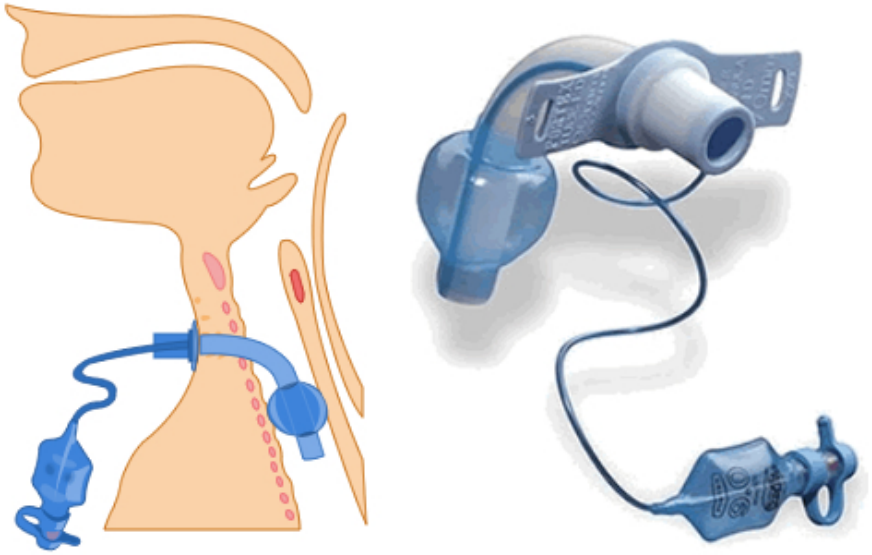
Different types of tracheostomy tubes

The different types of tubes available can seem confusing. Essentially tubes can be described by the presence or absence of a cuff at the end, by the presence or absence of an inner cannula, or by the presence or absence of a hole or 'fenestration.' Tubes can finally be made of different materials and be different diameters and lengths. Most modern tubes are made from medical grade polyvinyl chloride, polyurethane, silicone or a combination of these materials. Some are lined with special films to reduce the 'biofilm' that may develop inside the lumen. There are illustrations and diagrams of the different functions of the range of tubes available via the e-learning section of the website www.tracheostomy.org.uk. Alternative, narrated presentations can be found by clicking here: Explanations of these different types of tubes and cuffs.

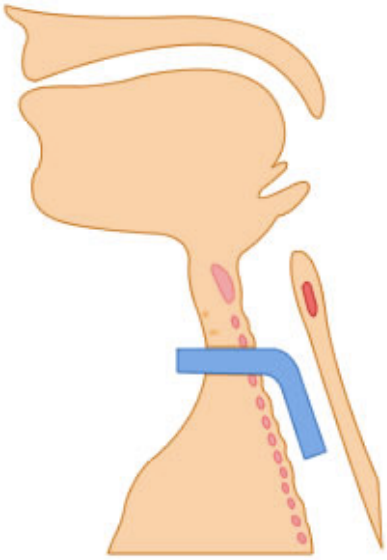
Cuffed Tubes

Cuffed tubes have a soft balloon around the distal end of the tube which inflates to seal the airway. Cuffed tubes are necessary when positive pressure ventilation is required or in situations where airway protection is essential to minimize aspiration of oral or gastric secretions (although all cuffs are not an *absolute* barrier to secretions). If the tracheostomy tube lumen is occluded when the cuff is inflated, the patient will not be able to breathe around the tube, assuming the cuff is correctly positioned and inflated within the trachea.

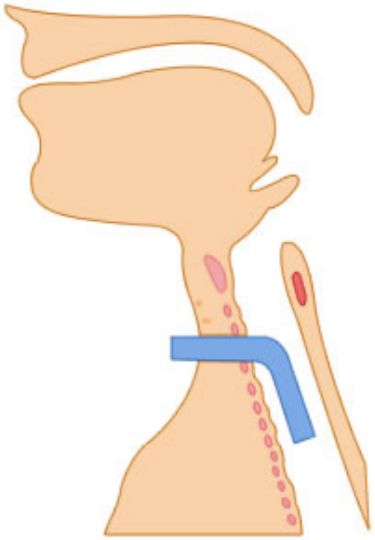


Un-cuffed Tubes

Un-cuffed tubes do not have a cuff that can be inflated inside the trachea and tend to be used in longer-term patients who require on-going suction to clear secretions. These tubes will not allow sustained effective positive pressure ventilation as the gas will escape above the tracheostomy tube. It is essential that patients have an effective cough and gag reflex to protect them from aspiration, as there is no cough to 'protect' the airway. Un-cuffed tubes are rarely used in acute care.



Another type of un-cuffed tube is the minitrach tube. These are typically 4 mm internal diameter and have no cuff. They are primarily designed to allow airway toilet (suction) but can facilitate delivery of oxygen. They are too small to provide any ventilation or removal of carbon dioxide and so can only be considered an emergency method of oxygenation. Minitrachs are sometimes used when preparing to decanulate a patient. The minitrach can remain in the stoma and keep it patent in case a tracheostomy tube needs to be re-inserted. Minitrachs can also be inserted through the cricothyroid membrane. Specialised insertion kits are available for this, either electively or in an emergency.



Fenestrated Tubes

Fenestrated tubes have an opening(s) on the outer cannula, which allows air to pass through the patient's oral/nasal pharynx as well as the tracheal opening. The air movement allows the patient to speak and produces a more effective cough. However, the fenestrations increase the risk of oral or gastric contents entering the lungs. It is therefore essential that patients who are at high risk of aspiration or on positive pressure ventilation do not have a fenestrated tube, unless a non-fenestrated inner cannula is used to block off the fenestrations (see figures).

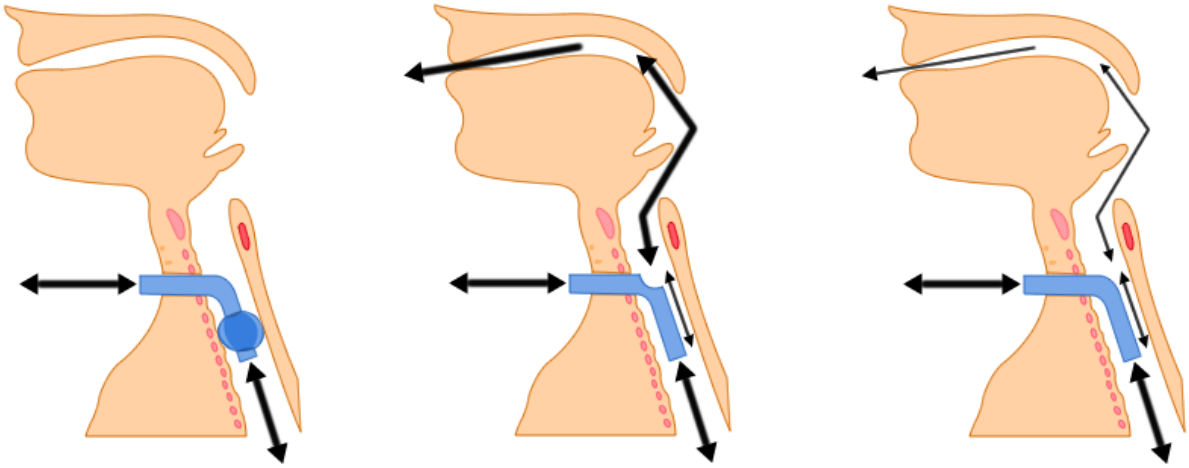
Suctioning with a fenestrated tube should only be performed with the non-fenestrated inner cannula in situ, to ensure correct guidance of the suction catheter into the trachea.

The upper type of inner tube (below right) has a fenestration in it, which lines up with the fenestration in the outer tube. Air can then flow through the tube as before, but in addition, some air can flow through the holes and out through the patient's mouth. This air flow to the upper airway allows the patient to talk. If positive pressure needs to be given to the patient to aid ventilation, for example in the event of a cardiac arrest or worsening respiratory function, then the tracheostomy inner tube without the fenestrations should be fitted, this then allows positive pressure airflow to enter the lungs rather than escaping through the mouth.

The lower inner tube (right) has no hole (or fenestration) and so air flow is allowed straight through the tube from one open end to the other. When this is in situ, minimal amounts of air pass through the patient's upper airway. This inner tube should be in place when the patient is suctioned as there is a small risk of a suction catheter passing through the fenestration and damaging the tracheal mucosa.

Fenestrated tubes can be cuffed or un-cuffed. The various inner tubes are shown.

The images below demonstrate different airflow patterns with different tubes inserted. There are video demonstrations available by clicking here.



Single Cannula Tubes

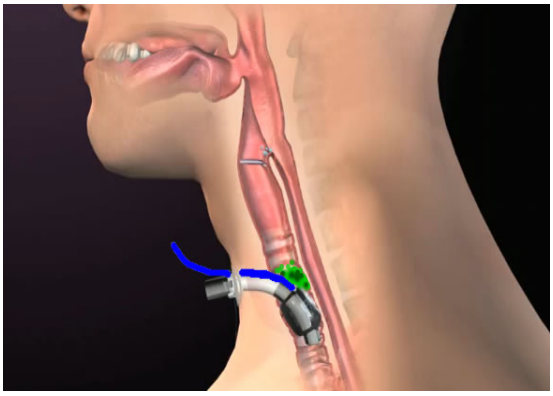
Single cannula tubes are traditionally the first tube to be sited in a critical care area. The system is less complicated than a double cannula tube and is usually for temporary use only. These tubes can be cuffed or un-cuffed. The larger inner diameter of the single cannula tube allows lower inflation pressures to be used when the patient is ventilated, as the larger diameter offers lower resistance to gas glow. The Intensive Care Society in their 2008 guidance have recommended that these tubes are not used routinely in critical care owing mainly to concerns about them becoming occluded with secretions, and the difficulty in cleaning this type of tube. Indeed, without a removable inner cannula, if these tubes do become blocked, often the only way to unblock them is to change the whole tube. Depending on the nature of the stoma and the condition of the patient, this can clearly be hazardous.

Double Cannula Tubes

Double cannula tubes have an outer cannula to keep the airway open and an inner cannula which acts as a removable liner to facilitate cleaning of impacted secretions. Some inner cannula are disposable, others must be cleaned and re-inserted. Patients discharged from a specialist area with a tracheostomy should have a double lumen, ideally un-cuffed cannula in place. This type of tube is the safest to use outside the specialist environment, although to reduce the incidence of tube occlusion, the inner cannula must be regularly cleaned. If an un-cuffed tube becomes blocked, it is more likely that a patient can breathe past the tube via their upper airway, making these tubes inherently safer for non-specialist locations. If there is a high risk of aspiration or need for long-term ventilation, then a cuffed tube may be required long-term. Regular care of the inner tube will prevent build up of secretions and reduce the risk of tube blockage as shown in the image. The inner tube should be removed and cleaned in sterile water every 6-8 hours, or more frequently if heavy secretion load. A spare inner tube should be kept in a clean container at the patient bedside when not in use. It should be noted that some designs of tracheostomy tube require the inner cannula to be in situ before the tracheostomy can be connected to an anaesthetic breathing circuit. It is essential that you understand the equipment being used in your place of work. Videos showing inner tube care can be found here, with YouTube videos from the NTSP here.

Tubes with sub-glottic suction

As part of a bundle of care, subglottic suction may reduce the incidence of a ventilator associated pneumonia occurring in those patients who require mechanical ventilation via a tracheostomy tube. Tubes are now available from various manufacturers which will allow continuous or intermittent suction from any material that accumulated above the inflated cuff of a tracheostomy tube. Again, when the patient leaves the specialist environment, these tubes should be changed for more simple devices. The extra tubing can potentially confuse carers and there is at least one report of the subglottic suction port being connected to enteral feed in error!



Adjustable Flange Tracheostomy Tubes

These tubes are used in patients who have an abnormally large distance from their skin to their trachea, and a standard tube would not fit properly. There are now dedicated kits for inserting these tubes. Standard tubes may not be the correct size for many critical care patients and increasing numbers may require these tubes. Clinical examination, ultrasound and endoscopic inspection before and after a tracheostomy procedure may help to decide which patients require these types of tubes.

Particular indications for an adjustable flanged tube are:

- Patients with very large neck girth including the obese
- Oedema caused burns classically or a capillary leak syndrome (sepsis etc)
- Actual or anticipated oedema after surgical procedures (including tracheostomy itself)

It is essential to review the position of the flange (hence the length of the tube) on a daily basis. If the patient has neck swelling, as this worsens or resolves, the flange may need adjusting. Adjustable flange tracheostomy tubes are more difficult to use and are associated with additional complications, some of which may be life threatening. Only use an adjustable flange tracheostomy tube when it is essential to do so. Patients within a ward area will not usually have an adjustable flange tubes. Newer adjustable flange tracheostomy tubes can have an inner tube.

Choice of tracheostomy tube

The UK Intensive Care Society produced guidance on tracheostomy care in 2008 which included information on the choice of tracheostomy tube. This is summarised below with expansion in some sections.

An important consideration is whether to use a tracheostomy with an inner tube from the time of initial percutaneous tracheostomy, which may be performed for weaning on the ITU. It is increasingly recognised that tube obstruction can occur in critical care areas as well as on the wards and the ICS recommend that these easily cleanable tubes should be used where possible as standard to reduce the risks of obstruction. The disadvantage is that these tubes have a reduced internal diameter which has implications for gas flow. There is also the problem of repeated disconnection from a ventilator which can cause de-recruitment of the lung, with disadvantages for gas exchange in the critically ill. These factors have to balanced against the increased risks of tracheostomy tube obstruction with single lumen tubes, and the possibility of requiring a tube change if the patient is to be moved to a non critical care area. A tracheostomy tube should not be changed for 7-10 days if possible after a percutaneous procedure.

Factors influencing temporary tracheostomy tube choice

Respiratory function

Most temporary tracheostomies inserted to assist with ventilation will be inserted whilst a patient is in an intensive care unit and still requiring some degree of positive pressure ventilation. This will require the use of a cuffed tracheostomy tube (although it is recognised that long term mechanical ventilation can be delivered through an uncuffed tube in certain circumstances).

Abnormal airway anatomy

Upper airway endoscopy following percutaneous insertion suggests that a standard tracheostomy tube may be anatomically unsuitable in as many as one third of adult patients. Obese patients may require a tube with an extended proximal length, whilst patients with fixed flexion abnormalities may not easily accommodate tubes with a fixed angulation. Airway pathology Localised airway pathology such as tracheomalacia, granuloma formation etc

may on occasion necessitate the use of a tracheostomy tube that has a longer distal length than standard.

Compromised airway, protection and weaning problems

Patients can be weaned to decannulation without any need to change to change from the cuffed tracheostomy tube that was initially inserted. In some cases however, it may be useful to consider options such as downsizing, to an un-cuffed or fenestrated tube, or a tube with the option for sub-glottic aspiration of airway secretions. The introduction of a speaking valve may also aid swallowing and secretion control (see next section).

Speaking

Consideration of whether the patient is able to speak, whether it is desirable for them to speak (laryngeal training) or indeed if they want to attempt speech can dictate the type of tube inserted. If the patient has significant 'mouth breathing' then they may benefit from a smaller tube to allow more air to pass around the tube. If a larger tracheostomy tube is required or desired (e.g. the patient requires intermittent cuff inflation and mechanical ventilation) then a fenestrated tube may be a better choice.

Obstructed / absent upper airway

Patients with an obstructed or absent upper airway are at particular risk should a tracheostomy become obstructed or misplaced. This has implications for both the choice of tracheostomy tube as well as the method by which the stoma is fashioned.

Clinical environment

Obstruction of a cuffed tracheostomy tube is a potentially life threatening emergency. Wherever possible a dual cannula tube (i.e. a tube with an inner cannula) should be used, particularly for patients cared for outside of a specialist environment who may not have immediate access to clinicians with emergency airway skills. Ward staff can change inner tubes easily and quickly to relieve obstruction with secretions.

The location that patients will be managed in will also influence the choice of tube. Simpler tubes without additional subglottic suction ports and channels will reduce the potential for confusion. If the patient is going to be discharged to a facility outside of a hospital environment, then consideration should be made to how easily the carers can manage with the device that is inserted. This will include balancing the risks of using a cuffed tube.

Tubes from different manufacturers

There are many different manufactures of tracheostomy tubes and devices around the world, some with significantly different internal and external diameters, and some tubes have significantly different lengths and angulations (see the image below comparing 2 tubes). The table and images below demonstrates some key measurements from a selection of tubes widely

available in the UK. (ID/OD – internal/outer diameter, lengths in mm). It can be seen that even with the same 'size' tubes, there can be significant differences in the diameter of the internal diameter.

A comprehensive list of the various sizes of many of the world's tracheostomy and laryngectomy tubes can be found in Linda Morris' book, *Tracheostomies – the complete guide (*Chapter 4) Springer 2010.

Manufacturer / tube	ID without inner	ID with inner	OD	Length
Shiley DCT	n/a	7.6	12.2	79
Kapitex Tracheotwist	n/a	8.0	11.4	76
Portex Blue Line Ultra	8.0	6.5	11.9	75.5