A Retrospective Study of the Short-Term Complication Rate following 750 Elective Elbow Arthroscopies

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Introduction

Surgical exploration via arthroscopy or arthrotomy may be beneficial in canine elbow dysplasia to achieve a definitive diagnosis, determine severity and allow for subsequent treatment. Direct examination and probing of the elbow joint surfaces helps achieve an earlier diagnosis (1), which has been shown to improve clinical outcomes (2,3).

Many reports describe advantages of arthroscopy over arthrotomy including superior field of visibility, minimal invasiveness, reduced surgical time, ability to access multiple joints, lower patient morbidity, faster recovery and reduced risk of septic arthritis (3-6). Arthroscopy has been shown to result in superior functional outcomes in the treatment of medial coronoid disease (6). Lameness deterioration postoperatively was reported in 5.2% of arthrotomy cases compared with 2.9% following arthroscopy (6). Postoperative septic arthritis has been reported in 1-3% of arthrotomy cases (7), which is higher than the reported rates of 0.85% following canine arthroscopy (4), 0.9% following equine arthroscopy (8) and 0.8% following human elbow arthroscopy (9). Other complications reported following elective arthroscopy include fluid extravasation, iatrogenic cartilage damage, persistent or worsened lameness and peripheral nerve injury (3,10,11), however their rates of occurrence have not been well defined.

In human arthroscopy, studies have shown higher complication rates in the elbow (9) compared to larger joints, such as the knee (12). As the types and rates of complications differ between different joints, procedures and species, the results from other studies are not directly applicable to elbow arthroscopy in dogs. To date, there are no large studies that investigate the full range of complications associated with canine elbow arthroscopy and the rates at which they occur. The provision of these data to owners will facilitate achieving informed consent.

Materials and Methods

Medical records of all dogs which underwent unilateral or bilateral elbow arthroscopy for confirmed or suspected canine elbow dysplasia between November 2002 and April 2012 at the Queen Mother Hospital for Animals were reviewed. Clinical records were attained from 437 dogs, of which 21 had repeat procedures, such that 458 dogs (750 elbows) were included. Data retrieved from the clinical records included signalment, body weight, laterality of clinical signs preoperatively and whether unilateral or bilateral arthroscopy was performed. Intraoperative data included arthroscopic findings, primary disease process(es) diagnosed, procedure(s) performed, requirement for arthrotomy, duration of elbow arthroscopy and duration of anaesthesia. Postoperative data included any complications encountered, necessity for a second surgery and, whether lameness at re-examination was graded as improved, the same or worse than that noted preoperatively. Cases were noted when a definitive diagnosis could not be achieved or where no arthroscopic abnormalities were evident.

All surgical procedures were performed by faculty surgeons or surgical residents under direct supervision of faculty surgeons. A standard medial approach was used for all arthroscopic procedures (10).

Perioperative Management

Postoperative analgesia consisted of administration of methadone[1] (0.1-0.2mg/kg IV q4-6h PRN) for the first 24-48 hours, followed by buprenorphine[2] (0.02mg/kg IV q6-8h PRN) for the following 24-48 hours. Either meloxicam[3] (0.1-0.2mg/kg IV) or carprofen[4] (2-4mg/kg IV) was administered to each patient at induction of anaesthesia, and then this medication (0.1mg/kg PO q24h or 2-4mg/kg PO q24h respectively) was prescribed for the following 10 days. A self-adhesive wound dressing[5] was applied to the surgical site until the patient was discharged from our hospital. Cage rest with gradually increasing duration of lead-only walking until 6-8 weeks postoperatively was advised.

[1] Physeptone™: Martindale, Romford, UK
[2] Vetergesic™: Reckitt Benckiser Healthcare, Hull, UK
[3] Metacam™: Boehringer Ingelheim, Rhein, Germany
[4] Rimadyl™: Pfizer, Sandwich, UK
[5] Primapore™: Smith & Nephew, Hull, UK

Complications

The definitions of complications used for this study were adopted from a study investigating complications of the tibial tuberosity advancement procedure in dogs(13). Perioperative complications were those occurring prior to recovery from anaesthesia, and postoperative complications those occurring at any time thereafter.

Any complications requiring a repeat arthroscopy,arthrotomy or both were defined as major; these cases were identified and reasons for repeat surgery reviewed. All other complications were defined as minor. Minor perioperative complications included unplanned conversion to arthrotomy, technical difficulties associated with the instruments, fluid extravasation, excessive haemorrhage from portals and significant iatrogenic cartilage damage. Minor postoperative complications included severe elbow swelling, septic arthritis, severe pain and temporary neurapraxia. Postoperative elbow swelling was only considered a complication when swelling necessitated additional treatment above standard postoperative measures, such as application of a pressure bandage. The presence of signs of severe pain during hospitalisation was considered a complication when it necessitated a change in the anticipated postoperative analgesia protocol.

A recommendation was made to the owners of all patients that re-examination be performed at six weeks postoperatively. One complication following discharge that was specifically investigated was lameness that was noted to be worse than that noted preoperatively during the postoperative re-examination. Not all dogs returned for re-examination rendering the outcome for these cases unknown. Despite the limitations of this, for the purposes of this study, these cases were presumed not to have deteriorated in terms of lameness relative to their preoperative status.

Quantitative descriptive data for metric variables are presented as median values (range).

Results

Study Population

Of the 458 cases reviewed, 292 (63.8%) arthroscopic procedures were performed bilaterally and 166

(36.2%) unilaterally yielding a total of 750 joints. While clinical signs were noted to be bilateral in 327 cases, only 292 cases underwent bilateral arthroscopy. In the remainder of cases, owners only perceived unilateral thoracic limb lameness to be a problem and elected to have only unilateral surgery due to their wish to avoid any risk of surgical complications for perceived limited advantage. Eighty-two of the unilateral procedures were performed in the right forelimb and 84 in the left forelimb. Labrador Retriever (41.3%) was the breed most commonly represented and the male:female ratio was 3:1 (Table 1).

The median age of the study population was 25 months (5 - 127 months) and 60.9% of cases were ≤18 months old. The median body weight was 32kg (5 - 77kg). Preoperative clinical signs of abnormalities were found bilaterally in 71.4% of cases. These included lameness, a pain response upon manipulation of the elbow, a pain response upon palpation of the medial musculature distal to the elbow, palpable elbow effusion and crepitus upon elbow manipulation. This study did not specifically investigate the diagnostics used for each case, however, the majority of cases were referred with plain radiographs. Further imaging in the form of computed tomography (CT) was performed in 690 of 750 elbows; CT was only omitted in cases with definitive radiographic findings or if there were financial restrictions. Arthrocentesis was used in 90 cases where the findings of the CT imaging were inconclusive. The median durations of elbow arthroscopy and general anaesthesia were 73 minutes (15-260 minutes) and 177 minutes (65-460 minutes) respectively.

Medial coronoid disease was the most frequently diagnosed primary disease process, found in 81.5% of elbows. All arthroscopic lesions found and their prevalence are detailed in Table 2. Conditions included in the “other” category include incomplete ossification of the humeral condyle and elbows where incongruity or osteoarthritis were the only abnormalities detected.

Minor Complications

Definitive diagnoses were not achievable in 10 elbows from seven dogs, due to marked synovitis in three cases and technical difficulties with the instruments in four. No signs of pathology were

detectable in 50/750 (6.7%) elbows from 28 dogs. Of these 50 arthroscopically normal joints, 48 of the respective limbs demonstrated preoperative clinical signs and 2 were asymptomatic and investigated at the request of the owners. Only 2/28 of these dogs proceeded to have shoulder arthroscopy in the same thoracic limb; findings were unremarkable in one case and demonstrated bilateral osteochondritis dissecans of the humeral head in the other. Therefore for 27 dogs (48 elbows, 6.4%) no definitive diagnosis was achieved.

One or more minor perioperative complications were encountered in seventy-four (17.1%) cases. Fifty-five (12%) cases of elbow arthroscopy progressed to require arthrotomy for treatment (Table 3), of which 32 were considered routinely necessary for the planned treatment or elective based on surgeon preference where the surgeon made no attempt to treat the condition arthroscopially following diagnosis. The remaining 23 were considered complications with arthrotomy being performed due to inability to treat the condition arthroscopically when this would normally be possible. Failure to remove medial coronoid disease fragment(s) arthroscopically occurred in 19 cases, and represented the most common reason necessitating arthrotomy.

Technical difficulties associated with the instruments occurred in 13 (2.9%) cases; nine of these were due to an inability to insert the arthroscope into the elbow or difficulties viewing the entire joint cavity, whilst four were due to faulty instruments which prevented definitive diagnoses being made. Excessive fluid extravasation resulting in impaired visibility was reported in two (0.44%) cases, however diagnoses were achieved in both. Significant iatrogenic cartilage damage occurred in eight (1.7%) cases, none of which resulted in postoperative deterioration in lameness. The exact nature of this damage, in terms of lesion size, was not discernible from the records, however all involved iatrogenic exposure of subchondral bone. Three (0.66%) dogs suffered from excessive haemorrhage during portal placement.

Minor complications during postoperative hospitalisation were found to occur in 24 (5.2%) cases: these included severe elbow swelling (2%), septic arthritis (0.22%), severe pain (2.8%) and temporary

neurapraxia (0.22%). The case of septic arthritis was diagnosed following development of drainage from the portals and elbow swelling one week postoperatively. Arthrocentesis revealed turbid joint fluid with an elevated neutrophil count and culture was positive for an unidentified *Staphylococcus* spp. Treatment with appropriate antibiotics resulted in lameness resolution. The one case of temporary neurapraxia was considered to be due to damage to the ulnar nerve based on clinical findings of overextension of the carpus during weight bearing and absence of cutaneous sensation on digit five and the caudal and caudolateral aspects of the antebrachium. These findings resolved by 48 hours postoperatively.

Major Complications

Of the 458 elbow arthroscopies, 21 were repeat cases, producing a major complication rate of 4.8%. Repeat surgery was performed at a median of 135 days (1 - 1095 days) following initial arthroscopy. The most common reason necessitating repeat arthroscopy was recurrent or persistent postoperative lameness of unknown aetiology. This was the case in 19 out of the 21 cases of repeat arthroscopy (90.5%). Seven of these dogs had developed a worsened postoperative lameness compared to that noted preoperatively. The other reason for repeat arthroscopy was technical difficulties or poor visibility during a previous arthroscopy in two cases. Signs of medial coronoid disease were arthroscopically appreciable in18/21 of the repeat cases. Out of all dogs that underwent arthroscopy for the first time,6/437 cases that did not have detectable fragmentation of the medial coronoid process in the initial arthroscopy went on to require repeat surgery for medial coronoid process fragment removal.

A total of 204 cases returned for re-examination 1.5 to 14 weeks postoperatively. Thirty-two out of 458dogs which had undergone elbow arthroscopy were reported to have developed a lameness postoperatively which was more severe than that noted preoperatively. Thirteen of these dogs had other concurrent complications associated with the arthroscopy procedure whilst 19 did not. Out of these 32 cases, seven subsequently underwent a repeat arthroscopy as described above. The initial and final arthroscopic findings for these cases are described in Table 4.

Table 5 summarises all the major and minor complications that occurred as a consequence of elbow arthroscopy. This gives a total major complication rate of 4.8%, and a total minor complication rate of 27.8%, (17.1% perioperative and 10.7% postoperative).

Discussion

There is a paucity of information in the veterinary literature regarding the complication rates associated with elbow arthroscopy and some studies have questioned the benefit of arthroscopic treatment over medical treatment (14). Given this controversy, informed consent is critical and this study provides valuable information which will enable owners to be made more aware of the potential complications associated with this procedure.

Failure to detect any signs of pathology or to make a definitive diagnosis by elbow arthroscopy was the most common complication overall (6.4%) in our study. This is a useful statistic which may allow owners to be prepared for this disappointing outcome. The authors recognise that this figure would probably vary between facilities as it will be heavily dependent upon the preoperative imaging used and the experience of the surgeon. Further investigation of the 50 elbows without any detectable elbow pathology on arthroscopy to ascertain whether a primary cause of clinical signs was ultimately diagnosed was not performed because our purpose was primarily to elucidate the complication rate associated with the initial arthroscopic procedure. The difficulty in localising the cause of thoracic limb lameness to the elbow or shoulder has been reported previously (15). Arthroscopic imaging of both the elbow and shoulder joints may be considered in dogs with thoracic limb lameness (15, 16).

The second most common perioperative complication was the need to convert to arthrotomy. A total of 12% of dogs required conversion but this was only considered a complication in 5% of dogs. While none of the dogs which required conversion to arthrotomy in this series developed joint sepsis, higher rates of septic arthritis have been reported following arthrotomy (4,7). While it is beyond the scope of this study, it would be interesting to investigate potential risk factors necessitating conversion to

arthrotomy. These may include surgeon experience, fragment size, patient size relative to fragment size and inadequate instrumentation.

Iatrogenic damage is not uncommon in arthroscopic joint surgery and is the most likely complication to be omitted from recording (8). In a previous paper, small to very small iatrogenic cartilage lesions were reported in 30% of dogs undergoing elbow arthroscopy (17) compared to 1.7% in our study. Only larger articular cartilage lesions were reported in our study but it was not possible to ascertain retrospectively the percentage of cases in which minor damage had occurred. Three cases suffered from iatrogenic excessive perioperative haemorrhage during creation of the arthroscopy portals which may have been due to damage to the median artery, the common interosseous artery, the articular branches of the brachial artery or the recurrent ulnar artery (18). Reported rates of iatrogenic injury may differ between surgeons of varying experience, arthroscopic techniques and choice of instruments (8,10). It is difficult to assess the impact of iatrogenic damage to the dog in terms of postoperative morbidity, however none of the dogs that suffered from iatrogenic cartilage damage or haemorrhage in this study developed a worsened postoperative lameness or required follow-up treatment. Nevertheless, surgeons should minimise iatrogenic damage through selecting appropriately sized instruments, maintaining adequate joint distension and inserting and manipulating instruments gently(8,10).

Peripheral nerveinjury is a complication often documented in humans (9,12,19), with risk factors including contracture of the elbow joint or a diagnosis of rheumatoid arthritis (9). However, only one dog suffered from temporary neurapraxia in our study. The low prevalence of these disorders in dogs may explain why this complication is rarely reported or it may be that the commonly reported symptoms in humans of weakness and numbness, (9) are undetected in veterinary patients. In humans, insufficient joint distension prior to creating arthroscopy portals may lead to an increased risk of iatrogenic nerve damage (20).

Joint infection following arthroscopy has been described as a rare occurrence in horses and humans (4,8,9). Although the rate of postoperative septic arthritis in our study was lower than that of previous

studies, the authors recognise the possibility that some cases of septic arthritis may have been treated elsewhere which could result in a falsely low rate of sepsis (0.22%) being reported here.

Lameness was more severe than that noted preoperatively in 7% of cases at the time of reassessment which ranged from 10-98 days postoperatively. This was higher than the previously reported rates of 2.9% following arthroscopy and 5.2% following arthrotomy (6). However, the lack of long-term follow-up and failure to determine the reason for ongoing lameness in many cases limits the value of this result in our study. Many dogs do not return to soundness as pre-existing secondary osteoarthritis may continue to progress even after surgical treatment of canine elbow dysplasia (6,21) making it difficult to distinguish whether the lameness is a complication of the procedure or is to be expected. As dogs may display clinical signs of canine elbow dysplasia and begin to develop secondary osteoarthritis as young as 4 months of age, lesions may have been well established by the time of arthroscopy. The delay in diagnosis and treatment may result in increased lesion severity and more advanced secondary osteoarthritis making treatment less effective (12). Regardless of the reason behind it, the potential for a deterioration in lameness following arthroscopy is a concerning complication of which the clientshould be forewarned.

Failure to remove osteochondral fragments is another recognised complication of arthroscopy in horses (8), however the prevalence of this complication in dogs remains unknown. Fragmentation may be undetectable during the initial elbow arthroscopy or develop postoperatively. We found that in 18 of the 21 elbows that underwent repeat arthroscopy there were medial coronoid disease lesions suggesting that diagnosis of medial coronoid disease still fails at the first attempt despite arthroscopy being considered the current gold standard (4).

The limitations of this study stem from it’s retrospective nature. As information from clinical records may be incomplete, the reported complication rates from this study should be considered potential underestimations. We did not attempt direct follow-up with the owners of each patient and relied solely on the information contained in the clinical records. The lameness assessments in this study were subjectively performed by multiple different clinicians and the lack of consistency and the need

to interpret this information retrospectively will have inevitably produced variability. The arthroscopies in this case series were performed by multiple different clinicians and the postoperative care varied. A further limitation is the classification of complications into minor and major based on the requirement for a further surgical procedure. Thirty-two dogs returned for re-examination with a lameness reported to be more severe than that noted preoperatively and it could be argued that all of these cases should have been classified as major complications.

In conclusion, results from this large number of elbow arthroscopies performed within a single institution demonstrate a low short-term major complication rate but a concerning minor complication rate. These findings may assist veterinarians in discussing the potential disadvantages of proceeding with arthroscopic investigation and treatment of canine elbow dysplasia.

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Table 1 Breed and gender distribution of the 458 cases of elbow arthroscopy

Breed	**Male**	**Female**	**Total number (%)**
Labrador Retriever	125	64	189 (41.3)
Rottweiler	30	20	50 (10.9)
German Shepherd Dog	34	11	45 (9.8)
Staffordshire Bull Terrier	17	5	22 (4.8)
Golden Retriever	14	6	20 (4.4)
Boxer	8	5	13 (2.8)
Bernese Mountain Dog	8	3	11 (2.4)
Other pedigree	47	21	68 (14.8)
Cross breed	24	16	40 (8.7)
Total number (%)	307 (67)	151 (33)	458

Table 2 Arthroscopic lesions in 750 elbow joints

Disease process	**Number of elbows (%)**
MCD	611 (81.5)
UAP	12 (1.6)
OCD	12 (1.6)
MCD and OCD	11 (1.5)
MCD and UAP	7 (0.9)
Other diagnoses or combinations	37 (4.9)
Definitive diagnosis not achieved with arthroscopy	10 (1.3)
No detectable abnormalities	50 (6.7)
Total	750

Abbreviations

MCD – Medial Coronoid Disease
UAP – Ununited Anconeal Process
OCD – Osteochondritis Dissecans

Table 3 Reasons for requiring arthrotomy in 55 cases following elbow arthroscopy

Reason for arthrotomy	**Number of elective arthrotomies**	**Number of arthrotomies as a complication**	**Total**
MCD fragment removal	0	19	19
UAP stabilisation	14	0	14
Subtotal coronoidectomy	7	0	7
OCD lesion removal	2	4	6
Correcting elbow incongruity	6	0	6
Treatment of IOHC	3	0	3
Total	32	23	55

337 **Table 4** Descriptions of the seven dogs with a worsened postoperative lameness necessitating repeat arthroscopy
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Breed (age at first arthroscopy)	**Findings from the first procedure**	**Findings from the repeat procedure**	**Length of time between the two procedures**
Labrador Retriever (10 months)	Removal of MCP fragments from both elbows	Removal of a small MCP fragment from the left elbow	2 months
Labrador Retriever (7 months)	Removal of MCP fragments from both elbows	Removal of a small fragment from the left elbow. Extensive eburnation of MCP detected in the right elbow	2 months
Labrador Retriever (7 months)	MCP fissures detected in both elbows, but MCP fragment removal only performed on the left elbow	Arthroscopic appearance of right elbow similar to before, and half of the right MCP was subsequently debrided	3 months
German Shepherd Dog (23 months)	MCP fragment removed from left elbow and underlying bone debrided	Severe cartilage erosion detected in medial compartment of left elbow and no further treatment was performed	3 months
Labrador Retriever (12 months)	Bilateral OCD lesions detected, but arthroscopic removal of the lesions only possible in the left elbow	Repeat right elbow arthroscopy was not successful for OCD lesion removal and arthrotomy was necessitated	6 days
Labrador Retriever (14 months)	MCP fragment removed from right elbow, however poor visibility due to severe synovitis in the left elbow prevented diagnosis and treatment	Removal of small MCP fragment from left elbow	1 month
Staffordshire Bull Terrier (15 months)	Chondromalacia over both MCPs which were subsequently debrided	Removal of fragments from both elbows	3 months

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343 **Table 5** Major and minor complications associated with elbow arthroscopy and rates of occurrence

Complication		**Rate %**
Major	Repeat surgery required	4.8
Minor – perioperative	Arthrotomy required due to inability to treat arthroscopically	5.0
	Technical difficulties associated with the instruments	2.9
	Excessive perioperative haemorrhage	0.66
	Significant iatrogenic cartilage damage	1.7
	Fluid extravasation impairing arthroscopic inspection	0.44
	No definitive diagnosis achieved	6.4
Minor – postoperative	Worsened postoperative lameness (no repeat surgery performed)	5.5
	Severe postoperative pain	2.8
	Severe postoperative joint swelling	2.0
	Postoperative septic arthritis	0.22
	Temporary postoperative neurapraxia	0.22

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