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Preface: Decoding Forelimb Lameness: Acquiring the Techniques to Diagnose and Treat  
Kevin Benjamino, Kenneth A. Bruecker  
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Forelimb Examination, Lameness Assessment, and Kinetic and Kinematic Gait Analysis  
Darryl Millis and Krysta Janas  
This article contains a guide for small animal practitioners to use when confronted with the challenge of diagnosing a forelimb lameness. The examination begins by monitoring the dog at a stance and a visual gait assessment. A hands-on evaluation includes the initial examination, checking for asymmetry and muscle atrophy while the dog is standing, and step-by-step instructions for a thorough forelimb examination.

Assessment of Orthopedic Versus Neurologic Causes of Gait Change in Dogs and Cats  
Sharon C. Kerwin and Amanda R. Taylor  
Diagnosis of forelimb lameness may be challenging, as it not only can be due to multiple common orthopedic diseases but also may occasionally be caused by neurologic disease. A thorough orthopedic and neurologic examination is key to determining which disease category is the likely culprit. Deficits identified on the neurologic examination, such as proprioceptive deficits, changes in reflexes, and presence of spinal hyperesthesia, are key in identifying neurologic causes of forelimb lameness.

Common Pathology Associated with the Digits and Metacarpal Region  
Alessandro Piras and Kenneth A. Bruecker  
Fractures and ligamentous injuries of the front paw are common in small animals and usually result from direct trauma, such as vehicular accident, collision with a stationary object, falls from a height, or entrapment of the paw with leverage (eg, stepping in a hole while running). Metacarpal and phalangeal fractures may be associated with concurrent ligamentous injury. Tendon and paw injuries are generally associated with direct traumatic etiologies, such as laceration. Treatment of digit injuries follows the principles of surgery associated with similar injuries at other anatomic locations. External coaptation may be necessary to protect undersized implants.

Canine Carpal Injuries: From Fractures to Hyperextension Injuries  
Lucas Henry Beierer  
The canine and feline carpus is a complex arrangement of bones, ligaments, and joint spaces that functions as a ginglymus joint to provide carpal flexion and extension. Given the demanding biomechanical demands...
on the carpus during weight bearing, a variety of region-specific pathology, often secondary to trauma, are reported. This review details carpal anatomy, biomechanical understandings, and current evidence surrounding carpal pathology and its management. Partial carpal arthrodesis and pancarpal arthrodesis outcomes are reviewed in detail.

**Physeal Injuries and Angular Limb Deformities**

Derek B. Fox

Physeal injuries are common in the developing small animal and can result in growth disturbances of the forelimb. Resulting deformities can include limb shortening, joint incongruity, angulation, and alterations in joint loading with subsequent osteoarthritis, remodeling, and debilitation. Because of the unique paired bone configuration, the antebrachium is the main source for malalignment resulting from physeal disturbance in the forelimb. Successful correction of deformities requires in-depth understanding of normal physeal activity; careful consideration of patient signalment; and the ability to quantify the location, magnitude, and plane of the deformity or deformities.

**The Shoulder Joint and Common Abnormalities**

Rebecca Stokes and David Dycus

The shoulder is a complex joint composed mostly of static and dynamic capsuloligamentous structures and plays an important role in forelimb lameness. Its complex anatomy and biomechanics necessitate thorough examination and diagnostic work-up for accurate diagnosis. This article provides an updated review of common canine shoulder pathologies, including osteochondrosis, bicipital and supraspinatus tendinopathies, infraspinatus contracture, medial shoulder syndrome, and luxation.

**Common Neoplastic Diseases Affecting the Forelimb**

Janis Lapsley and Laura E. Selmic

Lameness, new swelling, or mass occurrence are the most common reasons for presentation when neoplasia affects the limbs. Tumors of the skin or subcutaneous tissues, joints, muscles, bones, or digits of the forelimb are reported. Diagnosis with fine needle aspiration or biopsy is necessary before treatment to allow staging, planning of treatment, and prognosis. The planning of surgical treatment of limb tumors is essential to maximize the chance of a complete resection on the first surgery, given that less skin is available for primary closure in subsequent revision or recurrence surgeries.

**Neurologic Causes of Thoracic Limb Lameness**

Sharon C. Kerwin and Amanda R. Taylor

Although lameness of the thoracic limb typically is due to orthopedic disease, there are several important neurologic conditions that result in lameness. Neurologic diseases cause lameness due to disease of the nerves, nerve roots, spinal cord, or muscles. Common differentials include lateralized intervertebral disc extrusions, caudal cervical spondylomyelopathy
(wobbler disease), brachial plexus avulsion, neuritis, and peripheral nerve sheath tumors. Many of these diseases compress or destroy the nerve roots of the cervical intumescence, resulting in nonweight-bearing lameness, or root signature. Advanced diagnostics, such as magnetic resonance imaging, are necessary in these cases to determine the underlying cause.

**Juvenile Disease Processes Affecting the Forelimb in Canines**

**Nina R. Kieves**

Several juvenile diseases affect the canine forelimb. The most common are hypertrophic osteodystrophy, panosteitis, and retained cartilaginous core. Panosteitis and hypertrophic osteodystrophy tend to be self-limiting, with a good long-term prognosis, although severe cases can develop. These diseases may recur during growth. Severe cases of hypertrophic osteodystrophy can lead to angular limb deformities and may even be fatal. Retained cartilaginous cores can be benign with no evidence of clinical signs and be found incidentally on radiographs. However, if they disrupt the distal ulnar physis significantly, angular limb deformities may persist requiring surgical intervention with a corrective osteotomy.

**Advanced Imaging of the Forelimb: Use of Musculoskeletal Ultrasound and MRI of the Shoulder and Brachial Plexus**

**Ryan King**

Advanced imaging (ultrasound, computed tomography, MRI) is a key component in defining and localizing the underlying cause of forelimb lameness. Given the propensity of soft tissue injury/disease of the shoulder and brachial plexus, ultrasound and MRI are of particular utility in defining tendinous, muscular, and nerve lesions. An advanced knowledge of shoulder and brachial plexus anatomy is necessary for both image acquisition and interpretation. To determine clinical significance, interpretation of both normal anatomy and suspected pathology must be correlated with clinical signs and orthopedic examination findings.

**Rehabilitation of the Canine Forelimb**

**Jennifer A. Brown and Julia Tomlinson**

The goal of rehabilitation is to restore function and mobility and reduce pain associated with chronic disease. Physical therapy for humans is standard of care for acute and chronic injuries and an integral component of postoperative recovery. Although there is a dearth of evidence-based veterinary medical studies in rehabilitation therapy and modalities for forelimb injuries in dogs, some extrapolation from other species can be made and applied. When developing a rehabilitation and therapeutic plan, the biomechanics of the affected limb and timeline of tissue healing of the target tissue and/or joint are important to consider.
Humeral Intracondylar Fissure in Dogs
Andy P. Moores

Humeral intracondylar fissure (HIF) was first described as incomplete ossification of the humeral condyle. It is now known that the fissure is a stress fracture in some dogs. The descriptive term HIF is therefore preferred. In young dogs an incomplete ossification cause may still be valid. Symptomatic HIF is treated surgically with a transcondylar implant. The aim is to alleviate lameness and avoid condylar fracture. Choosing an appropriate surgical approach and implant can reduce complications. HIF is not always symptomatic and, in these cases, surgical management is more controversial, because a minority of such cases become lame or fracture.

Canine Elbow Dysplasia: Ununited Anconeal Process, Osteochondritis Dissecans, and Medial Coronoid Process Disease
Aldo Vezzoni and Kevin Benjamino

Elbow dysplasia is a major cause of front limb lameness in medium to large dog breeds. Underlying causes include ununited anconeal process, medial coronoid process disease, and osteochondritis dissecans. When a definitive diagnosis of elbow dysplasia is made, the surgeon can improve elbow function but cannot entirely prevent progression of osteoarthrosis. Conventional surgical treatment with joint debridement and removal of loose osteocartilaginous bodies is not rewarding if joint incongruity persists; the result is overloading and subchondral bone exposure with erosion of the cartilage of the medial humeral condyle and medial coronoid area of the ulna leading to medial compartment disease.

Canine Elbow Dysplasia: Medial Compartment Disease and Osteoarthritis
Kenneth A. Bruecker, Kevin Benjamino, Aldo Vezzoni, Charles Walls, Kirk L. Wendelburg, Christelle M. Follette, Loïc M. Déjardin, and Reunan Guillou

Erosion of the articular cartilage of the medial compartment of the elbow (the humeroulnar articulation) secondary to incongruency associated with elbow dysplasia or traumatic injury has been termed, medial compartment disease. When nonsurgical strategies to manage osteoarthritis (OA) fail, surgical solutions may be warranted. Surgical strategies to reduce pain include osteotomies of the humerus or ulna to shift the weight bearing axis laterally off the medial compartment of the elbow. Other strategies involve replacement of portions or all of the articular surface of the medial compartment. With global elbow joint OA (medial and lateral compartment), a total elbow replacement may be required.