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SHORT AND LONG TERM FOLLOW UP OF HUMERAL CONDYLAR FRACTURE TYPE II TREATED BY LAG SCREW AND ANTI-ROTATIONAL PIN ASSOCIATED TO OLECRANON OSTEOTOMY

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ABSTRACT

Humeral condylar fractures are relatively common in dogs and are most often associated with low-energy trauma, mainly affecting young animals. Anatomical reduction and rigid stabilization are mandatory to correct these types of articular fractures and achieve the main goals as early return of limb function, pain-free elbow movement, and prevent or at least reduce degenerative joint disease. Even with optimal anatomic reduction, surgical outcome complications associated to this type of fractures may be very common, giving this kind of osteosynthesis a reserve prognosis and making it challenging to the surgeon. In the case report, an adult mixed-breed dog, 3,9 kg, has fractured the lateral condylar portion of the left humerus after a 4 meters fall. Corrective osteosynthesis was performed using an association of a transcondylar lag screw and an anti-rotational pin through an olecranon osteotomy access. Monthly clinical and radiographic follow up were carried out with the intent to show bone healing evolution. Within 45 days consolidation of the fracture could already be seen. And after 180 days follow up, no signals of osteoarthrosis were found in the elbow joint, and the dog is fine, painless, has good weight bearing and optimal limb function.

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INTRODUCTION

Of all humeral fractures in dogs, those in the condylar portion of the humerus account for 41% (Bardet *et al*., 1983; Cinti *et al*., 2017).The lateral condyle is the most easily fractured, representing 34% to 56% of condylar fractures (Denny, 1983; Perry *et al*., 2014; Vida *et al*., 2005) and for 37% of all distal humerus fractures (Vaninni *et al*., 1988b). Fractures of the lateral humeral condyle are more prevalent in skeletally immature dogs and are more often associated with low-energy trauma (Cinti *et al*., 2017). Incomplete ossification between the humeral condyles is a predisposing factor for condylar fractures in some breeds (Moores, 2014). There is also a racial predisposition associated with this type of fracture, being more common in Spaniels, Yorkshire Terriers, English and French Bulldogs, and Gordon Setters. There is no predilection for sex (Perry *et al*., 2014). There are two probable reasons why these lateral fractures are more common than medial condylar fractures. First, the head of the radius articulates mainly with the lateral condyle of the humerus, and a sudden force of impact is primarily transferred laterally. And second, the lateral epicondylar crest is smaller and more biomechanically fragile than that of the medial compartment (Moores, 2014; Lewis *et al*., 1991). Medio-lateral, cranio-caudal or caudal-cranial radiographs of the affected limb are the most used diagnostic methods to detect and classify humeral condyle fractures. Computed tomography can also be used if the radiographs may leave any doubt as to the final diagnosis (Lefebvre *et al*., 2008). Fractures of the lateral humerus condyle are the ones with the most favorable prognosis in relation to treatment, with 70% to 89% of the cases excellent and good results in the postoperative period compared to other condylar fractures (Nortje *et al*., 2015; Vaninni *et al*., 1988b). Anatomical reduction, rigid internal fixation, joint mobility and support capacity immediately after surgery are mandatory in the repair of joint fractures and are usually achieved with open reduction of the fractured site. It is important that the animal maintains active movement of the elbow after surgery, to prevent the formation of fibrosis and ankylosis of the joint (Langley-Hobbs, 2012; Morgan *et al*., 2008). In addition to open reduction, closed and minimally invasive reduction guided by fluoroscopy has also been reported for correcting condylar fractures (Cook *et al*., 1999). The indicated and most widely used method for internal fixation of lateral condylar fractures includes the use of a transcondylar lag screw associated with an angled anti-rotational pin or screw through the distal metaphyseal portion of the humerus (Morgan *et al*., 2008). Other techniques have also been reported (Perry *et al*., 2014), but are less used, such as using Kirschner wires alone for animals under four kilograms (Morshead and Stambaugh, 1984) or immature dogs (Cinti *et al*., 2017), use of self-compressing pins (Guille *et al*., 2004), bone plates and screws (McCartney *et al*., 2007), external fixators (Au *et al*., 2008) and cannulated screws (Lewis *et al*., 1991). Possible complications can occur in the treatment of this type of fracture, ranging from 11% to 33% depending on the study (Morgan *et al*., 2008; Perry *et al*., 2014). The most common complication associated with the humeral condyle repair technique is pin migration in about 25% of cases. Migration of the intercondylar lag screw was observed in 13% to 17% cases, infection in around 5.2% of cases, and fracture of the anti-rotational screw or pin 0,028% (Bardet *et al*., 1983Cinti *et al*., 2017; Vaninni *et al*., 1988b). Regarding surgical access, olecranon osteotomy is one of the techniques used to access the elbow joint (Gullahorn *et al*., 2000; Palmer *et al*., 1988), and is associated with frequent complications, in around 25% to 38% of cases, with most common events: pin migration (5%), osteomyelitis (11%), failure of the tension band mechanism (37%), loss of osteotomy reduction (5%); inadequate position of the Kirschner wire (5%); fistula (0.18%), non-union (0.06%) and delayed union (0.16%) (Gullahorn *et al*., 2000; Halling *et al*., 2002; Palmer *et al*., 1988). Some previous reviews report that 28% to 57% of dogs experience pain and/or lameness in long-term follow-up of humeral condyle osteosynthesis (Bardet *et al*., 1983; Denny, 1983; Vaninni *et al*., 1988a). In general, the literature on the subject agrees that the osteoarthritis process that occurs after joint osteosynthesis has a multifactorial etiology, including fixation instability, presence of gaps or steps between condyles, and direct injury on the cartilage (Gordon *et al*., 2003).

CASE REPORT

A mixed breed dog, male, two years old, weighting 3.9 kg, was reported with a history of falling from a 4 meters height. The animal did not support the left thoracic limb, and on physical examination demonstrated pain, crackling and swelling in the left elbow. The dog had no apparent bleeding, was conscious, neurological tests were normal, and was walking without difficulty with the other three limbs.After physical and radiographic examinations, it was found that there was a fracture in the distal end of the left humerus, more specifically the left lateral condyle, characterizing it as a type II lateral condylar fracture according to Bardet *et al*., 1983 or 1-3-B1 according to the AO classification (Figure 1).

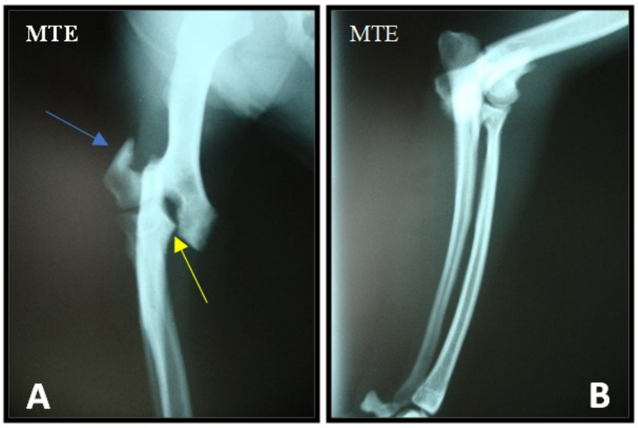

Figure 1. Caudo-cranial (A) and medio-lateral (B) radiographic images of the left elbow joint. Note the fracture between the lateral and the medial condyle (yellow arrow in A), and fracture of the lateral supracondylar crest (blue arrow in A) with great deviation of the anatomical axis, characterizing the fracture as a type II lateral condylar. MTE = left thoracic limb. Fonte: Daniel Garcia

The day after the trauma, the animal was prepared for corrective osteosynthesis. As pre-anesthetic medication, acepromazine 0.2% (Acepran® 0.2% - Univet S/A) was used at a dose of 0.05 mg/kg associated with pethidine hydrochloride (Dolosal® 10 mg/ml - Cristália) at a dose of 5 mg/kg, administered intramuscularly. Trichotomy of the entire left thoracic limb from the dorsal portion of the shoulder to the carpus was done. The joint was vigorously washed with 0.9% saline solution and clots and debris were removed, and then a maneuver was performed to reduce the condyles and assess the fit between the fractured parts in order to obtain the minimum gap between them.

Figure 2. Photographic images showing the animal's position during the surgical procedure. (A) He is positioned in the supine position on a surgical track and an elevated limb for assisting to facilitate handling during surgery. The limb is left free for the necessary manipulations. (B) Photographic image showing the caudal approach of the humerus-radio-ulnar joint. After skin incision, it is possible to visualize the olecranon (black arrow). (C) After osteotomy of the olecranon (yellow arrow) and dissection of the triceps and brachii muscles it was possible to visualize the left elbow joint with ease and the fractured and displaced left lateral condyle of the humerus (white arrow). Fonte: Daniel Garcia

Confirmed good coaptation between the condyles, a cancellous screw was introduced into the drilled hole, producing a compressive effect ("lag") between the two condyles, with compression of the fracture site between the two fragments (Figures 3 A and B).Then, with the condyles already stabilized, the fractured left supracondylar bridge was drilled using a 1.5 mm Steimann pin itself. The pin was inserted through the left lateral supracondylar bridge and crossed the distal portion of the humerus in a disto-lateralto proximo-medial direction until it pierced the opposite cortex in the medial region of the humerus. After distal humeral osteosynthesis was completed, a tension band in a “figure of eight” pattern with a compressive effect was performed on the ulna to reposition the olecranon in its original location (Figure 3 C).The triceps and anconeus muscles were sutured in their original positions with Vicryl 2.0, and the subcutaneous tissue and skin suture procedures were performed in the usual manner with Vicryl 3.0. Then, a padded bandage was made involving the operated limb for a period of four days. Postoperative antibiotic therapy was instituted with Cephalexin (Cephalexin® 500 mg - Bergamo Ltda) at a dose of 30 mg/kg every 12 hours for 10 days, in addition to using Meloxicam (Maxicam® 0.5 mg - OurofinoLtda) as an anti-inflammatory at a dose of 0.1 mg/kg every 24 hours for 7 days; Tramadol Hydrochloride (Tramadol® Hydrochloride 50mg/ml - UniãoQuímicaFarmacêutica S/A) at a dose of 3 mg/kg every 8 hours and Dipyrone Sodium (Dipyrone Sodium 500 mg/ml - Farmace) at a dose of 25 mg/kg each 8 hours as painkillers for 3 and 7 days, respectively.

RESULTS

Radiographs of the immediate postoperative period to assess the surgical procedure and position of the pins, screws and steel wire were performed (Figure 4). In these images, it was possible to observe anatomical reconstruction of both the lateral condyle and the supracondylar portion, and satisfactory position of the implants without compromising the supracondylar fossa. Upon removal of the stitches, the surgical wound was in good condition, and the skin was well healed.

Upon palpation, the animal did not present pain when flexion and extension movements were performed and there was no crepitation of the operated region, which seemed to be fine with the implants and bone. At first, returns were stipulated at 30, 45, 60, 90 and 180 days for new assessments, both clinical and radiographic. At thirty days, the animal was walking well, did not limp, and showed good support on the operated limb. He had no pain during manipulation and had good flexion and extension movements of the limb, but still had loss of range of motion in relation to the contralateral elbow.

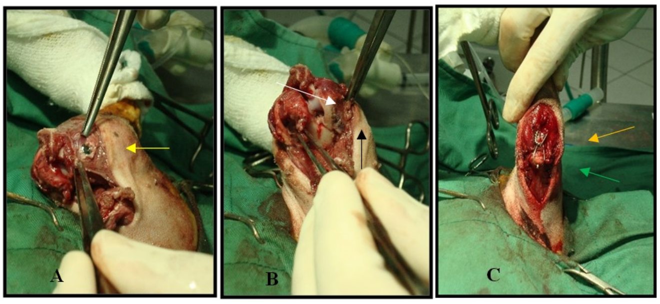

Figure 3. (A) Caudo-lateral view. Photographic images showing a 4.0 mm cancellous screw of 28 mm (yellow arrow) inserted through the left lateral humeral condyle, producing compression between the condyles. (B) Caudal view of the humerus-radio-ulnar joint after reduction of the intercondylar fracture. Note the good anatomical reduction between the condyles (white arrow) and condylar bridge (black arrow). (C) Photographic image showing a tension band in the osteotomized elbow, where the olecranon is in its anatomical position, being compressed by the steel wire (orange arrow) inserted in the ulna and passing behind the pin (green arrow) in a "figure of eight" pattern. Fonte: Daniel Garcia

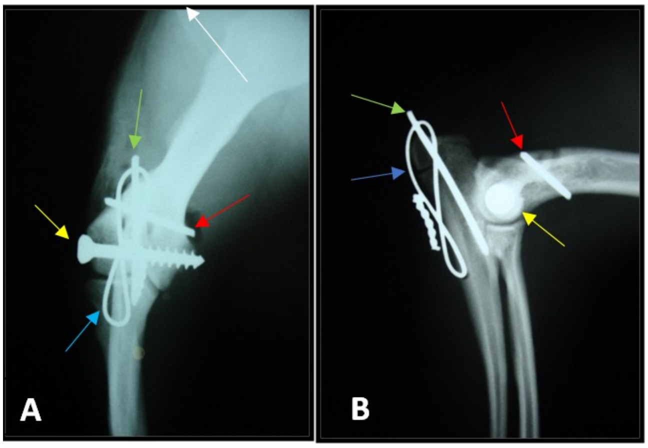

Figure 4. Radiographic images of immediate postoperative period of osteosynthesis of the humerus-radio-ulnar joint after lateral condylar fracture. Caudo-cranial (A) and medio-lateral (B) views.Note the 4.0 mm lag screw (yellow arrow) in A and B, the anti-rotational pin (red arrow) in A and B, the tension band wirein "figure of eight" composed by ulnar pin (green arrow in A and B) and steel wire (blue arrow in A and B). MTE = left thoracic limb. Fonte: Daniel Garcia

On the same date, radiographically, small radiotransparent lines could still be seen in the ulna osteotomy and in the lateral supracondylar region, but the implants were well positioned and unchanged (Figure5). The anatomical reduction on this date was considered satisfactory. With forty-five days of postoperative follow-up, the animal was clinically in excellent condition, presenting itself in a similar way observed at thirty days after the operation. He did not show any indication of lameness and could hardly be detected by the way he walked which member was operated. Radiographically, it was no longer possible to see the fracture lines, and consequently the bone union was reached in both places, with the presence of a bridged bone callus in the left supracondylar and olecranon region (Figure 6). However, at fifty-four days after surgery, six days before the previously stipulated return, a small fistula opened on the skin surface in the topographic region of the olecranon. In it was possible to observe the tip of the pin of the tension band of the ulna that was being externalized. It was decided to remove the pin and steel wire from the tension band on the same date. On the radiograph it was possible to notice that the transverse (and caudal) hole in the ulna where the steel wire passed was fractured (Figure 7).

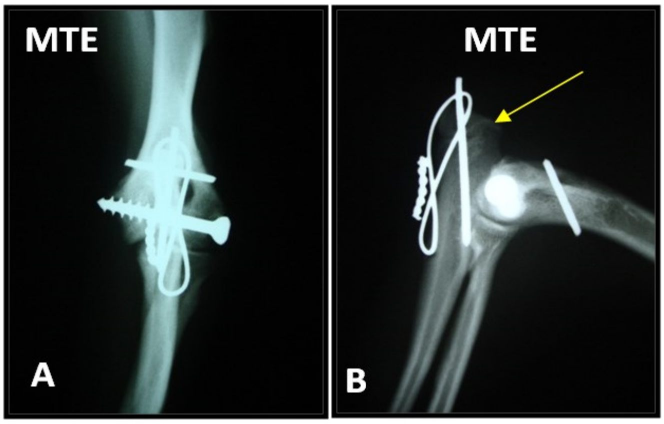

Figure 5. Cranio-caudal (A) and medio-lateral (B) radiographs 30 days after the operation. Note the subtle radiotransparent line (yellow arrow) at the osteotomy site of the olecranon. MTE = left thoracic limb. Fonte: Daniel Garcia

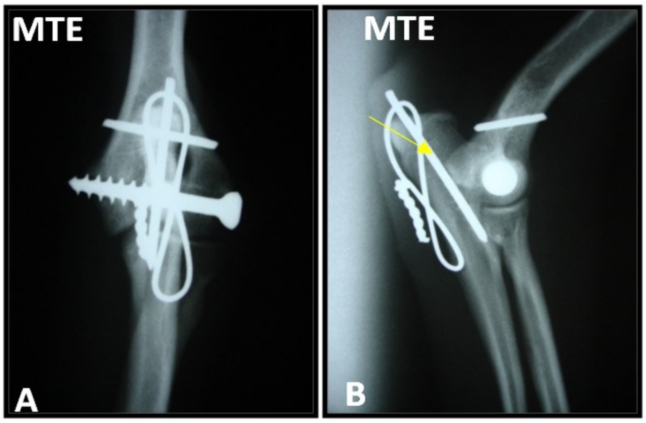

Figure 6. Cranio-caudal (A) and medio-lateral (B) radiographic images 45 days after surgery. There is already formation of the bone callus at the osteotomy site of the olecranon (yellow arrow in B). All implants are at the same location as on the immediate post-operatory images, with no migration or loosening (A and B). MTE = left thoracic limb. Fonte: Daniel Garcia

Subsequently, at ninety days the animal returned for further evaluation. Clinically the animal was fine and there was no problem during this period associated with the tension band that was removed thirty-six days ago. The skin healed well and there was no sign of content drainage at the site. The animal did not feel pain and the mobility in the elbow was fine.

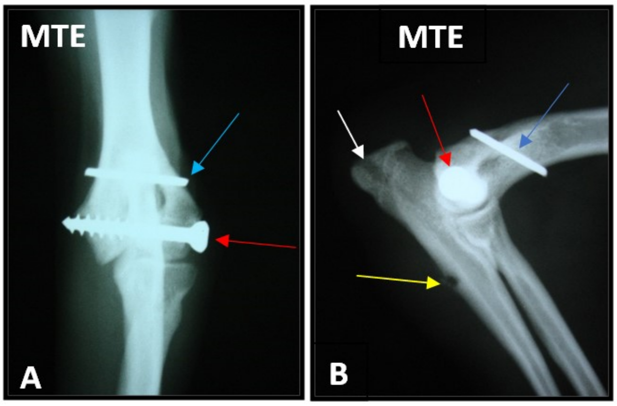

Figure7 – 54 days postoperative radiographic images. Cranio-caudal (A) and medio-lateral (B) views showing the left elbow after removal of the tension band wires. The intercondylar screw and the cross-pin were maintained (red arrow and blue arrow, respectively in A and B). Note the radiotransparency left by the pin removal (white arrow) and the fracture of the transverse hole in the caudal ulna during wire removal (yellow arrow). MTE = left thoracic limb. Fonte: Daniel Garcia.

Radiographically, it was observed that the places where the wire and pin of the tension band passed were consolidating, mainly the one where the steel wire was placed once. The presence of bridged bone callus that formed on the site could be seen. The lag screw and the anti-rotational pin were still well located in their initial positions (Figure 8). At one hundred and eighty days postoperatively, new radiographs were taken with cranio-caudal and medio-lateral views of the left humerus-radio-ulnar joint (Figure 9). No signs were observed that indicated the presence of osteoarthritis of the elbow or osteomyelitis. Clinically the animal is fine, has a normal gait, has no pain or lameness, and mobility of the elbow joint is normal. Both the intercondylar screw and the transverse pin were kept in their respective locations.

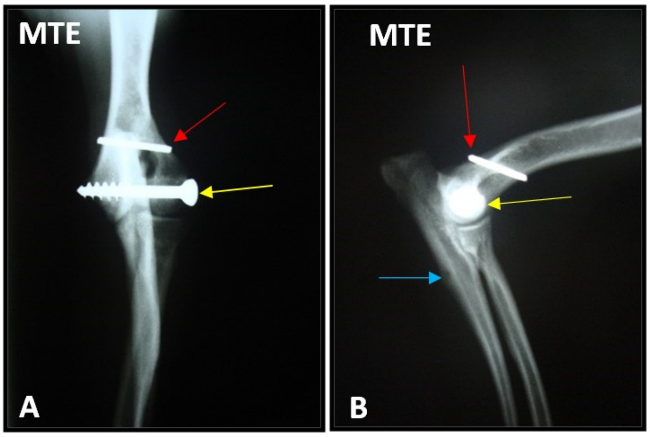

Figure 8. Radiographic images 90 days after the operation. Cranio-caudal (A) and medio-lateral (B) views of the left elbow joint. The intercondylar screw (yellow arrow in A and B) and the anti-rotational pin (red arrow in A and B) are still well positioned. The ulnar pin and steel wire locations of the tension band are still undergoing healing. Callus has already formed in the transverse (and caudal) tunnel of the ulna that fractured during the removal of the tension band wire (blue arrow in B) MTE = left thoracic limb. Fonte: Daniel Garcia

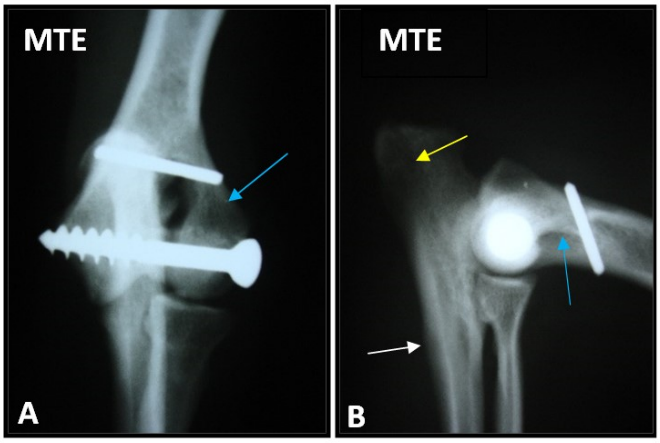

Figure 9. Cranio-caudal (A) and medio-lateral (B) radiographic images of the left humerus-radio-ulnar joint after 180 days of lateral humeral condyle osteosynthesis. Good bone consolidation can be seen in the lateral supracondylar bridge (blue arrow in A and B) and in the wire and pin holes of the removed tension band (white and yellow arrows, respectively, in B). There are no signs of osteoarthritis in the elbow until 180 days after the operation. MTE = left thoracic limb. Fonte: Daniel Garcia.

DISCUSSION

In immature dogs the distal metaphysis of the humerus and the humeral lateral epicondylar crest appear to be more susceptible to fractures than in adult dogs (Denny and Butterworth, 2006) which differs from the present report. However, some cases of adult animals with this type of fracture have also been reported in articles such as that by Bardet et al. (1983) and Vannini et al., (1988b).

Although these types of fractures are most often reported as a result of low-impact trauma, in this case the opposite has occurred, with a high energy transmission to the lateral condyle after a major impact trauma in consequence from a fall from a great height but without comminution of fracture. In order to be successful in the treatment of distal humerus fractures, especially the condylar fractures, it is essential to achieve good stabilization of the fracture site and perfect anatomical reduction between the condyles and humeral supracondylar portions in order to prevent or decrease the appearance of degenerative joint disease after the bone healing process. This stabilization will be achieved with the use of rigid and stable fixation, which does not allow the fracture site to move. The prognosis will be influenced by the type of fracture, and the lateral unicondylar fractures have a more favorable prognosis in relation to other condylar fractures. The type of implant used will influence since rigid stabilization is necessary, and the more unstable, the greater the chances of implant failure and movement of the fracture site, destabilizing the joint and leading to unwanted consequences, such as osteoarthritis, implant failure, non-unions, mal-unions, osteomyelitis, among others. In lateral unicondylar fractures, as in the case reported here, the most widespread and used technique for fracture reduction is the use of the intercondylar screw with lag effect associated with the anti-rotational supracondylar pin.

The technique corroborates the reports of other authors, who presented good results related to osteosynthesis using the same implants and technique. Both the diameter of the screw and the diameter of the anti-rotational pin fall within those used by other authors in their reports. In this report, there was no problem regarding screw or pin failures, migration or breakage as observed in some cases operated by the other authors. Other publications mention the preference for the use of a cortical screw as they believe that it has less chance of breaking, especially at the thread/smooth interface. Regarding to the caudal access performed in this report it did not seem to be any major difficulties. With a good dissection and performing an osteotomy of the olecranon correctly without interfering with the ulna joint, practically all the elbow joint is exposed with some ease and speed, obviously paying attention to noble structures adjacent to the osteotomy site and which need to be preserved such as the radial, ulnar and median nerves. I believe that the osteotomy site could have been performed more distally in the olecranon, increasing the bone area for later osteosynthesis with the tension band mechanism. Through the radiographs we could see that it has become a little small, however, it still allowed good exposure of the fracture site.

The stabilization and fixation of the fracture were performed according to the steps described in the literature and did not show any obstacles, except when keeping the lateral condyle reduced anatomically, when it was sliding between the portion of the lateral epicondylar crest and the metaphyseal region. But after reduction, the stabilization with the lag screw and the anti-rotational pin was fast, showing to be very efficient with regards to good stabilization and rigid fixation, and anatomical position between the condyles as recommended by others. Some authors have resulted in a gap between the condyles or even a step between them, which led to the formation of osteoarthritis observed during long-term follow-up. In this present report, this fact did not occur until the end of the 180 day of follow up. What was observed, on the other hand, was an osteosynthesis with anatomical reduction and bone healing process without any type of complication involving the articular cartilage. The bone healing process observed in relation to the time of bone callus formation is in line with what the authors report elsewhere. Between thirty and forty-five days after surgery, on the dates of return for postoperative radiographs, there were no longer any radiotransparent lines between the fracture sites, but secondary bone callus in the supracondylar and olecranon portions. It can be inferred that between the condyles the formation of primary bone callus was achieved, since there is no exuberance of bone callus in the articular fracture site and compression was applied between the fractured bone condyles. But we must take it into account that the ulna makes it difficult to visualize the focus of intercondylar fracture in the cranio-caudal radiographic images. Regarding the fractured surface of the articular cartilage, it is not possible to say which tissue was formed after healing, whether it was hyaline cartilage or fibrocartilage. But it is practically impossible for this tissue to regenerate into the original tissue, that is, for new hyaline cartilage to form at the fractured site. An important and controversial point about the surgical technique used is related to the surgical access performed through the olecranon osteotomy. Although several authors relate it to high rates of complications, in this case reported there were no complications from the mechanical point of view. Despite the skin fistula caused by the head of the ulna pin 54 days after the operation, the osteotomy region had already consolidated, thus allowing the tension band to be removed and thereby avoiding complications such as infections. Therewere not any worse consequences. There was no evidence of migration or weakening of the pin, but only the exposure of its most proximal tip. A criticism can also be made in relation to the ulnar orifice through which the steel wire was passed. It became very caudal, causing the tension band to fail, fracturing the bone in this part. Ideally, it should be done more centrally in the bone to reduce the area of stress on the cortical bone from that location, avoiding fracture of the ulna along the healing process. In fact, this is what happened, however, probably due to a maneuver to remove the wire at 54 days, when there was already a resolution of both the olecranon osteotomy and the condylar fracture. In this consolidation phase, the triceps would no longer be able to pull the olecranon dorsally and the removal of the implants would not cause problems or consequences for the elbow joint.

If the fracture of this orifice and the removal of the tension band had been earlier, it could have been a disaster for the consolidation process of all fracture and osteotomy sites due to the instability that would occur at the condyle fracture site. Because the animal is small and light, it probably allowed the fixation to remain until the moment of bone callus formation. Even with this type of problem, it is a technique described and adopted as a standard procedure in some veterinary centers. It allows good exposure of the joint and facilitates the visualization of the fracture focus, allowing a good reduction to be made between the fractured condyles. It will probably be more indicated in humeral bicondylar fractures, since in addition tointerfragmentary compression of the condyles, bilateral supracondylar stabilization will be necessary. As for lateral fractures, at first the olecranon osteotomy is not mandatory, and some authors do not recommend it due to the possibility of non-union of the osteotomized region, but as previously mentioned, it greatly facilitates the procedure surgery, providing more safety during fracture reduction. What many authors recommend in this case is a lateral surgical access for lateral fractures. With the latter approach described, it is possible to manipulate the fractured portion, but it is not possible to properly visualize the fracture site in many cases. The reduction may take longer to complete, as failure to view the fractured focus may raise doubts as to the perfect coaptation between condyles. In these cases, surgical trauma in the region can be increased by greater manipulation of the fracture site, as there will be cases where we will need better exposure, and the lateral dissection will be greater, with the possibility of compromising the radial nerve or collateral ligaments. Many authors report the use of fluoroscopy during the passage of the implants without opening the fracture site, to make sure that the screw, pin or wire are correctly placed, without compromising the intercondylar fossa and/or distal humeral bone growth line in immature animals. Perhaps the percentage of surgical failure with the presence of an intercondylar gap or steps between condyles is more common in cases in which the procedure cannot be performed with the aid of the fluoroscope. In Brazil, the use of this type of equipment in veterinary clinics and hospitals is not common due to its high cost.

This fact could contribute to the greater number of cases of post-surgical osteoarthritis, as the reduction would probably not be as perfect as it should be. In these situations, the caudal approach would help to better expose the fracture site. It is also important to note that the technique used in this report will be influenced by the animal's age. As the case in question is an adult patient, the physealline of bone growth plates of distal humerus and proximal ulna (olecranon and anconeal process) was already closed, which means that these bones will no longer grow. In immature animals the olecranon osteotomy is contraindicated. Thus, the most indicated access would be to perform a tenotomy of the triceps brachii muscle. This would enable greater joint exposure, without interfering with the bone growth lines, and decreasing the chances of degenerative joint disease, even making it possible to place bone plates on the epicondylar ridges if necessary. The clinical and radiographic monitoring of this animal was for a period of six months, and during this period no other changes were detected. Clinically, the animal was comfortable a few days after surgery and had already touched the limb on the ground after two days postoperatively and was walking at seven days, with only slight lameness. This corroborates with reports by other authors, who recommend active and passive movement just after a few days of surgery to avoid fibrosis and ankylosis of the joint. The evolution over the weeks was excellent and the patient did not feel pain and walked without limping. In addition, had good movement of extension and flexion of the left elbow and almost no decrease in the range of motion. Other authors who followed their patients for periods of one year or more found that in condylar lateral fractures the clinical evolution using the technique in question is very good, allowing the animal to quickly restore limb function and return to its activities after a few weeks. Better yet, it is the fact that the appearance of osteoarthrosis in cases of lateral fractures has a low percentage of occurrence as long as the fracture is properly reduced. But, even in these cases where the fracture is simpler and the chance of success is greater, we must emphasize the need to alert the patient´s owner to the possibility of the occurrence of degenerative joint disease as a result of the whole process, either by fracture itself or even after surgical correction.

CONCLUSION

The caudal access to the elbow joint through the osteotomy of the olecranon promoted good exposure of the distal portion of the humerus, allowing optimum visualization of the fracture site and allowing a perfect reduction between the condyles. The technique of stabilization for the fractured lateral condyle using the intercondylar lag screw and the anti-rotational pin on the lateral epicondylar crest of the humerus provided good fracture stabilization and anatomical reduction of the fractured condyle, allowing intercondylar bone healing within the expected time and without complications. The tension band made in the ulna to reduce the osteotomy of the olecranon conferred rigid fixation in the osteotomized region and allowed good bone healing, even though after bone consolidation it had to be removed by skin fistulation. It is important to carry out a good prior study of the articular surgical procedure using preoperative radiographs, in order to avoid or minimize errors, and to plan the chosen surgical technique with caution. Periodic radiographic follow ups after osteosynthesis, especially when they involve the articular joint, allows us to monitor the results so that, at any time, it can be re-intervened early in cases where there may be unexpected complications.

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