

## Treatment of ununited anconeal process in 8 dogs by osteotomy and dynamic distraction of the proximal part of the ulna<sup>1</sup>

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**ABSTRACT.**- Ferrigno C.R.A., Schmaedecke A., Sterman F.A. & Lincoln J. 2007. **Treatment of ununited anconeal process in 8 dogs by osteotomy and dynamic distraction of the proximal part of the ulna.** *Pesquisa Veterinária Brasileira* 27(8):352-356. Departamento de Cirurgia da Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Av. Prof. Dr. Orlando Marques de Paiva 87, São Paulo, SP 05508-270, Brazil. E-mail: [cassioaf@usp.br](mailto:cassioaf@usp.br)

A surgical technique for the treatment of ununited anconeal process in dogs treated by osteotomy and dynamic distraction of the proximal part of the ulna using a linear external skeletal fixator was evaluated. In all cases the osteotomy was distracted 1mm each day after the surgery until desired distraction had been achieved. Eight dogs and 9 joints diagnosed with ununited anconeal process were treated. The success of the procedure was determined by comparing clinical signs of lameness and degree of arthrosis at the time of diagnosis to 6 months after the surgical intervention. Radiographic union occurred in 88.9% of the affected joints between 21 and 42 days after the surgical procedure. Clinically, six elbows were classified as good, two as satisfactory and one as unsatisfactory. Six months after surgery two elbows had no arthrosis, one had Grade 1, two Grade 2 and one Grade 3. It is concluded the combination of ulnar osteotomy and dynamic distraction of the olecranon by a linear external skeletal fixator is a feasible procedure for the treatment of ununited anconeal process in dogs.

INDEX TERMS: Dogs, surgery, orthopaedics, elbow.

**RESUMO.**- [Tratamento da não união do processo ancôneo em 8 cães por osteotomia e distração dinâmica da porção proximal da ulna.] Foi avaliada nova técnica de tratamento da não união do processo ancôneo em cães através da osteotomia e distração dinâmica da porção proximal da ulna utilizando fixador externo. Em todos os casos a taxa de distração foi de 1mm a cada dia após a cirurgia até que a distração desejada fosse adquirida. Oito cães com nove articulações afetadas foram tratados. O sucesso do tratamento foi determinado pela comparação dos sinais clínicos de claudica-

ção e grau de artrose no tempo do diagnóstico, até 6 meses após a intervenção cirúrgica. Clinicamente, seis cotovelos foram classificados como bons, dois como satisfatório e um como insatisfatório. Seis meses após a cirurgia, dois cotovelos não apresentavam artrose, um apresentava Grau 1, dois Grau 2 e um Grau 3. Conclui-se que a combinação de osteotomia da ulna com distração dinâmica do olécrano por fixador externo linear é procedimento factível no tratamento da não união do processo ancôneo em cães.

TERMOS DE INDEXAÇÃO: Cães, cirurgia, ortopedia, cotovelo.

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### INTRODUCTION

The ununited anconeal process (UAP) is part of a group of abnormalities known as elbow dysplasia (Carlson & Severin 1961, Kirberger & Fourie 1998), and was first described and named in the 1950's (Stiern 1956, Cawley & Archibald 1959). Elbow dysplasia is the most common hereditary orthopedic condition affecting the elbow in dogs and is divided in four types of diseases: UAP, coronoid process fragmentation, osteochondrosis dissecans and incongruity of the elbow (Kirberger & Fourie 1998). Ununited anconeal process is

defined as a lack of fusion of the anconeal process with the proximal metaphysis of the ulna in animals 20 weeks old (Mäki et al. 2000). If the anconeal process does not fuse with the ulna within 20 weeks, union will not occur spontaneously (Cross & Chambers 1997, Sjöström 1998). The ununited anconeal process can be joined to the ulna by fibrous tissue or can stay completely separate from the ulna resulting in medial to lateral instability of the anconeal process. The instability of the joint leads to irritation, deterioration and secondary degeneration of the articular surfaces of the elbow (Kirberger & Fourie 1998). The pathogenesis of the UAP is controversial (Cross & Chambers 1997, Sjöström 1998), and many mechanisms such as genetic diseases (Roy et al. 1994), nutritional deficiency, genetic disturbance of the growth hormone and trauma have been considered. None of these causes has been proven to be involved in the development of the UAP in dogs (Cross & Chambers 1997). In one study regarding the pathogenesis of UAP, evidence was found that one of the causes of this disease is disproportionate growth of the radius and the ulna (Sjöström et al. 1995, Mäki et al. 2000). If the radius grows in length relatively faster than ulna, the head of the radius will exert direct pressure on the humeral trochlea. This pressure is transferred from the humeral trochlea to the anconeal process causing distortion of the anconeal process and hindering bony union. (Fox et al. 1996, Cross & Chambers 1997, Kirberger & Fourie 1998).

Clinical signs of ununited anconeal process may become evident between 4 and 5 months of age, but may not be obvious until 8 or 9 months of age. The most common clinical signs are intermittent to persistent lameness, pain, joint effusion, crepitus during examination of the elbow joint, osteoarthritis, reduction of extension and flexion, and sometimes instability of the ununited anconeal process can be palpated (Sjöström et al. 1995, Cross & Chambers 1997). Diagnosis is by lateral radiographic views of the elbow in extension and flexion. Lack of bony union between the anconeal process and the ulna after 6 months of age is considered confirmation of the diagnosis in dogs (Cross & Chambers 1997, Sjöström 1998, Turner et al. 1998). Computerized tomography or magnetic resonance imaging can also be used to confirm the diagnosis (Reichle & Snaps 1999). Treatments described by several authors are the removal of the anconeal process (Fox et al. 1996, Meji & Hazewinkle 1996, Cross & Chambers 1997, Kirberger & Fourie 1998, Krotscheck et al. 2000, Meyer-Lindenberg 2001, Padilha Filho et al. 2002), compression of the process to the ulna by use of lag screw fixation techniques (Fox et al. 1996, Kirberger & Fourie 1998, Sjöström 1998, Krotscheck et al. 2000, Meyer-Lindenberg 2001, Padilha Filho et al. 2002), use of cerclage wire to stabilize the fragment (Lewis & Leighton 1995), and the most recent technique of proximal ulnar osteotomy (Fox et al. 1996, Meji & Hazewinkle 1996, Cross & Chambers 1997, Kirberger & Fourie 1998, Meyer-Lindenberg 2001, Padilha Filho et al. 2002, Schulz & Krotscheck 2003).

The objective of this study was to evaluate the results osteotomy of the ulna distal to the coronoid process followed by dynamic distraction of the olecranon as a treatment for ununited anconeal process.

## MATERIALS AND METHODS

### Criteria for selection of cases

Dogs admitted to the Veterinary Hospital of the Surgery Department, University of São Paulo, from April 2, 2002, to July 3, 2003, in which UAP was diagnosed by means of radiographic examinations were included in this study. The diagnosis of the UAP was made by cranial to caudal and flexed medial to lateral radiographic views. (Fig.1) Elbow joint incongruency in which the ulnar joint surface was distal to the radial head and degree of arthrosis were also noted as part of the radiographic study.

### Procedures

With each dog under general anesthesia and the affected limb prepared and draped for aseptic surgery, the proximal shaft of the ulna (Piermattei & Johnson 2004) was exposed and an osteotomy of the ulna using a pneumatic oscillating saw was performed distal to the coronoid process. Desmotomy of the interosseous ligament was also performed. In order to provide axial stability, an intramedullary pin was inserted retrograde in the medullary cavity of the ulna. Two Schanz pins were drilled into the distal and proximal part of the ulna adjacent to the osteotomy site to which a dynamic external fixator connecting bar was attached. The connecting bar was marked with centimeter graduation marks, and



Fig.1. Radiographic image showing non-union of the anconeal process.



Fig.2. An external skeletal fixator used for distraction.



Fig.3. Radiographic image showing the fixator applied through the ulna and degree of distraction of ulnar fragments.

the osteotomy was distracted one centimeter before closure of the incision. (Figs.2 e 3) The osteotomy was distracted 1 mm/day until congruence of the ulnar and radial joint surfaces could be seen radiographically. Radiographs were taken every 7 days until congruence was obtained at which time distraction was terminated.

To assess the development of the osteoarthritis treated elbows were evaluated radiographically at 6 months. (Fig.4) Osteoarthritis was evaluated according to parameters based on the classification of the "International elbow working group grading system" (Fox et al. 1996, Lang et al. 1998). Joints without signs of arthrosis were normal. Joints classified Grade 1 (minimum arthrosis), had one or more radiographic changes including less than 2mm osteophyte thickness on the anconeal process, head of the radius, coronoid process caudopalmar aspect of the humeral trochlea or sclerosis of the trochlear incisure. Grade 2 (moderate arthrosis), radiographic changes included osteophytes with 2-5mm of thickness in any of the areas described above. Grade 3 (severe arthrosis) included osteophytes of more than 5mm thickness, in the same locations as Grade 1 and Grade 2.

Evidence of successful treatment was based on clinical signs of lameness, using a previously reported lameness classification system (Lang et al 1998). Animals with fusion of the anconeal process, no lameness after exercise or evidence of pain on flexion and extension of the joint were graded good. Dogs with fusion of the anconeal process, no lameness and moderate restriction of range-of-motion due to osteoarthritis were graded satisfactory. An unsatisfactory outcome was assigned dogs without fusion of the anconeal process,



Fig.4. Radiographic image showing consolidation of the anconeal process after ulna distraction treatment.

restricted range-of-motion due to development of severe arthrosis and evidence of lameness and pain.

## RESULTS

Animals included in this study were presented with clinical signs of lameness of one or both forelimbs and, unsatisfactory response to antiinflammatory and analgesic drugs. During the orthopedic examination all dogs had joint effusion, crepitation during range-of-motion and pain on palpation and extension of the elbow.

Eight dogs were treated, 2 Labrador retrievers, 2 Brazilian Fila, 2 Saint Bernards (one with bilateral UAP), 1 Napolitan Mastiff and 1 German shepherd for a total of 9 joints. There were 2 females and 6 males with an average age of 25.77 weeks. The distance of ulnar joint surface displacement distal to the radial joint surface varied from 15 to 27mm measured by observing the position of the ulnar joint surface relative to the head of the radius and humeral condyle on the extended lateral radiographic view. Fusion of the anconeal process varied between 21 to 42 days and averaged 32.37 days. Fusion of the anconeal process did not occur in one dog. At 6 months the dogs were evaluated for success of treatment based on clinical signs. Six of the nine treated joints were considered good, two satisfactory, and one unsatisfactory. The results are tabulated in Table 1. All joints were evaluated for degree

**Table 1. Presentation of each case studied and clinical results**

Elbow	Breed	Age at surgery (weeks)	Sex	Elbow	Distraction	Fusion time	Clinical results
1	Labrador retriever	20	F	Right	15 mm	35 days	Good
2	Saint Bernard <sup>a</sup>	26	M	Right	26mm	35 days	Good
3	Fila	32	F	Left	24mm	35 days	Good
4	Saint Bernard <sup>a</sup>	32	M	Left	26mm	21 days	Satisfactory
5	Fila	29	M	Right	18mm	21 days	Good
6	Mastiff	30	M	Left	20mm	35 days	Good
7	Labrador retriever	21	M	Right	18mm	35 days	Good
8	German shepherd	34	M	Left	23 mm	nonunion	Unsatisfactory
9	Saint Bernard	40	M	Left	27mm	42 days	Satisfactory

<sup>a</sup> Cases 2 and 4 are the same dog.

**Table 2. Grades of each animal, in a 6-month-period of analysis**

Elbow	Breed	Pre-surgical arthrosis grade	Outcome after fusion	Arthrosis after fusion	Results after 6 months	6-month arthrosis grade
1	Labradorretriever	Normal	good	normal	good	Normal
2	SaintBernard <sup>a</sup>	Normal	good	normal	good	grade 1
3	Fila	grade1	good	grade 1	satisfactory	grade 2
4	SaintBernard <sup>a</sup>	Normal	satisfactory	grade 1	satisfactory	grade 2
5	Fila	Normal	good	normal	good	Normal
6	Mastiff	grade 1	good	grade 1	good	grade 1
7	Labradorretriever	Normal	good	grade 1	good	grade 1
8	German shepherd	Normal	unsatisfactory	grade 2	unsatisfactory	grade 3
9	SaintBernard	grade1	satisfactory	grade 1	satisfactory	grade 1

<sup>a</sup> Cases 2 and 4 are the same dog.

of pre-surgical arthrosis, during the distraction time and after 6 months of treatment. Results are tabulated in Table 2.

## DISCUSSION

With the elbow in extension the anconeal process fits into the olecranon fossa of the humerus, is entirely intraarticular and has no muscular or ligamentous attachments (Beal et al. 2003). An ununited anconeal process (UAP) is a free fragment of bone within the elbow joint resulting in irritation, abnormal joint surface wear and osteoarthritis. Clinical signs of UAP include lameness, reduced extension and flexion during the stance phase of the gait, outward rotation of the antebrachium, pain on extension of the elbow, joint effusion, periarticular thickening, and loss of range-of-motion. Elbow joint surface pathology includes loss of cartilage, eburnation of subchondral bone and remodeling of the olecranon fossa. Radiographically, the UAP, periarticular osteophytes and subchondral boney changes can be seen. UAP in dogs usually results in disabling, painful osteoarthritis (Sjöström 1998).

Results of various treatments for UAP have been variable and unpredictable. Treatment has included conservative management of lameness, removal, stabilization using lag screw fixation techniques, ulnar osteotomy, and ulnar osteotomy with lag-screw fixation (Cross & Chambers 1997, Sjöström 1998, Turner et al. 1998).

Conservative treatment consisting of weight management, exercise modification and use of non steroidal anti-inflammatory drugs to control pain does not significantly alter the progression of osteoarthritis and comfortable use of the limb is not achieved (Brinker et al. 1999).

Removal of UAP has been described as the traditional surgical treatment. Long term results following removal have been variable with reports of 50% being free of lameness and approximately 70% improved over presurgery lameness. With removal of the UAP instability of the elbow is present resulting in continued progression of osteoarthritis. Results may be acceptable for dogs kept as pets but is unacceptable for working dogs (Krotscheck et al. 2000).

Stabilization of the UAP by lag screw fixation has been described (Fox et al. 1996, Schulz & Krotscheck 2003). With accurate and stable fixation union of the UAP to the ulna occurred resulting in remission of lameness and cessation of progressive osteoarthritis. Two dogs returned to successful working and show competition (Fox et al. 1996).

With concern for elbow incongruity as a significant contributing factor in the evolution of UAP, in selected cases ulnar osteotomy to allow realignment of the ulnar and radial joint surfaces and reduction of the shearing forces on the UAP have resulted in fusion of the process (Fox et al. 1996, Meyer-Lindenberg 2001). Stabilization of the anconeal process by lag screw fixation combined with ulnar osteotomy has been described (Krotscheck et al. 2001, Schulz & Krotscheck 2003). With ulnar osteotomy and accurate and stable fixation, union of the UAP to the ulna occurred resulting in remission of lameness and cessation of progressive osteoarthritis. Common to these procedures has been inconsistent healing of the ulnar osteotomy and other complications such as rotation of the ulna, and large callus formation.

Exposure and accurate alignment for fixation of UAP is difficult. When perfect positioning and fixation of the UAP is not achieved abnormal contact with the trochlea of the humerus during extension of the elbow exists. Abnormal shear forces on the UAP result in fatigue and failure of the screw and instability of the UAP (Fox et al. 1996, Cross & Chambers 1997).

To avoid arthrotomy, arthroscopic assisted insertion of a cannulated screw has been described. Using the arthroscope, direct visualization of the anconeal fragment was possible and as the screw is placed and tightened anatomic reduction and stabilization was confirmed. Successful bony union was verified 8 months later, but incomplete union of the ulnar osteotomy was also present (Parrisius 1985).

The procedure reported here addresses the ulnar osteotomy by aligning the ulnar axially with an intramedullary pin, stabilization of the osteotomy by application of an external skeletal fixator, and realignment of the joint surfaces and reduction of the shear forces on the anconeal process by dynamic distraction of the osteotomy until realignment of the joint surface could be determined radiographically. In this study fusion appears to have occurred in less time than previously reported, and invasion of the joint was avoided eliminating the morbidity associated with surgical invasion of the joint. The results and logic behind this procedure suggest an additional option for management of UAP.

## CONCLUSION

Ulnar osteotomy, axial alignment and stabilization of the ulna, and dynamic distraction of the osteotomy until alignment of the radio-ulnar joint surface is achieved results in reduction

of shear forces on the anconeal process. Fusion of the anconeal process can follow with less persistent osteoarthritis and deterioration of the elbow joint.

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