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Risk Factors for Patellar Luxation in Dogs in the Philippines

Camille Sophia L. Nacion[1], Rey B. Oronan[2*], Matthew Benedict T. Calibo[2]

[1]Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic,
[2]Department of Veterinary Clinical Sciences
College of Veterinary Medicine
University of the Philippines Los Baños, Philippines, 4031

*E-mail: rboronan@up.edu.ph

ABSTRACT

A retrospective case-control study was conducted on dogs with patellar luxation who presented to the Veterinary Teaching Hospital Diliman Station-Companion Animal Clinic between January 1, 2010, and December 31, 2019. There was a total of 73 dogs were diagnosed with patellar luxation. The majority of the dogs presented with limping, and the causes were mostly unknown. Unilateral medial patellar luxation was the most common type (21.92%). The average age of patients with patellar luxation was 3.24 years old. Puppies are 0.03 less likely to be diagnosed with patellar luxation, while juveniles are 3.74 times more likely, and mature adults are 2.19 times more likely to be diagnosed. The affected dogs included intact males (47.95%), neutered males (4.11%), and intact females (47.95%). The average weight of the affected dogs was 8.39 kg and the majority (35.62%) had a body condition score of 5/9. The Pomeranian was the most common breed for patellar luxation, followed by the mixed breed Shih Tzu, Toy Poodle, and Chihuahua. Mixed breeds are 0.39 times less likely, and dogs fed with dry dog food are 0.51 times less likely to develop the condition. Age and breed were also significantly associated with patellar luxation.

Keywords: Canine, Patellar luxation, Risk factors, Trochlear recession

INTRODUCTION

Patellar luxation is defined as the complete displacement of the patella from the femoral trochlear groove. It is primarily a developmental disorder, wherein musculoskeletal abnormalities of the hindlimb can lead to patellar instability during animal growth (Fauron and Perry, 2016). Secondary causes of patellar luxation include trauma, such as a vehicular accident or fall from height, and complications of the surgical treatment of cranial

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cruciate ligament rupture (Arthurs and Langley-Hobbs, 2007). This condition occurs more frequently in small-breed dogs, with medial luxation being the most common diagnosis. Lateral luxation is uncommon and is mostly observed in large-breed dogs (Gibbons *et al*., 2006; Alam *et al*., 2007; Nganvongpanit and Yano, 2011).

Patellar luxation is primarily diagnosed by physical examination, including palpation of the stifle joint, gait evaluation, and joint motion evaluation. Radiography can be performed to confirm the presence of underlying skeletal abnormalities, concomitant conditions, or possible complications. Dogs with patellar luxation can be managed conservatively or surgically (DiDona *et al*., 2018).

Previous studies have shown that the most commonly affected breeds are the Poodle, Pomeranian, Chihuahua, Yorkshire Terrier, and Shih Tzu breeds. The age at diagnosis is approximately 3 to 4 years, with females and neutered dogs being more likely to develop the condition. Those under 10 kg have 2.8 times odds of developing patellar luxation, reflecting the finding that small-breed dogs are more at risk (O'Neill *et al*., 2016; Di Dona *et al*., 2018).

Various epidemiological studies on canine patellar luxation have been conducted in the United States, Canada, United Kingdom, Germany, South Korea, and Thailand. Such research is not yet available in the Philippines. Identification of risk factors in dogs with patellar luxation can aid in predicting which animals are more likely to develop the condition, and may help veterinarians to decide which medical and/or management treatments to perform and allow for an improved patient condition with the risk factors in mind.

MATERIAL AND METHOD

The study was a retrospective case-control study using medical records of dogs from the Veterinary Teaching Hospital Diliman Station-Companion Animal Clinic (VTHD-CAC) from January 1, 2010, to December 31, 2019. The cases and controls were selected using convenience sampling.

Microsoft Excel files containing the patient medical records of the VTHD-CAC from January 1, 2010, to December 31, 2019, were used to filter the data. *patellar luxation, luxated patella* on the column for the diagnosis of patients were the keywords used to filter the inclusion of the study population. A case was included if the dog was confirmed to have patellar luxation through either physical examination or radiography. Patients who visited multiple times within the time frame with similar complaints were considered as one case. The information obtained from the patients' records included signalment, medical

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history, physical examination findings, diagnostic test results, cause and type of luxation, and treatment provided.

The patients in the control group were dogs that were examined after the case and were diagnosed as fit for vaccination and given vaccinations. The words *apparently healthy* in the column for the patient's diagnosis and the words *rabies* and *DHLPP* in the column for treatment were the keywords used to determine qualification as control. Patients with a history of musculoskeletal disease were excluded. Signalments, medical history, and physical examination findings were obtained from the control group.

The age groups were classified as puppy (0–6 months), juvenile (6 months–1 year), young adult (1–2 years), mature adult (2–6 years), senior (7–11 years), and geriatric (12+ years) (Harvey, 2021). Sex groups, including neutered status, were classified as male intact, male neutered, female intact, or female neutered. Weight groups were classified as <5 kg, 5 to 10.9 kg, 11–15.9 kg, 16–20.9 kg, 21–25.9 kg, 26–30.9 kg, and >31 kg. The body condition scores of the dogs were ranked from 1 to 9, with 1 representing an obvious loss of muscle mass and 9 representing massive fat deposits throughout the body (Hutchinson and Robinson, 2015). Diet was classified as milk, dry dog food, wet dog food, table food, mixed dry and wet dog food, mixed dry dog food and table food, or mixed wet dog food and table food. The housing of dogs was classified as indoor, outdoor, mixed indoor and outdoor, or caged. Lifestyle was classified as solitary pets or living with other pets.

The collected data were analyzed retrospectively using simple descriptive statistics and are presented as percentages. Frequency distribution analysis of the age, sex, neuter status, breed, weight, body condition score, housing, and lifestyle of dogs with patellar luxation was performed using Microsoft Excel®. A chi-square test ($p<0.05$) was conducted to determine whether there was a significant association between the factors and the occurrence of patellar luxation. Odds ratios (ORs) with 95% confidence intervals were also used to measure the strength of association. The estimation of the relative risk was considered significant if the 95% confidence interval for the odds ratios did not include 1.0.

RESULTS AND DISCUSSION

The current study included 146 dogs, 73 of whom were diagnosed with patellar luxation, and the rest were diagnosed as apparently healthy. Of a total of 106,026 canine patients who presented to the hospital during the study period, 3,653 (3.45%) were musculoskeletal cases, which is much lower than the 24% prevalence reported by Johnson *et al.* (1994) in the United States and Canada. Johnson *et*

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al. (1994) reported a 1.60% prevalence in patients diagnosed with patellar luxation, compared to the current study, which reported a prevalence of 0.07%. The lower prevalence rates may be due to an increase in the prevalence of other diseases, which may be more common in the Philippines. This may also be attributed to pet owners' lack of awareness of musculoskeletal disorders in dogs or the lack of finances that usually occur in these cases. The year 2012 had the lowest prevalence of patellar luxation (0.03%), whereas 2018 had the highest prevalence (0.18%).

The majority of dogs with patellar luxation presented with limping (45/73; 61.64%). Other chief complaints (28/73; 38.35%) included incidental findings during general check-ups, vaccination and deworming, abnormal limb conformation, and others. The most common cause was trauma (8/73; 10.96%), while the majority of the cases had an unknown cause (64/73; 87.67%); only one (1/73; 1.37%) case was classified as developmental. A possible explanation for this is that trauma can be clearly identified by owners as the cause of limping through history taking. However, trauma is considered a secondary cause of patellar luxation due to the tearing or stretching of the joint capsule and fascia (Arthurs and Langley-Hobbs, 2007). It is possible that the majority of the unknown causes are actually developmental in nature, although the determination of developmental causes may be difficult because the underlying structural abnormalities that are present in these cases are not always obvious, especially in Grade I luxation, where these abnormalities are minimal and luxation is intermittent (Holloway and McConnell, 2013; Kirberger and McEvoy, 2016). Moreover, not all owners would opt for radiography and other imaging techniques to visualize any underlying skeletal abnormality, because patellar luxation can be definitively diagnosed through physical examination.

Unilateral patellar luxation was found to be more common in 56.16% of the cases (19/73; 26.03% for the right stifle and 22/73; 30.14% for the left stifle) than in 28/73 (38.36%). Unilateral medial luxation had a higher prevalence (16/73, 21.92%) than bilateral medial luxation (11/73, 15.07%) (Table 1). Some studies reported a higher prevalence of unilateral luxation (62.2%) by O'Neill *et al.* (2016) and 63% by Nganvongpanit and Yano (2011), while Alam *et al.* (2007) reported a lower prevalence of 51%. This study agrees with that of O'Neill *et al.* (2016) and Nganvongpanit and Yano (2011) that unilateral medial patellar luxation is more common than other types and directions.

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Table 1. Types and direction of luxation in dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Type		Direction			Total	Frequency (%)
		Medial	Lateral	Unkown		
Unilateral	Right	10	0	9	19	26.03
	Left	6	3	13	22	30.14
Bilateral		11	3	14	28	38.36
Not specified				4	4	5.48
Total		27 (36.99%)	6 (8.22%)	40 (54.79%)	73	100.00

Among the different breed groups, medial patellar luxation (MPL) was more commonly observed than lateral patellar luxation (LPL), with small breeds almost exclusively diagnosed with MPL (Table 2). Approximately 64.38% of the patients were small-breed dogs (20 with MPL and 1 with LPL), 19.18% were medium- and large-breed dogs (4 with MPL and 4 with LPL), and 15.07% were mixed-breed dogs (3 with MPL and 1 with LPL). It is unknown why MPL is more common because of the uncertainty of the pathogenesis of patellar luxation as well as the possibility that both environmental and genetic factors contribute to the phenotypic appearance of the trait (Lavrijsen *et al*., 2013). According to Gibbons *et al*., (2006), Alam *et al*., (2007), and Nganvongpanit and Yano (2011), medial patellar luxation (MPL) is more common in small breeds that are almost exclusively diagnosed with MPL. LPL, while uncommon, are more commonly observed in larger breed dogs, which agrees with the findings of this study.

Table 2. Distribution and direction of patellar luxation in breed categories of dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Breed	Direction of patellar luxation			Total	Frequency (%)
	Medial	Lateral	Unknown		
Small size	20	1	26	47	64.38
Medium size	2	2	2	6	8.22
Large size	2	2	4	8	10.96
Mixed	3	1	7	11	15.07
Unknown			1	1	1.37
Total				73	

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The average age of dogs with patellar luxation in the study was 3.24 (± 0.63) years old while the average age of apparently healthy dogs was 1.62 (± 0.46) years old. This is similar to the report by O'Neill *et al.* (2016), in which dogs were diagnosed with patellar luxation at 3–4 years of age. Puppies aged zero to six months are 0.03 times less likely to be diagnosed with patellar luxation, while juveniles (aged six months to one year) are 3.74 times more likely, and mature adults (aged two to six years) are 2.19 times more likely to be diagnosed than dogs of other age groups (Table 3). Patellar luxation is not a congenital condition; therefore, puppies are less likely to be diagnosed with this condition. However, congenital musculoskeletal abnormalities of the hind limb can lead to anatomical changes in the distal femur and proximal tibia, subsequently leading to patellar instability during development (O'Neill *et al*., 2016; Di Dona *et al*., 2018). The results of this study revealed a significant association between dog age and patellar luxation (Table 6).

Table 3. Frequency, odds ratios (OR), and 95% confidence intervals (CI) of age, sex, weight, and body condition score of dogs with patellar luxation and clinically normal dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Characteristic	No. of case dogs n/N (%)	No. of clinically normal dogs n/N (%)	OR	95% CI
Age				
Puppy (0 - 6 mos)	2/73 (2.74%)	38/73 (52.05%)	0.03*	0.01-0.11
Juvenile (6 mos - 1 yr)	13/73 (17.81%)	4/73 (5.48%)	3.74*	1.16-12.08
Young adult (1 - 2 yrs)	17/73 (23.29%)	9/73 (12.33%)	2.16	0.89-5.23
Mature adult (2 - 6 yrs)	33/73 (45.21%)	20/73 (27.40%)	2.19*	1.10-4.36
Senior (7 - 11 yrs)	6/73 (8.22%)	2/73 (2.74%)	3.18	0.62-16.30
Geriatric (12+ yrs)	2/73 (2.74%)	0	N/A	N/A
Sex				
Male intact	35/73 (47.95%)	34/73 (46.58%)	1.06	0.55-2.02
Male neutered	3/73 (4.11%)	1/73 (1.37%)	3.09	0.31-30.38
Female intact	35/73 (47.95%)	37/73 (50.68%)	0.90	0.47-1.72
Female neutered	0	1/73 (1.37%)	N/A	N/A
Weight				
<5 kg	30/73 (41.10%)	36/73 (49.32%)	0.72	0.37-1.38
5 to 10.9 kg	24/73 (32.88%)	26/73 (35.62%)	0.89	0.45-1.75
11 to 15.9 kg	4/73 (5.48%)	5/73 (6.85%)	0.79	0.20-3.06

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Characteristic	No. of case dogs n/N (%)	No. of clinically normal dogs n/N (%)	OR	95% CI
16 to 20.9 kg	5/73 (6.85%)	1/73 (1.37%)	5.29	0.60-46.48
21 to 25.9 kg	4/73 (5.48%)	0	N/A	N/A
26 to 30.9 kg	0	3/73 (4.11%)	N/A	N/A
>31 kg	3/73 (4.11%)	1/73 (1.37%)	3.09	0.31-30.38
Unknown	3/73 (4.11%)	1/73 (1.37%)	3.09	0.31-30.38
Body Condition Score				
BCS 1/9	0	0	N/A	N/A
BCS 2/9	0	0	N/A	N/A
BCS 3/9	4/73 (5.48%)	0	N/A	N/A
BCS 4/9	6/73 (8.22%)	11/73 (15.07%)	0.50	0.18-1.45
BCS 5/9	26/73 (35.62%)	23/73 (31.51%)	1.20	0.60-2.39
BCS 6/9	9/73 (12.33%)	6/73 (8.22%)	1.57	0.53-4.66
BCS 7/9	5/73 (6.85%)	1/73 (1.37%)	5.29	0.60-46.48
BCS 8/9	1/73 (1.37%)	0	N/A	N/A
BCS 9/9	1/73 (1.37%)	0	N/A	N/A
Unknown	21/73 (28.77%)	32/73 (43.84%)	0.52	0.26-1.03

n: Number of dogs with each characteristic, N: Total number of dogs with patellar luxation or clinically normal dogs, * Statistically significant.

The affected dogs included intact males (47.95%), neutered males (4.11%), and intact females (47.95%). Specific sex and neuter status were not found to be at higher or lower odds of developing patellar luxation in this study (Table 3). However, O'Neill *et al.* (2016) showed that females are 1.3 times more likely to be affected by patellar luxation than males, and neutered dogs are 2.4 times more likely than intact dogs. Alam *et al.* (2007) and Nganvongpanit and Yano (2011) also reported higher prevalence in females. The pathogenesis is unclear; however, estradiol has been shown to contribute to the development of a shallow patellar groove, and hyperestrogenemia after ovariohysterectomy has been associated with other conditions of the stifle, such as cranial cruciate ligament disease (O'Neill *et al.*, 2016). However, the current results showed no significant differences between the sexes and neutering status.

The average weight of affected dogs was 8.39 (± 1.82) kg while the average weight of apparently healthy dogs were 6.75 (± 1.54) kg. This is similar to the study by O'Neill *et al.* (2016), where the mean weight of affected dogs was 8 kg and dogs weighing less than 10 kg were 2.8 times more likely to have the condition than those weighing 10–19.9 kg, and dogs with body weights that are below the normal average for their breed

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are 1.4 times more likely to be diagnosed with patellar luxation than those at or above the breed average. However, the current study cannot conclude the odds ratios for the weight categories (Table 3) and showed no significant association between weight and patellar luxation (Table 6).

The majority of the affected dogs (26/73; 35.62%) had a body condition score (BCS) of 5/9 (Table 3). BCS has not been evaluated in previous reports. In the current study, BCS was not a significant risk factor (Table 6). Since BCS is used to evaluate body fat, it cannot prove or disprove the theory previously mentioned that decreased muscle mass promotes increased patellar laxity, because muscle loss can occur separately from fat loss. Muscle condition scoring can be performed through the visualization and palpation of skeletal muscles over the skull, scapulae, spine, and wings of the ilia can be done however (Hutchinson and Robinson, 2015). Assessing both the body condition score and the muscle condition score of patients at every visit is still important at every visit as a routine clinical procedure.

The Pomeranian was the most common breed for patellar luxation (17.81%), followed by the mixed breed (15.07%), Shih Tzu (13.70%), Toy Poodle (12.33%), and Chihuahua (9.59%). On the other hand, mixed-breed dogs were 0.39 times less likely to develop patellar luxation than other breeds (Table 4). Previous studies have shown a high prevalence of patellar luxation in small breeds, supporting the theory that the condition has a heritable basis (Alam *et al.,* 2007; Nganvongpanit and Yano, 2011; O'Neill *et al.,* 2016). Soontornvipart *et al.,* (2013) revealed that upon genomic analyses of Pomeranians in Thailand, a region on chromosome 7 is potentially associated with MPL. Selective breeding for certain body conformations may have unintentionally co-selected risk factors, including tibial torsion, femoral varus, patellar positioning, or femoral head inclination, which contribute to the development of patellar luxation (O'Neill *et al.,* 2016). This may also explain why mixed breeds are less likely to be affected by patellar luxations. Statistically, there was a significant association between the breed of the dog and patellar luxation, as shown in Table 6; however, we could not assess other purebreeds due to a lack of data.

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Table 4. Frequency, odds ratios (OR), and 95% confidence intervals (CI) of breed of dogs with patellar luxation and clinically normal dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Characteristic	No. of case dogs n/N (%)	No. of clinically normal dogs n/N (%)	OR	95% CI
Akita	2/73 (2.74%)	0	N/A	N/A
American Bulldog	0	2/73 (2.74%)	N/A	N/A
Beagle	0	1/73 (1.37%)	N/A	N/A
Belgian Malinois	0	3/73 (4.11%)	N/A	N/A
Bichon Frise	1/73 (1.37%)	0	N/A	N/A
Boston Terrier	0	2/73 (2.74%)	N/A	N/A
Chihuahua	7/73 (9.59%)	3/73 (4.11%)	2.47	0.61-9.97
Chow Chow	1/73 (1.37%)	1/73 (1.37%)	1	0.06-16.30
Dachshund	2/73 (2.74%)	2/73 (2.74%)	1	0.14-7.30
Golden Retriever	2/73 (2.74%)	1/73 (1.37%)	2.03	0.18-22.87
Jack Russel	1/73 (1.37%)	0	N/A	N/A
Japanese Spitz	0	1/73 (1.37%)	N/A	N/A
Labrador	3/73 (4.11%)	4/73 (5.48%)	0.74	0.16-3.43
Maltese	1/73 (1.37%)	3/73 (4.11%)	0.32	0.03-3.19
Mixed	11/73 (15.07%)	23/73 (31.51%)	0.39*	0.17-0.87
Pomeranian	13/73 (17.81%)	0	N/A	N/A
Pug	1/73 (1.37%)	0	N/A	N/A
Rottweiler	1/73 (1.37%)	0	N/A	N/A
Schnauzer	0	2/73 (2.74%)	N/A	N/A
Shih Tzu	10/73 (13.70%)	16/73 (21.92%)	0.57	0.24-1.35
Siberian Husky	5/73 (6.85%)	3/73 (4.11%)	1.72	0.39-7.46
Toy Poodle	9/73 (12.33%)	3/73 (4.11%)	3.28	0.85-12.66
Yorkshire Terrier	2/73 (2.74%)	2/73 (2.74%)	1	0.14-7.30
Unknown	1/73 (1.37%)	1/73 (1.37%)	1	0.06-16.30

n: Number of dogs with each characteristic; N: Total number of dogs with patellar luxation or clinically normal dogs, * Statistically significant.

Dogs with dry dog food as their diet were 0.51 times less likely to develop patellar luxation (Table 5). This may be because commercial pet foods offer a more complete and balanced diet for each life stage of dogs. Conversely, studies of homemade and raw diets have shown that they are unbalanced or incomplete. Although some adult dogs may be able to cope with dietary imbalances, they can have negative effects on the bones, coat, fecal quality, skin, and immune system of growing dogs (Hutchinson and Robinson, 2015). Mixing dry dog food with other diets can also lead to an imbalance because measurements for the appropriate amount of food may be inaccurate. However, these differences were not significant, as shown in Table 6.

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Table 5. Frequency, odds ratios (OR),s and 95% confidence intervals (CI) of diet, housing, and lifestyle of dogs with patellar luxation and clinically normal dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Characteristic	No. of case dogs n/N (%)	No. of clinically normal dogs n/N (%)	OR	95% CI
Diet				
Milk	1/73 (1.37%)	1/73 (1.37%)	1	0.06-16.30
Dry dog food	28/73 (38.36%)	40/73 (54.79%)	0.51*	0.27-0.99
Wet dog food	1/73 (1.37%)	0	N/A	N/A
Table food	10/73 (13.70%)	9/73 (12.33%)	1.13	0.43-2.96
Dry + wet dog food	1/73 (1.37%)	2/73 (2.74%)	0.49	0.04-5.56
Dry + table food	15/73 (20.55%)	12/73 (16.44%)	1.31	0.57-3.04
Wet + table food	1/73 (1.37%)	0	N/A	N/A
Unknown	16/73 (21.92%)	9/73 (12.33%)	2	0.82-4.87
Housing				
Indoor dog	11/73 (15.07%)	6/73 (8.22%)	1.98	0.69-5.68
Outdoor dog	1/73 (1.37%)	3/73 (4.11%)	0.32	0.03-3.19
Mixed indoor and outdoor dog	2/73 (2.74%)	1/73 (1.37%)	2.03	0.18-22.87
Caged	1/73 (1.37%)	2/73 (2.74%)	0.49	0.04-5.56
Unknown	58/73 (79.45%)	61/73 (83.56%)	0.76	0.33-1.76
Lifestyle				
Solitary pet	3/73 (4.11%)	5/73 (6.85%)	0.58	0.13-2.53
Living with other pets	10/73 (13.70%)	8/73 (10.96%)	1.29	0.48-3.48
Unknown	60/73 (82.19%)	60/73 (82.19%)	1	0.43-2.33

n: Number of dogs with each characteristic; N: Total number of dogs with patellar luxation or clinically normal dogs, * Statistically significant.

The data on housing and lifestyle of dogs did not yield significant odds ratios (Table 5) and were not determined to be significant risk factors (Table 6). This may be due to the lack of data from the study population, wherein the housing of 79.45% and lifestyle of 82.19% of the affected dogs were not stated.

Table 6. Chi-Square test results of the age, sex, weight, body condition score, breed, diet, housing, and lifestyle distribution of dogs with patellar luxation and clinically normal dogs from 2010 to 2019 based on the records of the Veterinary Teaching Hospital Diliman Station – Companion Animal Clinic.

Parameter	X2	p-value
Age	46.81	0.00*
Sex	2.07	0.56
Weight	12.40	0.09

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Parameter	X2	p-value
Body Condition Score	13.20	0.11
Breed	42.20	0.01*
Diet	6.80	0.45
Housing	3.21	0.52
Lifestyle	0.72	0.70

*Statistically significant, $p < 0.05$.

Conservative therapy was the treatment of choice among the cases (50/73; 68.49%), which included the administration of drugs, weight management, and physical rehabilitation. It may be indicated in cases where the degree of patellar luxation is mild (i.e., grade I to II) if lameness is mild and infrequent and if the degree of osteoarthritis is mild. There are no specific drugs for the treatment of patellar luxation, but the management of orthopedic patients usually includes administration of nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics to reduce pain.

The most common medication prescribed was a combination of glucosamine hydrochloride and chondroitin sulfate in 42 of 50 patients who opted for conservative therapy. NSAIDs such as meloxicam, carprofen, and firocoxib were administered to 21 of 50 patients to relieve pain and inflammation. Tramadol was administered to one patient and is a synthetic opioid-like agonist useful as an analgesic to treat chronic pain in dogs, especially when combined with an NSAID or other analgesic (Plumb, 2011). In three cases, doxycycline was prescribed to address the possible blood parasite infection in two patients and leukocytosis seen in one patient's hematology results, which may indicate an infection. Ciprofloxacin was administered to one patient as a prophylactic antibiotic for surgery. Supportive medicines included turmeric, quercetin, coenzyme Q10, zinc, vitamins A, C, E, and B complex, Liv-52® (liver protectant), and dimethyl sulfoxide (DMSO).

Overweight patients experience an increased load on their joints, which worsens the clinical signs of osteoarthritis and puts them at a greater risk of developing degenerative joint disease. Weight loss and proper weight management can lessen the clinical signs and delay the development of osteoarthritis, as well as decrease reliance on anti-inflammatory medications and surgery (Fossum, 2019). Previous studies have shown that weight loss in overweight dogs leads to decreased limb lameness severity, improved patient mobility, delayed onset of chronic diseases, and increased average lifespan (Johnston *et al.*, 2008). Thus, the owners of four patients were advised to manage the weight of the

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dogs. Six patients were advised to undergo rehabilitation, including moist heat, passive range of motion exercises (PROM), and hydrotherapy.

Surgical treatment of patellar luxation involves bone reconstruction, with or without soft tissue reconstruction procedures. Only three of the 73 patients opted for surgery. One patient underwent trochlear groove recession only and had no follow-up checkup. Another patient underwent a combination of trochlear block recession and capsular imbrication, where walking improved 35 days after surgery; however, pain was still noted. The third patient underwent trochlear wedge recession, lateral capsular imbrication, medial retinacular release, and lateral suture placement. Medial patellar luxation was still observed 22 days after the surgery. Previous studies have noted that recurrence of luxation after surgical repair occurs in 48–50% of cases, but most of these are only observed during manipulation of the patella on physical examination. Recurrences were also of a lower grade than before surgery, and lameness was either milder or resolved. The incidence of relapse and method of surgical correction have not been correlated (DeCamp *et al.*, 2016; Fossum, 2019). The low number of patients undergoing surgery may be due to the financial constraints of owners, low grades of luxation, or mild clinical signs observed in dogs.

CONCLUSION

In conclusion, among dogs diagnosed with patellar luxation, the majority presented with limping and were mostly due to a previous history of trauma. Unilateral medial patellar luxation was the most common type of luxation. Puppies were less likely to be diagnosed as patellar luxation, whereas juveniles and mature adults were more likely to be diagnosed. The Pomeranian was the most common breed for patellar luxation, followed by the mixed breed Shih Tzu, Toy Poodle, and Chihuahua. Mixed breeds were 0.39 times less likely, and dogs fed with dry dog food were 0.51 times less likely to develop the condition. Given this etiology, pet owners should be educated on patellar luxation when they first present their small-breed dogs to the veterinary facility, and patellar examination should also be routine during physical examination. While patellar luxation is not preventable, the identification of risk factors will allow for the early diagnosis and intervention of the condition.

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