



**Monthly Update**

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**February 2013**

**Brachycephalic Airway Syndrome (BAS)**

**Editor's Note:**

*Dear Colleague, I decided to try something different this month because BAS is a very "visual disease". This is especially true for laryngeal sacculles. This was a Power Point lecture Dr. Briere gave a few years ago. There are pharyngeal and laryngeal photographs that gives you a good understanding of how obstructive this upper air way disease can be in the Brachycephalic breeds. If you visualize the photographs on an Ipad or similar device that allows your fingers to enlarge the photographs the laryngeal sacculles are labeled and very easily seen.*

**Brachycephalic Airway Syndrome BAS**

- Stenotic nares
- Elongated soft palate
- Everted laryngeal sacculles
- Laryngeal collapse
- Hypoplastic trachea
- Enlarged tonsils

**\*\*Hypoplastic Trachea** - Not part of BAS but should be evaluated in Brachycephalic Breeds



Brachycephalic syndrome occurs because of a compressed and redundant airway in two short a skull in brachycephalic individuals. By definition, a brachycephalic skull is one in which the width to length ration is greater than 0.81. Just like the skin, the amount of soft tissue within the airway is not reduced proportionally to the shortening of the bone. Similarly, the amount of oxygen needed is function of body size and not skull length.

*Continued next page*

**Continuing Education Opportunities**

All our lectures provide 2 hours of Continuing Education Credits. You can register online through our websites, Boston Veterinary Specialists ([www.bostonvetspecialists.com](http://www.bostonvetspecialists.com)) and Cape Cod Veterinary Specialists ([www.capecodvetspecialists.com](http://www.capecodvetspecialists.com)). A meal is provided during each lecture. Your technicians are welcome as well.

**BVS:**

**Dr. Catherine Briere:**  
 March 6, 2013, "Hip Dysplasia"

**CCVS:**

**Dr. Elizabeth Martin:**  
 March 19, 2013, "Endocrine Emergencies"

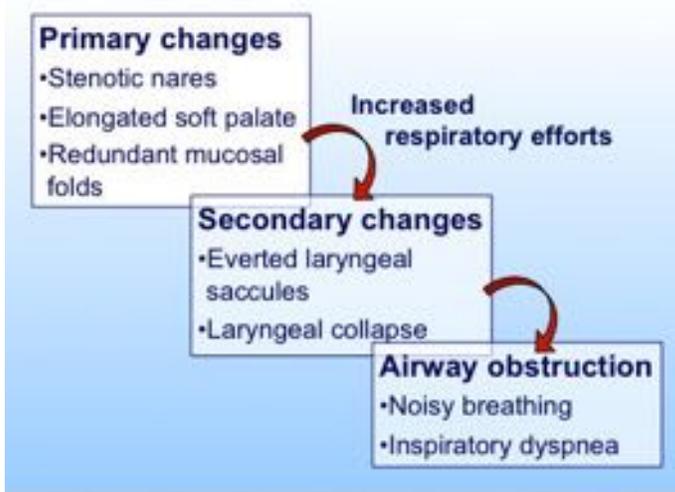
**Dr. Katherine Westcott:**  
 April 23, 2013, "Immune-mediated polyarthropathy (IMPA) in dogs"

**Dr. Louisa Rahilly:**  
 May 21, 2013, "Steroids in veterinary medicine: Friend or Foe."

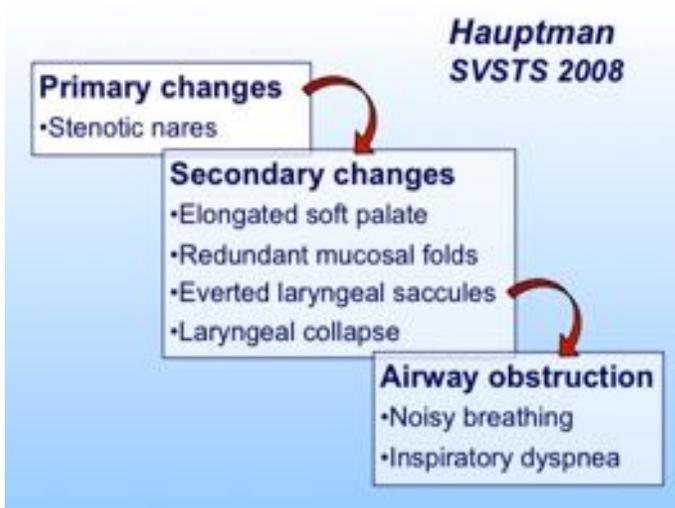
**Dr. Daniel Beaver:**  
 June 4, 2013, "Hip Dysplasia"

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Read our January newsletter article - Ultrasound as a Diagnostic Tool - by visiting our newsletter archive: <http://archive.constantcontact.com/fs032/1109892572426/archive/1110184841979.html>



The syndrome is generally presented as primary anatomical abnormalities that cause a partial airway obstruction and therefore increased respiratory efforts. This leads over time to secondary changes which worsen airway obstruction and lead to typical clinical signs.



This gradual progression through the stages of the syndrome is partially challenged by new studies published by Dr. Hauptman's group at Michigan State University which suggest that stenotic nares may be the only primary anatomical abnormality and that elongated soft palate would be secondary and develop later in life. This is an important finding because it will influence the timing of treatment.

**Typical breeds**

- English Bulldog
- Boston terrier
- Pug
- Shih Tzus
- Pekingese
- French Bulldog

Some things do not change and typical breeds are typically seen. The syndrome persists in many breeds because we actively select for it. AKC Standards perpetuate these inherited characteristics.

AKC ENGLISH BULLDOG STANDARDS

"The head should appear very high, and very short from the point of the nose to occiput."

"The face ( ) should be extremely short. The muzzle being very short ( ) and very deep from the corner of the eye to the corner of the mouth."

"The distance from bottom of stop, between the eyes, to the tip of nose should be as short as possible ( )"

In the points distribution, the nose has the **highest point allocation** of all body parts / criteria.

AKC BOSTON TERRIER STANDARD

"The muzzle is short, square, wide and deep and in proportion to the skull. It is free from wrinkles, shorter in length than in width or depth; not exceeding in length approximately one-third of the length of the skull. The muzzle from the stop to end of the nose is parallel to the top of the skull."

"Head faults: Eyes showing too much of jaw. Pinched or wide nostrils."

"The muzzle is short, blunt, square, but not upfaced..."



"In profile, the face is flat. When viewed from the side, the chin, nose leather and brow all lie in one plane, which slants very slightly backward from chin to forehead."  
 "Nostrils are wide and open rather than pinched."



## Less typical breeds

- Large breeds...
- Starting to see in Frenchies



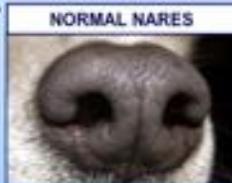
•Cats



## Pathophysiology

### Stenotic nares

- Cartilage plates are thick and displaced medially
- 48% (n=118)
- Likely underestimated
- Cause elongation of soft palate?



1. Hauptman JG. SVSTS 2008 abstract

## Pathophysiology

### Elongated soft palate

- Soft palate extends beyond epiglottis
- Vibrations exacerbate swelling
- Seen in 80 to 100% of cases
- Primary or secondary changes?



## Pathophysiology

### Everted laryngeal sacculles

- First stage of laryngeal collapse
- Mucosal lining of laryngeal ventricles
- Seen in 48-60% of cases



## Pathophysiology

### Laryngeal collapse

- Successive medial collapse of the cuneiform and corniculate processes of the arytenoids
- Secondary
- In advanced cases



S= Laryngeal Sacculles A= Arytenoid Cartilages  
 T= Endotracheal Tube

**Is brachycephalia synonymous with brachycephalic airway syndrome?**

Some basic anatomical features are shared by all brachycephalic dogs to some degree. Whether or not a dog is affected by brachycephalic airway obstruction syndrome is therefore a matter of severity of those abnormalities.

## Clinical signs

- Excessive noisy breathing
  - Inspiratory stertor (snoring) due to tissue interference
  - Stridor due to narrow airway
- Exercise and heat intolerance
- Inspiratory dyspnea
- Esophago-GI signs
  - 71 / 73 dogs presenting for BAOS<sup>1</sup>

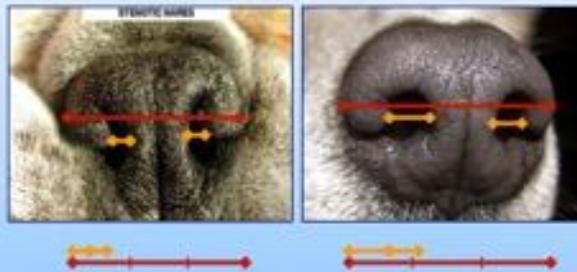


1. Poncet et al. JSAP 2006

## Diagnosis

### Physical examination

- Stenotic nares
  - Opening less than 1/3 width nose



## Diagnosis

### Laryngeal examination under light anesthesia

- IV Thiopental to effect is ideal induction agent<sup>1</sup>



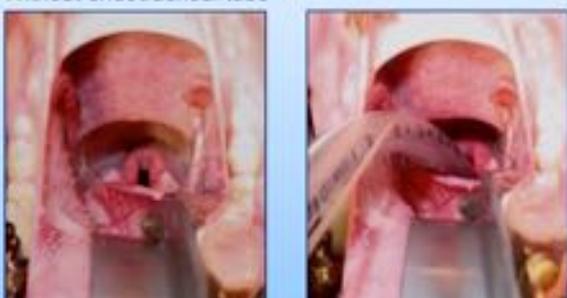
1. Jackson et al Vet Surg 2004

Light anesthesia using Thiopental to effect provides the best assessment. Other induction agents may inhibit arytenoid movement more or slow return of movement more than thiopental. Acepromazine will result in complete paralysis in some cases, mimicking laryngeal paralysis in some cases.

## Diagnosis

### Laryngeal examination under light anesthesia

- IV Thiopental to effect is ideal induction agent<sup>1</sup>
- Without endotracheal tube

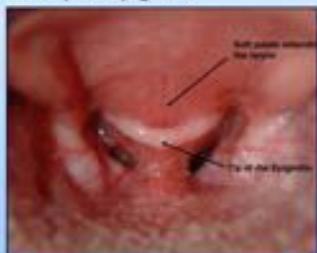


The endotracheal tube will impair visualization of the larynx and disrupt the anatomy so intubation should be delayed until the examination is complete.

## Diagnosis

### Laryngeal examination under light anesthesia

- IV Thiopental to effect is ideal induction agent
- Without endotracheal tube
- Evaluate palate length relative to tip of epiglottis
  - Tongue in normal position



The length of the soft palate is evaluated by its position relative to the tip of the epiglottis. The tongue must be in a normal position to allow for a representative relationship between the two structures.

Saccules will appear like white glistening structures protruding at the ventral aspect of the rima glottidis. In younger patients these may not protrude but in mature patients they are a common finding.

Laryngeal collapse is a component of brachycephalic syndrome in severely affected individuals. In cases of laryngeal collapse, the cartilage of the arytenoids degenerates and becomes soft allowing the arytenoids to collapse in the lumen of the larynx and even to fold on top of each other. Laryngeal collapse was considered by some to be a contraindication for surgery but most surgeons agree on pursuing correction of other brachycephalic syndrome abnormalities and in most cases, function is frequently improved despite persistent laryngeal collapse. Surgical procedures to address laryngeal collapse directly are rarely performed and are associated with significant complications and morbidity.

## Diagnosis

### Laryngeal examination under light anesthesia

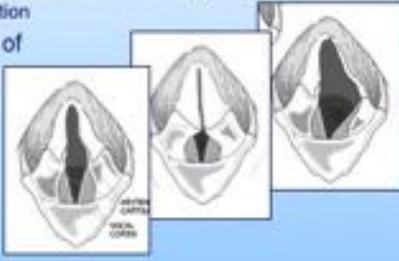
- IV Thiopental to effect is ideal induction agent<sup>1</sup>
- Without endotracheal tube
- Evaluate palate length relative to tip of epiglottis
  - Tongue in normal position
- Evaluate for presence of saccules



## Diagnosis

### Laryngeal examination under light anesthesia

- IV Thiopental to effect is ideal induction agent
- Without endotracheal tube
- Evaluate palate length relative to tip of epiglottis
  - Tongue in normal position
- Evaluate for presence of sacculles
- Evaluate laryngeal structure and function

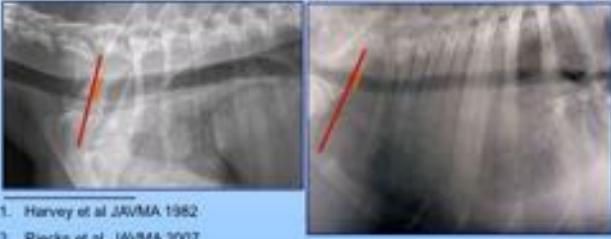


Even though laryngeal paralysis is not a component of brachycephalic syndrome, some brachycephalic dogs can have both conditions concurrently. It is extremely important to recognize this because laryngeal paralysis must be addressed if it is present otherwise those dogs will not do well in recovery.

## Diagnosis

### Radiographs

- Tracheal diameter : thoracic inlet  $< 0.2$
- Normal bulldog is  $0.106^{1,2}$
- Evaluate lung fields for aspiration pneumonia



1. Harvey et al. JAVMA 1982  
2. Riecks et al. JAVMA 2007

The first radiograph is that of a normal dog with a tracheal diameter to thoracic inlet ratio of 0.25, which is well above the target ratio of 0.2. The second radiograph is that of a dog evaluated for a cardiac condition who happens to have a hypoplastic trachea. This is not a bulldog so we expect a ratio above 0.2 and in this case the ratio is 1.5 which is consistent with a diagnosis of hypoplastic trachea.

The value of this assessment is questionable. On the one hand, we cannot correct hypoplastic trachea. The diagnosis of hypoplastic trachea was therefore historically given a prognostic value but the study by Riecks and coauthors did not find it to be of prognostic value.

## Diagnosis - summary

- Physical examination
  - Nares width : Nose width ratio  $< 1 : 3$
- Laryngeal examination:
  - Soft palate extends beyond epiglottis
  - Visible sacculles



In summary, the most important pieces of information in the diagnosis of BAS are visual evaluation of the width of the nares on physical examination and laryngeal examination under light anesthesia. Radiographs are not diagnostic but an helpful additional piece of information.

## Why treat young patients who are doing well?



What to do with dogs diagnosed with brachycephalic airway (obstruction) syndrome? The answer is easy in clinically affected patients in which surgery clearly and immediately improves quality of life and decreases the frequency of scary or life threatening dyspneic episodes. In young patients, in which anatomical changes are identified but there are no clinical signs, the answer may not appear as clear cut but there are some very strong arguments in favor of surgery. The first thing to consider and remember is that this is not a static condition. The anatomy of the airway will change and worsen as the dog ages.

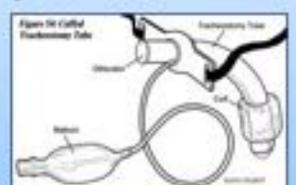
## Why treat young patients who are doing well?

- Anatomical changes progress toward complete laryngeal obstruction
- Acute exacerbation (heat, stress, exercise) can lead to collapse / death
- Worsening anesthetic risk
- Noisy breathing can be disturbing to the owner
- Chronic hypoxia can lead to pulmonary hypertension and right sided heart failure

## Treatment

### Emergency

- Limit stress
- Supply oxygen
- Sedation
- Control / limit hyperthermia
  - Lower temperature in O<sub>2</sub> cage
  - Fluids
  - Wet body
- Steroids
- Temporary tracheostomy



Older patients might be seen during an acute crisis. In those cases, resolving the crisis before surgery is paramount. Surgery will create inflammation and edema so it is better to have a quiet non-inflamed upper airway to start with. BAO crises are treated like any other respiratory emergency with providing a calm environment, supplying oxygen, and sedating struggling or panicked animals. An aspect of the emergency treatment of respiratory emergencies that is often forgotten is body temperature control. The hotter, the more panting, the more airway edema, the more obstruction etc... Steroids also help control airway inflammation and swelling. Finally, in patients in which control of the crisis can not be achieved, a temporary tracheostomy should be performed. Intubation is not a good solution because it adds to airway inflammation but it can be used to buy some time in extreme situations.

## Treatment

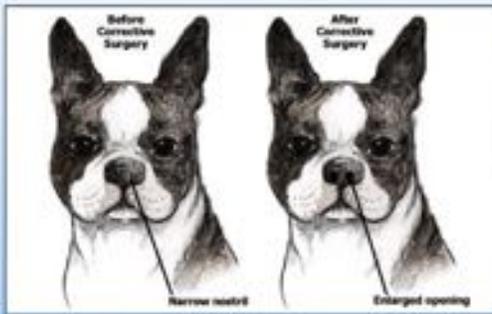
### Anesthesia

- No stress
- Perioperative steroids
- Pre-oxygenation with mask
- Quick induction to get early control of airway



Once the crisis is resolved, ideally in the next few days, airway surgery can be considered. Brachycephalic patients present a greater anesthetic risk so careful attention should be paid to the anesthesia technique and protocol. Have steroids on board (dexamethasone). The patient should be pre-oxygenated without causing stress. Usually 5 minutes. Induction should be quick to gain early control of the airway. Use thiopental ideally. Propofol is also acceptable. Laryngeal exam is usually performed at this time. It should be focussed and quick to allow timely intubation. Have many different sizes of endotracheal tubes readily available, especially small sizes for atraumatic intubation.

## Surgery - Stenotic nares



## Surgery - Stenotic nares



## Surgery - Stenotic nares

### Common techniques

- Wedge resections
  - Lateral
  - Vertical (Hedlund 1998)
  - Horizontal



## Surgery - Stenotic nares

### Common techniques

- Wedge resections
  - Lateral
  - Vertical (Hedlund 1998)
  - Horizontal
- Alarplasty
- Trader's technique



## Surgery - Stenotic nares



## Surgery - Stenotic nares

- Changed appearance
- E-collar needed
- Hauptman's conclusions and recommendations<sup>1</sup>
  - Early (<6 months) surgical correction
  - Candidates are puppies with stenotic nares and clinical signs
    - Nasal discharge
    - Upper airway noise
    - Difficulty breathing
    - Exercise intolerance
  - Consider Trader's technique

1. Hauptman et al. JAAHA 2008

## Surgery – Soft palate

- Staphylectomy has significant impact on airway obstruction
- Landmarks: caudal part of tonsil (?) / Tip of epiglottis
  - Tongue in normal position
- Metzenbaum scissors or laser?
  - Outcome is the same<sup>1</sup>
  - Laser faster
- Potential for pharyngeal swelling

1. Davidson et al. JAVMA 2001

## Surgery – Soft palate

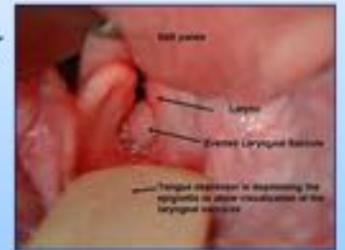


## Surgery – Soft palate



## Surgery – Laryngeal saccules

- Need for temporary tracheostomy?
- More helpful in the short term than long term
  - Saccules may recur



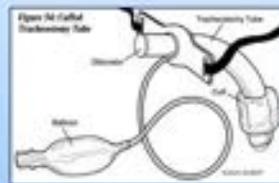
## Surgery – Complications

### Severe:

- Pharyngeal edema and inflammation
- Nasal regurgitation and aspiration pneumonia

### Minor:

- Persistent airway noise
- Change of voice
- Nares dehiscence



## Surgery – Complications

- Huck et al
  - No complications; Nares amputation only
- Riecks et al
  - 3.2 % mortality; 3.2 % complications
- Torrez et al
  - No perioperative deaths; Most dogs had persistent clinical signs
  - \*\*Australia\*\*
- Davidson et al
  - Laser and scissor staphylectomy have same outcome; most complications associated with tracheostomy
- Lorinson et al
  - 14 % mortality in the immediate post-operative period

## Surgery – Outcome

- Huck et al (AVMA 2001; n = 13)
  - 13/13 favorable outcome after nares amputation
- Riecks et al (JAVMA 2007; n = 24)
  - 94.2% good or excellent outcome. No difference between laser and scissor. Outcome not affected by hypoplastic trachea or laryngeal collapse.
- Torrez et al (JSAP 2006; n = 73)
  - 89% improved after surgery
- Lorinson et al (Canine Practice 1997; n = 56)
  - 17 excellent, 16 good, 23 poor outcomes. Outcomes worse for English Bulldogs and dogs with everted laryngeal saccules.

## In summary...

- Stertor, gagging, gurgling, constant open mouth breathing are not "normal" features of brachycephalic dogs!
- Surgery improves quality of life
- Consider nares amputation for puppies with stenotic nares
- Consider staphylectomy for young dogs with elongated soft palate to prevent secondary changes
- Your patients will breathe better and their owners will sleep better...

## Tech Tip: BRACHYCEPHALIC AIRWAY SYNDROME (BAS)

Brachycephalic breeds have become more popular in recent years. We now recognize early intervention surgically, at a young age, will avoid the more difficult and expensive surgical procedures when these dogs are older. The initiating abnormality is stenotic nares. This is followed by elongation of the soft palate and everted laryngeal sacculles. We now do much more upper airway surgery than we did in the past. Early in the disease surgically removing the tissue narrowing the nasal openings and later in the disease when the classic triad is seen: Stenotic nares, Elongated soft palate, and Everted laryngeal sacculles.

Technicians play a key role in facilitating effective treatments to patients suffering from Brachycephalic airway syndrome (BAS). As exam room technicians you will begin to recognize the very narrowed nasal openings in young puppies when receiving their early vaccinations. As surgical technicians you are a vital part of the anesthetic and surgical management of the disease. BAS is a condition affecting short-headed dogs and cats. These patients may suffer from stenotic nares (narrowed nostrils), elongated soft palate, everted laryngeal sacculles, and hereditary hypoplastic tracheas. Pug, Pekinese, Maltese, Boston Terriers, Shih Tzu, French Bulldogs, and English Bulldogs are common canine breeds affected, and the Persian and Himalayan are among the cats. The symptoms are classic of many upper respiratory conditions, including inspiratory stridor and stertorous breathing, cyanosis, hyperthermia, exercise intolerance, excitability, leading to collapse in severely affected patients. Owner's may also report coughing, gagging, and vomiting.

Sedatives, are often recommended to help relieve anxiety and excitement, as well as reduce the incidence of regurgitation. A complete physical exam, including auscultation of the chest and tracheal sounds, along with tracheal palpation for abnormalities is done on all patients. Right and left lateral, and ventrodorsal chest radiographs are taken to check for evidence of aspiration pneumonia or heart disease. Lateral cervical radiographs should be taken to determine tracheal diameter there as well, as they can have both cervical and thoracic hypoplastic tracheas. Radiographs can be taken with the patient under light sedation, such as butorphanol (0.2-0.4 mg/kg) and flow by oxygen delivered via face mask. Because there is a risk of vagal stimulation with many of these patients, an anticholinergic, such as atropine or glycopyrrolate (0.1 mg/kg IM), is given intramuscularly (IM) as a premedication to prevent bradycardia. Metoclopramide (Reglan) can be used to help reduce the incidence of regurgitation.

Other considerations for technicians is to always use a laryngoscope during oral exams and intubations. Just because you are capable of intubating without the aid of a laryngoscope, it does not mean you should. Light is necessary in recognizing potential irregularity or irritations of the oral cavity, that may be missed in the dark. Always have oxygen and a variety of endotracheal tubes (ETT) available when administering sedation to patients affected by airway disease, often the ETT size is over estimated. Many of these patients are administered steroids, so nonsteroidal anti-inflammatory drugs, NSAIDS, should be avoided due to the risk of GI ulceration that can lead to GI perforation.

When the airway is obstructed by stenotic nares and the amount of air required by the lung is not achieved, the pressure on the area is increased. The increase in pressure acts like a vacuum and pulls on the soft palate and surrounding tissues. Stenotic nares greatly reduces the amount of air the patient can breathe. Surgical treatment is required to resolve the clinical signs. The surgery option available for stenotic nares varies but the ultimate result is the same, a larger nasal passage. Surgical repair is recommended at 3-4 months of age, but can be done as early as 9 weeks in clinically affected patients. The sooner stenotic nares are fixed, the less likely the patient will have to be treated for elongated soft palate and everted laryngeal sacculles. An alar fold (obstructive nasal folds) resection can be performed on very young dogs. Because the alar folds are too small to allow primary wedge removal and closure with sutures we no longer suture the tissue. Following removal of the nasal folds, at any age, they heal well without suturing. Laser can be used, however the owner should be warned the nares will be white afterwards but will turn back to the original color (usually black) within 2-4 months.

Dogs with elongated soft palates will suck the soft palate back during inspiration, covering the larynx. A computed tomography (CT) evaluation of the soft palates of brachycephalic breeds were shown to be thicker than non-brachycephalic breeds. The soft palate is considered too long if it hangs down 1-3mm below the level of the epiglottis. During a soft palate resection surgery the patient is intubated, positioned in sternal recumbancy and the head is elevated so the mandible can hang open. Another method to keep the mouth open during pharyngeal/laryngeal surgery is to place two equal size mouth gags on the canine teeth to hold the mouth open. These can be held by the surgical tech to position the head so the surgeon can see the pharynx and larynx well during surgery. A bright, narrow focus light source is necessary for good visualization by the surgeon. The redundant soft palate tissue is excised, traditionally, by a cut and sutures technique, and a 3-0 or 4-0 monofilament absorbable suture (PDS) is placed to approximate the wound and control hemorrhage. Laser and radiofrequency cautery are both acceptable alternatives, often much faster than the traditional method and have similar clinical outcomes.

Laryngeal sacculles are located behind the arytenoid cartilages in the larynx and when everted they block the opening of the larynx. They are lateral to each vocal cord and "bulge" or "balloon" out obstructing the larynx. The surgeon may elect to remove the sacculles if they are significantly blocking the airway. The patient needs to be extubated for this procedure, so IV anesthetics (i.e. Propofol) should be available during this procedure. The surgeon can simply remove the sacculles with long scissors or cup-forceps. There is no surgical treatment for hypoplastic trachea.

BAS patients are at risk for aspiration pneumonia when heavily sedated. In dogs the aspiration can be silent, so a rapid recovery and late ETT extubation is recommended. If there are any concerns, the patient's neck is shaved and prepped in case an emergency tracheostomy is needed. If the soft palate has been shortened a soft food diet is recommended for 10-14 days post-op. Steroids; prednisone (0.5-1.0 mg/kg PO) or dexamethasone (1 mg/kg IV) is given to decrease edema and inflammation after surgery. Antibiotics are recommended prophylactically for an appropriate period of time. The outcome is favorable in young dogs when treated early for stenotic nares. If nares surgery is not done at a young age then it is often necessary to correct the nares, soft palate and laryngeal sacculle protrusion in adulthood. At either age the results are often dramatic. They snore much less, can exercise more easily, become more tolerant of warm summer days, thus enjoying life more.