

Tracheal Stent Measurement Guidelines

English

The two dimensions to be measured before placing a tracheal stent in a canine patient are the length of the tracheal collapse and the diameter of the trachea to be stented.

Both fluoroscopy and digital radiography can be used to appropriately measure a patient for stent placement. Fluoroscopy has the advantage that it can be performed in a patient that is awake and actively coughing. Digital radiographs are generally performed under general anesthesia and the length of collapse must be induced with negative pressure. However, anesthesia facilitates placement of the sizing/marker catheter in a more precise location than with the use of fluoroscopy.

Fluoroscopic Measurements

It is often helpful to perform fluoroscopy in both a relaxed patient and an actively coughing patient. The collapse is generally far more dramatic during coughing, but performing fluoroscopy in a calm patient may help to determine a location of interest, particularly in patients that are dyspneic with activity and/or are reluctant to hold still. By convention, the patient is placed in lateral recumbency with the head to the left.

Calibration: A sizing/marker catheter (available from Dextronix- DexCath-S) is used for calibration and limits magnification artifact. It enables precise measurement in patients where 1 mm may make an enormous difference in stent selection.

The sizing/marker catheter is taped to the dorsum of the patient following the path of the dorsal spinus processes. The dorsal spinus processes are ideal since they are located at about the same distance as the trachea relative to the image intensifier.

With most fluoroscopes, a known distance is measured (the start of one hash mark to the start of a second hash mark on the marker catheter is exactly 10 mm) and used to calibrate the machine. Since an internal standard has already been set, the fluoroscope will then allow the user to “free measure” a particular distance of interest. Using this method, the length of collapse is measured and accurately shown on the monitor.

Stent Length: When selecting a stent, it is ideal to choose a stent that is approximately 1 cm longer at both ends of the collapse (1 cm cranial and 1 cm caudal to the collapse). It is important to remember that the stent will actually be longer if it is not deployed to its maximum diameter (foreshortening). Narrower areas of the trachea will limit the expansion of the stent and will therefore make it longer. Calculation of length must account for possible foreshortening that may change the stent length (for details on individual foreshortening per stent type, please consult the foreshortening chart available for download from www.dextronix.com) and measurement of tracheal width mid-collapse below. If the collapse includes the crania, the caudal extent of the stent should be no more than 1 cm cranial to the carina. A majority of the cough receptors are located in the region of the carina. If the stent is placed too far distal into the crania, the patient will often exhibit a worsening of the cough following the procedure. It is equally important to avoid the larynx. A 1 cm buffer between the cranial extent of the stent and cricoid cartilage is recommended.

Stent Diameter: In order to determine the stent diameter, the trachea is measured at a minimum of 3 locations (just proximal to the carina, at mid-collapse and in the cervical region). See image below.

There can be a great deal of variability between measurements at different locations. The measurements just cranial to the carina and in the cervical region are often the most important when choosing stent diameter. A stent should ideally be 10-15% larger than the maximal measurement. Choosing a stent slightly larger than the measured maximal tracheal diameter helps ensure good apposition of the stent and limits the possibility of stent migration. If the measurements of the trachea at the carina and cervical trachea are significantly different (i.e. greater than 2 mm), then the two measurements are added together and then divided by two to give an average measurement. The stent should then be 10-15% larger than the average measurement. The diameter is often smallest at the mid-collapse level and represents an area of possible foreshortening. Although the mid-collapse measurement is actually a measure of diameter, its greatest importance is in helping choose the ultimate length of the stent.

It is ultimately the veterinarian’s decision to determine the exact stent diameter and length. The location of the collapse may need to be considered when placing a stent. If the collapse is primarily cervical but extends a small ways into the thorax, then the stent diameter should be more heavily weighted towards the cervical measurement. If the collapse is primarily intrathoracic, but extends a small ways into the cervical trachea, then the stent diameter should be more heavily weighted towards the carinal measurement.

Digital Radiographic Measurements

Measurements performed while using digital radiographs are similar to those described above for fluoroscopy with a few exceptions. The patient is anesthetized and placed in lateral recumbency. The endotracheal tube is carefully placed just distal to the larynx. The placement

should be verified with radiographs prior to performing measurements. The proximal location of the tube is important to allow maximal tracheal evaluation. The sizing/marker catheter is placed inside a 10F red rubber catheter to limit esophageal trauma. The red rubber and sizing/marker catheters are then introduced into the esophagus just dorsal to the trachea.

To induce tracheal collapse in an anesthetized patient, a 60 cc syringe is attached to the end of the endotracheal tube. This generally requires removing the proximal end fitting and attaching a tapered Christmas tree. Gentle traction is gradually applied to the 60 cc syringe to induce collapse. A radiograph should be taken when slight negative resistance is met. The length of tracheal collapse is then measured. Using the machine's software measurement tool, measure the hash markers on the sizing/marker catheter. If the distance between the hash marks on the marker catheter is not 10 mm, then all the tracheal measurements must be adjusted accordingly to account for magnification. For example: if the distance between the hash marks measures 7 mm when in all actuality it is 10 mm, then all of the tracheal measurements must then be multiplied by 7 and the total then divided by 10 to get an accurate result.

When performing tracheal diameter measurements, the patient is manually ventilated and a breath held at 20 cmH₂O while a radiograph is taken. The maximal tracheal diameters are then measured as above and the optimal tracheal stent diameter selected consulting the foreshortening chart.

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