Radiographic findings of the medial humeral epicondyle in 200 canine elbow joints

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Keywords

Enthesopathy, epicondyle, dog, elbow, radiography

Summary

Objectives: To determine the frequency and radiographic aspect of medial humeral epicondylar lesions as a primary or concomitant finding and to evaluate the association with osteoarthritis.

Methods: Medical records of dogs diagnosed with elbow lameness were reviewed. Inclusion criteria for this study were a complete clinical examination, a complete set of digital radiographs and a final diagnosis made by computed tomography or magnetic resonance imaging and arthroscopy. Changes of the medial humeral epicondyle were recorded and correlated with the radiographic osteoarthritis and final diagnosis. **Results:** Eighty of the 200 elbows showed changes of the medial humeral epicondyle.

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Introduction

The elbow joint is a frequent origin of forelimb lameness in the dog. The most common disorder affecting the canine elbow joint is elbow dysplasia, a disorder which includes medial coronoid disease, ununited anconeal process, osteochondritis dissecans of the humeral condyle, and inconIn 12 of these 80 elbows, changes of the medial epicondyle were the only findings within the joint, and these elbows were diagnosed with primary flexor enthesopathy. In the remaining 68 elbows, other concomitant elbow pathologies were found. In those cases of concomitant epicondylar changes, high grades of osteoarthritis were recorded, while most elbows with primary flexor enthesopathy showed a low grade of osteoarthritis.

Clinical significance: Changes of the medial humeral epicondyle are often considered clinically unimportant and are regarded as an expression of osteoarthritis. This study showed the relatively frequent presence of epicondylar changes of which the majority were considered concomitant to a primary elbow problem. If changes of the medial humeral epicondyle are the only pathologic finding (primary flexor enthesopathy) they should be considered as the cause of lameness and not as a sign of osteoarthritis.

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gruity (1–3). Diagnosis is based on the primary radiographic changes, or secondary sclerosis and osteoarthritis, often combined with the findings of computed tomography or arthroscopy (4–9).

In the authors' experience, lesions of the medial humeral epicondyle and the attaching flexor muscles can equally cause elbow lameness, distension of the elbow joint, a limited range-of-motion and elbow pain (10). These findings are comparable to the abnormalities present in joints affected by medial coronoid disease (4, 8, 11). Careful palpation of the medial side of the elbow joint, caudodistal to the medial epicondyle, often reveals a firm well-defined swelling, which is absent in joints with medial coronoid disease (10). Radiographic changes of the medial humeral epicondyle are often considered to be concomitant findings with limited clinical importance, although they have been mentioned as a cause of forelimb lameness in several, mostly older, case reports (2, 12–17). Radiographic changes at the medial humeral epicondyle were first described as an ununited medial epicondyle and were temporarily classified under the elbow dysplasia complex (2). It consisted of one or more loose ossified bodies either on the medial side of the elbow joint or distal to the medial epicondyle (18). A failed fusion of the medial epicondyle ossification centre to the humerus was considered to be the cause. In later papers, calcified bodies similar to those described as an ununited medial epicondyle were reported, and different terms were used to describe these calcifications: dystrophic calcification of the flexor tendon origins, traumatic avulsion of the humeral medial epicondyle, medial humeral condylar osteochondritis dissecans, and development of a preformed ossification centre (2, 12-17, 19, 20). Bony spur formation (enthesophytes) at the caudal edge of the medial epicondyle was described as another radiographic finding at the medial humeral epicondyle. Spur formation as a sign of elbow disease has been less frequently described compared to calcifications near the medial epicondyle (10, 14). A spur is considered to be an osseous outgrowth, extending from the skeleton into a tendon at its enthesis (21). Spur formation



Fig. 1 Distribution of the final diagnosis in 200 subsequent elbows and in 80 elbows with medial epicondylar changes. MCD = joints with medial coronoid disease, including medial compartment disease and joints with concomitant incongruity. FE = joints with primary flexor enthesopathy. OCD =

joints with osteochondritis dissecans, with or without medial coronoid lesions and incongruity. UAP = joints with an ununited anconeal process and concomitant other lesions. IOHC = joints with incomplete ossification of the humeral condyle.

has been described simultaneously with osteoarthritis, but it remains unclear whether epicondylar spur formation is a manifestation of osteoarthritis or the primary problem causing osteoarthritis (14). In recent studies the term 'flexor enthesopathy' was suggested referring to primary pathological changes within the flexor muscles and their attachment to the medial epicondyle (the 'enthesis'). However, the precise cause of the disorder was not reported (10, 22).

Lesions of the medial humeral epicondyle can occur as a single problem, but the presence of concurrent elbow problems has been described (15). Both for calcified bodies and spur formation, the challenge is to recognize the changes at the medial epicondyle as a sign of primary flexor enthesopathy and to make the distinction between clinically important and unimportant lesions using additional diagnostic methods.

The purpose of this study was to make an inventory of the radiographic changes of the medial epicondyle to determine the frequency of medial humeral epicondylar lesions and to evaluate the radiographic aspect as a primary finding or concomitant to other elbow diseases and its association with osteoarthritis.

Materials and methods

Consecutive files of dogs with elbow lameness diagnosed between 2008 and 2010 were reviewed. To be included in this study, a complete clinical examination and a complete set of digital radiographs (flexed and extended mediolateral and 15° oblique craniolateral-caudomedial projections) were required. The final diagnosis had to be confirmed either by computed tomography, magnetic resonance imaging, or arthroscopy depending on the type of elbow problem. According to these requirements, the files of 117 dogs corresponding to 200 elbows were included in this study.

The radiographic images of these elbows were reviewed on a workstation using the appropriate software^a by the first author (EdB), a board certified radiologist (HvB), and an experienced orthopaedic surgeon (BVR). The medial humeral epicondyle and surrounding soft tissues were evaluated and findings were classified as an irregular outline, presence of a calcified body, presence of spur formation, or presence of both spur formation and a calcified body. Other abnormalities of the elbow joint were also recorded; these were mainly the presence of medial coronoid disease, osteochondritis dissecans, neoplasia as well as elbow osteoarthritis classified into four grades according to the criteria defined by the International Elbow Working Group (25).

After evaluation of the radiographic images and the data obtained by further diagnostic methods (computed tomography, magnetic resonance imaging and arthroscopy), the elbow joints were divided into three groups: elbow joints without lesions of the medial humeral epicondyle, elbow joints with only lesions of the medial humeral epicondyle or surrounding soft tissues ('primary flexor enthesopathy') and elbow joints with lesions of the medial humeral epicondyle associated with other elbow disorders ('concomitant flexor enthesopathy').

^a OsiriX Imaging Software: Pixmeo, Geneva, Switzerland

Results

Two hundred elbows met the criteria for inclusion in this study. In 120 elbows no radiographical changes of the medial humeral epicondyle were seen. In 80 elbows four types of radiographic changes at the medial humeral epicondyle were diagnosed: an irregular outline of the medial humeral epicondyle, spur formation, a calcified body, or a combination of spur formation with a calcified body. In 12 of these, the radiographic changes of the medial epicondyle were the only findings and these elbows were diagnosed with 'primary flexor enthesopathy'. Ultrasonography, scintigraphy, computed tomography, magnetic resonance imaging and arthroscopy demonstrated pathology of the flexor muscles and their attachment to the medial epicondyle in these elbows and excluded other elbow pathology. In the remaining 68 elbows, other concomitant pathology was found, including medial coronoid disease (71%), osteochondritis dissecans (7.5%), tumour (1%), and osteoarthritis (0.5%). These elbows were classified as 'joints with concomitant epicondylar lesions'.

Of the total of 200 elbows, radiographic images for 170 elbows were obtained because of the lameness examination and 30 elbows had postoperative follow-up radiographs taken.

The postoperative elbow radiographs showed medial epicondylar lesions in 25/30 joints. Four of those had been diagnosed with primary flexor enthesopathy and showed similar lesions before surgery. The other 21 had been diagnosed with medial coronoid disease and did not show medial epicondylar lesions preoperatively. Of the 30 follow-up radiographs, five were without medial epicondylar lesions. Four had been diagnosed with medial coronoid disease and one with ununited anconeal process.

The distribution of the final diagnoses within the total of 200 elbows, and within the 80 elbows with changes of the medial epicondyle, is given in \triangleright Figure 1.

Four types of radiographic medial epicondylar changes were diagnosed (\triangleright Fig. 2). The two most frequent types were spur formation with or without the presence of a calcified body. Spur formation without a calcified body was the most frequent find-

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Fig. 2 Distribution of changes of the medial humeral epicondyle within 12 elbows with primary flexor enthesopathy (blue) and 68 elbows with concomitant elbow diseases (red).

ing in joints with concomitant epicondylar lesions, while spur formation combined with a calcified body was the dominant type of lesion in joints with primary flexor enthesopathy (\triangleright Fig. 2-4). The third type was the presence of a calcified body without changes of the medial epicondylar outline which was a less frequent finding ex-

clusively seen as a concomitant epicondylar lesion (Fig. 2 and 5). In cases of primary flexor enthesopathy, the calcified body was always accompanied by spur formation (Fig. 2, and 4). The fourth type of lesion was an irregular outline of the medial epicondyle, which appeared as a less frequent primary finding (Fig. 2, 4, and 6). An ir-



Fig. 3 Radiographic images (lateromedial flexed projections) of spur formation in an elbow with **(A)** primary flexor enthesopathy and in an elbow with a **(B)** fragmented coronoid problem. **A)** Female sevenyear-old Border Collie diagnosed with primary flexor enthesopathy. The medial coronoid process shows a normal appearance with mild osteoarthritis (black arrow) and mild sclerosis (white arrowhead). Clear spur formation is present (white arrow). **B)** Male nine-year-old Belgian Shepherd Dog diagnosed with a fragmented coronoid process. The medial coronoid process shows an unclear delineation (black arrowhead) with osteoarthritis (black arrow) and clear sclerosis (white arrowhead). The epicondylar spur is marked by a white arrow.

regular outline of the medial humeral epicondyle and spur formation were seen on the mediolateral-flexed projection. Calcified bodies were diagnosed either on the lateromedial (flexed and extended) or 15° oblique craniolateral-caudomedial projection. The mediolateral projection revealed 13 elbows with a calcified body, and the 15° oblique craniolateral-caudomedial projection showed 16 elbows with a calcified body. Only in four elbows was a calcified body visible on both the mediolateral and the 15° oblique craniolateral-caudomedial projections.

The general osteoarthritis distribution for the 200 elbows was no osteoarthritis in 28%, grade one in 23%, grade 2 in 28%, and grade 3 in 20%.





calcification is visible within the flexor muscle group (white arrowhead). A small osteophyte is seen on the medial coronoid process (black arrowhead). After intravenous injection of a contrast medium (2 mg/kg lopromid, Ultravist 300; N.V. Shering S.A.), clear contrast captation within the flexor muscles is visible (soft tissue window, F) (black arrow). **G-I**) Arthroscopy shows a normal coronoid process (white arrow), an erosion at the attachment side of the flexor muscles to the medial humeral epicondyle (black arrow) and ruptured fibres of the flexor tendons near their attachment to the medial humeral epicondyle (white arrowhead).

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Fig. 5 A-C) Radiographic (extended and flexed mediolateral and craniocaudal projection) images of a male Golden Retriever, 20-months-old, diagnosed with fragmented coronoid disease and concomitant flexor enthesopathy. **A-C)** An unclear delineated coronoid process (white arrowhead),

osteophytes (black arrow), and sclerosis (black arrowhead) can be seen. A large calcified body is visible caudal to the medial humeral epicondyle on the lateromedial projections (white arrow), but is not visible on the 15° oblique craniolateral-caudomedial projection.

The correlation between the degree of osteoarthritis and the presence as well as the absence of medial epicondylar lesions is illustrated in ► Figure 7.

Discussion

Lesions of the medial humeral epicondyle have not been well documented in literature. Calcifications in this area are mostly considered to be a coincidental finding, although several mostly older papers reported those lesions as a cause of elbow lameness (2, 12-20). Osteophytosis or a 'spur' is usually interpreted as a sign of osteoarthritis (14, 25). Our study demonstrated that both types of epicondylar lesions can be diagnosed frequently and can be clinically relevant in a limited but not insignificant number of cases. In order to define how frequently lesions of the medial epicondyle are diagnosed and how these lesions are related to other primary elbow disorders and osteoarthritis, 200 files of dogs with elbow lameness were analysed.

The final diagnosis in our series of elbows reflected the generally accepted occurrence of elbow pathology. Although it would be ideal to have each diagnosis confirmed by a full work-up protocol including computed tomography or magnetic resonance imaging and a final diagnosis by arthroscopy, this was not always allowed by the owner. Lesions of the medial coronoid

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process were the most frequent diagnosis. Since computed tomography has a sensitivity and specificity of 88% and 85% respectively for the detection of fragments of the medial coronoid process, the distribution of lesions can be considered quite accurate, even in the absence of an arthroscopic confirmation (23, 24).

Medial coronoid disease was the most frequent final diagnosis in our study, representing 77% within the total of 200 elbows and 60% within the 80 elbows with medial epicondylar changes. This is consistent with other reports in the literature where fragmented coronoid process is also the most frequently diagnosed elbow disorder (26).

Osteochondritis dissecans and ununited anconeal process are other wellknown elbow disorders, but both were diagnosed considerably less frequently in this study (7% and 2.5% respectively within the 200 elbows and 6% and 0% within the 80 elbows). This finding equally reflects the findings in other reports in the literature. In 5.5% of the 200 elbows in our study, osteoarthritis was found without the presence of a primary disorder confirmed by computed tomography and in some cases arthroscopy. In half of the cases, it involved



Fig. 6 Radiographic images (lateromedial flexed projections) of an irregular outline of the medial humeral epicondyle in an elbow with (A) primary flexor enthesopathy and an elbow with a (B) fragmented coronoid process. A) Four-year-old, male Great Swiss Mountain Dog with a normal medial coronoid process, no osteoarthritis, and no sclerosis. The irregular outline of the medial humeral epicondyle is marked with the white arrow. B) Ten-year-old male Bichon Frisé with an ill-defined medial coronoid process (black arrowhead), osteoarthritis (black arrows), sclerosis (white arrowhead), and an irregular medial epicondyle (white arrow).



the contralateral side in unilateral lameness.

The diagnosis of primary flexor enthesopathy was based on the radiographic findings and confirmed with additional diagnostic imaging techniques. Ultrasonography, scintigraphy, computed tomography, magnetic resonance imaging, and arthroscopy demonstrated pathology of the flexor muscles and their attachment to the medial epicondyle and excluded other elbow pathology. The abnormalities in these elbows were diagnosed as 'primary flexor enthesopathy', a term adopted from human medicine. It refers to pathological changes within the flexor muscles and their attachment to the medial epicondyle. The enthesis is receiving great attention in human medicine, because enthesitis or enthesopathy is considered to be an important cause of locomotion problems, such as tennis elbow and golfer's elbow (21). The percentage of elbows diagnosed with primary flexor enthesopathy in our study was six percent, which is comparable to the percentage of osteochondritis dissecans (7%) and higher than the percentage of ununited anconeal process (2.5%). This low but not negligible percentage draws attention to

primary flexor enthesopathy as a cause of elbow lameness.

In our study, 40% of the elbows showed radiographic signs of epicondylar changes. Logically, these changes were diagnosed at a high prevalence in joints with primary flexor enthesopathy, as pathology of this disorder is typically located in the area of the medial epicondyle. However in two cases of primary flexor enthesopathy, the only finding was an irregular outline. This should make the clinician aware that the problem may also be present in the absence of clear radiographic changes. The highest percentage of epicondylar changes was seen in elbows diagnosed with medial coronoid disease. In these elbows the epicondylar lesions were considered concomitant to the main joint problem and treatment was only addressed to that problem. A different approach was described in another study of 26 joints (23 dogs) with calcified bodies (15). In that series, the calcification was surgically removed in 22 elbow joints. However 11 joints were simultaneously treated for medial coronoid disease, osteochondritis dissecans or ununited anconeal process (15).

Changes of the medial humeral epicondyle, observed in the present study, were divided in four types: an irregular outline of the medial humeral epicondyle, calcified bodies in the surrounding tissues, osteophytosis or 'spur formation' at the medial humeral epicondyle, or a combination of spur formation with a calcified body. The less pronounced types were an irregular outline of the medial epicondyle and spur formation. These changes can be considered as a logical finding in joints affected by any elbow disorder and may be explained as a sign of osteoarthritis. Spur formation was the most frequent finding in joints with concomitant enthesopathy. However, in joints affected by primary enthesopathy, this finding referred to the primary disorder. A more obvious finding was a calcified body diagnosed with or without an epicondylar spur. In cases of primary flexor enthesopathy, calcified bodies were always seen in combination with a spur. This may illustrate the active involvement of the attachment of the flexor muscles (enthesis) in the disease process. This finding proves that a spur should not always be considered as a sign of osteoarthritis as is suggested in the guidelines of the International Elbow Working Group (25). A calcified body plus spur was the most frequent finding in joints with primary flexor enthesopathy. This is confirmed by the previous reports, all mentioning a calcification except two (2, 10, 12-17, 19, 20).

According to previous reports, calcified bodies are most frequently diagnosed on the 15° oblique craniolateral-caudomedial projection and can be missed on the mediolateral projection because of superimposition of the humerus and the radius (15, 18). The results of our study show that a considerable number of calcified bodies were seen only on the mediolateral projection. Only four calcified bodies were visible on both projections, therefore both projections are necessary to diagnose epicondylar calcifications.

Since changes at the medial epicondyle are often considered as a sign of osteoarthritis, the findings were compared with the degree of osteoarthritis. Our study shows that in the group of joints with concomitant epicondylar changes, the highest percentage of epicondylar lesions was

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found in joints with a high grade of osteoarthritis (grade 3). This was different for the group with primary flexor enthesopathy, where most changes were noted in joints with a lower grade of osteoarthritis (grade 0-2). In the group of elbows without medial epicondylar changes, lower grades of osteoarthritis (grade 0-2) were diagnosed more frequently than in the group of elbows with concomitant flexor pathology. These findings suggest that concomitant epicondylar lesions are correlated to a high degree of osteoarthritis, while primary epicondylar changes are not. In the latter, the changes illustrate the primary problem involving the flexor muscles and their attachment, which can in return cause secondary osteoarthritis. On the other hand, not every elbow joint with osteoarthritis shows a radiographic change at the medial humeral epicondyle, suggesting that the medial humeral epicondyle is not a standard localization for osteoarthritis.

As previously mentioned, the percentage of medial coronoid disease as the definitive diagnosis in the total of 200 elbows was very high. The diagnosis of medial coronoid disease also included radiographs taken after arthroscopic removal of the coronoid lesion. The number of these postoperative radiographs was significantly higher in the group with concomitant epicondylar changes (21 of 48 elbows) compared to the group without epicondylar changes (4 of 94 elbows). Apparently arthroscopic treatment of a medial coronoid problem can induce the development of a spur or a calcified body near the medial humeral epicondyle. Considering this, and knowing that osteoarthritis progresses after arthroscopic removal of medial coronoid disease, this finding supports the theory that concomitant epicondylar changes are related to the development of osteoarthritis (27-29).

Conclusion

Radiographic changes at the medial humeral epicondyle are a frequent finding in elbow disorders of which medial coronoid disease is the most important one. However these changes may also be a sign of primary flexor enthesopathy. This specific area of the joint should be evaluated carefully to detect the lesions in the first place and to interpret them correctly in order to make the right treatment decision.

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Conflict of interest

None declared.

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