Traumatic fracture of the medial coronoid process in 24 dogs

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Keywords

Elbow dysplasia, arthroscopy, medial compartment disease, fractured medial coronoid process

Summary

Objective: To describe traumatic fracture of the medial coronoid process in dogs as a clinically distinct disease unrelated to congenital elbow dysplasia.

Methods: Clinical records of dogs with acute, traumatic, unilateral lameness attributable to medial coronoid process disease were reviewed retrospectively. Clinical interpretation included findings on physical examination, orthopaedic examination, and subjective gait analysis. Radiographs of the affected and contralateral elbows were obtained and reviewed for pathology. Arthroscopy of the elbow joints was performed by one of three surgeons and findings were compared to preoperative diagnostics. Postoperative follow-up was continued for 16 weeks.

Results: Twenty-four dogs were included in this study. All dogs in this study were free of radiographic evidence of medial coronoid pathology. All dogs were diagnosed with a single, large, displaced or non-displaced fracture of the medial coronoid process, with no other joint pathology. Dogs generally had an excellent short-term outcome following arthroscopic treatment of the fractured medial coronoid process.

Clinical significance: Traumatic fracture of the medial coronoid process should be considered a clinical disease distinct from dysplasia-related fragmentation and should be considered as a differential diagnosis in dogs that are presented with the complaint of acute unilateral elbow discomfort or lameness, especially after concussive activities involving the forelimb.

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Introduction

Elbow dysplasia is a common cause of forelimb lameness that encompasses several disease conditions (medial compartment disease, ununited anconeal process, joint incongruity, and osteochondrosis of the humeral condyle) that may result in early onset osteoarthritis (1). Medial compartment disease, or specifically fragmented coronoid process, is one of the most common manifestations of elbow disease diagnosed in medium to large breed dogs (2, 3). The majority of cases of medial compartment disease are presented prior to 18 months of age with persistent forelimb lameness, however, some are presented later in life (>6 years) after the development of severe osteoarthritis (4). Clinical signs of medial compartment disease include signs of discomfort on palpation of the medial compartment of the elbow, joint effusion, crepitation during manipulation, peri-articular thickening, circumduction of the antebrachium, and abduction of the elbow during the swing phase of the stride, as well as a decreased range of motion of the elbow joint, especially in flexion (5). In some circumstances, affected dogs may not display any of the above mentioned clinical signs.

The aetiopathogenesis for the development of medial compartment disease is unclear, although there are increasing amounts of data to suggest that it is a multifactorial disease process (6). It has been acknowledged that some disease processes may co-exist in the same joint. The development of fragmented medial coronoid process has been theorized to occur due to a lesion of the subchondral bone, with abnormal loading leading to primary osseous fissuring and micro crack formation, elbow incongruence (radioulnar, humeroulnar or humeroradial), or through genetic heritability (6-15). Amongst these theories, elbow incongruence has been reported to be the primary cause of development of medial compartment disease (11, 12, 16). These abnormalities alter biomechanics within the elbow, specifically at the coronoid trochlea articulation, which may predispose to increased loads and resultant fissuring or fracturing at the medial coronoid process.

An alternative injury, consisting of a traumatic fracture of the medial coronoid process independent from elbow dysplasia has been theorized (17). An acute fracture of the medial coronoid process may result from traumatic concussive activities (such as agility contacts, fly ball, landing on forelimbs, and jumping from heights) that direct force onto the medial coronoid process (18). This frequently results in a single,

large non-displaced fragment of the medial coronoid process (17). While dogs that are diagnosed with traumatic fragmentation may also have elbow dysplasia, this acute fracture can also occur in dogs with anatomically normal elbows.

The purpose of this study was to document the clinical features, radiographic characteristics, arthroscopic findings, and treatment for a traumatic fracture of the medial coronoid process affecting dogs acutely with no elbow dysplasia, and to describe it as a clinical disease that can be distinct from dysplasia-related fragmented coronoid process.

Materials and methods

Inclusion criteria

Medical records (May 2006 – March 2015) of dogs with the presenting complaint of thoracic limb lameness that were diagnosed and treated with arthroscopy were reviewed. Information reviewed included history, signalment, limb(s) affected, presurgical radiographic findings, arthroscopic findings, arthroscopic interventions, and outcome following surgery. Dogs were excluded if the history of injury could not definitively be classified as acute and traumatic, or if they had clinical signs that were not attributable to MCP disease, if they were less than two years of age at presentation, there was prior history of elbow disease, if there was any abnormality detected on radiographs to suggest fragmented coronoid process was due to elbow dysplasia, if no fragments were present on arthroscopic examination, if pathology was bilateral, if there was arthroscopic evidence of any other intra-articular cartilage pathology, or if any joint incongruity was detected during arthroscopy.

Radiographic examination

Standard two-view (flexed mediolateral and craniocaudal) radiographs of affected and contralateral elbows were obtained for all dogs. The radiographs were assessed for abnormal contour or poor definition of the medial coronoid process, blunting or rounding of the medial coronoid process, fragmentation, subchondral bone sclerosis adjacent to the trochlear notch and proximal radioulnar articulation near the medial coronoid process, joint incongruity, osteophytosis, and soft tissue mineralization.

Arthroscopic examination

Arthroscopic evaluation was performed via a medial approach using standard portals (19). The cartilaginous structures along the medial coronoid process, medial humeral condyle, ulnar notch, radial head, and synovium were subjectively assessed and classified using the modified Outerbridge cartilage grading score (20). All elbow joints were also visually assessed during arthroscopy for evidence of incongruence.

Surgical technique

After arthroscopic examination, traumatic fracture of the medial coronoid processes were treated with fragment excision and abrasion arthroplasty using a mechanical shaver[a]. A 5 mm incision was made using a number 15 scalpel blade 2 cm cranio-distal to the arthroscope portal. Through this portal, the fragments were removed using arthroscopic graspers[b]. In some dogs, the fragment was too large to be removed through the initial portal; therefore, the incision was extended as necessary to allow removal of the fragment with arthroscopic graspers. In order to stimulate the formation of fibrocartilage, abrasion arthroplasty was performed to the underlying subchondral bone until small channels of subchondral bleeding were noted (21). Skin incisions were closed using polypropylene suture[c].

Postoperative care

Dogs were hospitalized following surgery and treated with hydromorphone (0.1 mg/kg IV q4h) for analgesia. A modified Robert Jones Bandage was placed on affected limbs for 24 hours postoperatively. Dogs were discharged the following day with instructions for the owner to administer oral analgesia consisting of an opioid such as tramadol (3–5 mg/kg PO q8–12h) or codeine (0.5–2.0 mg/kg PO q8–12h) along with carprofen (2.2 mg/kg PO q12h), meloxicam (0.1 mg/kg PO q24h), firocoxib (5 mg/kg PO q24), or deracoxib (1.0–2.0 mg/kg PO q24) depending on owner preference, previous response to drug, and history of drug intolerances. Analgesics were administered to all dogs for 14 days. Dogs were allowed short leash walks for elimination purposes in the first 14 days. At each of the follow-up examinations, gradual increments in activity along with a home exercise program (range of motion, various weight-bearing and stretching exercises) were prescribed.

Outcome measures

Follow-up orthopaedic examinations for all dogs were recommended at four, eight, 12 and 16 weeks postoperatively. At each re-examination, each dog was visually evaluated for any evidence of forelimb lameness at the walk and trot. Elbow manipulation was performed to evaluate elbow range of motion, where normal flexion was considered to be 34°-38°, and normal extension was considered to be 164°-167° (22). During examination, joint effusion was subjectively graded (mild, moderate and severe), and any signs of discomfort were noted.

Results

Records of 1011 dogs undergoing elbow arthroscopy for suspected fragmented coronoid process were reviewed. Twenty-four dogs met the study criteria with unilateral elbow arthroscopies performed from August 2009 to September 2014. Breeds included the Labrador Retriever (n = 5), mixed (n = 4), Boxer (n = 3), Australian Cattle dog (n = 2), and one dog of each of the following: Australian Shepherd, Bearded Collie, Belgian Malinois, Chow Chow, Golden Retriever, Keeshond, Shetland Sheepdog, Staffordshire Terrier, Sussex Spaniel, and Welsh Corgi. Mean age at surgery was 48 months (range: 24 – 132 months). Mean weight was 23.6 kg (range: 11.4 – 44.9 kg). The male:female ratio was

a Dyonics®: Smith & Nephew, Andover, MA, USA
b Acufex™ Raptor Jr. or Acufex™ Alligator: Smith & Nephew, Andover, MA, USA
c Prolene®: Ethicon, Somerville, NJ, USA

15:9 with 9/24 neutered females, 2/24 intact males, and 13/24 neutered males. Dogs included in this study acquired acute non-weight bearing lameness traumatically after chasing tennis balls, or squirrels, or after rough play or other vigorous activity involving concussive forces to the forelimbs.

Preoperative radiographic findings

Radiographs were assessed by board certified surgeons and there was no radiographic evidence of abnormal contour, poor definition, blunting or rounding of the medial coronoid process, fragmentation, subchondral bone sclerosis adjacent to the trochlear notch and proximal radioulnar articulation near the lateral medial coronoid process, joint incongruence, osteophytosis, or soft tissue mineralization in any of the 24 dogs.

Arthroscopic findings

There was no arthroscopic evidence of medial humeral condyle pathology or gross incongruity in any of the affected elbows. All elbows had a modified Outerbridge grade of zero; each elbow was treated with removal of the fractured medial coronoid process and abrasion arthroplasty. All dogs in the study had a single large fragment that was classified as either displaced or non-displaced. Nineteen of the 24 dogs had a single, large non-displaced fragment (fracture line clearly seen, but with no to minimal displacement and mobile upon probing). Five of the 24 dogs had a single, large displaced fragment (fragment clearly displaced with easily visible, bleeding subchondral bone). During arthroscopic manipulation and fragment excision, each fragment exhibited bleeding consistent with grossly healthy bone as depicted in ▶Figure 1.

Postoperative orthopaedic examination

All dogs included were evaluated postoperatively for joint effusion, range of motion (measured with goniometry), comfort and lameness. Some dogs missed these appointments due to owner non-compliance and loss to follow-up. At the four-week re-examination, 18/20 dogs had normal flexion angles on goniometry. Fourteen of the 15 dogs that returned 16 weeks postoperatively had full return to function. One dog was able to return to acceptable function after 16 weeks, with none experiencing unacceptable function after the eight-week re-examination.

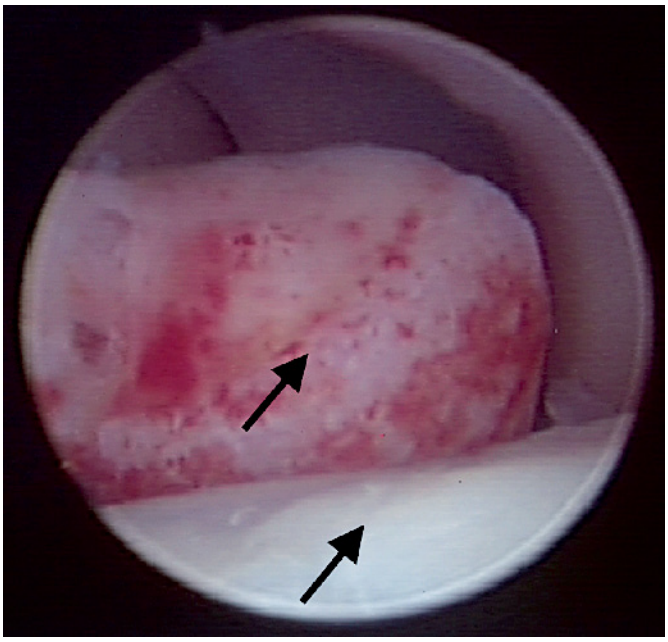

Figure 1
Example of a single, large, displaced, traumatic fracture of the medial coronoid process displaying bleeding (top arrow) consistent with healthy subchondral bone. The bottom arrow points to the base of the medial coronoid process, from which the fragment detached.

Discussion

Elbow dysplasia is a developmental condition and clinical signs of medial compartment disease are usually seen in immature dogs between six to 18 months of age, though dogs may begin displaying clinical signs at any age. These dogs may develop early onset elbow osteoarthritis (23, 24). Dogs with osteochondrosis or osteochondritis dissecans tend to be presented between five to eight months of age, whereas the mean age at diagnosis of medial coronoid disease is 13 months, with clinical signs occurring as early as four months of age (24, 25). Dogs with fragmented coronoid process due to elbow dysplasia suffer from bilateral disease 25–80% of the time (16, 19, 24). Our inclusion criteria were specifically designed to create a sample population that categorically excluded any dog afflicted with elbow dysplasia.

Dogs in our study experienced an acute onset of unilateral non-weight bearing lameness beginning immediately after a traumatic, concussive event. Dogs that were presented with chronic lameness, and secondary cartilage or radiographic changes after similar inciting events were excluded due to the impossibility of distinguishing a traumatic fracture of the medial coronoid process from a fragmented coronoid process event. While a number of the breeds diagnosed with traumatic fracture of the medial coronoid process in this study commonly suffer from elbow dysplasia, the individual dogs included in the study showed no signs of radiographic or arthroscopic lesions consistent with elbow dysplasia. Additionally, the unilateral, acute and traumatic presentation of these dogs further reinforced their distinction from traditional cases of fragmented coronoid process.

Arthroscopically, an important characteristic of traumatic fracture of the medial coronoid process is the quality of subchondral bone observed during manipulation. All dogs treated arthroscopically in our study were observed to have a single, large, displaced or non-displaced fracture with grossly healthy bleeding bone. This is in direct contrast to fragmented coronoid process lesions removed in dysplastic elbows that are typically discoloured and devital-

ized (26). The authors also noted that fragmented coronoid process lesions commonly have more than one fragment. All dogs had a modified Outerbridge score of zero and no other abnormalities within the joint. These observations aid in supporting the distinct pathophysiology of traumatic versus regular fragmented coronoid process. Additionally, using a recently proposed grading scheme for assessment of subjective clinical outcomes, follow-up data in our study showed that 14/15 of dogs that returned 16 weeks postoperatively had full return to function (27). One dog was able to return to acceptable function after 16 weeks, with none exhibiting unacceptable function after the eight week examination. In the authors' experience, juvenile onset medial coronoid disease generally carries a fair to poor long-term prognosis.

In dogs with medial coronoid disease, histomorphometry has demonstrated the presence of microcracks and subchondral bone disease, supporting the theory that repetitive traumatic concussive activities can result in acute fragmented coronoid process (9). Previous reports have described normal histomorphometry of fragments following acute development of clinical signs and normal elbow contact joint patterns, which is similar to our population of non-dysplastic dogs experiencing traumatic fracture of the medial coronoid process (28). While elbow incongruity such as radioulnar and humeroulnar incongruence, or varus deformity of the humerus, may cause abnormal contact patterns at the coronoid trochlear articulation and result in an increased likelihood of traumatic fracture of the medial coronoid process in dysplastic dogs, the pathogenesis of the fragmentation is fundamentally different. The histomorphometric findings of previous reports support the distinct physiology of traumatic versus regular fragmented coronoid process.

Several limitations should be considered when interpreting the data of this study. The retrospective nature of this study represents a main limitation. The absence of histopathology of excised fragments to objectively prove the absence of microdamage in our population represents another. The lack of long-term follow up (past 16 weeks) was tolerated as the focus of our study was to describe traumatic fracture of the medial coronoid process and present it as a clinically distinct disease unrelated to congenital elbow dysplasia, rather than to document any progression (or lack thereof) of disease in treated elbows. While acquisition of computed tomography images would be ideal for concurrent comparison with arthroscopy findings, we do not consider it to be a limitation of this study. The diagnostic value and reproducibility of arthroscopy has been shown to compare favourably with computed tomography for diagnosis of elbow dysplasia (29, 30). Furthermore, arthroscopy enables diagnosis and treatment of the disease simultaneously. In future studies, further evaluation through second-look arthroscopic evaluation, objective gait analysis, and radiographs would be necessary to determine long-term outcomes.

Given these findings, we propose that traumatic fracture of the medial coronoid process be considered a clinically distinct disease unrelated to congenital elbow dysplasia. As a result of this isolated pathology, arthroscopic treatment seems to result in an outcome that is generally excellent within 16 weeks of convalescence. The dogs in our study were presented without any other lesions commonly associated with medial compartment disease. Instead, they were presented in a manner similar to an injury; therefore, we believe that traumatic fracture of the medial coronoid process should not be considered a hereditary disorder. It should be included in the differential diagnosis for dogs of any signalment with forelimb lameness and pain localized to the elbow, unremarkable elbow radiographs, and no prior history of elbow disease or diagnosis of elbow dysplasia.

Conflict of interest

There are no conflicts of interest to declare.

References

1. Griffon DJ. Surgical Diseases of the Elbow. In: Tobias KM, Johnston SA, editors. Veterinary Surgery: Small Animal. St. Louis: Saunders; 2012. pg. 724–751.
2. Meyer-Lindenberg A, Langhann A, Fehr M, et al. Prevalence of fragmented medial coronoid process of the ulna in lame adults dogs. Vet Rec 2002;151: 230–234.
3. Meyer-Lindenberg A, Langhann A, Fehr M, et al. Arthrotomy versus arthroscopy in the treatment of the fragmented medial coronoid process of the ulna (fragmented coronoid process) in 421 dogs. Vet Comp Orthop Traumatol 2003;16(4):204–210.
4. Fitzpatrick N, Smith TJ, Evans RB, et al. Radiographic and arthroscopic findings in the elbow joints of 263 dogs with medial coronoid disease. Vet Surg 2009; 38: 213–223.
5. Hazewinkel HA, Kantor A, Meij B, et al. Fragmented coronoid process and osteochondritis dissecans of the medial humeral condyle. Tijdschr Diergeneeskd 1988; 113 Suppl 1: 41S–46S.
6. Fitzpatrick N, Yeadon R. Working algorithm for treatment decision making for developmental disease of the medial compartment of the elbow in dogs. Vet Surg 2009; 38: 285–300.
7. Burton NJ, Owen MR, Kirk LS, et al. Conservative versus arthroscopic management for medial coronoid process disease in dogs: a prospective gait evaluation. Vet Surg 2011; 40: 972–980.
8. Burton NJ, Perry MJ, Fitzpatrick N, et al. Comparison of bone mineral density in medial coronoid processes of dogs with and without medial coronoid process fragmentation. Am J Vet Res 2010; 71: 41–46.
9. Danielson KC, Fitzpatrick N, Muir P, et al. Histomorphometry of fragmented medial coronoid process in dogs: a comparison of affected and normal coronoid processes. Vet Surg 2006; 35: 501–509.
10. Guthrie S, Plummer JM, Vaughan LC. Aetiopathogenesis of canine elbow osteochondrosis: a study of loose fragments removed at arthrotomy. Res Vet Sci 1992; 52: 284–291.
11. Kirberger RM, Fourie SL. Elbow dysplasia in the dog: pathophysiology, diagnosis and control: review article. J S Afr Vet Assoc 1998; 69: 43–54.
12. Ness MG. Treatment of fragmented coronoid process in young dogs by proximal ulnar osteotomy. J Small Anim Pract 1998; 39: 15–18.
13. Mason DR, Schulz KS, Samii VF, et al. Sensitivity of radiographic evaluation of radio-ulnar incongruence in the dog in vitro. Vet Surg 2002; 31: 125–132.
14. Janutta V, Hamann H, Klein S, et al. Genetic analysis of three different classification protocols for the evaluation of elbow dysplasia in German Shepherd dogs. J Small Anim Pract 2006; 47: 75–82.
15. LaFond E, Breur GJ, Austin CC. Breed susceptibility for developmental orthopedic diseases in dogs. J Am Anim Hosp Assoc 2002; 38: 467–477.
16. Puccio M, Marino DJ, Stefanacci JD, et al. Clinical evaluation and long-term follow-up of dogs having coronoidectomy for elbow incongruity. J Am Anim Hosp Assoc 2003; 39: 473–478.
17. Yovich JC, Read RA. Traumatic fracture of the medial coronoid process in two Dogs. Vet Comp Orthop Traumatol 1994; 7: 173–176.
18. Hulse D, Young B, Beale B, et al. Relationship of the biceps-brachialis complex to the medial coronoid process of the canine ulna. Vet Comp Orthop Traumatol 2010; 23: 173–176.
19. Van Ryssen B, van Bree H, Simoens P. Elbow arthroscopy in clinically normal dogs. Am J Vet Res 1993; 54: 191–198.
20. Schulz KS. What's new in elbow arthroscopy. Proceedings of the 13th Annual American College of

Veterinary Surgeons Symposium; 2003 October 9; Washington DC, USA. pg. 329– 331.
21. Minas T, Nehrer S. Current concepts in the treatment of articular cartilage defects. Orthopedics 1997; 20: 525–538.
22. Jaegger G, Marcellin-Little DJ, Levine D. Reliability of goniometry in Labrador Retrievers. Am J Vet Res 2002; 63: 979–986.
23. Trostel C, McLaughlin R, Pool R. Canine lameness caused by developmental orthopedic diseases: panosteitis, Legg-Calve-Perthes disease, and hypertrophic osteodystrophy. Comp Cont Educ Pract Vet 2003; 25: 282–293.
24. Cook JL. Forelimb lameness in the young patient. Vet Clin North Am Small Anim Pract 2001; 31: 55–83.
25. Trostel CT, McLaughlin R, Pool R. Canine lameness caused by developmental orthopedic diseases: fragmented medial coronoid process and ununited anconeal process. Comp Cont Educ Pract Vet 2003; 25: 112–120.
26. Vermote KAG, Bergenhuyzen ALR, Gielen I, et al. Elbow lameness in dogs of six years and older. Vet Comp Orthop Traumatol 2010; 23: 43–50.
27. Cook JL, Evans R, Conzemius MG, et al. Proposed definitions and criteria for reporting time frame, outcome, and complications for clinical orthopedic studies in veterinary medicine. Vet Surg 2010; 39: 905–908.
28. Görtz K, Van Ryssen B, Taeymans O. Traumatic fracture of the medial coronoid process in a dog: radiographic, computed tomographic, arthroscopic and histological findings. Vet Comp Orthop Traumatol 2004; 17: 159–162.
29. Wagner K, Griffon DJ, Thomas MW, et al. Radiographic, Computed tomographic, and arthroscopic evaluation of experimental radio-ulnar incongruence in the dog. Vet Surg 2007; 36: 691–698.
30. Werner H, Winkels P, Grevel V, et al. Sensitivity and specificity of arthroscopic estimation of positive and negative radio-ulnar incongruence in dogs. Vet Comp Orthop Traumatol 2009; 22: 437–441.