

Prevalence of and Risk Factors of Patellar Luxation in Dogs in Chiang Mai, Thailand, during the Years 2006–2011

Korakot Nganvongpanit^{1,2*} Terdsak Yano³

Abstract

The purpose of this study was to report on the incidence of patellar luxation in 128 dogs out of a total of 317 dogs (40.3%) treated at orthopedic clinics in Chiang Mai, Thailand, from October 2006 through May 2011. Patellar luxation was most frequently found in small breeds, among which Poodles were the most commonly affected (34.3%). Most luxations were medial (89%), and 57.8% of affected dogs were female. Uniluxation of the patella was found in 63%, and biluxation in 37%. Most dogs were classified as patellar luxation grade III. Cranial cruciate ligament rupture was found only in medial patellar luxation grade IV. This study concluded that the incidence of patellar luxation in the local area is high.

Keywords: Chiang Mai, dogs, patellar luxation, risk factors

¹*Bone and Joint Research Laboratory, Department of Veterinary Biosciences and Public Health, Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai 50100, Thailand*

²*Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand*

³*Department of Food Animals, Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai 50100, Thailand*

**Corresponding author: E-mail: korakot.n@cmu.ac.th; korakot_n@hotmail.com*

บทคัดย่อ

การศึกษาความชุกและปัจจัยการเกิดโรคสะบ้าเคลื่อนในสุนัขเขตจังหวัดเชียงใหม่ ระหว่างปี 2006-2011

กรกฎ งานวงศ์พาณิชย์^{1,2*} เทิดศักดิ์ ยานอ³

การศึกษาค้นคว้าครั้งนี้ รายงานอุบัติการณ์การเกิดโรคสะบ้าเคลื่อนของสุนัขจำนวน 128 ตัว (ร้อยละ 40.3) จากสุนัขทั้งสิ้น 317 ตัว ที่เข้ารับการรักษาในคลินิกออร์โธปิดิกส์ ในจังหวัดเชียงใหม่ ตั้งแต่เดือนตุลาคม ค.ศ. 2006 ถึงเดือน พฤษภาคม ค.ศ. 2011 ในการศึกษาที่พบส่วนใหญ่เกิดสะบ้าเคลื่อนในสุนัขพันธุ์เล็กโดยเฉพาะสุนัขพันธุ์พุดเดิ้ล (ร้อยละ 34.3) พบว่าการเคลื่อนของสะบ้าส่วนใหญ่จะเป็นการเคลื่อนเข้าด้านใน (ร้อยละ 89) และพบว่าสุนัขที่เกิดส่วนใหญ่จะเป็นเพศเมียถึงร้อยละ 57.8 พบการเคลื่อนของสะบ้าเพียงข้างเดียวร้อยละ 63 และการเคลื่อนของสะบ้าทั้ง 2 ข้าง ร้อยละ 37 สุนัขส่วนใหญ่จัดเป็นเกรด 3 และพบการขาดของเอ็นไขว้หน้าเฉพาะในสุนัขที่เป็นสะบ้าเคลื่อนเกรด การศึกษาค้นคว้าครั้งนี้แสดงให้เห็นอุบัติการณ์ของการเกิดโรคสะบ้าเคลื่อนในสุนัขพื้นที่จังหวัดเชียงใหม่สูง

คำสำคัญ: ปัจจัยเสี่ยง สะบ้าเคลื่อน สุนัข เชียงใหม่

¹ห้องปฏิบัติการวิจัยโรคกระดูกและข้อในสัตว์ ภาควิชาชีวศาสตร์ทางสัตวแพทย์และสัตวแพทย์สาธารณสุข คณะสัตวแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ อ. เมือง จ. เชียงใหม่ 50100 ประเทศไทย

²ศูนย์วิจัยวัสดุศาสตร์ คณะวิทยาศาสตร์ มหาวิทยาลัยเชียงใหม่ อ. เมือง จ. เชียงใหม่ 50200 ประเทศไทย

³ภาควิชาสัตวบริบาล คณะสัตวแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ อ. เมือง จ. เชียงใหม่ 50100 ประเทศไทย

*ผู้รับผิดชอบบทความ E-mail: korakot.n@cmu.ac.th; korakot_n@hotmail.com

Introduction

The patella is an important structure that enhances the mechanical efficiency of the quadriceps muscle and helps maintain stifle stability (Payne and Constantinescu, 1993). Stifle stability is compromised when the patella slips out of its normal position. This may predispose an animal to ligament injury, in particular the cranial cruciate ligament (CCL), which can lead to the progression of arthritis. While patellar luxation is acknowledged to be a developmental disease, there is no consensus on the exact course of events in its pathogenesis. Patellar luxation is an intermittent or permanent fixing of the patella by changing its position toward the lateral or medial side of the femoral trochlea (Bobins, 1990; Payne and Constantinescu, 1993).

Patellar luxation may be either congenital or traumatic (acquired) (Vidoni et al., 2005). Congenital patellar luxation may occur due to: various congenital malformations of the coxa vara, coxa valga or genu vara; bending of the distal part of the femur; medial dislocation of the quadriceps muscle group; dysplasia of the femoral epiphysis; rotation of the stifle joint or tibia; and shallowness of the femoral trochlea. Traumatic patellar luxation is caused by a sudden inward rotation of the tibia while the stifle joint is extended-for example, when jumping or falling from a height.

As patellar luxation represents a frequently diagnosed orthopedic disease in dogs, it was of common interest to carry out a cross-sectional study in order to assess the actual incidence of patellar luxation in dogs in the local area, Chiang Mai, Thailand. This study determined the prevalence of patellar luxation using various criteria for patellar luxation identification and diagnosis. The results from this study would be helpful in determining a breeding program that would reduce the incidence of patellar luxation in dogs, and also in the search for candidate genes which control patellar luxation.

Materials and Methods

Animals: In this clinical study we investigated 128 dogs (54 males and 74 females) that had been treated at three different small animal hospitals in Chiang Mai (1 university animal hospitals and 2 private animal hospitals) from October 2006 to May 2011. Diagnostic procedures in patellar luxation patients included evaluation of the signalment, plus a clinical history and complete orthopedic examination including gait evaluation and palpation. The animal was excluded from this study if it had any previous orthopedic disorder, including bone fracture, hip dysplasia, hip luxation, and CCL rupture. The data were collected, including: breed, age, weight, sex, grade of disease, limb affected, lameness score, and incidence of CCL rupture.

Classifying the degree of luxation: The classification follows that of the Orthopedic Foundation for Animals and previous reports (Vidoni et al., 2009; Campbell et al., 2010), which categorizes the degree of patellar luxation into four grades. Briefly, in grade I: the patella easily luxates manually at full extension of the stifle joint, but returns to the trochlea when released; grade II: there is frequent patellar luxation, which in some cases becomes more or less permanent; grade III: the patella is permanently luxated, with torsion of the tibia and deviation of the tibial crest of between 30° and 50° from the cranial/caudal plane; and in grade IV: the tibia is medially twisted and the tibial crest may show further deviation medially, lying 50° to 90° from the cranial/caudal plane. Palpation of the stifle joint was performed on both standing animals and dogs in lateral recumbency.

Lameness score: The dogs were examined, both while standing and during movement, by two veterinarians who were blind to the grade of patellar luxation of the observed dogs. During movement, the dogs walked and trotted 6 m, three times, to evaluate lameness. The lameness score was adapted from Nganvongpanit et al. (2009) - grade I: dog can walk normally; grade II: slight lameness when walking; grade III: moderate lameness when walking; grade IV: severe lameness when walking; and grade V: reluctant to rise and will not walk more than five paces.

Statistical analysis: The data were recorded and manipulated with SPSS 17.0. Fisher's exact test was used to analyze the relationship between the pattern of patellar luxation and associated factors. A p-value of less than 0.05 was considered significant.

Results

A total of 128 dogs showing symptoms of patellar luxation were diagnosed out of 317 dogs treated in local orthopedic clinics from October 2006 to May 2011. This number represents 40.3% of the total number of orthopedic patients. From their histories, 13 dogs (10%) were found to show acute clinical signs, such as lameness after falling from height; all were small-size breeds, and showed unimedial patellar luxation.

Breed, sex and disease: Table 1 and Figure 1 show the frequency of patellar luxation among individual dog breeds in our sample of patients. Of the 128 dogs in

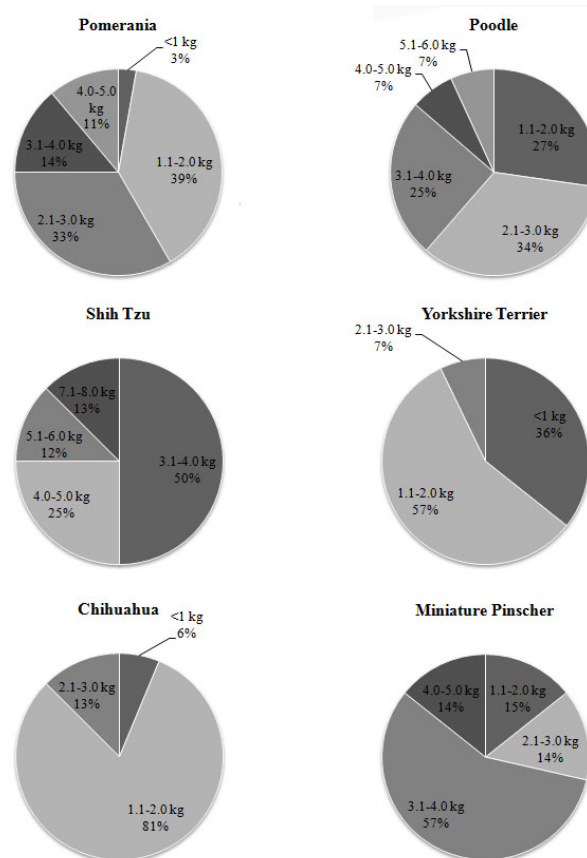


Figure 1 Distribution of patellar luxation by weight category for each breed. Siberian Husky and Native Thai are not shown because there was only one dog of each breed.

this study, the breeds affected by patellar luxation were: Poodle (34.37%), Pomeranian (28.91%), Chihuahua (12.50%), Yorkshire Terrier (10.94%), Shih Tzu (6.25%), Miniature Pinscher (5.47%), Siberian Husky (0.78%) and mixed breed (0.78%).

The ratio of males to females in this study was 42.19% (54 males) to 57.81% (74 females). Breeds in which the number of affected females was higher than males included: Pomeranian (56.76%:43.24%), Poodle (61.36%:38.64%), Shih Tzu (75%:25%), Chihuahua (62.5%:37.5), Yorkshire Terrier (57.14%:42.86%) and Native Thai (100%:0%). There were only two breeds where the number of affected males was higher than females: Miniature Pinscher

Table 1 Incidence of patellar luxation in individual breeds in the study group (n=128).

Breed	Male (%)	Female (%)	Total (%)	Weight (kg)	Age (months)
Pomeranian	16 (43.24 ¹)	21 (56.76 ¹)	37 (28.9 ²)	2.36±1.02	27.19±20.05
Poodle	17 (38.64 ¹)	27 (61.36 ¹)	44 (34.3 ²)	2.82±1.14	23.14±18.08
Shih Tzu	2 (25 ¹)	6 (75 ¹)	8 (6.2 ²)	4.60±1.55	30.38±19.24
Chihuahua	6 (37.5 ¹)	10 (62.5 ¹)	16 (12.5 ²)	1.44±0.33	28.31±21.50
Yorkshire Terrier	6 (42.86 ¹)	8 (57.14 ¹)	14 (10.9 ²)	1.19±0.40	26.21±18.73
Miniature Pinscher	6 (85.71 ¹)	1 (14.29 ¹)	7 (5.4 ²)	3.29±0.89	38.71±20.77
Siberian Husky	1 (100 ¹)	0 (0 ¹)	1 (0.7 ²)	15.3	12
Native Thai	0 (0 ¹)	1 (100 ¹)	1 (0.7 ²)	22	20
Total	54 (42.2¹)	74 (57.8¹)	128	2.72±2.42	26.48±19.28

¹Comparison between sexes in the same breed, ²Comparison between breeds

Table 2 Lameness scores for different luxation grades.

Luxation grade	Number of animals (%)	Number of joints affected (%)	Lameness score		
			Maximum	Minimum	Mean±SD
I	13 (10)	18 (10)	2	1	1.08±0.28*
II	24 (19)	42 (24)	3	1	1.67±0.64*
III	52 (41)	69 (39)	3	1	2.46±0.54*
IV	39 (30)	46 (26)	4	2	3.08±0.62*

*Significant difference ($p<0.01$) between grades.

(85.71%:14.29%) and Siberian Husky (100%:0%). Comparison between sexes using a chi-square test showed no significant difference ($p=0.476$).

The age of patients varied from 7-96 months, with the mean value being 26.48 ± 19.28 months. The number of affected animals in different age groups (Fig 2) was as follows: <12 months (13%, n=17), 13-24 months (53%, n=68), 25-36 months (12%, n=15), 37-48 months (6%, n=7), 49-60 months (6%, n=8), 61-72 months (6%, n=8), 73-84 months (2%, n=3) and >85 months (2%, n=2). However, a chi-square test did not find a significant difference ($p=0.922$) between ages.

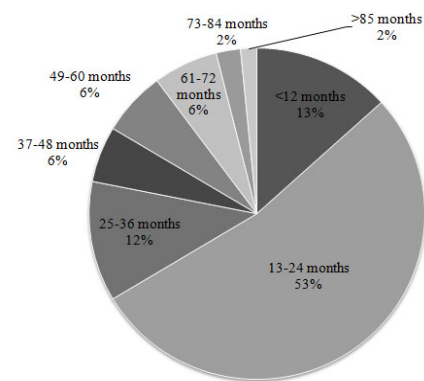
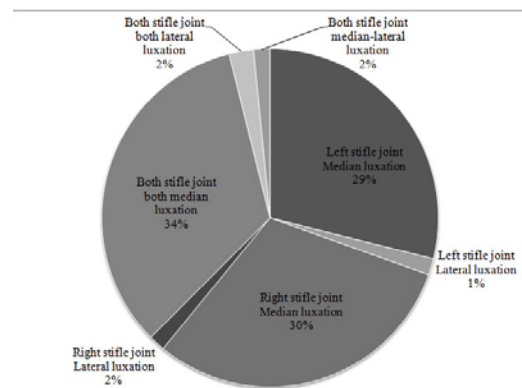
The weight range of most of the affected dogs, in terms of individual breeds, was as follows: Pomeranian, 1.1-2.0 kg (39%, n=14); Poodle, 2.1-3.0 kg (34%, n=15); Shih Tzu, 3.1-4.0 kg (50%, n=4); Chihuahua, 1.1-2.0 kg (81%, n=13); Yorkshire Terrier, 1.1-2.0 kg (57%, n=8); and Miniature Pinscher, 3.1-4.0 kg (57%, n=4). Siberian Husky and Native Thai could not be categorized by weight because there was only one animal of each breed in the study group.

Lameness score: Lameness scores were significantly different ($p<0.01$) between luxation grades. The lameness score for the 13 dogs with grade I luxation averaged 1.08 ± 0.28 . Twenty-four dogs suffering from grade II had an average lameness score of 1.67 ± 0.64 . Most dogs (n=52) in this study had grade III luxation, and received a lameness score of 2.46 ± 0.54 ; and 39 dogs were classified as grade IV, with a lameness score of 3.08 ± 0.62 (Table 2). Moreover, the number of animals and grade of patellar luxation was confirmed statistically by a chi-square test, which found a significant difference ($p=0.002$).

Location of patellar luxation: Figures 3 and 4 show that uniluxation of the patella was found in 81 dogs (63%), and biluxation in 47 dogs (37%). When categorized into two groups including small and medium size, 89.5% (154/172) of affected stifle joints in 126 small-size dogs were diagnosed as medial patellar luxation, while 10.5% (18/172) were lateral patellar luxation; in medium-size dogs only lateral patellar luxation was found (Table 3). Luxation of the

patella was present in 87 joints (right stifle) and 88 joints (left stifle) of the dogs.

Patellar luxation and cranial cruciate ligament rupture: Cranial cruciate ligament (CCL) rupture was only found in medial patellar luxation grade IV. The rupture was complete in 7/46 (15.2%) of grade IV luxation joints, and in 7/153 (4.6%) of total medial luxation joints. Incomplete rupture was found in 5/46 (10.9%) of grade IV luxation joints, and 4/153 (2.6%) of total medial luxation joints.

**Figure 2** Percentage of animals with patellar luxation, by age group**Figure 3** Incidence of patellar luxation in affected limbs**Table 3** Distribution of direction of patellar luxation in small- and medium-size dogs.

Dog	Weight	Number of dogs	Number of joints affected	Direction of patellar luxation	
				Median	Lateral
Small size	$2.47\pm 1.28^*$	126 (98.5% ¹)	172	153 (89% ²)	19 (11% ²)
Medium size	$18.65\pm 4.74^*$	2 (1.5% ¹)	3	0 (0% ²)	3 (100% ²)

¹Comparison of number of dogs by size, ²Comparison of direction of luxation in dogs of the same size,

*Significant difference ($p<0.01$) between dog sizes

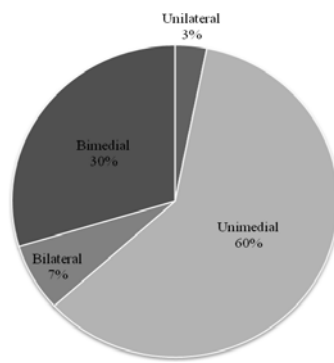


Figure 4 Frequency of uniluxation and biluxation of patella (total number of joints is 175)

Discussion

A radiographic examination was not performed in this study, as it is of no importance for the diagnosis of patellar luxation. Radiographs may yield false negative results due to reduction of a luxated patella during manipulation for proper positioning (Vasseur, 1993). For this reason, diagnosis of patellar luxation must be made by physical examination. In this study, physical examination of the dogs was performed on the basis of a standardized protocol including inspection and palpation of the standing and lying animal. For inspection of moving animals, lameness was one criterion. Lameness score was found to be related to luxation grade - the highest mean lameness score, 3.08, was for dogs with grade IV luxation, while the lowest mean score of 1.08 occurred in dogs classified as grade I. Moreover, this study showed that 10% of patellar luxation had been caused by traumatic injury, while 90% was suspected to be congenital. Most cases of patellar luxation are considered congenital because they are apparently unrelated to trauma. However, we believe that some of these animals should have been included in the trauma group, because an owner may not have recognized lameness signs in the dog after an accidental injury. Hence, the owner provided information that the animal had not suddenly become lame. In fact, mild patellar instability may predispose an animal to traumatic patellar luxation; therefore, it is not certain that these are two completely separate entities.

Similar to the present report, previous studies (Hayes et al., 1994; Vidoni et al., 2005) also found that patellar luxation of grades III and IV were the most frequently diagnosed. This result may be related to the lameness score; grades III and IV showed lameness scores of around 3, a score high enough where dog owners would recognize that some problem had occurred, and that they should bring their dog to the hospital.

Malalignment of the quadriceps muscle, tendon and patellar ligament, as well as internal rotation of the proximal tibia, is thought to increase the stress on the CCL and cause a predisposition to rupture. A previous study found that CCL rupture

was complete in 17/39 (43.5%) of stifle joints, and incomplete in 22/39 (56.5); all stifle joints were medial patellar luxation grades ranging from II to IV/IV (Yeaton et al., 2011). Our study found CCL rupture occurring only in medial luxation grade IV; 26.1% of those stifle joints had CCL rupture (15.2% complete and 10.9% incomplete).

The frequency of occurrence of patellar luxation in this study was 40.3%. A previous study diagnosed patellar luxation in 61.6% of examined dogs (Vidoni et al., 2005). As far as the direction of patellar luxation is concerned, lateral luxation in small dogs is uncommon. Another study found a lateral luxation rate of about 10-20%, and it was seen more often in large breeds (Bobins, 1990). The present study found lateral luxation in 10.5% of small-size dogs and in 100% of medium-size dogs. Thus, in small dogs 89.5% of patellar luxation was medial luxation. This is in agreement with previous studies, which reported medial patellar luxation occurring more frequently in toy and miniature-breed dogs (Ruble and Hird, 1993; Johnson et al., 1994; Ness et al., 1996; Vidoni et al., 2005). The percentage of medial patellar luxation in all study animals (128 dogs) was 89%, a result similar to a report by Bound et al. (2009) in which 92% (155/168) of the studied dogs had medial patellar luxation.

Many studies have reported that females appear to be more at risk for patellar luxation than males (Ruble and Hird, 1993; Vasseur, 1993; Vidoni et al., 2005). In our study, in Pomeranian, Poodle, Shih Tzu, Chihuahua and Yorkshire Terrier (as well as the one Native Thai) there was a higher frequency in females than in males. But in the other two breeds, Miniature Pinscher and Siberian Husky, affected males outnumbered females. (However the result for Siberian Husky was based on only one animal, which cannot serve as a representative sample for statistical analysis.)

Based on our study, breeds showing a predisposition for patellar luxation are Poodle, Pomeranian, Chihuahua, Yorkshire Terrier, Shih Tzu, Miniature Pinscher, Siberian Husky and Native Thai. Results from studies in other parts of the world show some similarities to these findings; for example, Vidoni et al. (Vidoni et al., 2005) reported a predisposition among certain breeds in Australia, including Jack Russell Terrier, Pug, Papillon, Pekingese, Shih Tzu, Tibet Terrier, West Highland White Terrier, Poodle, Yorkshire Terrier, Maltese Terrier and Chihuahua.

In comparing uniluxation and biluxation of the patella, an earlier study found medial patellar luxation in 162 dogs (a total of 266 affected stifle joints); 58 dogs (36%) had unimedial patellar luxation and 104 (64%) had bimedial patellar luxation (Campbell et al., 2010). But our study had a contrasting result: unimedial patellar luxation was found in 77 dogs (60%) and bimedial luxation in 38 (30%). Including both lateral and medial luxation, uniluxation was found in 63% of the study animals, and biluxation in 37%.

Medial patellar luxation is often associated with deformities of the tibia and femur in varying degrees. In our study, the clinical signs of such deformities included lateral bowing of the distal femur, lateral torsion of the distal femur, coxa vara, and internal rotation of the tibia. In cases of lateral patellar luxation, the abnormal anatomic features were reversed: coxa valga and medial torsion of the distal femur. However, some dogs in this study did not present any abnormality of the limbs.

Acknowledgements

The authors would like to acknowledge financial support via research grants from the National Research University Project under Thailand's Office of the Higher Education Commission in year 2010-2011.

References

- Bobins, G.M. 1990. The canine stifle joint. In: Canine Orthopedics. 2nd ed. W.G. Whittick (ed). Philadelphia, Lea&Febiger: 693-760.
- Bound, N., Zakai, D., Butterworth, S.J. and Pead, M. 2009. The prevalence of canine patellar luxation in three centres. Clinical features and radiographic evidence of limb deviation. *Vet Comp Orthop Traumatol.* 22: 32-37.
- Campbell, C.A., Horstman, C.L., Mason, D.R. and Evans, R.B. 2010. Severity of patellar luxation and frequency of concomitant cranial cruciate ligament rupture in dogs: 162 cases (2004-2007). *J Am Vet Med Assoc.* 236: 887-891.
- Hayes, A.G., Boudrieau, R.J. and Hungerford, L.L. 1994. Frequency and distribution of medial and lateral patellar luxation in dogs: 124 case (1982-1992). *J Am Vet Med Assoc.* 205: 716-720.
- Johnson, J.A., Austin, C. and Breur, G.J. 1994. Incidence of canine appendicular musculoskeletal disorders in 16 veterinary teaching hospitals from 1980 through 1989. *Vet Comp Orthop Trauma.* 7: 56-69.
- Ness, M.G., Abercromby, R.H., May, C., Turner, B.M. and Carmichael, S. 1996. A survey of orthopaedic conditions in small animal veterinary practice in Britain. *Vet Comp Orthop Trauma.* 9: 43-52.
- Nganvongpanit, K., Pothacharoen, P., Suwankong, N., Ong-Chai, S. and Kongtawelert, P. 2009. The effect of doxycycline on canine hip osteoarthritis: Design of a 6-months clinical trial. *J Vet Sci.* 10: 239-247.
- Payne, J.T. and Constantinescu, G.M. 1993. Stifle joint anatomy and surgical approaches in the dog. *Vet Clin North Am Small Anim Pract.* 23: 691-701.
- Ruble, R.P. and Hird, D.W. 1993. Congenital abnormalities in immature dogs from a pet store: 253 case (1987-1988). *J Am Vet Med Assoc.* 202: 633-636.