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LONG ISLAND VETERINARY SPECIALISTS
163 SOUTH SERVICE ROAD ▪ PLAINVIEW, NEW YORK 11803
PH: 516-501-1700 ▪ FAX: 516-501-1169 ▪ WWW.LIVS.ORG

Inside This Issue

Brachycephalic (obstructive) Airway Syndrome, *Part 3 [OF 3 PART SERIES]*

Dr. Robert Waddell DACVS-SA

Surgery

The majority of disease states involved with brachycephalic airway syndrome are considered surgical conditions. Surgical preparation is with the use of dilute antiseptic solution or povidone-iodine (betadine). Preoperative metoclopramide can be used to decrease intraoperative and post-operative regurgitation risk associated with upper airway surgery, although its efficacy is being questioned. The current recommendation is to surgical correct affected pets after 6 months of age.

Elongated soft palate

Options for surgical correction of the elongated soft palate include excision palatoplasty (staphylectomy) and folded flap palatoplasty.

The goal of palate surgery is to return the soft palate tip to just before (rostral to) the epiglottic tip or at a level midway to caudal to the tonsillar crypts (palatine tonsils). It may be allowed to barely contact the epiglottic tip. If resection is insufficient, then the epiglottis will continue to be prevented from returning to its normal position. If resection is excessive, then the patient risks aspiration, rhinitis, sinusitis, and pneumonia.

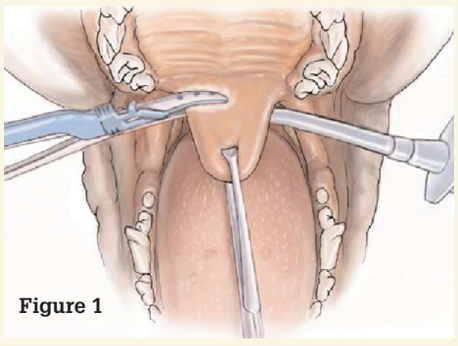

Figure 1

Options for performing the palatoplasty include use of a bipolar sealing device (LigaSure) [**Figure 1**], CO_2 laser, manual crushing, electrocautery, electroscalpel, low-temperature high-frequency radiosurgery units, and sharp dissection (scissors or scalpel blade). These procedures may be performed with the patient in dorsal or ventral recumbency.

Surgical time and hemostasis are both improved with the use of electroscalpel, the bipolar sealing device, and CO_2 laser. The surgical time with the use of a bipolar sealing device is less than that of the CO_2 laser. Excision with the use of LigaSure, an electrothermal, feedback controlled, bipolar sealing device, is 67.5 seconds in duration, results in a 3 to 5 mm depth of histologic changes at 48 to 96 hours

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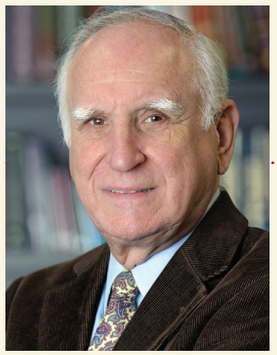
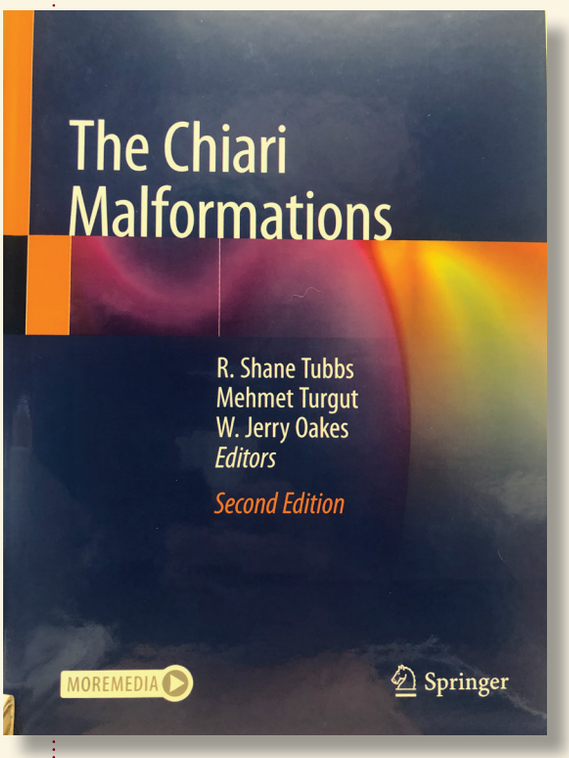
A Note from the Editor



LIVS has arrived at its twenty-second year serving the veterinary community locally and beyond. The renovations and new construction on its campus are proceeding at a pace initially slowed by the spread of COVID-19 but they are now moving along purposefully as the hot summer months have begun. The new parking areas will make rainfall a passing event and flooding a memory. LIVS was the first specialty referral hospital on Long Island and it maintains its place at the forefront continuing to offer its many services to the veterinary community while fully maintaining social distancing and separation during drop offs and pick ups of pets. Wipes, hand washes, face masks, gloves and careful techniques have kept our employees , clients and pets safe. We are confident that LIVS will continue to pioneer novel diagnostics and treatments and it is with great pride that it continues to offer these services in support of the veterinary community.



The second edition of "The Chiari Malformations" a respected textbook for human neurologists and neurosurgeons has just been released. It contains a chapter written by Drs. Dominic Marino and Curtis Dewey from LIVS and Cornell, the only veterinary surgeon authors cited. We proudly applaud them.

The high temperatures bring instances of pets, and children too, being left in cars; dangerous for even a few moments as temperatures reach unbearable levels in minutes, as high as 160 degrees in 10 minutes when the temperature outside is 90. Death can occur in 10 to 20 minutes in those instances. Law enforcement officials are permitted to break windows to rescue pets or children when found inside locked vehicles. Coming upon a situation like this, an individual should call the police before breaking the glass, as current events might subject one to harassment accusations instead of Good Samaritan status.

During the early quarantining days, LIVS initiated a "Neighbors helping Neighbors" food drive. Boxes of cereals, canned foods, pasta etc. were collected; dog and cat food too which were deposited in a bin at LIVS and distributed to help fill our local food banks. A big thank you to all.

While we are still deeply involved in the pandemic, the concept of "One Health," the global initiative that links humans, animals, and the environment places veterinary professionals in a crucial role.

People were going to a wildlife market, got exposed to a reservoir host, got the infection, and then for a variety of reasons it spread worldwide. Now big cats in zoos as well as domestic cats are being affected and to solve this problem takes many kinds of interventions.

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Brachycephalic (obstructive) Airway Syndrome, *Part 3*

➤ *Continued from Page 1*

post-operatively, and has no safety precautions. It seals vessels that are 7 mm or less in diameter. The device is applied at the level of the cranial commissure of the tonsillar crypt. The clinical signs severity score preoperatively (score of 2.6) decreases postoperatively (score of 0.3) and at the recheck (score of 0.9). No complications are seen. Pet owners report a good outcome in 47% of cases, an excellent outcome in 47% of cases, substantial improvement in 57% of cases, some improvement in 33% of cases, and no improvement in 11% of cases with the use of a bipolar sealing device.

Surgical duration with the CO2 laser ranges from 174.5 to 309 seconds. Surgical duration with the use of sharp excision is 704 seconds. Healing duration with both CO2 laser and sharp excision usage is 14 day or less. With the use of laser, due to its coagulation effects, sealing of the vascular vessels, lymphatic vessels, and nerves occurs, resulting in less hemorrhage, less edema, and less pain, respectively. Benefits of laser transection include no suture material needed, less soft tissue swelling formation, less bacterial presence, a 50% decrease in surgical time, and histopathology results showing decreased collateral tissue damage. The depth of histologic changes when laser is used is 0.34 mm. Additionally, one report states that a greater reduction in respiratory signs was obtained when using the CO2 laser, when compared to the electrical scalpel. Laser disadvantages include equipment expense and safety hazards. There is no difference in the depth of tissue injury with these techniques.

With sharp dissection, the oropharyngeal and nasopharyngeal mucosa are apposed using absorbable suture material. The suture knots are buried to decrease irritation. Excessive postoperative edema may be seen comparatively with electroscalpel, electrocautery, and crushing techniques.

The folded flap palatoplasty can be considered in dogs with a thinner soft palate. The soft palate is folded upon itself, decreasing the nasopharynx and laryngopharynx obstruction, and allowing visualization of the caudal nasopharyngeal opening via the oral cavity. The resulting soft palate is less thick, shorter in length, and alleviates the obstruction. In the Pug and French Bulldog breeds having undergone this procedure, owners perceive clinical improvement in 88.5% of all dogs, with no difference in the grades of respiratory signs, digestive signs, and laryngeal collapse present.

Complications of elongated soft palate surgery include dyspnea, aspiration pneumonia, sinusitis, rhinitis, oronasal regurgitation, and nasal aspiration. Dyspnea may be due to the presence of edema and inflammation, a hypoplastic trachea, and laryngeal collapse. Treatment options for such complications may include analgesic medications, corticosteroids, oxygen supplementation, sedation, and temporary tracheostomy tube placement.

Stenotic nares

An improved outcome may be seen with early correction of stenotic nares at the time of soft palate resection, when compared to soft palate resection being performed alone. Many techniques have been described.

The Trader's technique is a dorsolateral nares (alae) amputation. The left nare is excised at the rostral 3:30 O'clock position and the right at the 8:30 O'clock position, with the use of sharp excision or electrocautery. It has been reported in the immature Shih Tzu breed. This procedure results in the absence of dyspnea, exercise restrictions, nasal discharge, and nasal-mediated noise. Second intention healing is allowed. Hemorrhage, which is seen more so with this technique than with wedge resection techniques, is managed with direct manual pressure or the use of phenylephrine (1% solution diluted 10-times). The benefits of this technique include its effectiveness, decreased surgery time, cosmesis, lack of suture material required, its ease, lack of open wounds, and that a greater amount of nare tissue can be removed. When compared to the wedge techniques, no scar formation or depigmentation occurs postoperatively.

Wedge resection alaplasty techniques are excision of the external nare epithelium and the underlying alar fold [**Figure 2**, blue line]. Types of wedge resection include caudolateral, horizontal [**Figure 2**, green line], and vertical [**Figure 2**, blue line]. The lateral wedge resection involves excision of the caudolateral ala nasi, thereby narrowing the thickened alae. The horizontal wedge resection increases the transverse diameter by narrowing the thickened alae. The vertical wedge resection is excision of the apex located at the dorsal most aspect of alae wing involving an ala nasi wedge and excision of the tissue caudal to the alar, narrowing the thickened alae. Both the horizontal wedge resection and the vertical wedge resection are performed with the use of an #11 or #15 scalpel blade, electrosurgical or electrocautery devices, or CO2 laser. The length of wedge to be removed is dependent on the degree of nare opening desired. The caudal aspect of the incision, medially at the alar cartilage, pulls the alae out of the nasal opening. As increased tension is created, the patient is more apt to self-traumatize the incision. The horizontal, vertical, and lateral wedge resections may require suture material placement. There is described a crescent-shaped wedge resection which involves the removal of the dorsolateral alar cartilage.

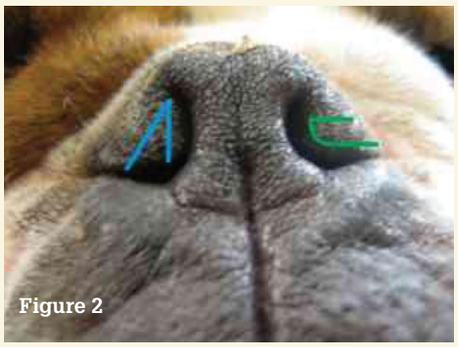

Figure 2

The alarpexy (or alapexy) is a ventrolateral incision of the alar skin and lateral incision of the muzzle (located 3 to 5 mm lateral to the alae) with suture material placement that results in a fixed abduction of the nare caudally and laterally. With time, the more mobile dorsolateral nasal cartilage becomes positioned medially. When compared to other surgical techniques, surgical time appears longer and more suture material is required for the alarpexy. Post-operative success is 80%, equivalent to the amount of wedge resection performed.

The novel punch resection alaplasty technique has been used in dogs and cats, resulting in 100% symmetrical resection and excellent cosmesis. The owners report good to excellent results in 80% of cases.

Nares amputation involves the removal of the alar skin and underlying cartilage.

The rhinoplasty technique has also been reported and may be performed at the age of 3 to 4 months. The lateral alar wings are opened up, increasing nasal air flow.

Vestibuloplasty involves the dorsomedial and caudal portion of the ala. This results in a wide and open vestibule.

Everted laryngeal saccules

Treatment is excision of the everted laryngeal saccules (laryngeal sacculectomy). One option for excision is via the use of Allis tissue forceps and long hemostats for tissue grasping. Transection is then performed with Metzenbaum scissors or a #15 scalpel blade and the surgical site allowed to heal by second intention. Other techniques include the use of the electroscalpel, electrocautery, laryngeal cup forceps, or a tonsil snare. Complications include laryngeal webbing and regrowth.

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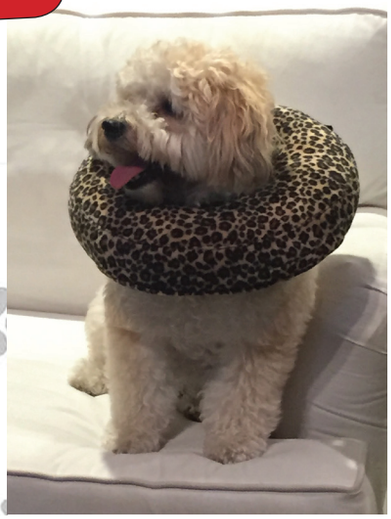

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Brachycephalic (obstructive) Airway Syndrome, *Part 3*

➤ *Continued from Page 4*

Everted palatine tonsils

Everted tonsils may revert back into their crypts if the primary cause or causes are corrected. Tonsillectomy is the treatment for eversion, however this technique is currently not recommended as no overall change in outcome is seen postoperatively. Reported techniques include a bipolar vessel sealing device, microdebrider, and bovie tip electrosurgery. Histologic evidence of tissue damage from the bipolar vessel sealing device ranges from 3.5 to 10 mm.

Laryngeal collapse

The Leonard grading system (1960) is used to characterize laryngeal collapse severity. Stage 1 is characterized by laryngeal saccule eversion into the glottis cavity. Inward collapse of the cuneiform process can also be noted in stage 1 disease. Stage 2 is characterized by cuneiform process protrusion into the laryngeal lumen. The cuneiform process is less rigid than normal. Stage 3 is characterized by a combination of stages 1 and 2, in addition to corniculate process protrusion medially and loss of the rima glottidis dorsal arch.

Stage 1 progresses to stage 2 and then stage 3 with time. Stages 2 and 3 are considered the advanced stages [**Figure 3**]. The incidence of stages 2 and 3 is 50 to 65%. Based on the Leonard grading system, 97.5% of affected dogs have laryngeal collapse. Laryngeal collapse is considered moderate to severe in 65% of dogs. The Pug breed contains a smaller rima glottidis size, are more affected by laryngeal collapse, and are afflicted with higher collapse grades when compared to the French Bulldog breed. This may be due to the presence of arytenoid chondromalacia. There may be a correlation between laryngeal collapse severity and age as well.

The treatment for stage 1 laryngeal collapse includes elongated soft palate resection and nare resection. Stage 2 laryngeal collapse treatment includes partial arytenoidectomy and laryngeal saccule resection. Stage 3 laryngeal collapse requires a permanent tracheostomy tube. Laryngeal resection may also be considered in advanced cases. Laser-assisted partial arytenoidectomy has also been described. Arytenoid lateralization can be considered in dogs with laryngeal collapse. A unilateral crycoarytenoid lateralization combined with thyroarytenoid caudolateral lateralization has also been described as treatment of grade 2 and 3 laryngeal collapse.

The outcome is seen as favorable in 76.4% of dogs with stage 2 collapse treated surgically. Combining a thyroarytenoid lateralization (arytenoid laryngoplasty) with a cricoarytenoid lateralization results in improved respiratory function in 83.3% of dogs. Of those dogs with laryngeal collapse, 55% have everted ventricles, necessitating ventriculectomy. The addition of this procedure improves the prognosis. Laryngeal web formation (webbing) is the primary complication associated with ventriculectomy. Partial laryngectomy carries a 50% mortality rate and a high incidence of bronchopneumonia.

For permanent tracheostomy tube placement, the tracheal stoma begins at the second tracheal rings and includes removal of 3 to 4 tracheal rings. Less than 33% of the tracheal circumference is removed. Post-operative management in those dogs with a permanent tracheostomy tube includes cleaning of the surgical site once daily, trimming the peri-stoma hair, ensuring a clean living environment, termination of swimming or similar high-risk activities, and promoting increased breathing to increase energy tolerance.

Complications associated with permanent tracheostomy tube placement include alterations in vocalization (60% incidence), infection, skin fold occlusion, soft tissue swelling, stoma stenosis, subcutaneous tissue emphysema, and surgical incision dehiscence. These complications are lessened with appropriate surgical planning, gentle tissue handling, and ensuring tracheal mucosa to adjacent skin apposition.

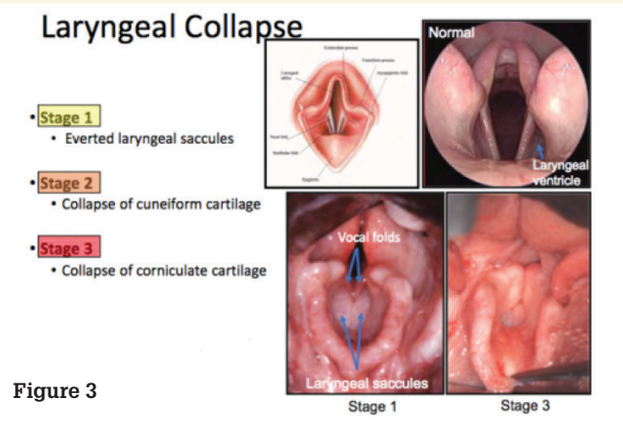

Figure 3

Nasopharyngeal stenosis

Using balloon expandable metallic stent, biodegradable stent, or retrievable stent placement to treat nasopharyngeal stenosis in dogs and cats shows resolution of clinical signs postoperatively in all cases. The median surgical time is 38 minutes. If nasopharyngeal stenosis is located extremely caudal in the nasopharynx, then a septal balloon dilatation is performed prior to stent placement. If the nasopharyngeal stenosis is completely closed then a covered stent is used. This technique has been shown to be rapid, safe, noninvasive, and effective.

Laser-assisted turbinectomy using a diode laser has also been described for removal of the concha nasalis ventralis, rostral aberrant turbinates, and caudal aberrant turbinates as a method of creating a patent intranasal airway. When combined with vestibuloplasty and staphylectomy, a decrease in intranasal resistance of 55% by 3 to 6 months postoperatively is seen. Transient intraoperative hemorrhage is seen in 32.3% of cases. After 6 months, regrowth of turbinates (with fewer contact points) requires resection of re-obstructing tissue in 15.8% of dogs.

Hypoplastic trachea

Currently, medical therapy is indicated in the management of hypoplastic trachea in dogs as it is not considered a correctable condition. As of yet, there is no recommended surgery. Anecdotal reports of intraluminal tracheal stent placement in affected dogs have been performed with success.

Surgical complications

The overall postoperative brachiocephalic surgery complication incidence is 0 to 29.5%. Surgical complications include aspiration pneumonia, coughing, gagging, hemorrhage, incisional dehiscence, infection, inflammation, laryngeal swelling, nasal discharge, noncardiogenic pulmonary edema, regurgitation, temporary tracheostomy placement, voice change, vomiting, and death. Gastrointestinal medical treatment in combination with upper respiratory surgery decreases the overall complication rate.

Those patients who develop radiographic evidence of bronchopneumonia are at a higher risk of requiring temporary tracheostomy placement, developing major complications, and dying or being euthanized postoperatively.

Outcome

It is thought that approximately 89 to 100% of dogs show significant improvement postoperatively. Classically, preoperative mortality rates were reported to be 15%. More recent mortality rates are reported to be 4%.

Ideally, surgery is performed at 3 to 4 months of age. The success incidence in those dogs that are treated at 4.5 to 6 months of age is 76.4% with a permanent tracheostomy tube

Continued on Page 8 ➤

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Brachycephalic (obstructive) Airway Syndrome, *Part 3*

➤ *Continued from Page 4*

being needed if no response is seen. Overall outcome by 6 months postoperatively is excellent in 65% and good in 25% while overall outcome seen by 1 year postoperatively is excellent in 50% of cases, moderate in 48% of cases, and poor in 2% of cases. The success rate in those dogs with laryngeal edema is 54%.

Post-operative improvement is seen 85 to 100% of dogs after elongated soft palate resection.

Of the dogs with brachycephalic airway syndrome that are afflicted with bronchial disease, an adequate outcome is seen in 58.3% of treated cases, a moderate outcome in 30.6%, and a poor outcome 11.1% of cases.

Outcome in those dogs with a permanent tracheostomy tube includes successful improvement in 56% of dogs, some improvement in 33% of dogs, and static clinical signs in 11% of dogs. Advanced stage disease is associated with a mortality of 50% with survival decreasing in the face of aspiration pneumonia.

Of those cases that require mechanical ventilation, survival incidence seen with dogs afflicted by pulmonary disease is 22% and those afflicted by primary hypoventilation 39 to 60%.

Postoperative gastrointestinal clinical signs are less frequent than preoperatively, with 66.7 to 91% resolution occurring postoperatively. A good to excellent outcome, as per owner evaluation, is seen in 68% of cases when only the respiratory clinical signs are treated. This success rate increases to 89%, based on owner evaluation, if the gastrointestinal clinical signs are treated and resolve. Improvement seen with surgery and eventual discontinuation of gastrointestinal medications after management is 80%, with resolution of gastrointestinal changes occurring by 6 months post-operatively as determined by endoscopic evaluation.

Prognostic factors

The prognosis is better with early surgical intervention as it decreases secondary disease and progressive disease. Those dogs with stenotic nares that are treated at less than 2 years of age have a better prognosis when compared to those over the age of 2 years.

Laryngeal collapse stages 2 and 3 are associated with a guarded prognosis. The presence of hypoplastic trachea carries a worse postoperative prognosis.

A prolonged recovery is expected in those dogs with both gastrointestinal and respiratory diseases present. Partial laryngectomy carries a 50% mortality rate and a high incidence of bronchopneumonia. ❑

A Note from the Editor

➤ *Continued from Page 3*

While government officials do battle with the novel coronavirus in the name of public health, veterinarians are becoming alert to the possibilities of COVID-19 in cats or ferrets in their practices, but most veterinary practitioners have been on guard against zoonotic disease from the first day they set foot in practice, whether they're vaccinating against rabies, educating pregnant clients about toxoplasmosis, or deworming to eliminate intestinal helminths. When they prevent and treat zoonotic disease in their patients, they're also protecting the health of pet owners.

Rep. Ted Yoho, DVM, a congressman from Florida introduced a bill in July 2019 in the U.S. House of Representatives with his colleague Rep. Kurt Schrader, DVM, of Oregon. The One Health Act—H.R. 3771—it calls for collaboration among major U.S. health agencies to prepare for future zoonotic disease outbreaks.

Dr. Yoho reinforced that veterinarians are among the most knowledgeable about zoonotic disease—if not the most knowledgeable of all healthcare professionals.

"Being trained as veterinarians is key," I spent most of my time with cattle and horses, and we were always tuned into the prevention side. We've been dealing with coronavirus for 4 or 5 decades in cattle, horses, dogs, and cats. The goal is to be proactive."

"Can you imagine if African swine fever crossed to the human species?" he says. "We're both monogastric animals, us and swine. If we're facing a virulent virus with a 98% mortality rate, we'd better have something in our arsenal that can counter that."Veterinarians understand disease transmission and prevention better than human doctors because we look at health much more globally," he says. "We look at the herd, and we look at prevention. If we don't, we know what we can expect."

LIVS is continuing to be available for all emergencies at all hours, every day.

While the number of infected individuals has been rising, the mortality rates are fortunately dropping but as soon as laxity in safety measures appear, rates have begun to bounce up, a sign that we need still be vigilant as schools are about to open in many communities.

LIVS is continuing to be available for all emergencies at all hours, every day.

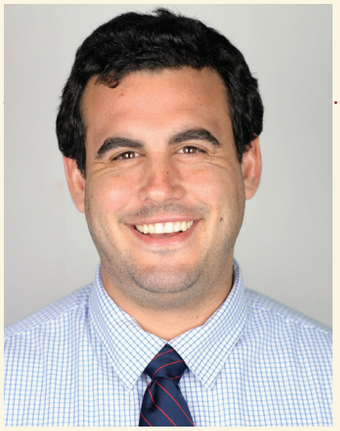
On a regular basis, Dr. Curtis Dewey, associate professor and section head of Neurology/Neurosurgery at the College of Veterinary Medicine at Cornell is here at LIVS regularly for consultation. Appointments can be made at 516-501-1700.

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

Leonard J. Marino, MD, FAAP, LVT

Tibial Tuberosity Avulsion Fracture in Dogs

Kevin Barber DVM, Staff Surgeon



Tibial tuberosity avulsion fractures (TTAF) are relatively uncommon and occur most often in immature dogs. TTAF's can occur in three patterns: isolated tibial tuberosity avulsion fracture, TTAF accompanied by separation of the proximal tibial epiphysis or TTAF with epiphyseal separation extending to produce Salter-Harris type II fracture of the caudal tibial metaphysis. To understand and treat this disorder, it is essential to have an understanding of the growth plate.

To understand and treat this disorder, it is essential to have an understanding of the growth plate.

In dogs, major growth occurs between 3 and 6 months of age and growth plates close between 4 and 12 months of age depending on breed and anatomic site *(Hare WCD. The age at which epiphyseal union takes place in the limb bones of the dog. Wien Tierarztl Monatsschr 1961; 49:210-215).*

The tibial tuberosity is an apophysis that fuses to the proximal epiphysis and the n to the metaphysis of the tibia, as the animal reaches skeletal maturity. The secondary ossification centers of the tibia appear between 3 and 4 months of age and include the tibial tubercle, proximal and distal epiphysis *(Sumner-Smith G. Observations on epiphyseal fusion of the canine appendicular skeleton. J Small Anim Pract 1966; 7(4): 303-311).* The tibial tuberosity serves as the insertion site of the quadriceps femoris muscle, and avulsion of the tuberosity can result from contraction of the muscle while the stifle joint is flexed and the foot is set firmly on the ground. Avulsion of the tibial tuberosity occurs infrequently and is limited to younger animals, usually between 4 and 8 months of age. *(Piermattei DL, Flo GL, DeCamp CE: Fractures of the tibia and fibula. In Brinker, Piermattei and Flo's handbook of small animal orthopedics and fracture repair, ed 4, Philadelphia, 2006, Saunders, p 633.).* In large breed dogs, the tuberosity growth plate closes late in development and therefore the endochondral ossification process may seem irregular radiographically and may be mistaken for a pathologic process *(Von Pfeil DJ, Decamp CE, Diegel KL, et al: Does Osgood-Schlatter disease exist in the dog? Vet Comp Orthop Traumatol 2009; 22:257).*

On physical exam, lameness, pain, stifle effusion and soft tissue swelling are noted. The detached tuberosity can usually be palpated, is dislocated proximally and the distal end is rotated cranially. Varying degrees of avulsion may be seen, from minimal displacement to complete detachment with or without separation of the proximal tibial epiphysis. *(Goldsmid S, Johnson KA: Complications of the canine tibial tuberosity avulsion fractures. Vet Comp Orthop Traumatol 1991; 4:54)*; *(Pratt JNJ: Avulsion of the tibial tuberosity with separation of the proximal tibial physis in seven dogs. Vet Rec 2001; 149:352).* Avulsion of the tuberosity is best demonstrated on a lateral radiograph, especially when the leg is flexed (see **Figure 1**). Radiographs of the contralateral limb may be obtained for comparison and prevent a false positive diagnosis.

Treatment should be based on the degree of displacement, the size of the patient and the remaining growth potential. Conservative management with external coaptation should be considered only when the displacement is minimal (2-3mm), with only a slight angulation of the tuberosity. If the breed is small, and if optimal athletic function is not of paramount interest to the owner, external fixation will be adequate. External coaptation should be maintained for 2-3 weeks. In most cases, open reduction and internal fixation is recommended. Failure to return the tibial tubercle to its original position results in loss of power to the quadriceps muscles and in extension of the stifle joint. Different techniques have been described for repair of this fracture, including the use of pins alone or pins and tension band wire. *(Piermattei DL, Flo GL, DeCamp CE: Fractures of the tibia and fibula. In Brinker, Piermattei and Flo's handbook of small animal orthopedics and fracture repair, ed 4, Philadelphia, 2006, Saunders, p 633.).*

Figure 1: *Preoperative lateral radiograph of the left stifle of a 6 month old female spayed Labrador Retriever. Isolated tibial tuberosity avulsion fracture.*

Prognosis: Good to excellent, but dependent on the amount of damage sustained by the proliferative zone, for continued growth of the physis. Premature closure of the apophyseal growth plate and deformity of the tibial tuberosity can occur, however the prognosis for normal function is generally good.

Surgical treatment: A longitudinal incision is made just medial or lateral to the patella, the patellar ligament and the tibial tuberosity. The blood and fibrin clot is removed from the original location of the tuberosity. The displaced tibial tuberosity is reduced and two Kirschner wires are driven across the physis and into the proximal tibia. Additionally, a tension band wire can be placed to improve stabilization. To place the tension band wire, a hole is drilled transversely in the major bone segment of the tibia and passed around the Kirschner wire(s) in a figure eight, and the wire is then tightened. *(Piermattei DL, Flo GL, DeCamp CE: Fractures of the tibia and fibula. In Brinker, Piermattei and Flo's handbook of small animal orthopedics and fracture repair, ed 4, Philadelphia, 2006, Saunders, p 633.)*

Postoperative radiographs should be taken to document fracture reduction and implant positioning. (see **Figure 2**).

Aftercare: Strict exercise restriction is recommended for 4-6 weeks, followed by progressive limited leash walking over 2-3 weeks following radiographic healing. Short term application of a soft padded bandage with or without a splint may be applied for a few days

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Tibial Tuberosity Avulsion Fracture in Dogs

➤ *Continued from Page 9*

to control swelling and support soft tissues. The limb is placed in moderate extension to relieve stress on the patellar tendon. Physical therapy is recommended to help restore joint function. Radiographic examination is performed at 4 and 8 weeks postoperatively to confirm healing. If the animal has a considerable amount of growth potential remaining (large and medium breeds <6 months old, and small breeds <4 months old), the fixation should be removed as early as possible (when radiographic union is achieved) to avoid premature fusion of the tuberosity to the shaft *(Goldsmid S, Johnson KA: Complications of the canine tibial tuberosity avulsion fractures. Vet Comp Orthop Traumatol 1991; 4:54.)*

Figure 2: *Postoperative lateral radiograph of the left stifle of a 6 month old female spayed Labrador Retriever. Isolated tibial tuberosity avulsion fracture stabilized with two K-wires and a tension band wire.*

Complications: Fixation complications include avulsion of the tuberosity from the implant, wire or pin breakage, bending of the pin(s), pin migration, entry of a pin into the proximal epiphysis, and deformity of the proximal tibia. *(Goldsmid S, Johnson KA: Complications of the canine tibial tuberosity avulsion fractures. Vet Comp Orthop Traumatol 1991; 4:54.)*; *(Pratt JNJ: Avulsion of the tibial tuberosity with separation of the proximal tibial physis in seven dogs. Vet Rec 2001; 149:352.).* ❑

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