

## ULNAR OSTEOTOMY:

“A premature closure of growth plates makes things curvy”



DPUO Procedure

(Dynamic Proximal Ulna Osteotomy)



PAUL Procedure

(Proximal Abducting Ulna Osteotomy)

**Overview—“I don’t understand what Angular Limb Abnormality is; please help me understand the condition & the treatment.”**

Legs grow in length because of a growth plate (“physis”), several of them located on each end of each bone in the leg. Toes, foot bones, lower arm, upper arm, shin, thigh—they all have growth plates at the top & bottom that create new bone & thus make us & your pet, grow taller. Any of these growth plates can be disturbed/slowed down/stopped by an injury, birth defect or nutritional abnormalities; they also can be purposefully altered by genetic tinkering to create short-statured breeds (i.e. basset hound, dachshund, etc.)

In any of those situations (regardless of the original cause), the result of a growth plate disturbance will be a bone that is not normal (& “normal” is relative when talking about purposeful breed alterations; the breed “normal” is not the bone “normal”.) The bone can be just short. It can be long on one side & short on the other, creating a bend. Or, if it is paired with another bone next to it, one can be short & the other long, creating a slight dislocation of one of the paired bones from its corresponding joint.

The most common angular limb abnormalities are seen in the paired bones of the lower front limb, the radius & ulna, most commonly in the short-statured breeds. In these pets, presumably the genetic messages in the lower end of the radius & the lower end of the ulna are slightly wonky. They grow asymmetrically, with the ulna producing slower & stopping sooner. In the normal breed scenario, they grow at the same rate but finish sooner overall, resulting in just a short/crooked leg. In the angular limb scenario, in the short-statured breeds or other breeds after a minor (often unrecognized injury), the ulna slows/stops much too early but the radius wants to keep growing. What results is a “bow string” effect; imagine a bow (think...bow & arrow). The string is tight & shorter, while the wood is longer & bent. The ulna is the “string” & the radius is the “bow”. The elbow is the loser. The radius keeps pushing up on the upper arm bone (humerus) but the short little ulna is just hanging on with its fingernails! A slight dislocation, in this case, is called subluxation. Subluxation of the elbow in the angular limb abnormality is the most common cause of pain & lameness in the growing animal & chronic arthritis in the adult.

**“Why is a Corrective Ulnar Osteotomy procedure being recommended for my pet?”**

A relatively simple corrective procedure can be used in the still-growing animal to relieve the restrictions imposed by a prematurely closed/stopped ulna growth plate. The younger the better; if we catch it early (4-6mo), we can reverse & normalize many of the abnormalities that are created by the “bow string” effect. A little later in a youngster’s development (6-10mo), we still can make some progress, but the cosmetic appearance of the crooked leg & the overall length of the leg may not be corrected. As a young adult, when growth has stopped, we can improve the elbow joint comfort to some degree, but leg length & curvature may need additional corrective surgical work to be improved.

The “low” ulnar ostectomy is a straightforward procedure to remove the restriction of the ulna “bow string”. We simply remove a short but significant segment of the lower ulna bone/growth plate. In doing this, we are allowing the radius to dictate lower leg growth; we remove the restriction created by the ulna & the dislocation of the elbow caused by the asymmetric growth. The radius continues on with its development & self-corrects many of the abnormalities. Since the radius is the major player in the lower leg, we are not concerned about removing large portions of ulnar bone. (In fact, we worry more about removing too little & the ulna “healing” before the radius is done with its work, thus re-creating the bow string.)

The “high” ulnar osteotomy is slightly more involved, & involves cutting the ulna higher on the bone, closer to the elbow. This procedure is used in older youngsters when overall growth potential is less (i.e. there is less time & growth distance ahead to self-correct the abnormalities.) A cut is made in the upper ulna to free the segment closest to the elbow, allowing it to float a bit & find its happy spot within the elbow configuration.

### **“What options do I have to treat my pet’s problem?”**

In young animals with enough growth potential to self-correct the elbow subluxation, the low ulnar osteotomy is a very good choice. If the only growth plate abnormality is in the ulna, this will remove the restrictions & allow the radius to keep doing its work. The procedure is relatively, minimally invasive; recovery is relatively quick.

In young animals with a shorter window of growth opportunity, the high ulnar osteotomy may be the surgical preference. If the elbow is the primary source of concern, making a cut in the ulna up near the elbow allows just that subluxated portion of the ulna to shift & find a more appropriate position in the joint relatively quickly/immediately.

In all patients with joint abnormalities of most sorts, there may be improvement in longterm joint health (i.e. less arthritis) using supplements longterm. Glucosamine/chondroitin/MSM supplements theoretically supply the building blocks of joint fluid & cartilage, keeping them healthier. High dose fish oil supplements counteract the inflammation & pain of arthritis & may minimize arthritis over the long haul.

Without treatment, most of these elbows will have reduced function & comfort. If the condition is in both front legs, this outcome may be hard to see & appreciate (i.e. one leg won’t be lame, both legs will). In short- statured animals, their gait is not heavily dependent upon a full elbow range of motion & their activity levels may be dramatically less than their tall counterparts. It is difficult to gauge precisely whether any one animal is at his/her full potential relative to mobility.

**“What postoperative complications do I need to know & understand when considering this surgery?”**

For the low ulnar osteotomy procedure, the complications are few. The incision may develop a temporary fluid pocket underneath it, called a seroma. Rarely does that need more than a compression bandage or warm compresses & time to go away. The uncommon but biggest concern is that the osteotomy site heals/bridges too soon. If this happens, a second procedure to re-release the bow string restriction may be needed. This is more likely to occur when the procedure is performed in younger animals with a longer growth period to monitor.

With high ulnar osteotomy procedures, the combination of active patient & a highly mobile joint/surgery site creates a delay in bone healing that can be uncomfortable for several months. Many techniques to surgically stabilize the osteotomy have been tried through the years; they carry their own complications. Each patient is evaluated & a plan made to balance the risks of surgically stabilizing vs leaving the osteotomy unstabilized at the time of original surgery.

**“Are there situations when the surgical outcome is not what we hoped it would be?”**

Precise predictions cannot be made about an individual animal’s growth plates. We can tell on x-rays when they are completely closed, but prior to that, we do not have diagnostic tools to judge their status specifically. If a small portion of a growth plate is damaged or abnormal, we can only comment on it retrospectively when the bone is curved. Because of this limitation & the additional challenge of the balancing act of paired bones in the specific locations of the lower front leg (radius & ulna) & lower rear leg (tibia & fibula), a corrective osteotomy/osteotomy may not fully address or correct the limb problem caused by premature or asymmetric closure of one or more growth plates. Ongoing leg curvature or a leg that is too short both may need additional corrective procedures if the leg function is insufficient when development is complete.

**“How is my pet’s life & lifestyle likely to change after this procedure?”**

When corrected young, & when the growth plate abnormalities are not complex, the long-term lifestyle of comfortable leg use will be improved.

**“Are there things I can do to prepare myself, my home &/or my pet for this procedure?”**

Often these abnormalities, when found in short-statured breeds, effect both legs. Having surgery on both front legs can be logistically challenging during recovery. Your pet will need a lot of assistance from you in navigating the simple tasks of daily life until healing advances & comfort improves. A well designed, ergonomic sling is a good investment for this recovery period.

**Outpatient Surgery & Anesthesia** can be uncomfortable, painful, disorienting, & frustrating experiences for animals; watching your pet work through the early postoperative period & recover from anesthesia & pain medications can be worrisome, scary & frustrating for pet owners. The vast majority of the time this period of difficulty is brief & your pet is actually more comfortable & secure at home with you. Sometimes it doesn't feel like that at two in the morning when your pet is anxious & not consolable & you are unsure of what to do. You always have the option of transporting your pet to a 24-hour veterinary facility postoperatively. If you do not want to have your pet home in the first few days postoperatively, please advise your primary care veterinary staff. They will provide contact information for a local 24-hour veterinary facility & help get an estimate for the ongoing care.

It is important that you have proper expectations about this procedure; your experience & your pet's outcome will benefit greatly.

**What To Expect? — DPUO & PAUL procedures are salvage procedures**

that are only used when there is extensive elbow damage present. As such not every undergoing an osteotomy will return to normal. ~80% of dogs having one of these procedures will show significant improvement leading to greater activity & reduction in need for medication, though chronic progression & loss of function may still occur as the dog ages.

**COMPLICATIONS** can occur with any major surgery. Dogs having an ulna osteotomy can often show more lameness following surgery than before the operation. This can last up to 6 weeks before an improvement is seen. Especially with DPUO a large callus may occur at the surgery site, which will present as a large hard swelling under the skin. The callus should reduce over time, but it may be possible to feel it in the long term.

Infection may occur following any surgery. Despite modern antibiotics, preparation techniques & disposable drapes & gowns, this occurs in ~3% of cases, & in some dogs requires removal of some implants. This is likely to show as swelling, heat & pain at the surgery site & a discharge may be present.

## **POST-OPERATIVE INFORMATION: Corrective Ulnar Osteotomy**

Your pet has had a growth abnormality of the ulna (bone of forearm) corrected with either a high ulnar osteotomy or a low ulnar osteotomy or both. These procedures are used to correct developmental abnormalities of the elbow &/or the wrist (which often are both present to some degree). The key to success with these procedures is that the remaining bone growth will continue after surgery & slowly bring the elbow &/or the wrist back into alignment. Long term joint stiffness & degenerative joint disease (i.e. "arthritis") may be a complication of these growth abnormalities that may need to be managed.

### **ACTIVITY RESTRICTION x 6 weeks**

\*Please keep your pet in a comfortable, safe indoor location without free access to stairs for the next 24 hours as he/she recovers from anesthesia & surgery. Your pet may be groggy for the first few days. He or she may whine or appear more anxious than usual; this may indicate pain/discomfort or side-effects of the medications. Please call your veterinarian for assistance with medication adjustments or return for exam & additional pain medications as needed.

\*Confine your pet to one level/section of the house on carpeted floors. Use baby gates, etc. to prevent access to slick floors or stairs. Do not allow jumping on/off furniture. Confine to a small area/room/crate when unattended. Please do not allow any playing, running or jumping. For dogs, use a short leash on a chest harness when going outside to urinate/defecate.

\*Your pet will feel like using the leg normally before the bone is healed. Please continue the restriction during this difficult time when he/she is feeling "too" well! Failure to do so may cause serious healing problems.

### **INCISION CARE**

\*Do not allow your pet to lick or chew the incision once the bandage is removed. Pets tend to want to lick early in the healing period & this can compromise the incision & predispose to infection. If necessary, please use an E-collar if you must leave your pet unattended.

\*Lick Sleeve should be used with the E-collar. If the lick sleeve becomes dirty ~2-4 days, please remove it & wash & dry then replace onto your pet.

## **BANDAGE/SPLINT MANAGEMENT**

\*A bandage may have been applied to the operated limb. The goal of the bandage is to provide pressure to the surgical site to minimize swelling & improve patient comfort for the first few days. Please place a plastic baggy over the foot whenever you take your pet outside to prevent soiling of the bandage; remove when indoors. You may remove the bandage in 5 days. If the bandage slips below the incision or becomes soiled or wet before this time, please remove it by simply cutting away one layer at a time (use caution, avoid skin); no need to replace.

\* Please monitor the bandage for slipping or damage from chewing, etc. If it changes position or loses its integrity (i.e. section is chewed off), serious problems may occur with healing or new problems with pressure sores may develop. Please call if any changes in bandage position occur; the bandage may need to be replaced.

## **PROGRESS EXAMS**

\*Return to your veterinarian in 10-14 days for a progress exam. Skin healing & leg function will be evaluated, sutures will be removed, & any physical therapy questions will be addressed.

\*Your pet should start touching his/her toe down within the first 2 weeks. Thereafter, leg use should steadily improve to 90% normal at ~6-8 weeks. If you notice a sudden deterioration in leg use or more angular change to the wrist at any time after surgery, please see your veterinarian for exam.

\*For dogs younger than 10 months at the time of surgery, it is not uncommon for a second (& rarely a third) surgery to be performed to keep the bone that was cut from healing. This is exactly opposite to what we normally want bone to do; in your pet's case, we want the ulna gap (that we surgically created) to stay open to allow the radius to grow unrestricted & self-correct its angle. We are in a race between the radius finishing its growth (& straightening things out) & the surgical ulna gap healing/bridging. Please monitor the degree of wrist angulation; if this continues or worsens, please see your veterinarian. If exam or x-rays show that the ulna gap is bridged & the radius still needs time to grow, we may need to open up the bridging bone again with a short procedure. Please return for re- evaluation every 2-4wks (as directed) for follow-up exam &/or x-rays.

## **DIET**

\*Ideally, keep your pet on the thin side of normal his/her whole life. Any orthopedic condition can progress with arthritis over time with excessive, wear & tear; carrying less body weight will relieve some of this stress from the elbow (& other) joints. Good parameters to monitor body condition are:

- 1) you should be able to feel the ribs & pelvic bones, but not see them;
- 2) your pet should have an "hour glass" figure when viewed from above looking down;
- 3) your pet should have a tucked up belly when viewed from side.

\*Glucosamine/chondroitin supplements, promoting healthy joint cartilage, might have some beneficial effects in these cases but that this has not been clearly established. You & your veterinarian should discuss whether or not these products would be helpful for your pet long term.

## **PHYSICAL THERAPY REGIMEN**

\*Our lives are often very busy, so if you must err, err on the "do less" side of these instructions. Less physical therapy will result in a slower return to function, but more aggressive physical therapy by a non-professional too early may result in failure of the implants & surgical repair.

### **\*Week 1: Cold & Warm Therapy --**

For the first 3 days after surgery, use an ice pack (or bag of frozen vegetables) wrapped in a damp tea towel to apply cold therapy to the operation wound for 20 minutes 2 to 3 times daily. For the next 3 days apply a warm pack (or a hot water bottle wrapped in a towel) to the wound for 20 minutes 2 to 3 times daily. It is normal for your dog to have some soft swelling of the operated leg to the level of the carpus. You can help reduce this with twice daily massage, starting at the carpus, & working upwards to the elbow.

### **\*Week 2: Passive Range of Motion Exercise (pROM)--**

Have your pet lie on his/her good side. Apply a warm compress to the elbow & wrist. Grip the foot with one hand & slowly & gently push the foot up into flexion of all joints; hold for 5 seconds. Slowly pull the foot & push the leg down & back into full extension of all joints; hold for 5 seconds. Focus on the wrist & elbow. Repeat this motion 15-20 times twice daily. This exercise should not be performed to the point of pain or resentment. Continue 4 weeks.

### **\*Week 3: Massage--**

Have your pet lie on his/her good side. Perform both superficial skin massage & deeper muscle massage. Skin massage around the forearm involves using your fingers loosely on the surface of the skin, applying enough pressure to move the skin relative to the underlying tissues. Muscle massage of the forearm & upper limb involves deeper kneading & pushing of the muscles. Perform massage for 10-15 minutes twice daily. Continue 4 weeks.



**\*Week 4: Active exercise (for dogs)--**

Place your pet on a short leash on a chest harness & have him/her walk at your side. Walk outside on even/solid footing for 10 minutes twice daily. Continue 4 weeks.

\*Swimming is wonderful rehabilitation exercise (for some dogs) when performed correctly. You may allow controlled swimming after week 4. Controlled swimming requires that your pet not jump or leap into the water; walking into the water until it is deep enough to swim is required. Throwing balls to fetch often results in sudden jumping & lunging, which can cause serious problems in the healing phase. Do not over extend your pet; start with short excursions (5 minutes) & increase duration & frequency gradually.

**LONG TERM LIFESTYLE**

\*After the supporting bones are done growing & the surgical sites are healed, there are no restrictions on activities for your pet. A gradual return to full function should occur, to allow for a smooth return of muscle function & strength following the restricted period.

\*Elbow joints can be very unforgiving following growth abnormalities such as this; wrists are much more tolerant. Stiffness & discomfort can be signs of degenerative joint disease (i.e. arthritis) that may progress over time. Maintaining a lean body condition & a moderate degree of low-impact activity will be very helpful in optimizing the long term function of your pet's elbow & wrist.

\*Growth plates are difficult to evaluate; we can make educated guesses about how healthy they are (based on x-rays), but many times we can only see the problem once they are "closed" & have stopped growing (when a short or crooked bone is the result). The main goal with surgical manipulation of young bones with growth plate abnormalities is to return the joints to alignment to prevent future arthritis. Early correction & frequent monitoring until full grown are essential. Once a dog has stopped growing, other procedures can be used to further straighten bones that did not achieve full self-correction.

If you would like assistance with your pet's exercise recovery, please let your veterinary team know so we can provide a referral to a local veterinary physical rehabilitation center. If you have any questions, please feel free to ask your primary veterinarian &/or veterinary surgeon.

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