

LONG BONE FRACTURES IN CATS: A RETROSPECTIVE STUDY

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ABSTRACT

The aim of this study was to retrospectively assess a population of cats with long-bone fractures *over a six year period*. Data about cat signalment (breed, sex, age, body weight); domiciled or not; cause of injury; time of occurrence; injured limbs and fractured bones (humerus, radius/ulna, femur, tibia/fibula); soft-tissue damage (closed, open); and fracture location (*proximal*, middle or *distal* one-third), direction of the fracture line in relation to the bone's longitudinal axis (transverse, oblique, spiral) and extent of damage (incomplete, complete, multi-fragmentary) were evaluated. To compare the variable proportions was used G-test assumed that the proportions in each category were equal. The differences were considered significant at $p < 0.05$. A total of 141 cats were evaluated, 90.07% were crossbreed, 6.38% Siamese, and 3.55% Persian. The body weight was greater than or equal to 2.0 kg in 68.08% of the cases. The femur was the most affected bone (50.84%), followed by the tibia/fibula (29.05%), and radius/ulna (10.61%) and humerus (9.50%). The cats had from six to 180 months of age, being 58.16% up to 12-month-old. Motor vehicle accidents accounted for 42.55% of the causes, followed by dog bites (12.76 %), falls (4.25%), and accidents in general. The closed fractures (85.47%) were more frequent than open fractures (11.12%). In conclusion, this population was constituted mainly of domiciled crossbred cats, under 12 months of age, *weighing more than or equal to 2.kg*, that have been more frequently affected by complete and closed fractures of the femur due to traffic-related accident.

Keywords: feline, fracture, cause, classification.

FRATURAS DE OSSOS LONGOS EM GATOS: ESTUDO RETROSPECTIVO

RESUMO

O trabalho teve por objetivos analisar, retrospectivamente, uma determinada população de gatos com fraturas dos ossos longos, por um período de oito anos. Foram pesquisados dados sobre a identificação do animal (raça, sexo, idade, peso); se domiciliado ou não; causa da lesão; tempo da ocorrência; membros (torácico e/ou pélvico) e ossos acometidos (úmero, rádio/ulna, fêmur, tíbia/fíbula); comprometimento de partes moles (fechada, exposta); e tipo

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de fratura quanto à região (terço proximal, médio e distal), orientação da linha de fratura relativa ao eixo ósseo (transversa, oblíqua, espiral) e extensão do dano (incompleta, completa, multifragmentar). Para comparar as proporções das variáveis avaliadas foi usado teste G assumindo proporções esperadas iguais. O limite de significância estatística foi $p < 0,05$. Um total de 188 gatos foi avaliado, sendo 89,33% sem raça definida, 5,85% da raça Siamês e 4,78% da raça Persa. A idade dos gatos variou de 6 a 180 meses, sendo 60,63% até 12 meses de idade. O peso corpóreo foi maior ou igual a 2,0 kg em 68,08% dos casos. Entre as causas: 40,95% por acidentes por veículos motorizados, seguido por mordidas (9,04%), quedas (4,78%), e acidentes em geral (5,31%). O fêmur foi o osso mais afetado (53,81%), seguido pela tíbia/fíbula (28,38%), e rádio/ulna (9,74%) e úmero (8,05%). As fraturas fechadas (84,74%) foram a mais frequentes que as expostas (11,44%). Baseado nos dados obtidos foi possível concluir que a população estudada constitui-se principalmente de gatos domiciliados, sem raça definida, com menos de 12 meses de idade, peso maior ou igual a 2,0 kg e que são mais frequentemente acometidos por fraturas fechadas e completas do fêmur devido ao atropelamento.

Palavras-chave: felino, fratura, causa, classificação.

FRACTURAS DE LOS HUESOS LARGOS EN LOS GATOS: ESTUDIO RETROSPECTIVO

RESUMEN

El objetivo de este estudio fue analizar, de forma retrospectiva, una población de gatos con fracturas de huesos largos en un período de seis años. Los datos significativos del gato (raza, sexo, edad, peso corporal); domiciliados o no, causa de lesión, el tiempo de ocurrencia; extremidades lesionadas y los huesos fracturados (húmero, radio/cúbito, fémur, tibia/peroné), el daño de los tejidos blandos (cerrado, abierto), y localización de la fractura (proximal, medio y distal tercero), la dirección de la línea de fractura en relación al eje del hueso longitudinal (transversal, oblicua, espiral) y el alcance de los daños (incompleto, completo, multi - fragmentaria) fueron evaluados. La prueba para comparar las proporciones variables que se utilizó, supone que las proporciones de cada categoría fueron iguales. Se consideraron valores significativos de $p < 0,05$ las diferencias. En conclusión, esta población estuvo constituida principalmente de gatos mestizos domiciliados, de menos de 12 meses de edad, de peso superior o igual a 2.kg, que han sido más frecuentemente afectados por fracturas completas y cerradas de fémur a causa de accidentes de tráfico.

Palabras clave: felino, fractura, causas, clasificación.

INTRODUCTION

Most of the long bone fractures in small animals take place in the hind limbs, and femur bone is the most commonly injured (1-7). This may be associated to survival ability, since traumas located to the caudal half of the body would be less likely to be fatal, or *sense of self-defense, the animal put the hindquarters to absorb the major impact force in a situation of imminent trauma* (2).

Depending on loading forces that the bone is submitted, such as compression, bending, tension, or torsion, will occur distinctive fracture patterns (8, 9). In addition, the rate of force application *influences the type of fracture* and the degree of soft tissue injury (9). There are various *fracture classification systems* including cause, anatomical location, morphology,

severity, whether or not the broken bone is *exposed* to the external *environment*, extent of bone injury, reducibility, stability, among others (3-5, 7, 10).

Fractures in cats exhibit some similarities with fractures in dogs, but anatomical differences need to be considered, such as humerus and femur straighter, supracondylar foramen in the humerus in which brachial vessels and median nerve pass, presence of clavicle (6, 11), which may reflect *treatment approach*. Furthermore, the type and severity of the fracture may be associated with the environment to which the animal is exposed (12).

Therefore, the aim of this study was to analyze a population of cats with long-bone fractures. The hypothesis was that characterization of the prevalence and types of lesions may contribute to understanding of disease and its prevention and treatment.

MATERIAL AND METHODS

Data from cats with long bone fractures treated at the Veterinary Hospital of the School of Veterinary Medicine and Animal Science, UNESP Botucatu, Brazil, were analyzed retrospectively for a period of six years (2006 to 2011).

Data about cat signalment (breed, sex, entire or castrated, age, body weight); domiciled or not; cause of injury; time of occurrence; injured limbs (forelimb or hind limb) and fractured bones (humerus, radius/ulna, femur, tibia/fibula); soft-tissue damage (closed, open); and fracture location (*proximal*, middle or *distal* one-third), direction of the fracture line in relation to the bone's longitudinal axis (transverse, oblique, spiral) and extent of damage (incomplete, complete, multi-fragmentary) were evaluated.

To compare the variable proportions was used G-test assumed that the proportions in each category were equal. Data without information were excluded from the analysis. The differences were considered significant at $p < 0.05$.

RESULTS AND DISCUSSION

A total of 141 cats were evaluated in the present study, 90.07% ($n=127$) were crossbreed, 6.38% ($n=9$) Siamese and 3.55% ($n=5$) Persian. The high number of crossbred cats probably is associated with limited financial resources as well as preference of the owners. About sex, 57.45% ($n=81$) were males, 41.84% ($n=59$) females ($p=0.062$), and 0.71% ($n=1$) there was no information. Regarding age, the fractures were observed in cats from six to 180 months of age (mean, 18.1 months; approximately 1.5 years), being 58.16% ($n=82$) detected in animals up to 12 months of age, and 31.20% ($n=44$) over 12 months of age ($p < 0.001$). In 9.93% ($n=15$) of cases the age was not mentioned. In a survey of 109 bone fractures in cats was also observed absence of sex-associated prevalence, but 75% of patients had two years of age or younger age at time of fracture occurrence (1), age range different of the determined for the present study. In turn, in a study of 298 fractures in domestic cats was observed that 80% occurred in animals less than 3 years, with greater representation of males (13).

The body weight of the cats ranged from 0.3 kg to 6.3 kg (mean of 2.75 kg), and 68.08% ($n=96$) had body weight greater than or equal to 2.0 kg, 27.66% ($n=39$) had lower body weight than 2 kg ($p < 0.001$), and 4.25% ($n=6$) of cases there was no information. The entire cats were 38.30% ($n=54$) and castrated accounted for 11.35% ($n=16$) of the total ($p < 0.001$), but in 50.35% ($n=7$) of medical records this information was not reported. In general, heavier and neutered adult male cats are more prone to have spontaneous femoral capital physal fractures (14). Early neutering may induce *delayed closure* of the growth *plate*, especially in growth plates that close later (6, 7). Since apparently most of the cats in the present study were entire this may have reflected for the absence of this type of fracture.

The causes of fractures in cats are varied, but the most common causes are accidents by cars or *other* types of *motorized vehicles*, or falls from high places (3-4, 10). There are also those associated with bone destruction or bone weakness including neoplastic diseases, nutritional or metabolic disorders; by indirect violence and repetitive stress; or spontaneous fractures (3-4, 15). In the present study, motor vehicle accidents accounted for 42.55% (n=60) of the causes, followed by dog bites (12.76 %, n=18), falls (4.25 %, n= 6), and accidents in general (6.38 %, n=9) (p<0.001). However, the owner was unable to determine a cause in 34.04% of the cases (n=48). In addition, the patient's environment should be considered *in determining* why a *fracture* occurs (16). In this study, the majority were domiciled cats (72.34%, n=102), 7.09% (n=10) stray cats (p<0.001), and 20.57% (n=29) there was no information. Thus, the fractures probably occurred during the time that the cats roam or *escape outdoors*. Young cats have a higher tendency to roam outdoors, and are less accustomed to the environment and traffic, which favor traumatic fractures (12).

One hundred and forty-three fractures (79.89%) fractures occurred in the hind limbs (p<0.001) being the femur (63.64 %, n=91) the most affected bone, followed by the tibia/fibula (36.36%, n=52) (p=0.001). In turn, 20.11% (n=36) of the fractures occurred in the forelimbs, 52.78% (n=19) in the radius/ulna and 47.22% (n=17) in the humerus without statistical differences between bones (p=7.739). Concerning both forelimbs and hind limbs, femur (50.84%, n=91) was the most affected bone, followed by the tibia/fibula (29.05%, n=52), and radius/ulna (10.61%, n=19) and humerus (9.50%, n=17). Other population studies in cats have also found the femur as the *most frequently fractured bone*, but there were variations in the prevalence of fractures among tibia/fibula, humerus and radius/ulna (1, 11, 13, 17). Some authors consider fractures of the radius/ulna to be infrequent accounting for 3% of all bone fractures in cats, while humeral fractures represent approximately 5% (18).

The closed fractures are characterized by no puncture or open wound in the skin, while open fractures there is communication with the external environment (3, 10). Open fractures may be presented with varying degrees of *soft tissue damage* (9, 10) and are apparently more common in cats than in dogs (7). In the present study closed fractures (85.47%, n=153) were more frequent than open fractures (11.12%, n=20) (p<0.001), and 3.35% (n=6) cases there was no information. Open fractures are observed more frequently in bones below the elbow and stifle due to *poor soft-tissue coverage* (7, 19). Likewise, in the present study the bones most often associated with open fractures were tibia/fibula (70%, n=14). However, the second was the femur (n=6, 30%), probably related to severity of the injury. The interval *between* the injury and *the time* of treatment is very important in open fractures, because these fractures are predisposed to bacterial contamination and infection (19). In this study, this interval ranged from 1 hour to 720 hours (mean of 71.79 hours or approximately 3 days). Thus, the data indicate that the owners must be clarified about the risks of this delay in treatment.

Based on the extent of damage the fractures may be classified as complete if occurs complete disruption of the bone continuity, incomplete if has partial disruption of the bone, and multifragmental if one or more fragments are completely separated (3, 10). Salter-Harris are fractures that occur through growth plate of immature animals (5, 10), and these fractures have risk of premature physal closure and potential development of a bone deformity (5, 7). In the present study, 67.03% of the diaphyseal femur fractures were complete (n=61), 8.79% (n=8) multifragmental, and 2.20% (n=2) incomplete (p<0.001). Based on fracture line orientation relative to the long axis of the bone, 45.90% (n=28) of the complete femur fractures were transverse, 32.79% (n=20) diagonal, and 21.31% (n=13) spiral (p=0.06). In addition, 21.98% (n=20) were growth plate fractures. The tibia/fibula fractures were in 73.08% (n=38) complete, 11.54% (n=6) incomplete, and 1.92% (n=1) multifragmental (p<0.001). Of these tibia/fibula fractures 47.368 % (n=18) were transverse, 42.10% (n=16) oblique, 10.53% (n=4) spiral (p=0.004), and 13.46% (n=7) were considered physal.

In the forelimbs, 82.35% of the humeral shaft fractures were complete (n= 14), 5.88 % (n=1) incomplete, and 5.88 % (n=1) multifragmental (p<0.001). Based on fracture line orientation, 42.86 % (n=6) were transverse, 42.86 % (n=6) oblique, and 14.28% (n=2) spiral (p=0.267). One fracture was considered physeal (5.88%). The radius/ulna fractures were in 63.16% (n=12) complete, and 15.79% (n=3) multifragmental (p=0.001). Of these radius/ulna fractures 50% were transverse (n=6) and 50% oblique (n=6) (p=0.7697). In addition, 21.05% (n = 4) were growth plate fractures.

Thus, in this study the pattern of the majority of the fractures was complete, and transverse orientation was more common in tibia/fibula and radius/ulna fractures. Since the cats have ability to *pronation and supination* of the antebrachium and paw, this should be considered in the treatment choice in the radius/ulna fractures (18). Depending on localization in the bone, the fractures can be classified into proximal, shaft and distal zones (3). The diaphysis of the femur (56%) is the most common site of fracture in cats, followed by physeal fractures (20%) (18). However, in the present study 42.86 % (n=39) of the femoral fractures occurred in proximal, 25.27% (n=23) in middle, and 31.87% (n=29) in distal (p=0.059) third of the bone. In tibia/fibula was observed that 7.69% (n=4) of the fractures were located in the proximal third, 25% (n=13) in the middle third, and 67.31 % (n=35) in the third distal (p<0.001) that increasing the incidence of open fractures. Some authors have reported that most fractures of the humerus, as well as radius, preferably involving the middle and distal one-thirds of these bones (11, 17). However, in the present study 17.65% (n=3) of the humeral fractures occurred in proximal, 47.06% (n=8) in middle, and 35.29% (n=6) in the distal thirds (p=0.152), and 36.84% (n=7) of the radius/ulna fractures were located in proximal, 21.05% (n=4) in middle, and 42.10% (n=8) in distal thirds (p=0.241).

It was possible to conclude that the population evaluated in this study was constituted mainly of domiciled crossbred cats, under 12 months of age, *weighing more than or equal* to 2.0 kg, that have been more frequently affected by complete and closed fractures of the femur due to traffic-related accident.

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