Juvenile Canine Orthopedic Diseases: Part 1
Thoracic Limbs

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Objectives
- Identify common juvenile orthopedic diseases of the thoracic limb
- Be able to accurately diagnose and discuss the medical and surgical options to owners
- Give an accurate prognosis for common orthopedic issues

Introduction

Orthopedic pathology is commonplace in veterinary medicine and can sometimes pose a diagnostic challenge for the clinician. Knowledge of the regional anatomy is imperative in making an accurate diagnosis. Age of the patient also has a bearing on the diagnosis. There are common issues that are encountered in the juvenile canine patient versus a skeletally mature patient. If we are seeing juvenile issues in the mature patient, we are likely also dealing with secondary degenerative changes. It is very important to be able to recognize and diagnosis the most common juvenile disease processes. This lecture is aimed at reviewing some of the common forelimb juvenile issues.

Our primary focus will be on congenital/hereditary orthopedic issues affecting the forelimb in the canine patient. The antebrachium – carpal flexural deformity, premature closure of growth plates of the radius and ulna, elbow dysplasia, and shoulder osteochondritis dissecans (OCD) will be reviewed. While a separate lecture could be dedicated to each of these topics, we will focus on an overview of the disease process, treatment and potential outcome.

Carpal Flexural Deformity

Carpal flexural deformity is also known by other names such as carpal laxity syndrome, etc. This is a process that is generally seen in medium to large breed young puppies as young as 6 weeks of age. In this condition the puppy may be affected in one or both forelimbs and has a characteristic stance. There is extreme hyperflexion noted at the level of the carpus and the carpus may be positioned more laterally in relation to the more medially positioned paw when the pet is weight bearing.

Examination of these patients is crucial for both the diagnosis and prognosis. In dogs affected by carpal laxity syndrome, the noted changes are typically only present during weight bearing. If the pet is placed in lateral recumbency the joints resume a normal range of motion and the angulation disappears. Radiographs are also necessary for these
patients. In true carpal flexural deformity, the radiographs are normal as the condition is extraosseous. That being said if the deformity is severe and chronic, it is feasible that angular limb deformities could be seen due to excessive stress being placed on the growth plates. At this young age, radiographs may be difficult to interpret and must be read carefully and not overinterpreted.

In most cases, surgery is not needed. It is typically recommended that graded exercise that is controlled (leash based walks) be performed. A consultation with a rehabilitation service (if available) is recommended in order to hasten recovery and improve range of motion. The patient should only be walked on secure flooring to assist with walking. It is rare that bandaging and bracing would be needed, however this could be considered in the severe cases that have some level of chronicity. Most of the time bracing will cause more problems from a bandage complication stand point and be counterproductive by limiting the range of motion to the joint.

Carpal flexural deformity typically has a good prognosis and generally takes 6-8 weeks for recovery. Most owners are skeptical of this good prognosis because their pet can be so severely affected. It can be difficult to assure them that this condition will resolve without surgical intervention. Unfortunately, the etiology of this condition has not been defined.

**Premature Growth Plate Closure**

Early closure of growth plates can be extremely problematic in the developing patient. The growth plates in any bone can be affected and the real key as to the amount of issues a patient may have is dependent on what age the growth plate closes. We can see a disastrous result if this occurs at a young age (under 6 months) versus the near skeletally mature patient.

There are two main categories of causes for premature closure of growth plates. The first would be trauma (Salter Harris fractures) and the second would be congenital/developmental. It is known that the germinal cartilage cells of the growth plate are very sensitive to pressure changes. Even light trauma at this level can damage these cells that cause early closure. Inflammatory processes at the level of the bone can also cause early closure, such as panosteitis, hypertrophic osteodystrophy, etc.

There are three main growth plates in the antebrachium (minus the anconeal and the olecranon processes) and all can cause issues to either the carpus, elbow, angulation or problems with limb length. The most common growth plate to be affected is the distal ulna. We commonly see this in the chondrodystrophic dog, however this can be seen in any breed of dog.

**Distal Ulnar Physis Closure**
This is the most common site of growth plate changes in the dog. Due to the connection to the adjacent radius by the interosseous ligament there is a “bow string” effect when the distal ulna closes prematurely. This can cause the radius to deform in the cranial-caudal plane (radius curvus), in external rotation and cause a valgus deformity to the carpus. It is important to know that about 75% of a puppy’s growth is complete by approximately 6 months of age. It is also important to realize the times at which different growth plates close.

The most common cause of this type of early closure would be a Salter Harris type V fracture or compression fracture. This will cause the germinal cartilage cells at the growth plate to close down. This type of fracture is nearly impossible to catch early in onset and even if it were caught early, little could be done to salvage the growth plate. Another cause of early growth plate closure is a retained cartilaginous core. This occurs in the large and giant breed dogs and appears as a “candlestick” appearance within the distal physis. It is marked by delayed endochondral ossification of a zone of the metaphysis and this results in cores of hypertrophied cartilage cells versus the normal trabecular bone pattern.

If the carpal valgus is less than 25 degrees and the patient is under 6 months of age, a good outcome can result with a minimal surgery called an ulnar ostectomy. A distal ulnar ostectomy with removal of a segment 1.5x the diameter of the ulna is recommended. The periosteum at this location is removed and a fat graft is placed ideally. This surgical approach can have a potentially good outcome and releases the radius from the “bow string” tension. Over the next few weeks correction of the abnormal valgus deformity will begin to correct. I would not expect a complete correction, however the limb should be functional.

If the carpal valgus is more excessive and/or the patient is greater than 6 months of age, a simple ulnar ostectomy will likely not yield the desired results. It would be recommended to perform a distal radial corrective ostotomy with an ulnar ostectomy to perform an acute correction of the deformity. This is typically a multiplanar correction and requires pre-operative planning with either radiographs and/or CT scan. Stabilization of the correction is with either an external fixator or internal fixation with a plate and screws. Prognosis for this type of correction is good. It is recommended that this type of acute correction be performed near the end of growth (around 9-10 months of age).

Another problem that can arise from distal growth plate closure is elbow incongruency. This is generally diagnosed on radiographs. A CT scan can be performed for additional information regarding other signs of elbow dysplasia (see elbow dysplasia section). This will cause long-term lameness, as abnormal force will be placed across the elbow joint. Other factors of elbow dysplasia such as fragmented medial coronoid processes can be seen with this issue. When this condition is noted, a proximal or mid-diaphyseal ulnar
ostectomy should be performed to allow for improved congruency. Depending on the area of the cut and the angulation of the cut in the bone, an intramedullary pin can be placed. Be sure to measure the length of the incongruency and remove that much (or more) of the ulna.

**Proximal and Distal Radial Physis Closure**

These closure issues only account for about 17% of cases (versus distal ulnar closure). The hallmark of this issue is a shorter radius. There may or may not be an angular limb deformity that develops, however in some cases either a varus or valgus deformity can develop. If distal antebrachial angular limb deformities develop, these are corrected as previously mentioned. With regards to elbow incongruency issues, some cases will respond to an ulnar ostectomy, however this will not address the length of the limb if that is a major issue. Again, it is important that enough of the ulna be removed in order to achieve congruency. A proximal ulna ostectomy is recommended in these cases. Another option is performing distraction osteogenesis (limb lengthening) using an Ilizarov fixator. The prognosis for these cases would be deemed fair.

**Elbow Dysplasia**

Elbow dysplasia is a multifaceted disease that can affect both juvenile and mature dogs. The complex of elbow dysplasia can be divided into the following categories:

- **Fragmented coronoid process (FCP)**
- **Medial compartment disease (MCD)**
- **Osteochondrosis dissecans (OCD)**
- **Ununited anconeal process (UAP)**
- **Elbow incongruency (EI)**
- **Ununited medial humeral epicondyle**

One or more of these problems can affect a patient and cause a varying amount of lameness. Elbow dysplasia is a congenital issue and affects mostly larger breed dogs, but can affect small breed dogs, as well. The most common clinical sign that is reported in dogs is front leg lameness. This can vary in intensity and can occur slowly or acutely (all of a sudden). Some pets will develop swelling at the elbow. Typically, limping becomes worse with activity and can subside with rest. Unfortunately, clinical signs can vary from pet to pet.

**Diagnosis:** A thorough exam is recommended to isolate the elbow as the problem (please refer to other lecture on forelimb examination). It is important to evaluate the whole front leg as well as the opposite leg for any abnormalities, because elbow dysplasia is congenital, both elbows tend to be affected (>80%).

**Radiographs** – In juvenile dogs, changes can be very minimal. Classic radiographic signs
include: osteoarthritis (anconeal ridge is an early sign), subtrochlear sclerosis (STS) of the ulna, joint swelling and fragmentation of the medial coronoid process (33-50% visible on radiographs). OCD and UAP lesions typically will be evident on radiographs. It is standard to take three views of each elbow. – cranial-caudal view, normo-flexed lateral view, and hyper-flexed lateral view.

*CT scan* – Computed tomography (CT scan) may be necessary in some cases to make a diagnosis. A CT scan requires sedation or general anesthesia. The advantage of a CT scan is that it gives greater detailed imaging of the joint allowing for earlier detection of changes. Sensitivity of a CT scan is >90% in diagnosing elbow dysplasia.

**Treatment:** Successful treatment of elbow dysplasia can occur with early diagnosis and treatment. The more advanced the arthritic changes (which will occur with time), the less successful treatment becomes. The following is a brief overview of the current treatments that are performed, usually in combination. It is important to inform the owner that the elbow will never be normal and our goal is to improve comfort and quality of life.

*Arthroscopy* – Considered to be the “gold standard” when evaluating the joint, arthroscopy allows us to obtain critical information about the joint by looking in the joint via a minimally invasive approach. An arthroscope is introduced into the joint and the joint surfaces are assessed for arthritis, cartilage wear, incongruency and fragments. If fragments exist, these can be removed arthroscopically. If substantial cartilage wear is present other procedures may be recommended such as subtotal coronoidectomy and biceps tendon release.

*Conservative management* – Conservative management includes non-steroidal anti-inflammatories drugs (NSAIDs), supplements, physical therapy, acupuncture, and regenerative therapy (platelet-rich plasma and/or stem cells). These therapies are often used in conjunction with arthroscopy and surgical management.

*Advanced surgical procedures* – Depending on the assessment of the joint, other procedures may be recommended such as the following: sliding humeral osteotomy (SHO), unicompartiment elbow replacement (CUE), proximal abducting ulnar osteotomy (PAUL) procedure, biceps tendon release and elbow replacement surgeries.

The prognosis for this disease varies due to the severity. With early diagnosis and aggressive treatment, the success rate for treating elbow dysplasia is approximately 80% for making the patient comfortable. This generally entails elbow arthroscopy and sometimes more advanced procedures. Also, if changes are detected on the opposite leg, arthroscopy of this leg is also recommended. In about 20% of the cases continued therapy and multiple procedures may be needed. In the end, elbow dysplasia is a life long, progressive disease. Elbow replacement surgeries are still up and coming and can be considered in patients with “end-stage” changes to the elbow
Osteochondritis Dissecans (OCD) – Shoulder

This disease process typically affects the juvenile patient (6-18 month), occur in the medium and large breed dog, and is a congenital/hereditary issue. The most noteworthy joints affected are the shoulder (proximal humerus), the elbow (distal humerus), stifle (distal femur), and hock (talus). The underlying etiology is similar in all the joints, however this will focus on the shoulder.

Osteochondrosis (OC) precedes osteochondritis dissecans (OCD) and is characterized by a problem between the metaphyseal growth plates of the affected bone and the cartilage. In essence, the cartilage surface does not adhere to the underlying subchondral bone surface. When a cleft or break develops in this “soft” cartilage, this fulfills the term OCD. Once the area progresses to an OCD lesion, the patient becomes clinically lame and will exhibit a degree of lameness/limping.

There are multiple suspected causes of this issue in the dog, with the most reasonable explanation being that of a congenital/hereditary cause. There is some support of other predisposing factors that may enhance the genetic expression of this disease such as juvenile obesity and imbalances in calcium intake. Patients with this type of condition will usually be within 6-18 months of age and have a varying level of lameness on one or both front legs. An owner may also see more limping/lameness after strenuous activity or rising from rest.

Physical examination of the suspected patient usually will direct us in the right direction. A thorough gait evaluation is needed to identify which leg or if both front legs are affected. There are certain techniques that can be used to detect which leg is the culprit even with a mild lameness. The next step in the evaluation is direct palpation of the leg starting from the digits, working up to the neck. It is very important that care is taken at each joint and long bone on evaluation, since shoulder OCD is not the only cause for limping in the young dog. Typically, discomfort will be elicited on manipulation of the affected shoulder(s) and especially on hyperflexion and hyperextension of the joint. The next step is diagnostic tests.

Radiographs are typically the first type of diagnostics performed. In many cases there will be a “classic” flattening of the caudal humeral head and possibly early osteophytes can be seen. This lesion also typically has an area of increased lucency/decreased opacity directly under the flattened area. The ability to see the lesion does require specific positioning of the shoulder as it can be located medially. Another way to diagnostically evaluate the joint is with a computed tomography (CT) scan. This will give more detail into the region of interest. Generally this is not needed, however indications for it may be to evaluate the elbows as well.
For the best possible outcome do not delay treatment! At this time, the gold standard approach is arthroscopic debridement (removal) of the fragmented cartilage and the surrounding diseased cartilage and subchondral bone. Curettage may allow the now vacant cartilage bed to fill in more quickly with fibrocartilage.

If there is an osteochondrosis (OC) lesion and there is no fragmentation (OCD), non-surgical treatments (activity restriction, dietary restriction, etc) may be attempted. Unfortunately, if OCD has not occurred then the patient will not be limping and most of these dogs go undiagnosed.

There are older techniques of opening the joint to get access to the cartilage flap, however the recovery time on this type of procedure is significantly longer than arthroscopy. Also, complications are increased with an “open” technique than with arthroscopic techniques. Arthroscopy is a minimally invasive tool that allows both diagnosis and treatment of this condition. Generally speaking, the patient can walk on the surgery leg (even if both legs have surgery at the same time) following an arthroscopic procedure. Generally 2-3 small ports are placed over the shoulder (2-4mm in length) and this allows access to the joint and work within the joint.

Recovery for the arthroscopic procedure is generally 4-6 weeks. Every surgeon has a different protocol post-operatively. I prefer controlled movement for my patients. In the first two weeks, passive range of motion is very important, followed by active icing of the joint(s). Short leash based walks are started shortly after surgery and incrementally increased as we proceed through the recovery phase. Introduction into a formal rehabilitation program is recommended, however there are times when this is not possible and rehabilitation must be performed at home.

When diagnosed and treated early, the patient affected with OCD can have a good prognosis and resume a normal or near normal activity level and quality of life. The longer the lesion is present, the more inflammation and arthritis will develop, decreasing our success with surgery. Of the OCD lesions the shoulder has the best prognosis. I do encourage all my patients to continue on joint supplementation for life and to be removed from any breeding program.

The above was a very brief overview of some of the more common congenital, juvenile conditions seen in regards to the forelimb. As with most conditions, the earlier the detection the better the prognosis.