



Clinical Report

Bilateral Pancarpal Arthrodesis in a German Shepherd Dog

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Abstract

Case Description- A 5-year old male German shepherd weighting 28 kg with the history of falling from the third floor 9 month previous was referred to the Small Animal Hospital.

Clinical Findings- In clinical examination roughness and thickness of the skin of the palmar surface of both forelimbs were felt. The animal was using his palmar plane of both forelimbs to walk without any signs of pain during walking or weight bearing. Diagnostic radiographs revealed old traumatic carpal luxation in both forelimbs.

Treatment and Outcome- Bilateral pancarpal arthrodesis was performed on both right and left carpal joints in a staged surgery. Under general anesthesia the carpal joint was reduced and fixation was done at 10 degree extension. A dynamic compressive plate dorsally attached from the distal end of radius to the carpal joint. Arthrodesis was carried out by cancellous bone auto-grafting. Palmar molded splint was applied to support the internal fixation for nine weeks. Survey radiographs during 12 months follow up revealed successful fusion of inflicted joints. Patient exhibited no clinical signs of pain and could normally bear weight on both forelimbs.

Clinical Relevance- Plate applications on the dorsal aspect provide easier approach for panarthrodesis of the carpal joint and use of cancellous grafts and external support after surgery increase healing and stability.

Key words: Arthrodesis, Joint, Luxation, Hyperextension.

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Case Description

A 5-year-old male German shepherd weighing 28 kg was referred to the Small Animal Hospital. The dog had fallen from the third floor of a building, nine months before he was brought to the clinic. One month after that, he had been using the palmar plane of both forelimbs to walk.

Clinical examination showed that he was using the palmar plane of both forelimbs to walk without any signs of pain during walking or weight bearing. Roughness and thickness of the skin of the palmar surface of both forelimbs were felt, due to long time walking on them. There were no signs of disuse atrophy because of use of the both forelimbs during walking.

Lateral and dorsopalmar radiographs of the right and left carpal joints revealed luxation of the antebrachio-carpal, middle carpal and carpometacarpal joints bilaterally. Old and nonunion fractures of the right and left proximal 5th metacarpal bone were noticed. Degenerative changes were also seen at both joints (Fig. 1).



Figure 1. Dorsopalmar (A) and mediolateral (B & C) radiographs of both carpal joints in a 5-year-old male German shepherd dog. Complete luxation of the bilateral carpal joints were seen. The arrowheads indicate the presence of old fractures in both 5th metacarpal bones.

Treatment and Outcome

Acepromazine (0.03 mg/kg IM) and Atropine (0.05 mg/kg IV) were administered for pre-operative medication; Thiopental (10 mg/kg IV) for anesthesia induction and Halothane 1% for maintenance. After carrying out general surgical rules, a cranial (dorsal) skin incision of approximately 10 cm was made starting from the distal antebrachium to the distal metacarpus. Following subcutaneous tissue dissection, cephalic vein and accessory cephalic were moved to one side in order to remove from the surgical site. Reaching to intercarpal and carpometacarpal joints were performed by cutting of the extensor carpi radialis muscle. Following opening of the joint capsule an electric powered burr was used for the removal of articular cartilages from radiocarpal, intercarpal and carpometacarpal joints. Cancellous bone autografts were taken from the great humeral tubercle of the same forelimb, were placed in the

bone spaces. An 8 holes 3.5 dynamic compression plate which was appropriately countered, dorsally attached from the distal end of the radius to the carpal joint in 10 degree extension and fixed with 4 cortical screws in the radius, 1 screw in the radial carpal bone and 3 screws in the third metacarpal bone. All tissues were appropriately closed and the palmar molded splint was applied to support the internal fixation for nine weeks. Postoperative medication included Flunixin Meglumine (1.1 mg/kg, 12 qh) following of the operation, and Cefazolin (22 mg/kg, 3 qh) for five days. The splint changed every 2 weeks. The same procedure was accomplished for the left forelimb three months later, except the 9 holes; 3.5 mm dynamic compression plate was used.

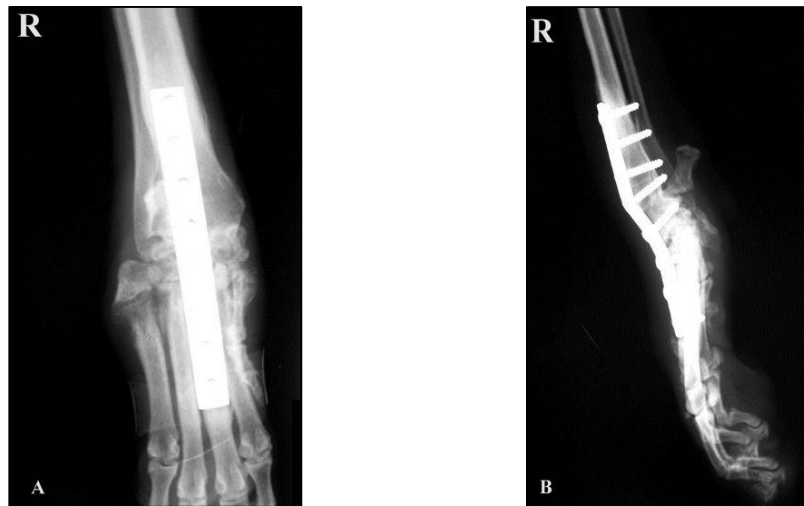


Figure 2. Postoperative dorsopalmar (A) and lateral (B) radiograph of the right carpus at 10 weeks after panarthrodesis with 3.5 DCP plate.

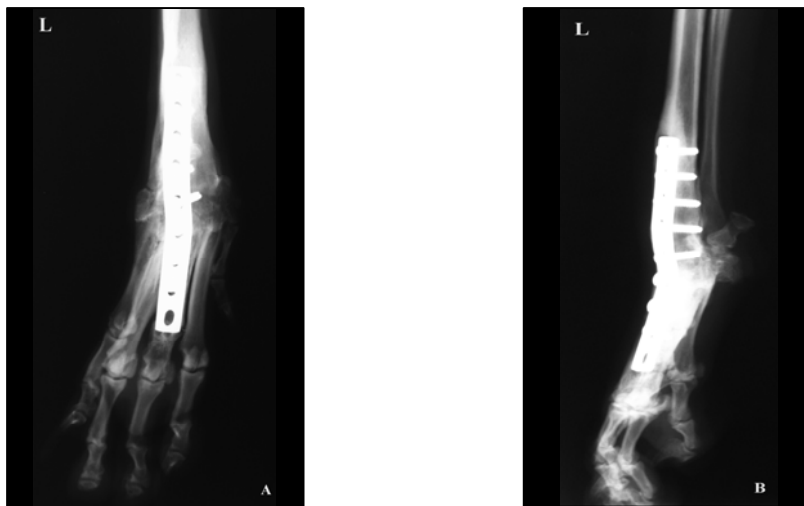


Figure 3. Postoperative dorsopalmar (A) and lateral (B) radiograph of the left carpus at 10 weeks after panarthrodesis with 3.5 DCP plate.

Radiological evidence of healing at follow up examination nine weeks postoperatively revealed successful fusion of inflicted joints (Fig 2). Patient exhibited no clinical signs of pain and could normally bear weight on both forelimbs. After the removal of the cast, exercise was

gradually increased on a leash over the next 6 weeks; during the first week 5 minutes walk twice daily was permitted, the duration of walking increased by 5 minutes increments each week until a normal walking achieved. In left limb, distal screw loosening was noted at 12 weeks postoperatively that treated with screw removal and antibiotic therapy. The plates were removed after 7 months.



Figure 4. Dorsopalmar (A) and lateral (B) radiographs of right carpus after implant removal at 7 months.

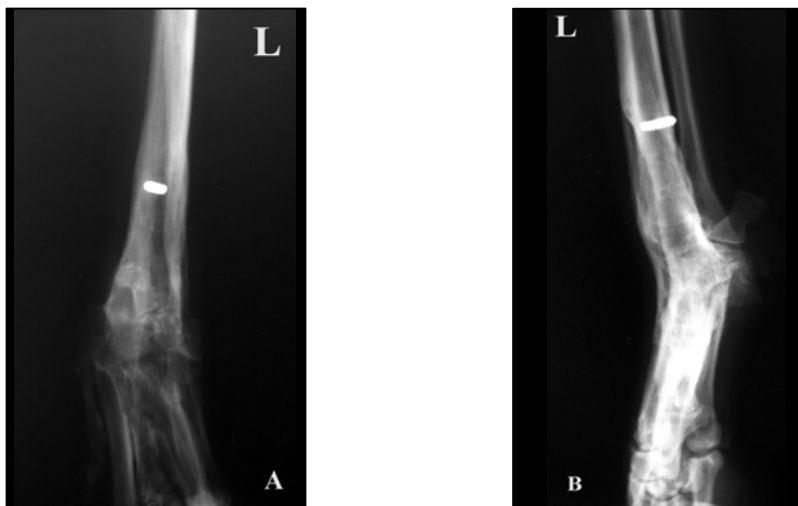


Figure 5. Dorsopalmar (A) and lateral (B) radiographs of left carpus after implant removal at 7 months.

Discussion

Hyperextension injuries of the carpus usually occur in midsize and large breeds of dogs after falling or other impact traumas that hyperextends the carpus. Damage to palmar ligaments and carpal fibrocartilage occurs, and varying degrees of carpal hyperextension result, affecting one or both forelimbs. Hyperextension injuries of the carpus don't respond well to conservative treatment by application of casts or splints alone. In these cases, after cast removal, the early scar tissue stretches, and the carpus hyperextends again. Surgical repair and

reconstruction of some palmar ligaments have been reported, but traumatic disruption of the deep palmar carpal ligaments, and the palmar carpal fibrocartilage, typically do not heal with sufficient carpal hyperextension. Since primary repair of these structures is not feasible, the treatment of choice is an arthrodesis of the affected joint.^{1,2,3,4} Pancarpal arthrodesis is the most widely used method of treating carpal hyperextension.^{1,8} This procedure is quick, easily performed, and has minimal complications, and finally results in the most normal function of the limb than arthrodesis of any other joint.^{1,5}

Postoperative complications after pancarpal arthrodesis in the dog are relatively common. These include failure of arthrodesis, implant loosening or fracture, osteomyelitis, sinus formation, and discomfort associated with the implants.^{6,7,8,9} Regardless of the method used, important principles must be respected to help prevent implant loosening or failure and achieve a successful arthrodesis. These can be listed as complete removal of articular cartilage, cancellous bone grafting of the joint space and rigid internal fixation (preferably under compression), supported by external coaptation until there is radiographic evidence of fusion.^{5,10,11}

Pancarpal arthrodesis can be accomplished by using bone plates positioned on the dorsal, palmar or medial aspect, cross pin and external skeletal fixation application. Bone plate fixation probably represents the best combination of rigid fixation, fewest complications, and technical ease of application.^{1,5,10} There are several technical challenges for arthrodesis in carpus that include sound location for a bone plate, appropriate size of the plate and closure of skin and soft tissues over the distal end of the plate.^{1,8} Plate application on the dorsal aspect of the carpus is biomechanically suboptimal because the plate is on the compression side rather than the tension side and is therefore subject to bending forces that may fracture the plate or loosen screws. External coaptation is essential to protect the plate from excessive bending forces until radiographic evidence of bony union is present (at least 6-10 weeks). The palmar approach is technically more demanding than the dorsal approach and the outcomes are the same, therefore the simpler dorsal approach tends to be used often for pancarpal arthrodesis.^{1,7,10,12} In our study, a palmar molded splint was used for nine weeks, followed by a bandage with thick cotton padding for 2 weeks.

The length of a DCP that covers the third metacarpal bone is a matter of concern. Metacarpal fractures have also been reported with an incidence ranging from 8–19% of dogs that had dorsal plate application.^{8,13} Fractures at the ends of metal plates occur as a result of concentration of forces (stress risers) because of differences in elasticity between stainless steel and bone. After dorsal bone plating for pancarpal arthrodesis, the biomechanical forces that are normally dissipated by the carpus become concentrated at the proximal and distal bone-implant interfaces. Because of its relatively small size, the third metacarpal bone is the weakest structure in the arthrodesis, and repetitive loading occasionally results in fractures of this bone.^{2,8} Whitelock et al showed that the length of the metacarpal bone covered by the bone plate did affect the frequency of metacarpal fracture, with fewer fractures occurring when greater than 53% of the bone length was covered by dynamic compression plate.⁸ In our case the length of the metacarpal bone that covered with plate was more than 55% and no fracture of the bone was noticed.

Screw loosening is the most frequent complication, with a reported incidence ranging from 2% to 23% of dogs undergoing pancarpal arthrodesis in which dorsal plating has been used and 30% of dogs that had medial plate application.¹³ In our dog, screw loosening was recognized as a postoperative complication at left carpus within the follow-up period of 4 months. Screw loosening was manifested by soft tissue reaction over the plate.

In pancarpal arthrodesis dimensions of the plate and screws to be applied to the metacarpal regions play an important role in the screw-holding strength of the bone and in closure of the surgical wound in this region. To reduce the risk of these complications, specialized plates are available that provide holes for larger screws (3.5 mm) proximally and smaller screws (2.7 mm) in the metacarpal bone.^{14,15} To perform pancarpal arthrodesis in our case, an 8 holes 3.5 DCP was used for the right and a 9 holes 3.5 DCP was used for the left forelimb. But several difficulties were encountered during application of screws. Locating the centre of the bones and providing sufficient screw holding strength was difficult. Although the diameters of the screw used in the distal and proximal parts were equal, no fractures occurred in these bones. The prognosis after complete carpal arthrodesis is favorable.¹⁶ One study described that 74% of 45 dogs returned to normal walking and running on the limb and 97% were clinically improved to a degree that the owners expressed satisfaction with the procedure.^{6,10} In summary, plate applications on the dorsal aspect provide easier approach and stability compared to other areas and use of cancellous grafts and external support after surgery increase healing and stability.

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آرترودسیس کامل مفصل مچ در هر دو دست یک قلاده سگ نژاد ژرمن شفرد

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توصیف بیمار - یک قلاده سگ نر ۵ ساله نژاد ژرمن شفرد به وزن ۲۸ کیلو گرم با سابقه ی سقوط از ارتفاع در ۹ ماه قبل از مراجعه، به بیمارستان دامپزشکی ارجاع داده شد.

یافته های بالینی - در معاینات بالینی دام به هنگام راه رفتن بر روی سطح کف دستی هر دو اندام حرکتی قدامی بدون درد وزن گیری می نمود. رادیوگراف های تهیه شده از هر دو اندام حرکتی قدامی در رفتگی مزمن مچ و شکستگی های قدیمی التیام یافته در استخوان های قلم ۵ را نشان دادند.

درمان و نتیجه آن - بیمار متعاقبا تحت دو عمل جراحی آرترودسیس کامل مفصل مچ به فاصله ۳ ماه به ترتیب بر روی اندام حرکتی قدامی راست و چپ قرار گرفت. تحت بیهوشی عمومی مفصل مچ در حالت باز با زاویه ی ۱۰ درجه جا اندازی و با استفاده از پلیت شکل داده شده در سطح پشتی مفصل تثبیت گردید. متعاقبا اتوگرافت های اخذ شده از بخش اسفنجی استخوان بازو در محل مفصل مچ قرار داده شدند. به منظور حمایت از تثبیت داخلی به مدت ۹ هفته از آتل قالبی در سطح کف دستی استفاده شد. رادیو گراف های سریالی اخذ شده که تا ۱۲ ماه پس از عمل جراحی دنبال شدند حاکی از آرترودسیس موفقیت آمیز مفاصل مبتلا بودند و بیمار می توانست به طور طبیعی بر روی هر دو اندام حرکتی قدامی بدون درد وزن گیری نماید.

کاربرد بالینی - آرترودسیس کامل مفصل مچ با استفاده از قرار دادن پلیت در سطح پشتی آن و استفاده از آتل قالبی یک روش مناسب برای درمان در رفتگی های کامل مفصل مچ دست می باشد.

کلید واژگان - آرترودزیس، مفصل، در رفتگی، باز شدن بیش از حد.