EMPHASIS:

Hyperextension injuries of the carpus rarely respond well to conservative management. Traumatic disruption of the deep palmar carpal ligaments, and the palmar carpal fibrocartilage, typically do not heal with sufficient strength to prevent persistent carpal hyperextension and pain.

Since primary repair of these structures is not feasible, panarthrodesis of the carpus is advised. This prevents hyperextension and gives excellent relief of pain. The gait is typically normal or very close to normal postop. In this paper, we will describe the technique for panarthrodesis of the carpus.

AXIOM: If only the carpometacarpal joint is traumatized, only that joint should be fused. This technique will be described in a subsequent “Dimensions in Surgery” article.

AXIOM: The goal of arthrodesis is not the restoration of normal joint motion. This is a salvage procedure that eliminates pain at the expense of carpal range of motion. Reassure the clients that, once healing is complete, these patients are typically able to run, jump and engage in full athletic activity.

PREOPERATIVE DIAGNOSTICS:

1. Physical Examination:

AXIOM: Sedate the patient if necessary, to fully assess the stability of the joint.

AXIOM: While the patient is sedated, be sure to check the collateral ligaments as well. Concurrent collateral ligament damage may be present. If pancarpal arthrodesis is planned, then this collateral injury is moot, since the entire joint will be fused. However, if carpometacarpal arthrodesis is planned, then the collateral ligament injury will also need to be stabilized.


AXIOM: These radiographs should be taken with the patient sedated to ensure that the films are of diagnostic quality and that all bony abnormalities of the carpus and foot are identified.

AXIOM: Stressed views of the carpus, with the joint in full extension, are necessary to confirm specifically which carpal joint or joints are involved.

AXIOM: If the injury occurred due to a fall (i.e. having leapt off a balcony), chest radiographs to check for a diaphragmatic hernia are indicated.

PREOPERATIVE CARE:

1. Indwelling cephalic catheter.

2. Intravenous anesthetic induction protocol (Ketamine/Valium, Propofol, etc.)

3. Endotracheal intubation and inflate cuff.

4. Isofluorane inhalant anesthesia to effect.

5. Lead II ECG and pulse oximetry monitoring during prep and surgery.

6. Clip and prepare the limb circumferentially.

7. Clip and prepare a site for harvesting cancellous bone graft: either the proximal humerus or the iliac crest.

8. Cefalexin 20 mg/kg IV immediately preoperatively.

9. Position the dog in sternal recumbency, with the leg forward.

AXIOM: Rather than using an orthopedic stockinette to cover the entire limb, we prefer to prep the leg circumferentially, and place an impermeable wrap over the paw, leaving the remainder of the limb exposed. This facilitates visualization of the angle of the carpal joint, and prevents the risk of inadvertently creating a slight carpal valgus when the plate is applied.

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**SURGICAL TECHNIQUE:**

1. Skin and subcutaneous craniomedial incision over the distal radius, extending to the level of the distal end of the metacarpal bones.

2. It is preferable, but not mandatory, to preserve the cephalic vein if possible.

3. Retract the extensor carpi radialis tendon medially and the common digital extensor muscle and tendons laterally.

4. Incise the periosteum and joint capsule, from the distal radius to the proximal portion of the third metacarpal bone.

5. Using an elevator, or by sharp excision with a scalpel, elevate all of the soft tissues from the dorsal 180 degrees of the distal radius, carpal bones, and proximal end of the metacarpal bones.

6. Incise the joint capsule across its entire width, at the radial carpal, intercarpal, and carpal metacarpal joints (See Figure 1).

**AXIOM:** Sufficient exposure is necessary to visualize all articular surfaces of all bones in the surgical field.

7. Using a high speed nitrogen driven drill, debride all of the cartilage from the surfaces of the carpal bones.

**AXIOM:** Hyperflex the carpus to facilitate this process.

**DANGER:**

Without adequate cartilage debridement, a non-union could result. Successful arthrodesis requires:

a. Complete debridement of all articular cartilage.

b. Rigid internal fixation.

c. Cancellous bone grafting.

d. Avoidance of infection. While the presence of infection may not prevent healing, it will necessitate in most cases removal of the hardware once the joint has fused.

8. Contour a bone plate with a 5-10 degree angle, with three screws to be placed in the third metacarpal bone and a minimum of three in the radius.

9. Apply the plate first to the metacarpal bone, placing all three screws, making sure that the plate is precisely parallel to the long axis of the bone (See Figure 2).

10. Protect the surgical site with a damp gauze and now, harvest the cancellous bone graft.

**AXIOM:** By waiting until this moment to harvest the graft, the maximum viability of the graft is maintained: it will be extracted, collected momentarily on a blood-soaked gauze, and then placed directly into the surgical site. Since the distal three screws are already placed, a minimum of subsequent manipulation of the joint will be needed, ensuring that the graft material is not dislodged and lost during manipulation of the limb.

11. After placing the cancellous graft material, place the screws in the radius to complete the fixation (See Figure 3).

12. Routine subcutaneous and skin closure.

**POSTOPERATIVE CARE:**

1. Pain management using oral, injectable or transdermal analgesics.

2. Place a fiberglass cast, to a level just distal to the elbow.

3. Using a cast cutter, “clam shell” the cast by cutting it at its medial and lateral edges.

**AXIOM:** By “clam shelling” the cast immediately postop, rather than waiting for the first redcheck appointment, we find that this minimizes the risk of cast abrasions, moist dermatitis of the interdigital area, etc.

**AXIOM:** In theory, internal fixation should eliminate the need for external coaptation. However, in this circumstance, the plate has been placed on the compression side of the joint, rather than the tension side, a violation of normal orthopedic principles. Placing the plate on the ventral aspect can

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Figure 1: This schematic drawing depicts a dissection exposing the dorsum of the carpus.

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Figure 2: This schematic drawing depicts: 2A) A high speed nitrogen drill is shown debriding all of the cartilaginous surfaces from the distal radius, the carpal bones, and the proximal metacarpals. 2B) A cancellous graft has been harvested and is about to be packed into the debrided spaces. 2C) The cancellous graft is in place. 2D) An ASIF plate has been fixed by 3 cortical screws to the third metacarpal bone.

Figure 3: This schematic drawing depicts the ASIF plate rigidly affixed to the distal radius, across the carpus and to the 3rd metacarpal bone.
be performed, but this approach is more technically challenging. Likewise, arthrodesis using other techniques such as cross-pinning, external fixation, etc. can be performed, but we feel that the most straightforward and reliable means is by the above-described plating technique.

4. Redress the cast, with the patient sedated, every two weeks until the cast is removed at eight weeks.

5. Follow up radiographs at four weeks and eight weeks postoperatively.

PROGNOSIS:
The prognosis is excellent for a return to full weightbearing. In only two to three percent of cases have we found it necessary to remove the implants.

Coming Attractions
Distal humeral fractures are common in small animal practice, particularly in young dogs. Typically, these involve merely the lateral condyle and they heal nicely with a lag screw and K wire repair.

However, in some patients and particularly in cats, severely comminuted distal humeral fractures may pose a much greater challenge. Anatomic reduction and interfragmentary fixation of the numerous tiny fragments can be challenging or impossible; the distal humeral fracture fragments may be too small to easily accommodate screws for plate fixation; contouring a plate over the distal humerus, particularly in a cat is difficult. In addition, open reduction and attempts at interfragmentary fixation may devitalize the small fragments, resulting in sequestration and non-union.

External fixation provides an excellent means of stabilization while avoiding all of these difficulties.

Next month, we shall outline our surgical protocol for external fixation of distal humeral fractures.

See you then!

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