

JOINT TRAUMA SYSTEM K9 CLINICAL PRACTICE GUIDELINE



Orthopedics (K9 CPG: 13)

This CPG provides guidance on diagnosis and treatment of orthopedic injuries in Military Working Dogs (MWDs).

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SUMMARY OF CHANGES

1. Revision to updated format.
2. Renamed CPG from “Long Bone Fractures” to “Orthopedics”.
3. Added table for step-by-step instructions for splint application.
4. Expanded CPG content to include axial orthopedic injuries.
5. Removed recommendation to culture open fractures at point of injury.
6. Added Performance Improvement (PI) Monitoring and Class VIII Medical Materiel list.

INITIAL CARE CONSIDERATIONS

Recognize and manage life-threatening problems FIRST. Fractures, muscle, tendon, or ligament injuries are rarely life threatening. Provide treatment to prevent further compromise to the fracture site and neurovascular structures and minimize infection risk.

Recognize fractures. Military Working Dogs with fractures will have varying degrees of lameness or weight bearing and will likely have limb deformity, swelling, pain, and loss of function. Open fractures are generally obvious but pose greater risk of local and systemic infection and loss of function.

Provide analgesia and confine the MWD. Any MWD with possible fractures or joint injury should initially be given parenteral analgesia, continued orally once stabilized (see [Analgesia and Anesthesia K9 CPG](#)). Any MWD with possible fractures will be confined to a kennel or small space at all times with controlled opportunities to go outside to urinate and defecate (three times daily as a minimum). Aid patients using a make-shift sling placed under their abdomen while walking patients outside. Analgesia and confinement may be the only treatment necessary or feasible, as noted below.

Level of treatment required, requirement for evacuation, or ability to return to duty (RTD) requires a veterinary consultation or examination if the K9 is initially triaged by a non-veterinary provider.

APPENDICULAR ORTHOPEDIC INJURIES

THORACIC AND PELVIC LIMB INJURIES

Lower Limbs

Fractures or joint abnormalities distal to the elbow (radius/ulna, carpus, metacarpals) or stifle/knee (tibia/fibula, tarsus, metatarsals) should be stabilized by a provider while the K9 is waiting for medical evacuation. Manage any wounds (see [Wound Management K9 CPG](#)) and then apply a splint, ensuring the joints above and below the fracture site are immobilized (see Table 1). Bandages and splints should ALWAYS begin at the toes and then extend proximal to the location required for appropriate immobilization.

Cast application is not recommended as cast pressure or friction sores are extremely common in K9s and complicate recovery.

Many K9s tolerate splints and bandages poorly, so any K9 with a bandage or splint must wear a device to prevent self-mutilation or bandage removal, such as an e-collar or bucket (see [Normal Clinical Parameters K9 CPG](#)).

Splints and bandages must be changed as needed. If wounds are present with exudate, bandages will likely need changed every day or every other day. If no wounds are present, splints and bandages may stay in place for 5 to 7 days if they remain clean and dry and there is no evidence of slippage, limb swelling, severe patient discomfort, foul odor or other complications.

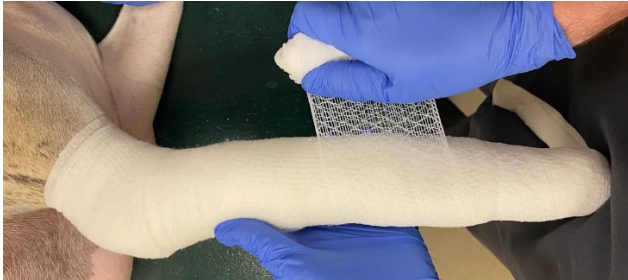
If the bandage slips, becomes wet or soiled or limb swelling is noted, the bandage/splint must be changed immediately.

Table 1. Application of a splint in a K9.¹

APPLICATION OF A SPLINT IN A K9 ¹	
1. Provide cushion and protection for pressure points. Cast padding or cotton balls can be placed between the toes to provide cushion. Donuts made from cast padding or foam can be placed between a bony prominence and a bandage to decrease risk for bandage sores.	
2. Create tape stirrups (optional). Place two strips of porous white tape on opposite sides of the limb (either cranial and caudal or lateral and medial). Extend tape approximately halfway up the target length of the bandage, leaving an equal length extending beyond the toes. Place the tape on either side of a tongue depressor to prevent the pieces of tape from sticking together. Do not place tape in areas where wounds are present.	
3. Apply cast padding. Beginning with the toes, apply several layers of cast padding (more will be needed if exudate is expected). Apply enough padding to cushion the splint (usually 3 to 4 layers). Overlap each layer by 50%. Make sure cast padding is snug to prevent slippage of the bandage. Leave the middle two toenails exposed (if possible, based on any wounds present) to monitor for swelling.	

APPLICATION OF A SPLINT IN A K9¹

4. Apply first layer of elastic type gauze. Begin at the toes and overlap by 50%. Keep even tension and conform to the limb, but do not stretch tightly as this can cause limb swelling.



5. Apply a premade or fiberglass splint (e.g., SAM splint). Ensure no gaps between the bandage and splint. The bandage materials should extend 1-2 inches above the splint.
 - For forelimb splints, the splint can be placed on caudal/posterior or lateral aspect of the limb.
 - For hindlimb splints, the splint should be placed on the lateral side.



6. Apply second layer of elastic type gauze to secure the splint. Beginning at the toes, apply 1 to 2 layers, extending proximally, overlapping by 50%.



7. Reposition stirrups (optional). Remove the tape from the tongue depressor, rotate 180 degrees, and secure the adherent side of the tape to the bandage.



8. Apply cohesive bandage. Beginning at the toes, apply 1 to 2 layers of cohesive bandage extending proximally, overlapping by 50%. Do not pull material too tight during wrapping as this can cause a tourniquet effect and damage the limb. Unrolling and rerolling the cohesive bandage before application can help prevent excess tension.



APPLICATION OF A SPLINT IN A K9¹

9. Apply elastic tape. Cut a piece of elastic tape so the toes can be accessed and apply to the palmar or plantar surface of the foot to enhance durability where the bandage contacts the ground.



10. Make sure to provide a waterproof cover (e.g., plastic bag, IV fluid bag) for the bandage to provide protection against outdoor moisture and debris. When inside, the cover should be removed.

Upper Limbs

Fractures of these bones (humerus, scapula, femur) are very difficult to immobilize. Splints are poorly tolerated, and can increase fracture displacement, jeopardize neurovascular bundles and cause significant morbidity if not applied properly.

If the provider has had proper training and is experienced in spica splint application, one can be applied. This may help the K9 be more comfortable.

For providers without experience with spica splint application, or if materials are not available, the K9 should be strictly confined, minimizing movement to the maximal extent (kennel confinement except for limited leashed walks using ancillary support).

K9s with these fractures should receive adequate pain control +/- sedation (see [Analgesia and Anesthesia K9 CPG](#)).

Definitive Repair

Definitive repair should be delayed until the patient can safely undergo anesthesia and surgery by veterinary personnel best equipped to manage K9s postoperatively. There is no role for human healthcare providers to attempt definitive repair of long bone fractures in K9s. Temporary external skeletal fixation is not indicated in K9s with long bone fractures. Specific guidelines for management of open fractures are discussed below.

PELVIC FRACTURES AND COXOFEMORAL LUXATION²

K9 pelvic fractures in deployed settings will most likely be due to crush or blast injury (BI) but can also occur due to falls from height or blunt force trauma. Evaluate the pelvis for external evidence of trauma or deformity.

The major joints involving the pelvis are the coxofemoral and sacroiliac joints. Pelvic asymmetry is a key clinical sign of pelvic fractures or coxofemoral dislocation. Carefully palpate the hip joints and lower back for swelling, pain, or deformity. Move the pelvic limbs carefully through their range of motion while palpating the hip area and lower back to evaluate hip luxation, crepitus, or asymmetrical movement of pelvic structures.

Trauma to adjacent structures such as the rectum, descending colon, urinary bladder, urethra, and reproductive organs is a concern. Evaluate the inguinal area and external genitalia for evidence of trauma or herniation. Fractures of the pelvic floor commonly cause asymmetry, swelling, and bruising in the inguinal region. Hidden internal injury due to fractures (e.g., urethra, urinary bladder, prostate, vagina) is difficult to detect. Assess neurologic input to the anus by pinching the skin around the anus with hemostatic forceps—the expected response is sudden tightening of the anal sphincter.

Examine external genitalia for trauma. Carefully perform a digital rectal exam with a well-lubricated finger to assess any bleeding in the rectum and injury to the urogenital structures in the pelvic canal, and to palpate for pelvic fractures.

Manage pelvic fractures and coxofemoral luxation by confining the K9 to its kennel or to a small space, limiting movement to short, frequent, handler-controlled leash walks using a towel or other material passed beneath the abdomen to provide support when walking (if the K9 is ambulatory), and adequate analgesia (see [Analgesia and Anesthesia K9 CPG](#)) while waiting for medical evacuation.

Severe pelvic fractures may render a K9 non-ambulatory. In these cases, it may be necessary to consider indwelling urinary catheterization for hygiene in the acute phase. Nursing care is critical for these K9s until evacuation and surgical stabilization (when indicated) can be performed. It is not recommended to place an Ehmer sling for coxofemoral luxation in operational environments as risk for bandage complications is high and re-luxation is common.³

AXIAL ORTHOPEDIC INJURIES

This section will discuss some axial orthopedic injuries secondary to trauma that may be encountered in K9s in an operational environment. It is not a comprehensive list of all possible injuries.

VERTEBRAL FRACTURES AND LUXATIONS⁴

Fractures and luxations of the spinal column can cause serious spinal cord injury. K9s must be triaged and stabilized for immediate life-threatening injuries, first.

Depending on the location and severity of the injury, K9s may present with spinal pain, paresis or paralysis. Perform an initial neurological exam to localize the lesion and determine extent and severity. See the [Traumatic Brain Injury and Acute Neurologic Injury K9 CPG](#) for additional information regarding localizing the injury. Note all neurologic deficits, get accurate neuroanatomic localization and assess deep pain perception.

If the history or physical examination leads to suspicion of spinal instability, the K9 should be immobilized in lateral recumbency. These injuries are often very painful and pharmacologic intervention (see [Analgesia and Anesthesia K9 CPG](#)) is typically needed immediately following emergent neurologic assessment.

Radiographs are only moderately sensitive for detecting vertebral fractures and luxations but can be a useful screening tool if the only available imaging modality. The modality of choice for evaluation of the bone is computed tomography (CT). Magnetic resonance imaging (MRI) is the modality of choice for diagnosing spinal cord injury. Imaging should be obtained once the K9 is stable.

Imaging that indicates fractures or ruptures to two or more of the spinal compartments indicates vertebral column instability.

- Dorsal – articular processes, lateral pedicles, dorsal laminae, interarcuate ligaments, dorsal spinous processes
- Middle – dorsal $\frac{1}{4}$ of the vertebral body and disc, dorsal longitudinal ligament
- Ventral – ventral $\frac{3}{4}$ of the vertebral body and disc, ventral longitudinal ligament

With spinal cord compression, surgical decompression is necessary. Unstable vertebral fractures and luxations require surgical stabilization. Surgical procedures need to be performed as soon as possible after initial stabilization. The procedures should only be performed by a veterinary surgeon or veterinary neurologist.

Note that neurological spinal cord presentations can also be caused by non-traumatic diseases such as intervertebral disc disease.

Traumatic spinal cord injury with loss of deep pain perception is a negative prognostic factor. Remember, reflex arcs (e.g., withdrawal reflex) are often intact even with loss of deep pain perception. Movement related to a reflex arc does NOT mean that deep pain sensation is present. Assessing deep pain sensation involves applying a painful stimulus (e.g., pressure across a digit with a hemostat or similar item) to the limb (usually the toes) and/or the tail and watching for a behavioral response such as vocalization, turning to look or bite, increased heart rate, or attempting to move away from the provider. Prolonged loss of deep pain perception, particularly when greater than 48 hours, is another indicator that treatment is less likely to be successful.

RIB FRACTURES

K9s with traumatic rib fractures may have concurrent damage to thoracic structures resulting in pneumothorax, pulmonary contusions and hemothorax. If multiple ribs are fractured at several sites, an unstable segment may be formed (“flail chest”) which moves paradoxically with respiration.

Stabilization of these K9s is a priority.

After the K9 is stabilized, a chest wrap should be placed over the flail segment and around the thorax to decrease motion of the flail segment, reduce pain and decrease the risk for lung and intercostal vessel laceration. Ensure the bandage does not restrict respiration.

Definitive treatment of flail chest is controversial (surgical stabilization or conservative management) and should be determined after evacuation and evaluation by a veterinarian and consultation with a veterinary surgeon.⁵

For K9s with isolated rib fractures, provide appropriate analgesia and strictly rest the K9 while waiting for medical evacuation.

SKULL FRACTURES⁶

Skull fractures can occur in the face (incisive, nasal, maxillary, lacrimal, zygomatic arch, palatine, vomer bones), cranial vault (frontal, parietal, temporal, occipital, ethmoidal bones) or base of the cranium (pterygoid, sphenoid, basioccipital bones).

Neurological signs are more common in K9s with cranial vault fractures. Neurological signs are also more likely to occur with depressed fractures (compared to non-displaced or displaced but not depressed). Death after one week has been shown to be more likely with cranial vault fractures. The occurrence of neurological signs is significantly associated with immediate death.

Radiographs are not accurate for ruling out fractures. A non-contrast CT scan should be performed if available, once the K9 is stabilized, to identify fractures, damage to brain parenchyma and hemorrhage as well as signs of brain herniation (see [Diagnostic Imaging K9 CPG](#)).

For K9s with head trauma, evaluate life-threatening injuries first. Address hypotension, hypovolemia and oxygenation. Hypovolemia and hypoxemia strongly correlate with increased intracranial pressure and mortality.⁷

Complete a full neurological exam and modified Glasgow Coma Scale (GCS) (see Table 2). For additional treatment, see the [Traumatic Brain Injury and Acute Neurologic Injury K9 CPG](#).

Table 2. The modified Glasgow coma scale.⁸

MODIFIED GLASGOW COMA SCALE ⁸	
	Score
Motor activity	
Normal gait, normal spinal reflexes	6
Hemiparesis, tetraparesis, or decerebrate rigidity	5
Recumbent, intermittent extensor rigidity	4
Recumbent, constant extensor rigidity	3
Recumbent, constant extensor rigidity with opisthotonus	2
Recumbent, hypotonia of muscles, depressed or absent spinal reflexes	1
Brainstem reflexes	
Normal pupillary light reflex (PLR) and oculocephalic reflexes	6
Slow PLR and normal to reduced oculocephalic reflexes	5
Bilateral unresponsive miosis with normal to reduced oculocephalic reflexes	4
Pinpoint pupils with reduced to absent oculocephalic reflexes	3
Unilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes	2
Bilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes	1
Level of consciousness	
Occasional periods of alertness and responsive to environment	6
Depression or delirium, capable of responding, but response may be inappropriate	5
Semicomatose, responsive to visual stimuli	4
Semicomatose, responsive to auditory stimuli	3
Semicomatose, responsive only to repeated noxious stimuli	2
Comatose, unresponsive to repeated noxious stimuli	1
MODIFIED GLASGOW COMA SCALE ⁸ SCORE	
3-8	Grave
9-14	Guarded
15-18	Good

K9s need to be medically evacuated. Indications for surgical intervention (craniotomy) include removal of epidural or subdural hematomas, decompression of skull fractures, removal of foreign materials lodged into the brain parenchyma, achieving hemostasis and decompression for progressive neurologic deterioration. These types of procedures should only be performed by a veterinary surgeon or veterinary neurologist.

OPEN FRACTURES

Proper management of open fractures is essential. Open fractures should be treated as a medical emergency, once more serious conditions are addressed. If there are delays in medical evacuation, the wounds must be properly treated and the fracture appropriately immobilized, if feasible. Closed fractures are not typically medical emergencies except in instances where vital structures may sustain secondary injuries due to the closed fracture (e.g., bladder rupture due to pelvic fracture).

INITIAL MANAGEMENT

While evaluating the entire patient and initiating life-saving therapy, take measures to protect the open fracture site:

- Do not attempt to reduce bone(s) protruding at fracture sites, as this drags contamination to the fracture site and may cause injury to the neurovascular bundle.
- Quickly remove any large gross contaminants from the wound (e.g., leaves, rocks, stick fragments), but do not attempt to clip the hair or cleanse the wound at this point.
- Cover the fracture and wound with sterile non-adherent dressing and apply a light bandage. This bandage should not be placed as a form of stabilization; it is simply to protect the open wounds and exposed bone from further contamination during initial patient resuscitation.

SPECIFIC MANAGEMENT

K9s with open fractures generally require surgical correction of the fracture once evacuated. This should be completed by veterinary personnel. Goals are to prevent bacterial infection, protect from further damage, and promote normal healing.

- It is not necessary to culture the fracture at the point of injury, as these cultures typically do not represent the organisms that eventually cause infection.⁹ If cultures are obtained, it is more appropriate to take samples during the time of definitive surgical repair, or if signs of infection develop.
- Administer antibiotics (see [Wound Management K9 CPG](#)), focusing on use of intravenous antibiotics based on likely contaminants. Never withhold antibiotic therapy in any patient with an open fracture.
- Address pain with appropriate analgesic therapy (see [Analgesia and Anesthesia K9 CPG](#)). Reassess pain every 4-6 hours.
- Manage soft tissue injuries over the fracture site appropriately, as proper management of the wound postures the patient for successful outcome. See the [Wound Management K9 CPG](#) for wound management recommendations.
- Apply a splint, if indicated, based on fracture type as described above. Confine K9s with any fracture, but especially with fractures that cannot be immobilized.

PERFORMANCE IMPROVEMENT MONITORING

POPULATION OF INTEREST

All MWDs with orthopedic injuries.

INTENT (EXPECTED OUTCOMES)

- Return to duty (RTD).
- No amputation.
- No persistent lameness.

PERFORMANCE / ADHERENCE MEASURES

- Number and percentage of patients in the population of interest (deployed MWDs) that sustained orthopedic injuries.
 - Specify what type of orthopedic injury (bone and/or joint affected and type of injury).
- Number and percentage of patients in the population of interest (deployed MWDs) that RTD.
- Number and percentage of MWDs that did not show evidence of persistent lameness or other long-term effects (such as neurological signs).

DATA SOURCE

- Patient Record
- Department of Defense MWD Trauma Registry

SYSTEM REPORTING AND FREQUENCY

The above constitutes the minimum criteria for Performance Improvement (PI) monitoring of this K9 CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by direction of the K9 Combat Casualty Care Committee Chair.

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APPENDIX A: CLASS VIII MEDICAL MATERIEL

FRACTURE IMMOBILIZATION AND SPLINTING

SPLINTING / FRACTURE IMMOBILIZATION MATERIALS

- SAM-type splints / moldable splinting material
- Cast padding material
- Elastic cohesive bandage
- Rolled gauze
- Medical adhesive tape

PATIENT PROTECTION

- Elizabethan collars / E-collars
- Protective muzzles
- Leashes and restraint equipment

OPEN FRACTURE AND WOUND MANAGEMENT

WOUND IRRIGATION

- Irrigation solution (sterile normal saline or similar)
- Irrigation syringes, tubing, tips/adapters

WOUND DRESSINGS

- Non-adherent wound dressings
- Antimicrobial wound dressings
- Absorbent dressings
- Rolled/conforming gauze
- Elastic cohesive bandages

ASEPTIC TECHNIQUE

- Sterile surgical gloves
- Sterile drapes
- Surgical skin-preparation supplies
- Antiseptic solution

VASCULAR ACCESS AND FLUID ADMINISTRATION

PERIPHERAL VASCULAR ACCESS

- Peripheral IV catheters: 18, 20, and 22 gauge
- Injection ports/stop cocks
- Saline flush syringes

VASCULAR ACCESS AND FLUID ADMINISTRATION (CONT'D)

IV ADMINISTRATION SUPPLIES

- IV administration sets
- IV extension tubing
- IV fluid bags
- IV fluid pressure bags

ANALGESIA, SEDATION, AND PERIOPERATIVE SUPPORT

ANALGESIC/SEDATION ADMINISTRATION

- Injectable analgesic and sedative medications
- Oral analgesic medications
- Syringes, and needles

PATIENT MONITORING

BASIC MONITORING EQUIPMENT

- Stethoscope
- Thermometer
- Pulse oximeter
- Non-invasive blood pressure monitor
- ECG monitor

ADDITIONAL MONITORING CAPABILITY

- Capnography
- Patient monitoring cables/sensors
- ECG electrodes
- Pulse oximeter probes appropriate for canine patients
- Blood pressure cuffs appropriate for canine patients

DIAGNOSTIC CAPABILITY

RADIOGRAPHIC EVALUATION

- Portable radiographic capability
- Digital radiography equipment
- Appropriate canine positioning/support equipment

For additional information including National Stock Number (NSN), please contact dha.ncr.med-log.list.lpr-cps@health.mil

DISCLAIMER: This is not an exhaustive list. These are items identified to be important for the care of combat casualties.