



Case Report: Conservative Treatment for Ulnar Fracture after Pancarpal Arthrodesis

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ABSTRACT

An 8-year-old neutered mixed-breed female dog weighing 28 kg was presented with mild front limb lameness 4 weeks after pancarpal arthrodesis. Orthopedic examination revealed discomfort during the antebrachial manipulation. Radiographic examination revealed an ipsilateral diaphyseal ulnar fracture at the level of the proximal border of the pancarpal arthrodesis plate. Solid periosteal new bone formation in the area of the fracture and around the tip of the most proximal screw on the transcortex of the adjacent radius was detected. The oblique ulnar fracture was not displaced. Cage rest for 4 weeks was elected over surgical intervention. No lameness was detected on clinical examination 2 weeks later. The ulnar fracture showed delayed union evident on radiographs at 17 weeks postoperatively.

Since this is the first report of an ulnar fracture after pancarpal arthrodesis, there are no treatment recommendations for this complication. Based on the clinical outcomes of this case, conservative treatment of ulnar fracture in a healthy, adult, large breed dog should be considered as an alternative for aggressive interventions.

Keywords: Pancarpal arthrodesis; Ulnar fracture; Osteomyelitis; Periosteal new bone formation; CastLess

INTRODUCTION

Pancarpal Arthrodesis (PCA) in dogs is usually performed as a salvage procedure for hyperextension injuries, collateral ligament injuries, non-repairable articular fractures, shearing injuries, end-stage degenerative joint disease, immune-mediated polyarthritis of the carpus, or neurogenic injury affecting the distal limb [1,2]. Palmar, medial, and dorsal pancarpal arthrodesis techniques are described. The ideal angle for pancarpal arthrodesis is 10-12 degrees of extension of the antebrachio-carpal joint [3].

Complications after PCA include implant breakage, screw loosening, fracture of the metacarpal bones, discomfort associated with the implants, incomplete arthrodesis, infection, osteomyelitis, and continual gait abnormality [3-5].

During plate application, stress risers are created in areas where there is a transition from an area with a relatively high moment of inertia to an area with a lower moment of inertia

[1,6].

Fractures in the vicinity of a bone plate are a well-known complication in veterinary orthopedics [5,7-10]. Fractures of adjacent bones after bone plating have been reported, for example, in the fibula after tibia plateau leveling osteotomy and in the metacarpus IV after PCA [5]. To the best of our knowledge, there have been no reports of ulnar fractures after PCA.

CASE PRESENTATION

The decision to perform PCA was made owing to an antebrachio-carpal luxation resulting from jumping from a height (Figure 1). The patient had no orthopedic disease in the past.

A dorsal approach to the distal radius, carpus, and metacarpus was performed [11]. A high-speed burr (Elan 4 BBraun, Aesculap, Tuttlingen, Germany) was used to remove the

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articular cartilage from the antebrachioacarpal, middle carpal, and carpometacarpal joints. Moreover, an autogenous cancellous bone graft was harvested from the ipsilateral proximal humerus and placed at the level of each joint. A 3.5 mm/2.7 mm CastLess PCA plate (CLP; Orthomed, Ltd., Halifax, West Yorkshire, UK) with a length of 130 mm was deemed appropriate on pre-operative radiographs for covering a maximum amount of length of the metacarpus as it is recommended by the manufacturer. The plate was applied to the bone in a standard dorsal orientation and all screw holes were filled as foreseen. Four screws were placed in the radius; one in the intermedioradial carpal bone; and three were placed in the metacarpal bones III and IV (**Figure 2**).



Figure 1: Preoperative radiographs showing an antebrachioacarpal luxation: (A) dorsopalmar and (B) lateral

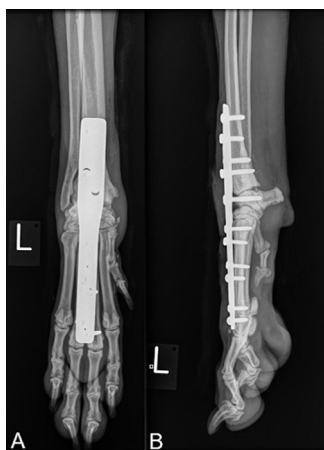


Figure 2: Immediate postoperative radiographs showing the arthrodesis plate and screws in place, without evidence of an ulnar fracture: (A) dorsopalmar and (B) lateral

The surgical wound was closed in layers. No bandages or splints were used postoperatively. Postoperative radiographs were obtained in two planes. Additionally, the position of the implant was considered good. The postoperative PCA angle was 2°. The canine patient was discharged the following day with a prescription for meloxicam (0.1 mg/kg p.o. SID) and Gabapentin (10 mg/kg p.o. TID) to be administered for 1 week. No antibiotics were prescribed postoperatively. Furthermore, cage rest was prescribed until re-check in 4 weeks.

Four weeks postoperatively, the dog was presented again for a planned re-check with mild front limb lameness (1/4°) on the operated leg. Orthopedic examination revealed mild swelling and pain during palpation of the distal antebrachium.

Radiographs of the affected front limb revealed a closed, diaphyseal, short oblique, non-displaced fracture of the ipsilateral ulna at the level of the proximal end of the arthrodesis plate. The owner reported no history of trauma. Moderate solid periosteal new bone formation was noticed circumferentially around the ulna in the area of the fracture gap and at the caudal aspect of the distal ipsilateral radius at the same level (**Figure 3**).



Figure 3: Radiographs four weeks postoperatively showing a closed, diaphyseal, short oblique, non-displaced fracture of the ipsilateral ulna at the level of the proximal end of the arthrodesis plate with moderate periosteal new bone formation at the ulna in the area of the fracture gap (arrowhead) and on the radius at the same level (black arrow): (A) dorsopalmar and (B) lateral

The body temperature was 39.1°C and the C-reactive protein was mildly increased (18 mg/l, reference range 0-10 mg/l). The antibiogram from fine needle aspiration of the area of the ulnar fracture gap was negative. Amoxicillin-clavulanate (22 mg/kg p.o. BID) was prescribed for four weeks. Cage rest was recommended for 6 weeks. The patient showed no signs of lameness, swelling, or pain in the affected front limb at a re-check 2 weeks later. Body temperature and C-reactive protein were within normal limits again.

Radiographs taken 8 weeks postoperatively showed no progression of healing of the ulnar fracture. Orthopedic examination was again unremarkable; therefore, the cage rest was set aside, and stepwise increasing exercise was allowed. Radiography at 17 weeks showed a partially widened gap of the ulnar fracture, compatible with delayed union (**Figure 4**). The owner reported no lameness and was satisfied with the outcome.

No further follow-up was possible, because the patient died 24 weeks postoperatively for a reason unrelated to the case report.



Figure 4: Dorsopalmar radiograph four-month postoperatively, showing a partially widened fracture gap of the ulnar fracture (arrowhead)

DISCUSSION

To the best of our knowledge, this is the first report describing the postoperative complications of an ulnar fracture in a dog following PCA. Isolated ulnar fractures, particularly in the distal region, are rare. Stabilization of the ulna is usually unnecessary if the radius is intact [12].

The location of the ulnar fracture at the level of the proximal end of the plate on the radius suggests potential connection to the PCA. Stress riser fractures at the ends of plates occur as a result of the concentration of biomechanical forces at the proximal and distal bone-implant interfaces because of differences in elasticity between the plate and bone [7,8].

Stress riser fractures in the PCA have been described for metacarpal bones III and IV, especially when not more than 50% of the length of the metacarpus is covered with the plate [5]. Metacarpal fractures following the use of a CLP in PCA have been reported in 3.8% of cases [13].

Fractures of adjacent bones after PCA were described for the metacarpus IV [5]. Whitelock, et al. described two PCA cases using a 2.7 mm or 3.5 mm dynamic compression plate with a concomitant fracture of metacarpus IV. In both cases, the plate was applied to metacarpus III, and no screws were placed in metacarpus IV; nevertheless, fractures of MC III and MC IV at the distal end of the plate have been identified postoperatively.

3.5 mm/2.7 mm CastLess PCA plates are available in 4 different lengths (110 mm-140 mm). The difference in plate length only concerns the distal part of the plate, which is applied to the metacarpus. The proximal part of the plate, which is applied to the radius and the radial carpal bone are identical in all plate lengths. The four holes for placement of screws in the radius and the hole for placement in the radial carpal bone are therefore predefined. The manufacturer of the implant suggests to cover a maximum length of the metacarpus III and IV which was achieved in this case report using a plate of 130 mm length.

Postoperative PCA angle in this case was 2° in extension,

which was less than the suggested 10°-12° [2]. Additionally, hyperextension of the carpus due to PCA might increase stress risers at the distal end of the plate by increasing the moment of weight-bearing forces at this point [5]. Whether the stress riser also increases at the proximal end of the plate and in the adjacent ulna remains unclear. To support this theory, biomechanical studies are warranted.

In this case, no additional bandage or cast was applied at any time. Several studies have reported no decrease in complications when using postoperative bandages or casts when performing PCA using a CLP [13,14].

The exact date of the event of ulnar fracture remains unclear, since the owner did not report any incident. Furthermore, the owner did not report a spontaneous change in the severity of lameness and believed that the lameness was due to the PCA procedure itself.

The radiographic pattern and extent of periosteal new bone formation in the area of the fracture was suspicious for post-traumatic osteomyelitis secondary to the ulnar fracture. A mildly increased body temperature and mildly increased C-reactive protein at 4 weeks postoperatively would support this suspicion. Regarding the negative anti-biogram in this case, negative culture results despite ongoing infection are possible due to insufficient specimen volume or the presence of fastidious bacteria [15]. Cytological examination could have helped to identify possible bacterial infection.

In this case, inflammation potentially spared to the adjacent radius. The radius potentially was susceptible to inflammation because it had already weakened owing to recent screw implantation. Early signs of infection in the form of periosteal new bone formation have been reported for implant-associated infections in the PCA [14]. Despite potential osteomyelitis, the dog showed no lameness 6 weeks postoperatively.

Notably, the periosteal new bone formation diminished, as documented on radiographs taken 4 months postoperatively. The area of the fracture gap showed a decreased bone density, and the ulna showed a partially mildly widened fracture gap. The owner reported no lameness at that time.

Limitations of this study are a missing latero-lateral radiograph at 17 weeks postoperatively and the impossibility for long term follow-up. Biomechanical studies evaluating the ulna in the context of PCA could potentially help to understand this complication.

CONCLUSION

A postoperative PCA angle of 2° potentially leads to changed biomechanics in the antebrachium and a stress riser at the level of the proximal end of the PCA plate. This circumstance potentially results in ulnar fractures. Considering the favorable clinical outcome in this case, addressing the ulnar fracture surgically seems unnecessary. Instead, strict cage rest and regular monitoring are viable options.

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CONFLICT OF INTEREST

No conflicts of interest have been declared.

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