservative management for intermittent lameness as reported by Off et al15 were added. This study reported mixed results for different subjective and objective outcome measures in dogs weighing >25 kg that had FHNE.15 On the basis of these data, a 50% rate of intermittent (182 d/y) conservative treatment was added to the cost of FHNE.15

Conservative management was calculated to include medication and diet costs per day for a 35-kg dog. This weight is an average of the weights listed in breed standards for the top 15 breeds affected by CHD in the Orthopedic Foundation for Animals database as reported by Oberbauer et al25 in 2017. The cost per dose-appropriate tablet or capsule of carprofen (75 mg), amantadine (100 mg), and gabapentin (300 mg) and the cost per bag of prescription joint diet were obtained through national online mail order companies. Cost per day for joint diet was determined by use of the equivalent volume of food for the hypothetical dog’s caloric resting energy requirement.24

The resting energy requirement multiplier was set at 1.0 (weight loss) times the energy requirement for an ideal weight of 35 kg. Use of all treatments (joint diet, carprofen, amantadine, gabapentin) at previously published doses was considered the high end of conservative treatment and use of carprofen alone was considered the low end, and the two were averaged. Inflation adjustment of 4.5% was used for all subsequent years on the basis of past veterinary inflation rates.26 Cost was calculated to 11.3 years on the basis of reported life span of dogs with THR.27

Results

Twenty-four hospitals were identified that advertised THR in or near the cities generated. Five were excluded because THR was no longer offered and 4 because they would not give oral estimates for procedures. Of the 14 practices from which data were obtained, 7 were private practices and 7 were academic institutions. Ten practices used only the BioMedtrix system, 3 used only the Kyon system, and 1 practice used both. Data were used for the BioMedtrix system because of its popularity in the US and the availability of data in the literature.

Average THR surgery cost (range) was $7,064 ($4,500 to $12,000), and average FHNE surgery cost (range) was $3,347 ($1,800 to $5,700). Average daily cost (range) of conservative management was $2.31 ($0.66 to $3.96). Lifetime costs were calculated and are displayed by age in years at presentation for clinical signs (Table 1). Year-to-year data are provided in Supplementary Table S1. For dogs presenting with clinical signs between ages 1 and 7 years, FHNE had the lowest lifetime cost. Total hip replacement had the second lowest lifetime cost until 4 years of age, after which point the lifetime estimated cost of conservative management was less than THR (though still more expensive than FHNE). For dogs presenting after 8 years of age, conservative management was the least expensive. The lifetime cost difference between THR and FHNE for a 1-year-old dog was $1,136.
Table 1—Lifetime cost in US dollars ($) for total hip replacement (THR), femoral head and neck excision (FHNE), and conservative management by age of clinical onset. For example, if a dog presented at age 3, the lifetime cost of THR surgery, including the possibility of revision or explant, is $8,302.65. The table is truncated at 11.3 years because that is the average expected life span of dogs requiring THR.

<table>
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<tr>
<th>Age at clinical onset (y)</th>
<th>THR cost ($)</th>
<th>FHNE cost ($)</th>
<th>Conservative cost ($)</th>
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Discussion

This study confirmed our hypothesis that overall FHNE would be the least expensive treatment for management of canine hip OA, with conservative management becoming less expensive in the geriatric years. The average lifetime cost of THR in dogs up to 1 year of age differed from FHNE by $1,136. This suggests that, for dogs presenting with clinical signs at 1 year of age, the perceived benefits of THR may not be financially prohibitive if lifetime cost is considered. In addition, lifetime medical management was more expensive than THR unless clinical signs started at > age 4. Though CHD is commonly a bilateral disease, dogs with bilateral CHD are not always equally clinically affected. Among studies reporting THR in dogs, the percentage undergoing bilateral procedures ranges from 10% to 30%. All publications we found that included bilaterally affected dogs treated each THR surgery as a unique procedure for purposes of calculating complication rates and outcomes. We are unaware of any published case series of single-session bilateral THRs. While there are published data on single-session bilateral FHNE, we treated FHNE as if staged to remain consistent.

Use of our institution’s estimated cost for the revision and explantation surgeries was another limitation of this analysis. It would have been ideal to have average cost data for these procedures. However, the costs of the THR and FHNE procedures at our institution were close to the average costs of the practices surveyed, so we believe these to be reasonable estimates of cost for revision or explantation.

Because these cost estimates were generalized across the population and limited to the data available, the interpretation must be taken in accordance with the applicability of the specific assumptions made in the calculations. There is a wide range of costs for surgical procedures across the country, with a difference between the least and most expensive locations of $7,500 for THR and $3,900 for FHNE. As expected, academic locations were less expensive than private practices. Average cost varied by region, but given the low sample numbers in each region, we did not use regional cost averages due to high risk of bias. There is no easily accessed database of veterinary practices performing THR in the US. We suspect that many of these practices are clustered around the largest metropolitan areas in the US, which could have led to an overestimation of the average cost of surgery. For this reason, we attempted a more random sample, ensuring that we included cities in each of the 4 census regions. It was concerning that we had to eliminate 5 practices from the few we identified because they had ceased performing the procedure, possibly indicating a significant lack of access to care outside of the largest US metropolitan areas. It is unknown why there is such a large variation in cost to clients. Implant costs to clinics are similar across the country, so other local factors such as operating overhead, caseload, surgeon efficiency, and client base likely influence this variation. For instance, in a practice where the revision rate is < 11% for THR, the lifetime cost of THR would be less than that reported in the results of this study and more comparable to FHNE and vice versa if complications were higher. This analysis extrapolates best to those practices closest to the mean.

Conservative management, often thought of as the cheapest treatment option, was not found to be so in this study unless the dog presented at 8 years or older. This finding is similar to human systematic reviews of total joint replacements that have found early surgical intervention is more cost-effective than delayed intervention. With the introduction of new medications to the OA market, such as the anti–nerve growth factor antibody bedinvetmab, the cost of conservative management may soon be much higher than estimated here. Zoetis, the manufacturer of bedinvetmab, reported that, after 2 years on the market, 51% of UK veterinarians surveyed were using it in severe OA and 88% of owners rated the cost of a monthly injection (around €90) to be “inexpensive,” “a good value,” or “expensive but reasonable,” with only 12% rating it very or too expensive, compared to 31% of veterinarians. This suggests that owners are willing to spend more to achieve a greater perceived benefit for their pet. While market research indicates veterinarians are using fewer total pain medications in dogs with OA after starting anti–nerve growth factor therapy, the average monthly cost of pain medications was estimated in this study as $49.50, which is 50% less than that of a monthly bedinvetmab injection. This highlights the importance of communication of the available options, both surgical and conservative, and the costs, care burden, and outcome data of each to owners so that they can make a fully informed decision regarding care of their pet.

While monetary analysis is helpful, it is often not the only input in an owner’s decision-making process. Although surgical options can be less expensive over the lifetime of the animal, it may be that paying smaller amounts over a long period of time is more...
feasible for the client or a client may have concerns about subjecting their dog to a surgical procedure. In addition, this analysis did not consider any other factors that may affect individual dogs, such as adverse reactions to medications, successful weight-reduction programs, client compliance, waxing and waning clinical signs, and the caregiver burden of having a dog with OA, all of which may affect decisions. In human healthcare settings, the cost of a treatment is usually compared to the health improvement gained from the treatment, with improvement in health measured in Disability-Adjusted Life Years that can be averted or Quality-Adjusted Life Years that can be gained because of a treatment.\textsuperscript{32} Unfortunately, there is a dearth of comparable outcome measures in veterinary medicine. Despite the proposal of the Wellness-Adjusted Life Year in 2018 as a canine metric comparable to the Disability-Adjusted Life Year, determining the impact of interventions on wellness remains difficult.\textsuperscript{33,34} Among the many publications describing clinical outcomes after surgical treatments for CHD, few provide strong evidence to allow an adequate assessment of therapeutic efficacy or comparison of treatments.\textsuperscript{14} The veterinary literature is often not comparable or combinable, and follow-up time is limited and highly variable.\textsuperscript{14,34} Therefore, benefit to quality of life of one treatment over another could not be taken into account. Cost analysis is often performed from multiple perspectives, such as that of the healthcare sector, focused on direct costs, and that of society, which includes time costs of patients in seeking and receiving care and of informal (unpaid) caregivers, transportation costs, and effects on future productivity and consumption.\textsuperscript{35,36} In this study, the perspective used is that of the client or financially responsible party. Cost analysis for veterinary conditions from a societal perspective will require additional research into the caregiver burden or detriment to human health of those conditions, the benefits of having a healthy active pet, and other factors, which are outside the scope of this paper. This study provides data that may help veterinarians to inform owners on costs incurred from various treatment options over the lifetime of their pet. It is vital to provide such data to clients so that an informed decision can be made. It shows the utility of this type of analysis, but such analysis should continue to be refined in the future as better data on outcomes and impacts of care become available.

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Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org.