Grossly apparent cartilage erosion of the patellar articular surface in dogs with congenital medial patellar luxation

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Introduction

Congenital medial patellar luxation (CMPL) represents more than 80% of all patellar luxations seen in dogs. They are routinely classified into four grades (Grade I–IV), and 25–50% are observed bilaterally (1, 2). Repetitive medial luxation of the patella can induce lesions on the articular surface of both the medial femoral condyle and the patella. Cartilage defects have been described in Grade III and Grade IV patellar luxation, and more recently in Grade I and Grade II (2, 3).

Corrective surgery as a treatment of CMPL in dogs is recommended for Grade III and IV luxations, but not routinely for Grade I and II luxations (2, 4). Other authors have recommended surgery in the lower grades, but only if the dogs are lame (5). Surgical correction of CMPL does not lead to excellent clinical results in many dogs. This may be due to recurrent patellar luxation which occurs in up to 50% of the operated stifles (3). However lameness is also seen in dogs with post-surgically stable patellae. This may be caused by arthritic changes in the stifle (5) or the pre-surgical condition of articular cartilage. For large breed dogs with patellar luxation, a poor post-operative prognosis has been described if severe cartilage erosion of the femoral trochlea and the patella was present at the time of surgery (2).

Our aim was to document the occurrence of cartilage erosion on the articular surface of the patella in dogs with CMPL and to determine if the occurrence of cartilage erosion was associated with greater body weight, degree of patellar luxation, gender and age.

Materials and methods

Patients

One hundred and forty-five stifles in 141 different dogs with CMPL presented to our clinic for corrective surgery were included. The distribution of dog breeds is reported in Table 1. The affected stifles of the dogs with CMPL were classified in four grades (Grade I to Grade IV) according to the classification system described by Putnam and Singleton (2).

Cartilage erosion on the articular patellar surface was intra-operatively examined. To better visualise the cartilage lesions, a few drops of blood from the nearby surgical field were dropped onto the patellar cartilage and wiped away with a gloved finger. The blood adhered to the eroded areas, but was easily removed from the cartilage areas that visually seemed to be normal (Fig. 1). The eroded cartilage surface was graded as a percentage of the total articular surface of the patella. To assess the percentage of cartilage erosion, the patella was virtually divided into four equal sections by mid-sagittal and transverse axes (Fig. 1). The eroded surface area was then estimated in each quarter and an estimated total surface-percentage was determined. The total estimations were grouped into quintile ranges (1–20%, 21–40%, etc). All estimations were done by the same author (LJ) to avoid inter-personal variability.

The cartilage surfaces of 13 patellae were photometrically analyzed using a software programme by a blinded co-author (RD). The measured surface erosion of each patella was compared with the intra-
BREEDS Number
Yorkshire Terrier 36
Maltese 30
Toy Poodle 16
Mongrel 15
Chihuahua 6
Bichon Frisé 5
English Bulldog 5
Miniature Pincher 4
Cavalier King Charles Spaniel 3
Jack Russel Terrier 3
Bouvier des Flandres 2
Fox Terrier 2
Lhasa Apso 2
American Staffordshire Bull Terrier 1
Austrian Shorthaired Pincher 1
Bull Terrier 1
Chow Chow 1
Labrador Retriever 1
Pekingese 1
Pharao Dog 1
Pitbull Terrier 1
Pyrenees Shepherd 1
Shih Tzu 1
Tatra 1
Tibetan Terrier 1
Total 145

Table 1 Breed distribution (number of affected stifles)

Table 2 Congenital medial patellar luxation grades and extent of grossly apparent articular cartilage erosion on the patella.

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The extent of grossly evident cartilage erosion varied between 0 and 100%. The most prevalent location was on the distal and medial patellar articular surface. The percentage of cartilage erosion in relation to CMPL grade is reported in Table 2.

Statistics

A one-way ANOVA (analysis of variance), with a multiple range test according to Student Newman-Keuls, was used for the comparison of the percentages of cartilage erosion in the four patellar luxation grades. The statistical relationships between cartilage erosion and weight or age were analyzed with the Spearman Rank Correlation test. Gender effects were analyzed by means of the distribution-free Mann-Whitney test and a Chi-square test. The level of significance was set at $P \leq 0.05$.

Results

The distribution of CMPL grades is presented in Table 2. The median age of the dogs at the time of surgery was 49 months (range 8 to 134 months). The median weight was 8.8 kg (range 1 to 42 kg). Surgery was performed on 79 left stifles (54%) and 66 right stifles (46%). Of the 145 stifles, 65 (45%) were in male dogs and 80 (55%) were in female dogs. Thirty-seven (25%) stifles of male dogs and 56 (39%) stifles of female dogs showed cartilage erosion. The distribution of the four grades of patellar luxation in both sexes was similar (Chi-square test, $P = 0.63$).
The only significant correlation between the percentage of cartilage erosion and CMPL grades was that Grade IV patients had larger cartilage defects (P = 0.037). No significant difference in cartilage erosion was found between Grade I, II or III (0.1<P<0.2). There was no significant correlation between the percentage of cartilage erosion and age. However, a weak but significant rank correlation existed between the percentage of cartilage erosion and body weight, with heavier dogs being more severely affected (erosion located in the higher surface percentage ranges) (R = 0.17, P = 0.04). A relationship was also found between cartilage erosion and gender. The median percentage of cartilage erosion was 30% for female dogs and 15% for male dogs; however, a Mann-Whitney analysis revealed the significance (P = 0.06) of this difference to be borderline.

Of the 13 cases in which the cartilage erosion surface was measured with the software programme, all measured areas correlated with the visually estimated percentage range.

**Discussion**

The amount of cartilage erosion was significantly more extensive in heavier dogs. The observation might be explained by the influence of body weight on the biomechanics of the canine stifle, and thus on the loading of the patellar cartilage (7). The median weight of the dogs in this study was lower than reported in other studies on patellar luxation (1, 4). This might be because we only included dogs with CMPL, which is primarily associated with small breed dogs and excluded dogs with traumatic or lateral patellar luxations, which are observed more often in large breed dogs (1).

The distribution of the luxation grades in dogs undergoing surgical correction was the same as in other reports, with Grade II and Grade III being most frequently observed (1, 6). The data from our study suggest that an increase in luxation grade is accompanied by an increase in cartilage erosion. We observed that cartilage erosions in Grade IV were greater than in the other Grades of CMPL.

The dogs in our study had a median age of 49 months at the time of surgery which is consistent with observations of previous reports (1). Although dogs undergoing surgery for CMPL at an older age might have been expected to show cartilage erosion in higher percentage ranges because of significant repetitive luxation of the patella, no correlation was found. It might be that our study group was too small to reveal any influence due to age.

The gender distribution of dogs in this study (45% male – 55% female) is consistent with other reported male:female ratios, with females being over-represented (1). Although the male group did not differ statistically from the female group either in age, weight or patellar luxation grade, a trend was found for female dogs to show more frequent and more severe cartilage erosion. A similar tendency is found in human patients, where female patients (especially older women) are at higher risk of developing osteoarthritis and cartilage damage in the knee than male patients (8, 9).

Overall clinical results from patellar luxation surgery in dogs are mediocre with 25–50% of patients functioning poorly after surgery (4). We postulate that one of the reasons for the surgical failure in stable post-surgical patellae might be the presence of cartilage erosion.

The estimation of the extent of articular cartilage erosion is a subjective method of measurement that weakens our study results. The methodology for subjective classification is however generally accepted in human and veterinary scientific publications (10). Although the visual estimation of the cartilage erosion surface can be criticised, it should be noted that the classification of the Grade of patellar luxation is also subjective, but generally accepted in veterinary science. Based on this subjective classification system, conclusions are drawn on lameness severity and therapeutic outcomes (1, 4). The fact that all observations on patellar luxation and cartilage erosion in our survey were performed by one author (LJ) probably reduced inter-personal variability. Also, the correlation between the measured and estimated cartilage erosion in 13 cases gives weight to the reliability of the estimated measurements of cartilage erosion. In further research we would advocate the use of more exact measurements in all cases.

In conclusion, most dogs with CMPL had grossly apparent cartilage erosion on the articular surface of their patella. The erosions occurred most frequently on the disto-medial side of the articular surface of the patella and were observed in all grades. The amount of cartilage erosion was significantly greater (erosions located in the higher surface percentage ranges) in heavier dogs and dogs with Grade IV CMPL. No correlation was found between the occurrence of cartilage erosion and age or gender; however, a trend was found for females to show more frequent and larger areas of cartilage erosion.

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**References**