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Open Fractures — How To Assess And Stabilize

Jaclyn Holdsworth, DVM

With the nice weather approaching, people and their four-legged companions will be spending a lot of time outdoors. This leads to veterinary practices seeing more vehicular trauma-related injuries. Injuries can be all across the spectrum from superficial abrasions to extensive open fractures with de-gloving injuries of the limb(s). The goal in management of open fractures is

**Injuries can be all
across the spectrum
from superficial
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of the limb(s)**

to prevent further contamination, prevent additional damage to the bone and surrounding soft tissues especially nerve and vascular supplies, and facilitate timely stabilization.

This topic paper will focus on the types of open fractures, what can be done to assess the patient's wounds and how to stabilize them for repair or referral to a specialty hospital. We will also touch upon advantages and disadvantages of internal and external skeletal fixation and associated complications with each.

Upon presentation, a thorough physical exam should be performed to assess all injuries to the patient. Once this is complete, a problem list should be made and the injuries



listed in order of importance, starting with most life-threatening first and non-life-threatening injuries last.

Once the patient has been systemically stabilized, assessment of any wounds and/or associated fractures can be performed. One important point to remember is that bone may not be protruding through the skin at the time of presentation. Any wound over an extremity containing a fracture is considered open and should be treated as such.

First, we will discuss the types of open fractures and what soft tissue injuries are also included with each type of open fracture.

1. Type I

This is an open fracture with a wound smaller than 1 cm. The surrounding soft tissues are mildly/moderately contused. Frequently, the

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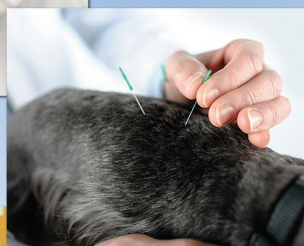
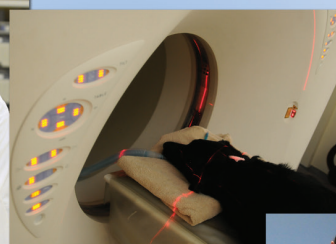
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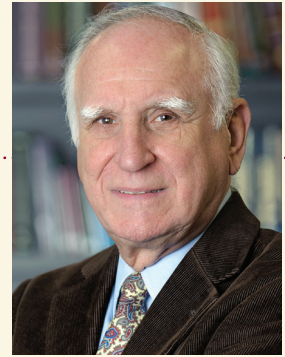
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A Note from the Editor



There has been a report this April concerning contamination of foodstuffs and eggs have recently been implicated in Salmonella infections. A producer has recalled more than 200 million eggs after an outbreak of salmonella was traced to one of its farms in North Carolina. Eggs from the affected farm were distributed to nine states including NY and were likely connected to 22 reported cases of salmonella infections. None of the supermarkets serviced are in our area.

Lately, there seems to be an increased fascination with keeping poultry in backyards. Along with the benefits of connecting with nature and easy access to fresh eggs comes the risk of disease. Most people who contract salmonella typically recover without treatment after a few days of diarrhea, fever and abdominal cramps, some cases require hospitalization and some can be fatal.

There's a belief that those eggs are safer than commercial eggs, but that's not so. Eggs from small flocks are more likely to be contaminated with salmonella than eggs sold in grocery stores.

As always, the key is thorough hand washing after handling chicks or other poultry.

We have finally had some mild weather, with enough sun and precipitation, including some quite cold days, to encourage the pollens, weeds, and other allergens to add to the itchy, tearing and wheezing sensations that cause discomfort to ourselves and our pets. The Dermatology department led by Dr. Meghan Umstead has extended hours so that it may better offer its services to our clients and referring veterinarians and is available to consult in cases that need direction and appropriate allergic management.

Many schools and colleges have already concluded classes and outdoor graduation ceremonies and parties will begin for many this month. Our pets will be doing their usual begging for tasty bits of BBQ'd foods, most of which will cause intestinal distress as they are hardly compatible with canine metabolic processes. Additionally, summer seems to bring on more accidents, rashes, accidental ingestions, gastrointestinal disruptions with subsequent dehydration and injuries of many kinds. LIVS is open for any emergencies that may arise and our extended hours remain as before with each service ready to serve the needs of our clients and those patients which are referred to LIVS.

All departments can be reached by calling our telephone receptionists at 516-501-1700 for appointments.

As before we welcome all comments, please submit them to lmario@livs.org.

Leonard J. Marino, MD, FAAP, LVT

Open Fractures — How To Assess And Stabilize

► Continued from Front Cover

external wound is created from the inside out by sharp bone fragments. Often the bone retracts back to below the level of the skin at the time of presentation.

2. Type II

This is an open fracture with a wound larger than 1 cm without extensive soft tissue damage, flaps, or avulsions. External wounds are typically created from the outside in by higher energy forces.

3. Type III

This is an open fracture *with* extensive soft tissue damage. Soft tissue avulsions, de-gloving injuries, and bone loss are frequently noted. These include fractures with accompanying neurovascular injury requiring repair, gunshot injuries, and traumatic partial amputations. Within the type III category are sub-categories to further classify more extensive injuries.

- i. *Type III A* – An open fracture with adequate soft tissue coverage of the fracture bone despite extensive soft tissue damage.
- ii. *Type III B* – An open fracture with extensive soft tissue loss, periosteal stripping, and bone exposure; usually associated with large contamination.
- iii. *Type III C* – An open fracture associated with arterial injury requiring immediate cessation of arterial blood loss.

The keys to successful treatment include prompt and aggressive debridement of contaminated material and nonviable tissue, vigorous irrigation, administration of antimicrobials, and restoration of soft tissue coverage to facilitate healing bone, tendons, ligaments and neurovascular structures.

Again, after the patient has been systemically stabilized and initial wound/fracture assessment has been performed, the patient's wound treatment may begin. Copious amounts of sterile, water soluble lubricant should be applied directly into the wound. Lavage with isotonic fluids at a desired pressure of 7 to 8 PSI, can be achieved by a 1 liter fluid bag in a pressure sleeve pressurized to 300 mmHg. After lavage is complete, culture and sensitivity of the wound should be performed. After this, broad-spectrum antimicrobial therapy should be initiated. A prospective study showed that when antibiotics were administered within the first 3 hours after injury the infection rate was approximately 4.7%. If soft tissue injury is extensive, surgical debridement may be necessary and should be performed within 6 hours for a more successful outcome. After lavage, culture, and initial wound debridement, a temporary sterile bandaging of the limb should be

Type I



Type II



Type II



performed (+/- splint) until surgery can be performed or until transfer to a specialty hospital can be accomplished.

For fractures involving the digits, metacarpals, carpus or metatarsals, either a lateral or caudal (Mason Metasplint or spoon) splint is applied. For fractures below the elbow or stifle a lateral splint is applied. A caudally placed splint is unable to stabilize the tibiotarsal joint or the elbow appropriately. A humeral fracture should be stabilized with a Spica splint. This is important since a large number of humeral fractures occur at the level of the radial nerve.

Increased motion of the fracture during transportation may result in laceration or further trauma to the radial nerve. A lateral splint alone without including the shoulder joint and scapula will result in a fulcrum at the level of the fracture increasing the risk of further trauma to the nerve, vasculature and surrounding soft tissues. For the femur, placing a splint can be very difficult. The argument for not placing a splint is the large volume of muscle surrounding femur fractures allows most patients to protect the limb coupled with the difficulty of appropriately placing a Spica splint especially on the rear limb. Whether or not a splint is applied, the wound must still be managed over the femur prior to transport.

There are many advantages and disadvantages of internal and external skeletal fixation after open fractures. Advantages of internal fixation include increased stability at the fracture site and primary bone healing. Some disadvantages include additional disruption of soft issue and blood supply, possible need for implant removal in the future and infection.

Advantages of external fixation include decreased application time, location of implants away from the fracture site, easy access for open wound management, minimal disruption of soft tissues during application and easy implant removal. Some disadvantages include pin loosening, pin tract drainage, infection, delayed union or non-union and fixation failure.

General complications for open fractures include superficial infection, deep-seated infection, delayed or non-union (Type I – 0-5%, Type II – 1-14%, Type III – 2-37%), necrosis of soft tissue, breakdown/dehiscence of soft tissue repair, temporary or permanent neurologic damage, septicemia and even death. General infection rates for open fractures are as follows: Type I – 0-2%, Type II – 2-10 %, Type III – 10-50%. Amputation may be needed or indicated with complicated type III fractures.

If help and/or guidance regarding open fracture assessment is needed, please feel free to reach out to our Surgery Service at Long Island Veterinary Specialists. ■



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Michel Selmer, DVM, CTCVMP (Integrative Medicine)

Dr. Michel Selmer is an Integrative Veterinarian and one of only a handful of Traditional Chinese Veterinary Medicine Practitioners in the United States.

Dr. Michel Selmer attended Long Island University and graduated Cum Laude with a Bachelor of Arts Degree in Psychology. Following his undergraduate studies, he was admitted to Michigan State University School of Veterinary Medicine and earned his Doctorate of Veterinary Medicine in 1995. Following his Traditional Veterinary studies, he was admitted to the Chi Institute where he graduated with the top honor of being a Certified Traditional Chinese Veterinary Medicine Practitioner (CTCVMP).

Dr. Selmer is a published author and consults with other veterinarians as well as pet parents around the globe. In 2018, he made the exciting decision to join the Long Island Veterinary Specialists team as the Lead Veterinarian in their Integrative Medicine Department.

The passion Dr. Selmer has for his profession - and his love for all animals - has contributed to the high quality medicine that he practices.

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Non-Weight Bearing Lamé – What Is Your Diagnosis?

Ann Bilderback, DVM, DACVIM (Neurology)

History

A 9-year-old neutered male Toy Poodle was referred to LIVS for MRI for cervical pain.

Two weeks prior to presentation to LIVS, the patient was reluctant to go out for his walk and appeared reluctant to move. Within 24 hours, weight bearing lameness of the right thoracic limb was noted which progressively worsened over the first week despite Carprofen therapy. He was evaluated at another specialty hospital with radiographs of the right shoulder obtained 1 week after onset of clinical signs and they were reported to be unremarkable. Carprofen dose was increased and Tramadol was initiated at that time.

The patient continued to worsen with progression to non-weight bearing lameness and frequent yelping/screaming episodes when picked up or approached. Two weeks after onset of clinical signs, the patient was evaluated by a neurologist and surgeon at the same specialty hospital at which time concurrent cervical pain was observed. Carprofen was discontinued (to “wash-out” in case corticosteroid therapy was initiated) and the patient was subsequently referred to LIVS for cervical MRI. Several days later the patient presented to LIVS at which time the family reported further progression with pronounced neck guarding and reluctance to turn the neck to either side.

The patient continued to eat and drink well but only when the food/water was held to his face. There was no vomiting, regurgitation, diarrhea, sneezing nor coughing noted. The

patient's only previous medical history was surgery for a ruptured anterior cruciate ligament of the right stifle at 4 years of age.

Physical and Neurologic Examination

On presentation to LIVS, physical examination revealed bilateral stifle thickening with medial buttress (worse on the right), non-weight bearing lameness of the right thoracic limb, severe right shoulder discomfort, especially with extension > flexion > abduction/adduction, and right axillary discomfort.

Neurologic examination revealed severe neck guarding with low head and neck carriage, tendency to carry neck with slight turn towards the left, severe reaction on cervical palpation and slightly reduced withdrawal of the right thoracic limb. The following were noted to be normal: mentation, cranial nerve examination, postural reactions (except right thoracic limb which could not be tested as patient refused to place paw on floor), spinal reflexes of the other three limbs; no ataxia nor paresis were noted.

Neurolocalization was made to a right-sided C1-T2 with primary concern of C6-T2 radiculopathy (i.e. disease of nerve root) +/- concurrent musculoskeletal disease of the right shoulder.

Differential Diagnoses included intervertebral disk disease (IVDD), neoplasia (primary or metastatic), inflammatory/autoimmune disease, trauma, and infectious disease; degenerative disease and vascular event were



considered less likely given the discomfort and progression of clinical signs. Based on age, history and progression of clinical signs, the two primary concerns were IVDD and neoplasia.

Diagnostics Performed

CBC/Chemistry: platelet count 118K but otherwise unremarkable

Urinalysis: unremarkable

Three view thoracic radiographs (radiology report): no radiographic abnormalities of the pulmonary parenchyma, pleural space, mediastinum or thoracic wall. No definitive evidence of nodular pulmonary metastasis or intrathoracic lymphadenopathy. On right lateral image, possible radiolucent lesion within the cranial portion of the vertebral body of C6 (see **Figure 1**)

MRI C1-T2 (see **Figure 2):**

1. T2-weighted hyperintensity of the vertebral bodies of C6, C7, and T2
 - Rule out Neoplasia vs Infectious vs Inflammatory
2. Multiple degenerative intervertebral disks C4-C7 with intervertebral disk protrusion and ventral mild spinal cord compression at C4-C5 with dilation of the central canal of the spinal cord rostrally (C3 and C4)

CSF Analysis: mild mononuclear pleocytosis with normal protein count

Two View Right Shoulder Radiographs (performed 2 days after above diagnostics): lytic lesion associated with the caudal aspect of right humeral head (see **Figure 3**)

Biopsy of the Right Caudal Humeral Head: carcinoma, bone, with frequent mitotic figures. Histogenic origin of carcinoma unknown – consider renal, prostatic, urothelial, and pulmonary carcinomas.

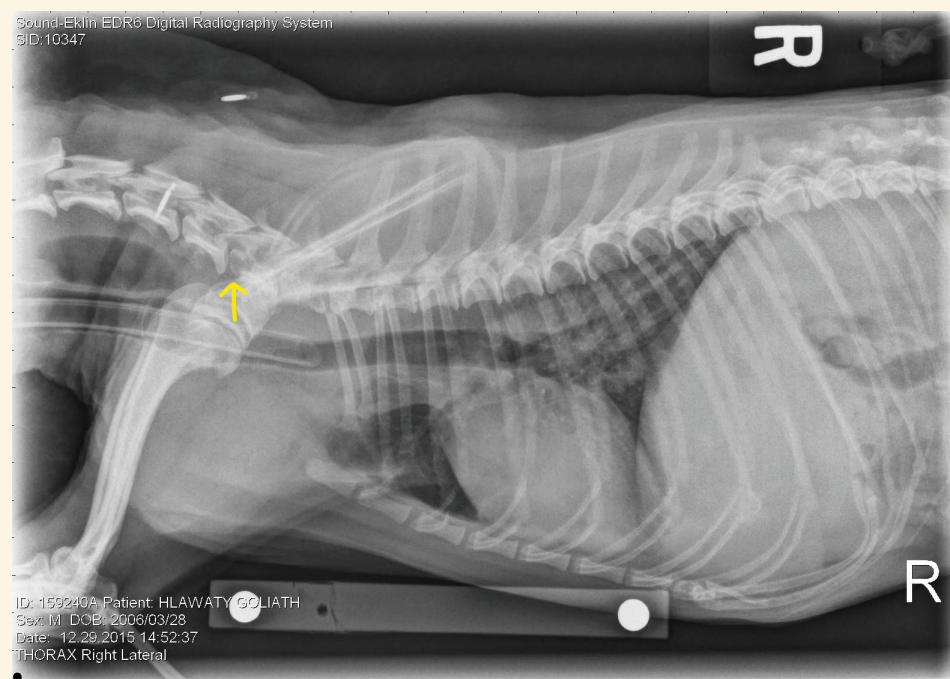


Figure 1. Lateral thoracic radiograph. Unremarkable thorax with possible radiolucent lesion within the cranial portion of the vertebral body of C6 (yellow arrow).

Continued on Page 8 ►

Non-Weight Bearing Lameness — What Is Your Diagnosis?

► Continued from Page 7

Outcome

Pending results of the biopsy, the patient was discharged from the hospital with Tramadol, Gabapentin, Corticosteroids and Famotidine. Once the diagnosis of metastatic carcinoma was made, further diagnostics (such as abdominal ultrasound) was discussed to see if the primary tumor could be ascertained but the overall poor long-term prognosis was discussed with the family. The family ultimately declined further diagnostics and opted for euthanasia after spending several days at home with him.

Discussion

You may ask, why present such a straightforward case? For LIVS Neurology Service, this was not a straightforward case, especially if we wanted a single lesion to explain all the patient's clinical signs.

The cervical pain was obvious and indicated a cervical issue. The perplexing issue was the non-weight bearing lameness (non-WBL). The author has yet to see a patient with non-WBL due to a primary neurologic disorder. Weight bearing lameness can be present with a primary neurologic disorder, such as diseases affecting nerve roots or nerves themselves, e.g. intervertebral disk disease or nerve sheath neoplasia, etc. However, when presented with a patient with non-WBL, the author's first inclination is to rule out a musculoskeletal cause within the affected limb (and so far, that has been the cause in all the non-WBL cases the author has seen). Although the author has yet to see a patient with non-WBL due to a primary neurologic disorder, that does not mean it cannot happen (always try to keep an open mind!). Cervical MRI was pursued, especially considering the unremarkable shoulder radiographs performed 2 weeks prior to presentation to LIVS.

Once the results of the MRI were available, the Neurology Service was once again perplexed. The cervical pain could be explained by the mild C5-C6 IVDD and/or the lesions of the vertebral bodies at C6 and C7, however, the MRI findings did not explain the non-WBL exhibited by the patient, as something affecting the nerve roots of C6-T2 on the right side would be expected if this was a primary neurologic cause.

Although the right shoulder radiographs performed 2 weeks prior to MRI were unre-

markable and initial evaluation of the thoracic radiographs performed at LIVS (which included the shoulders) were also unremarkable, once the MRI/CSF results were available, we were not satisfied with the findings. We felt that something was being missed and that the source of the non-WBL was not yet as-

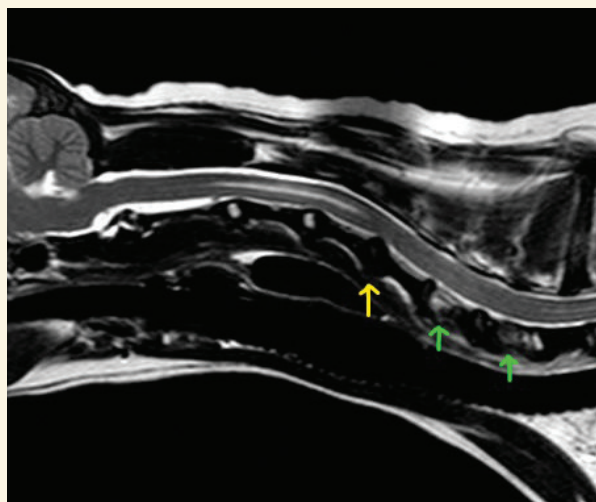


Figure 2. Sagittal T2-weighted MRI of C1-T2. Hyperintensity of the vertebral bodies of C6, C7, and T2 (green arrows). Multiple degenerative intervertebral disks C4-C7 with intervertebral disk protrusion and mild spinal cord compression ventrally at C4-C5 (yellow arrow) with dilation of the central canal of the spinal cord rostrally (C3 and C4).



Figure 3. Lytic lesion associated with caudal aspect of right humeral head (yellow arrow)

certained resulting in further scrutiny of the shoulder region on thoracic radiographs. On subsequent evaluation, a radiolucent area of the humeral head was suspected and two view shoulder radiographs were repeated at LIVS with the family consenting for biopsy at the same time if lytic lesion was present (see **Figure 3**). With the new shoulder radiographs, the lytic lesion of the caudal aspect

of the humeral head was evident and biopsy performed.

This case is a good example of repeating diagnostics. It can be difficult for owners to understand the necessity to repeat diagnostics that may have been recently performed (such as bloodwork, urinalysis, radiographs, ultrasound etc.). Things can change from day to day - what was normal yesterday may not be normal today! Radiographic changes may not be evident initially, even though the patient is clinical, and the changes may take time to develop. Diskospondylitis is one example where a patient may be clinical with spinal pain but the radiographic changes can take several weeks to develop (i.e. spinal radiographs can appear normal initially).

Many clinicians may have stopped making further inquiries based on the results of the MRI, which is understandable considering the MRI findings in this case. However, even though the MRI reveals this patient had a mild C4-C5 IVDD compression and multifocal lesions of the vertebral bodies resulting in the cervical pain observed, we are left with a list of differentials including neoplasia vs infectious vs inflammatory disease. In order to obtain a diagnosis, spinal surgery would have had to be performed to obtain a vertebral bone biopsy. Although vertebral bone biopsy is an excellent option, it was unnecessary in this case with a less invasive (and less costly) humeral head biopsy providing the diagnosis, however, it is understood that it is an assumption that the vertebral bodies in this patient contain the same lesion as the humeral head, but a reasonable assumption, considering the clinical signs of non-WBL and cervical pain occurred and progressed within 2 weeks of each other.

Unfortunately, the diagnosis of carcinoma present in the bone indicates the presence of metastasis. Carcinomas are cancers that arise from epithelial cells, such as the skin or lining of organs but not bone. Presence within bone indicates metastasis from a primary site. Carcinomas can metastasize prior to manifestation of clinical signs attributed to the primary tumor. In people, detailed diagnostics fail to identify the primary tumor in approximately 2-4% of patients with metastatic carcinoma. Regardless of the origin of the primary tumor, the prognosis for metastatic carcinoma is poor. ■

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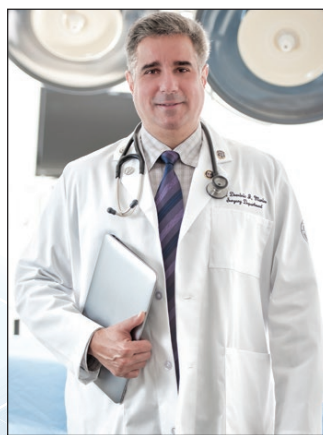
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