“Elbow Dysplasia: Options for Treatment”

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Elbow dysplasia: Conservative management, fragment removal and osteotomies.

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What are the conservative management options for elbow disease?

Medical management of elbow osteoarthritis should be multimodal and include; activity control, weight management, physical therapy, administration of non-steroidal anti-inflammatory drugs (NSAIDs) or analgesic drugs and nutraceuticals.

Weight control is a pivotal aspect of conservative management of osteoarthritis. Weight reduction alone has been shown to lessen severity of lameness in dogs with hip osteoarthritis. Cohort studies demonstrate that food restriction reduces not only the incidence of hip dysplasia but also reduces the severity of radiographic signs. Weight control may slow progression of elbow osteoarthritis but the effect is not as great as in hip osteoarthritis.

Activity control and physical therapy has less evidence to support its role in the management of osteoarthritis. In people, trials suggest that physical therapy can provide improvement in pain and disability scores. No specific studies directly support the use of physical therapies in canine elbow disease. A frequent opinion of animal physical therapist is that poorly executed physical therapy activities (particularly swimming) will exacerbate elbow osteoarthritis, limiting the physical therapy to under water treadmill activity. Unrestricted activity has been demonstrated to exacerbate lameness in dogs with chronic stable hind limb lameness, which suggests that exercise restriction is an important component of management. A clinical trial investigating the effect of physical therapy for rehabilitation of limb function following stifle surgery suggests benefits associated with this therapy. Additionally an objective study assessing weight loss and physiotherapy in obese dogs with osteoarthritis demonstrated that significant weight loss was achieved and significant improvement in ground reaction forces was observed.

A systematic review of medical treatments for osteoarthritis concluded that for the nutraceuticals; pentosan polysulphate, green lipped mussels, polysulphated glycosaminoglycans, chondroitin sulfate combined with glucosamine hydrochloride and manganese ascorbate a moderate level of comfort supported their use on the basis of one or two studies identified for each product. Hyaluronan was given an extremely low level of comfort. A high level of comfort was defined as ‘qualified scientists agree that a specific claim is scientifically valid’ and a moderate level of comfort was defined as ‘a relationship is promising but not definitive’. Omega-3 fatty acids have gained popularity with the introduction of formulated diets (j/d Hills). Randomized, double-blinded, controlled clinical trials support its use with dogs feed exclusively Hills j/d having significantly improved ground reaction forces compared with controls and improved owner assessed function.

Systematic review of NSAID treatments for osteoarthritis concluded that a high level of comfort supported the use of meloxicam (on the basis of 4 studies), and a moderate level of comfort supported the use of carprofen (on the basis of 7 studies). Numerous clinical studies with subjective outcomes suggest that limb function has been shown to improve following administration of firocoxib. A case control study using a urate-induced synovitis with objective measures of limb function demonstrated firocoxib to have superior efficacy relative to carprofen, deracoxib and meloxicam.

A systematic review of safety and efficacy of long-term NSAID use in the treatment of canine osteoarthritis concluded that the evidence supports longer-term use of these agents for increased clinical effect without a reduction in safety. Long –term use in the clinical trials evaluated
ranged from 28 to 84 days. Consequently the evidence suggests that a 28 days course of NSAIDs (compared to 14 days or less) is likely to result in improved clinical effect without the risk of an increase side effects.

What are the surgical options for medial coronoid disease in young dogs?

Medial coronoid disease has been documented in older dogs with similar pathology to young dogs hence the assumption that the age of the dog and the severity of the lesion are correlated is not true \(^ {17,18} \). This question would be better stated as what are the options for dogs which do not have advanced disease?

The term ‘elbow dysplasia’ overly simplifies a complex combination of pathologies of the elbow which include medial coronoid disease (of which there are several distinct pathologies recognised), ununited anconaeal process and OCD of the humeral condyle. ununited medial epicondyle and elbow incongruity are variably included as components of elbow dysplasia. These pathologies do occur concurrently and hence the surgical options for medial coronoid disease are influenced by the presence or absence of concurrent pathology. With the gradual increase in the understanding of elbow pathologies the surgical recommendations have become increasingly complex. A working algorithm (Figure 1,2 and 3.) for the management of elbow elbow dysplasia has been proposed by several authors and are as follows:

![Algorithm Image]

Figure 1. Decision making algorithm chart for treatment of medial coronoid disease (MCD) without significant medial humeral condylar pathology.
Figure 2: Decision-making algorithm for treatment of commonly identified manifestations of pathology of the medial humeral condyle. Figures 1 and 2 from Noel Fitzpatrick, and Russel Yeadon; Working Algorithm for Treatment Decision Making for Developmental Disease of the Medial Compartment of the Elbow in Dogs. Veterinary Surgery 38:285–300, 2009
Figure 3. Algorithm for the treatment of elbow dysplasia. MCP, medial coronoid process; OATS, osteoarticular transfer system; PAUL, proximal abducting ulnar osteotomy; SCO, subtotal coronoidectomy; SHO, sliding humeral osteotomy; UAP, ununited anconeal process. Figure 3 from Jacob Michelsen; Canine elbow dysplasia: Aetiopathogenesis and current treatment recommendations. The Veterinary Journal 196 (2013) 12–19

As the working algorithms demonstrate the surgical options for medial coronoid disease are influenced by the presence or absence of other pathologies. In the absence of severe or diffuse medial compartment disease, concurrent OCD of the humeral condyle or humeroulnar conflict the surgical options include fragment removal via either arthroscopy or arthrotomy, subtotal coronoidectomy via either arthroscopic / arthrotomy, biceps ulnar release procedure or combinations of the above.

Fragment removal is increasingly been performed via arthroscopy. As the veterinary profession has become increasingly aware of elbow dysplasia we are identifying subtle lesions that can not be appreciated without CT and arthroscopy. Despite subtle pathology patients can have marked lameness and lameness severity does not correlate with the extent of the pathology (Figure 4) [19]. My personal experience is that there has been a gradual progression in the pathologies identified over time. Historically arthroscopy would reveal large osteochondral fragments which could be removed. Increasingly subtle lesions restricted to cartilage pathology are been identified. This is likely to be due to elbow screening programs (which screen out those dogs with severe radiographic lesions) and increased awareness that results in early detection of disease. Consequently the management of medial coronoid disease via arthrotomy is limited without arthroscopy as cartilage health can not be assessed and the subsequent decision making can not be made.
Figure 4. Arthroscopic images (left) with matched extended and flexed mediolateral radiographs and craniocaudal radiograph (left to right) demonstrating the spectrum of joint pathology identified. (A) 12-month-old male neutered German Short Haired pointer with moderate synovitis and modified Outerbridge grade 2 cartilage pathology at the tip of the MCP without overt fissure or fragment formation (left elbow); (B) 11-month-old male entire Rottweiler with fissure formation in the region of the radial incisure of the MCP (right elbow); (C) 18-month-old female neutered Labrador retriever with gross fragment formation at the radial incisure of the MCP (left elbow); (D) 28-month-old male neutered Golden Retriever with modified Outerbridge grade 3 pathology of both MCP and medial humeral condylar surface demonstrating typical linear striations in absence of gross fragmentation of the MCP (left elbow); (E) 15-month-old male entire English Springer Spaniel with modified Outerbridge grade 3–4 pathology of both MCP and medial humeral condylar surface including gross fragmentation of radial incisure of MCP with apparently undiseased cartilage cap (right elbow); (F) 60-month-old female neutered German Shepherd Dog with modified Outerbridge grade 5 pathology of both MCP and medial humeral condylar surface in absence of gross fragmentation of the MCP (right elbow); (G) 20-month-old male entire Golden Retriever with modified Outerbridge grade 5 pathology of both MCP and medial humeral condylar surface including gross fragmentation of radial incisure of MCP with apparently undiseased cartilage cap (left elbow). From Noel Fitzpatrick et al. Radiographic and Arthroscopic Findings in the Elbow Joints of 263 Dogs with Medial Coronoid Disease. Veterinary Surgery 38:213–223, 2009

The rational for subtotal coronoidectomy (Figure 5.) is based upon histomorphometry of excised fragments demonstrating both diffuse damage and fissure formation in conjunction with increased osteocyte loss, and greater porosity of subchondral bone that extended beyond the gross fragmentation and occurred before gross fibrillation of articular cartilage develops. Consequently excision of the entire medial coronoid will remove the entirety of the diseased bone whereas fragment removal may under estimate the extent of the pathology and future pathology. The evidence to support subtotal coronoidectomy is poor. A prospective subjective un-controlled study of subtotal coronoidectomy in 263 dogs utilising video gait analysis documented improvement in lameness assessment to a score of 0 in some dogs noted. At 5 weeks a lameness score of 0 was present in 74.4% of elbows (veterinary assessment) and 45.6% (owner assessment). At 12 weeks a lameness score of 0 was present in 71.5% (veterinary assessment) and 91.2% (owner assessment). 38% of dog were considered lame on video gait analysis and yet none of these were receiving NSAID. Unfortunately this study had no control dogs to compare to fragment removal alone.
Figure 5. Typical configuration of subtotal coronoid ostectomy (SCO) depicted by green lines. Red line depicts typical location of fragment at radial incisure of medial aspect of coronoid process. From Noel Fitzpatrick, and Russel Yeadon; Working Algorithm for Treatment Decision Making for Developmental Disease of the Medial Compartment of the Elbow in Dogs. Veterinary Surgery 38:285–300, 2009

The biceps ulnar release procedure aims to reduce loading forces on the medial coronoid process and compression of the medial coronoid against the radial head hypothesized to occur as a secondary effect of musculotendinous mismatch. Specifically, the biceps brachii/brachialis muscle complex is considered to have the potential to produce substantial loading forces during elbow flexion and compression of the medial coronoid process against the radius due to its eccentric pull during flexion²¹,²²,²³.

This hypothesis has been termed rotational instability and is suspected when fissure formation occurs in the region of the radial incisure without overt fragmentation or appreciable osseous incongruity, or where there is a high index of suspicion that dynamic incongruity is the underlying cause medial coronoid disease. Dynamic incongruity is suspected in juvenile dogs with bilateral elbow pain/lameness and minimal arthroscopic changes bilaterally or with minimal arthroscopic changes affecting the elbow contralateral to an elbow overtly affected by fragmentation²¹. The procedure is restricted to cases in which the cartilage injury is minimal and fissure formation and/or subchondral sclerosis is limited to the area of the radial incisure. Candidates should be young dogs with minimal radioulnar incongruity and mild to marked clinical signs without fragmentation of the medial coronoid. Biceps ulnar release procedure involves tenotomy of the distal insertion of the biceps brachii/brachialis complex onto the ridge immediately caudal to the abaxial portion of the medial coronoid process (Figure 6)²¹. This procedure can be performed either via arthroscopy or via open arthrotomy. There is no published evidence to support biceps ulnar release procedure despite several surgeons advocating its use. The relationship of the biceps brachii/brachialis complex to the medial aspect of the medial coronoid process has been confirmed²²,²⁴.
Is there any merit in early intervention in the form of arthroscopy and fragment removal for medial coronoid disease?

Determining the benefit of early intervention is challenging. Small studies (10-13 surgical dogs) have shown no difference in outcomes between conservative management and arthrotomy to remove fragments. A study of 109 dogs showed no difference in the incidence of lameness between conservative management and fragment removal via arthrotomy. However those dogs managed with arthrotomy and fragment removal were more active and less severely lame.

In a retrospective study of 518 joints in 421 dogs comparing arthrotomy to arthroscopic fragment retrieval, arthrotomy resulted in lameness resolution in 42.4% of cases and mild persistent lameness was present in 29.3%. In total 79.1% were improved. Following arthroscopic fragment removal, lameness resolved in 60.1% of cases and mild persistent lameness was present 29.4%. In total 91.2% were improved, which was significantly superior to fragment removal via arthrotomy. Irrespective of the management the arthrosis progressed over time. Meta-analysis of these four studies concluded that arthroscopy was superior to medial arthrotomy and medical management, but medial arthrotomy was not superior to medical management. However due to the paucity of randomized controlled trials these results must be viewed with caution.

In contrast a recent prospective objective (inverse dynamics) controlled study in 20 dogs demonstrated that arthroscopically treated dogs had increased mechanical asymmetry at 4 and 8 weeks compared to the control group revealing surgery worsened limb function. There was no significant difference in mechanical symmetry between groups at 26 and 52 weeks. Unfortunately this study did not provide CT data of the control dogs and hence it was unknown the extent of the elbow pathology in the control dogs (worse or less severe?). Additionally as with many veterinary studies there was a small number of cases and different walking paces during the objective assessment which could have impacted on the outcomes.
Essentially there is no definitive proof to support early intervention and we can only conclude that arthroscopy gives the dog the chance to improve with a very low risk of complications. The owner needs to be advised that we are managing symptoms only and that osteoarthritis will still progress.

**Is there a role for ulnar osteotomies in elbow disease?**

Proximal ulnar osteotomy is used consistently to treat short ulna syndrome (premature closure of distal ulnar physis) and frequently to manage an ununited anconeal process. The routine use of ulnar osteotomy for medial coronoid disease is essentially historical with proximal ulnar osteotomy described for treatment of medial coronoid disease combined with medial arthrotomy in a case series. Routine use has been largely discontinued due to marked post operative morbidity and a lack of evidence to support its use. The current use of ulnar osteotomies in the management of medial coronoid disease is advised in those patients in which concurrent medial condyle OCD lesions or ‘kissing lesions are present or when radioulnar length disparity exists (>2mm for most authors). Joint incongruity has been documented in normal, or at least asymptomatic elbows, hence questioning the degree of incongruence that can be defined as pathological. Incongruence of 1.4 ± 0.9 mm has been shown in diseased elbow joints, however radiographic detection of elbow incongruity is unreliable when the radioulnar step is smaller than 2 mm. In contrast the detection of joint incongruity by CT and arthroscopy is reliable in detecting incongruities of 1 mm or more.

Proximal ulnar osteotomy has been demonstrated to result in adequate movement of the ulnar to restore normal contact patterns whereas distal ulnar osteotomies do not. Transverse proximal osteotomies should be stabilised with an IM pin to prevent varus deformity. Double oblique proximal ulnar osteotomy which is a caudoproximal to craniodistal oblique osteotomy has been described in combination with OATS for treatment of elbow OCD with subjectively improved outcomes (6 dogs) when performed, compared with OATS alone (20 dogs). The double oblique osteotomy has been shown to result in ~ 5mm of caudoproximal displacement of proximal segment without development of varus deformity. There are however no studies to document what the effect of oblique osteotomies on congruency or contact mechanics in clinical cases, to document improvement in clinical cases that have had proximal ulnar osteotomies or to document what is the long term effect on the joint of these procedures. Consequently the use of proximal ulnar osteotomies not recommend for routine use and is restricted to those patients with obvious radiographic / CT incongruity or cases with focal medial compartment disease. If a proximal ulnar osteotomy is used then the double oblique osteotomy is advised.

**What are the surgical options for elbow disease in dogs with moderate cartilage erosion?**

The surgical options for those patients with moderate cartilage erosion are dynamic proximal ulnar osteotomy, proximal abducting ulnar lateralising osteotomy (PAUL) or sliding humeral osteotomy (SHO). Dynamic proximal ulnar osteotomy is described for focal humeral / coronoid cartilage erosion whereas PAUL and SHO are described for more diffuse medial compartment disease.

PAUL makes no attempt to alter joint congruity and aims to laterlise the mechanical axis of the limb from the medial compartment to the lateral compartment use 4 or 6 degree angled plates. At present there are no in-vitro studies which show that PAUL actually changes contact mechanics or studies documenting clinical outcomes or complications.

SHO lateralises the mechanical axis of limb by induce a medial translation of the distal humerus. SHO has been demonstrated to reduce in contact pressure on medial coronoid process. A case series demonstrated that lameness improved for all limbs by 26 weeks, and resolved in 21/32 limbs. Additionally 2nd look arthroscopy and histology revealed fibrocartilage over previously eburnated bone. However early case significant complications which have been largely addressed by refinement of technique and redesign of implants.
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