Transtracheal Oxygen Therapy

FASTTRACT

Insertion Technique

Physicians Instructions
The transtracheal oxygen therapy program has been developed and continuously refined since its inception in 1986. Safety and efficacy of the transtracheal program has been amply demonstrated in the medical literature. The original transtracheal insertion procedure using a modified Seldinger technique (MST) has remained virtually unchanged during this period. However, many busy pulmonology practices have found patient education, scheduling, and post procedure time to be too time and labor intense to justify implementation. Your pulmonologist colleagues may well wish to offer TTOT to their oxygen dependent patients, and simply need to know that you (the ENT surgeon) are available to do the Fast Tract procedure.

To address these and other clinical issues (ongoing tract problems, mucus management, etc.), an alternative method of placing a transtracheal oxygen catheter has been developed. It is called “Fast Tract.” Fast Tract offers several advantages over the older MST. These include:

1. Earlier initiation of transtracheal oxygen therapy. Transtracheal oxygen therapy may be initiated in just one day, rather than the usual stenting period of one week as seen with the MST.
2. Rapid tract maturation. The surgically created tract matures (heals) in just 2-3 weeks, rather than the 6-8 week maturation period seen with the MST.
3. Reduced incidence of mucus and tract problems. Because the maturation time is reduced approximately 75%, the incidence and severity of minor morbidity associated with the MST is greatly reduced.
4. Reduced incidence of lost tracts. Since the transtracheal tract is surgically created, it is virtually impossible for the patient to inadvertently lose their tract.
5. Economic models are much more favorable using the Fast Tract procedure due to the requisite overnight hospital admission.

The Fast Tract procedure was developed by Dr. Alan Lipkin, a Denver area Otolaryngologist. It is performed in the operating room, utilizing a combination of conscious sedation and local anesthetic. The procedure normally takes about 45 minutes, and the patient must spend the night in the hospital. The Fast Tract procedure utilizes skin flaps to fashion an epithelialized tract down to the anterior wall of the trachea. A custom tracheal punch and stent have been developed to ensure uniformity of the tracheal opening, as well as patient comfort and safety during the overnight stenting period.

Fast Tract may be considered as the definitive treatment for patients with chronic tract problems associated with the MST such as tracheal chondritis or keloids. It has been reported in the surgical literature that the incidence of chondritis, keloids, and granuloma formation are all significantly reduced when using the Fast Tract procedure compared to the MST.

As a clinician, you are probably aware of the significant clinical advantages of transtracheal oxygen therapy over oxygen delivered by nasal cannula. Over 160 professional publications have documented a wide variety of clinical and economic benefits including:

1. Reduced work of breathing.
2. Increased exercise capacity.
4. Improved comfort, mobility, and quality of life.
5. Reduced hospitalizations.
7. Lower costs per admission.
8. Improved survival.
Although the Fast Tract procedure was initially developed as an alternative to the MST, it has however, become the procedure of choice for the vast majority of new transtracheal programs since it was initiated in 1996. Fast Tract may specifically benefit those physicians who recognize the clinical advantages of transtracheal oxygen therapy, but may not have the time or resources necessary to establish a traditional transtracheal program. It may also benefit those physicians in referral centers who were previously unable to recommend transtracheal oxygen therapy due to the lengthy maturation period. Additionally, due to the overnight stay required by the Fast Tract procedure, hospitals can also enjoy a new source of revenue, while providing a “new service” to the communities they serve.

While it is convenient to think of the Fast Tract procedure as just that…a procedure, it is in reality a very structured program. It is important that there is good communication between each key team member. Successful hospital based programs have a dedicated TTOT work area, an assigned respiratory therapist or nurse, the involvement of the patient’s home oxygen company, and of course the patient and their significant other. A typical referral scenario develops something like this. The pulmonologist has pre-identified a good TTOT candidate and has done the basic required preliminary testing. A pre-procedure appointment with the surgeon is scheduled and reviewed. The Fast Tract procedure is scheduled and the patient is prepared for what to expect, and the fact that they are going to spend the night in the hospital. Following the procedure, routine follow-up appointments are scheduled within the appropriate designated departments. If not already discussed, this is a very good time to bring up the topic of pulmonary rehabilitation if available. While the term “program” has been used for decades in hospital settings, there may be no better example of a program of care than the Transtracheal Oxygen Therapy program of care.

A Fast Tract DVD for both the physician showing the FastTract procedure and a DVD showing patients their post procedure care instructions is supplied at no charge. A TTOT Patient Reference Manual has also been developed. A program is in place to offer on-site in-service to physicians and hospitals that are interested in initiating a new Fast Tract program at their facility. If you would like further information regarding the Fast Tract procedure, or initiating a Fast Tract program at your institution, please contact our respiratory services division at Transtracheal Systems, by phone, fax, or e-mail. You may wish to visit our website at www.tto2.com for much more detailed information.

Be sure to speak with the Pulmonologists in your hospital and let them know you are available to perform the FastTract procedure.
The best time to do the procedure is early in the week. This allows the patient to be monitored in the hospital for the remainder of the day, the next morning, and then at home throughout the week. Patients should arrive in optimal medical condition and be psychologically prepared for the FastTract\textsuperscript{TM} procedure.

The patient arrives at the hospital at the time specified by the surgeon’s office, having followed the NPO guidelines established previously by the surgeon.

The following information should already be on the patient’s chart - the pulmonologist’s current history and physical, EKG, requested laboratory results, and any other pertinent data obtained from the evaluation interviews with the pulmonologist and surgeon.

The surgeon briefly reviews and evaluates the patient prior to the procedure, answering any additional questions that the patient may have. The pulmonologist is available if needed for further preoperative care. A brief interim history and physical is taken to identify any new symptoms such as increased cough, purulent sputum, or wheezing. The patient’s oxygen saturation on the nasal cannula or mask should be checked via pulse oximetry to ensure adequate oxygenation. If the patient is unstable for any reason the procedure is postponed.

If the patient is stable, an IV is started, and the previously ordered medications are administered. Patients at risk for bronchospasm are given a nebulized bronchodilator or MDI thirty minutes prior to the procedure per pulmonologist order.

In the pre-operative holding area, the anesthesiologist reviews the patient’s chart and conducts a brief interview to assess cardiopulmonary functional status and ascertain optimal condition for surgery. In particular, NPO status and history of reactions to medications and anesthesia is noted, the airway is inspected, and the (ASA) physical status is designated. If needed, sedation may be administered in prudent doses to the anxious patient at this time. Pulse oximetry monitoring is initiated.

Upon arrival at the OR suite, the surgeon fits the bead chain necklace to enable proper catheter placement. A bead chain necklace is passed around the patient’s neck. A proper fit will usually accommodate two fingers

**Typical Preoperative Orders**

- Procedure: Tracheostomy with skin flaps - access procedure for transtracheal oxygen therapy
- Plan on overnight admission postoperatively
- Allergies
- NPO guidelines:
  -8 hours for solids or non-clear liquids
  -4 hours for clear liquids
  -oral medications with sips of water up to 1 1/2 hours prior to surgery
- Use metered dose inhalers or nebulized bronchodilator 1/2 hour prior to surgery
- Intravenous hydrocortisone 100mg IV
- Hold anticoagulants
- History and physical by pulmonologist - must be on the chart
- Have on the chart: recent CXR report, spirometry results, ABG results, EKG, CBC, SMAC, and UA
- Oxygen via nasal cannula and or mask; titrate to keep SaO2 above 92%
snuggly between the neck and the chain, but not excessively tight with neck hyper-extension or heavy coughing. It is suggested that the chain not be cut at this time but only used for proper catheter placement marking, due to possible mild neck swelling with the procedure. The chain will be checked again for proper fit prior to stent removal/catheter placement. This may be done by the surgeon or pulmonologist or under the direct supervision of the physician, a respiratory therapist or nurse. The patient is seated in a high Fowlers position in the bed with the head square on the shoulders. This position should help avoid rotational distortion of the neck anatomy. Attention is focused on the anterior neck. The head of the bed should be angled up 80 degrees and the patient is instructed to slightly extend the neck. The ideal neck position is the same as when the patient is looking into a mirror at his or her own neck.

The nasal prongs are positioned to arrive from behind. This leaves the anterior neck unobstructed. Patients who are wearing masks should have the device inverted and taped to the forehead.

The notch of the thyroid cartilage is marked using a surgical marking pen with a “V” The cricothyroid membrane is marked with a horizontal “____” The notch of the manubrium is marked with a gentle “U”

The most recent PA and lateral chest x-rays are reviewed prior to marking the procedure site. With the neck slightly elevated and square on the shoulders, the superficial anatomy of the anterior neck is palpated. Special attention is paid to anterior neck veins and position of the trachea. The notch of the thyroid cartilage is marked using a surgical marking pen with a “V”, the cricothyroid membrane is marked with a horizontal “— “, and the notch of the manubrium is marked with a gentle “U”. The cervical trachea rests between the “— “ and the “U” and creates a vertical axis. With the fitted bead chain necklace in place, the crossing point may be marked using the surgical pen with two dashes laterally over the sternocleidomastoid muscles. In about 85% of patients, the necklace will cross at the first or second interspace. In about 10%, it will cross lower; and in 5%, it will cross the cricothyroid membrane. In the latter case, the chain is loosened to permit it to dip to the first tracheal interspace. The necklace is removed and saved for use the following day when transtracheal oxygen is initiated.

A tract should not be created through the cricothyroid membrane because it predictably results in hoarseness. This appears to be related to the presence of the cricovocal ligament passing from the cricoid up to the vocal cords. More importantly, experience with the procedure has demonstrated that tracts through the cricothyroid membrane often become indurated and tender. Keloids may form and make catheter insertion difficult. Many tracts created at this level subsequently require revision.

The patient is positioned supine on the operating table with the neck gently extended and a roll is placed under the shoulders. The head of the bed may be elevated slightly for patient comfort. Monitors are applied: BP cuff, EKG, and pulse oximeter. The degree of sedation to be provided will depend on the previous clinical
assessments. Small doses of midazolam (0.5-1.5 mg) and fentanyl (25-75 micrograms) will be tolerated by nearly all patients and will not only provide relaxation, but the fentanyl will also depress the cough reflex. In addition, many patients will be able to tolerate amnestic, if not induction doses of propofol (30-70 mg) or methohexital (20-60 mg) just prior to injection of local anesthesia by the surgeon. Nasal oxygen is provided throughout. Although it is rarely necessary, a patient may be converted to general anesthesia on an emergency basis.

![Figure 1](figure1.jpg)

The area between the cricoid and sternal notch is infiltrated with lidocaine 1% with epinephrine 1:100,000. The neck is prepped and draped. Using cutting cautery, a vertical incision of approximately 1.5 to 2 cm is centered on the site selected by the surgeon (Reference Figure 1). Flaps of full-thickness skin are elevated laterally 2 cm in each direction. The cutting cautery is then used to perform a cervical lipectomy, removing all the fat down to the level of the strap muscles (Reference Figure 2). The strap muscles are separated at the midline, exposing the anterior wall of the trachea (Reference Figure 3). More often than not, division of the thyroid isthmus is necessary.

![Figure 2](figure2.jpg)

![Figure 3](figure3.jpg)

The previously elevated skin flaps are then used to fashion an epithelialized tract down to the anterior wall of the trachea. This is performed by suturing the flaps to the undersides of the previously exposed sternothyroid muscles with a running suture of 3-0 vicryl or similar absorbable material (Reference Figure 4). It may be reinforced with additional interrupted sutures as necessary. Prior to entering the trachea, the entire surgical field is inspected and complete hemostasis is obtained. Additional local anesthetic (lidocaine 1% without epinephrine) is injected into the tracheal wall and lumen, particularly at the point of entry into the trachea.
This will help prevent movement and coughing when the trachea is entered. Since oxygen in high concentration is flowing into the trachea, the electro cauterity cutting blade should never be used to enter the trachea.

![Figure 4](image)

The trachea is then entered with a small horizontal incision in the interspace between two upper tracheal rings previously marked by the necklace (Reference Figure 5).

![Figure 5](image)

The blunt end of the punch is passed through the incision, the punch is engaged (Reference Figure 6), and a small window of cartilage is resected (Reference Figure 7). In cases with scarred or calcified tracheal cartilage, or with revision on tracts that had been created with previous techniques, a Boston Medical Products fenestrator or scalpel can be utilized. With a circular motion, gentle pressure is placed on the fenestrator, creating an opening in the trachea. Suction is applied to the end of the fenestrator, capturing the resected cartilage.
Using the available stylet, the stent is inserted into the tracheal window (Reference Figure 8). A trach dressing is placed over the procedure site, and ties or straps are then used to secure the stent in proper position. A trach collar is applied over the stent to provide humidity for the patient’s comfort. Oxygen is supplied by nasal cannula and/or mask to achieve an oxygen saturation of > 92-94% via pulse oximetry.
Post-Op Stenting Routine

The patient is transported to the Recovery Room at the conclusion of the surgery for monitoring for 1/2 - 3/4 hour. While in the Recovery Room, the patient should have a posteroanterior and lateral chest x-ray. This should document the absence of extravasated air (subcutaneous emphysema, pneumomediastinum and pneumothorax) and confirm the intratracheal location of the radiopaque stent. The relationship of the tip of the stent to the carina is noted. If the tip is closer than 1 cm to the carina, a shorter catheter should be obtained before transtracheal oxygen is started the next day. The sedative and anesthetic agents utilized during the procedure are short-acting, and at judicious doses, the sedative and cardiopulmonary effects are largely dissipated within one hour, even in elderly or debilitated patients. Once stabilized the patient is moved to the floor where he or she will stay until the next morning when transtracheal oxygen is initiated.

Once in the Recovery Room, the patient is often evaluated by the pulmonologist. The head of the bed should be elevated to 45 degrees. Vital signs and pulse oximetry are continuously monitored to keep O₂ saturations at the appropriate level. Bronchodilator medications are used as needed per physician’s order, and the stent may be suctioned with an 8 French suction catheter, if needed for secretion clearance.

Post-operative drugs are dispensed per pulmonologist. IV fluids are maintained along with the appropriate antibiotics, cough suppressant and analgesics. Topical lidocaine (without epinephrine) may be instilled into the stent to further reduce coughing. Pre-op medications may be restarted. Anticoagulants such as aspirin, Heparin and Coumadin are held for one day and restarted again on post-op day one.

Typical Post-Operative Orders

- Status post-tracheostomy with skin flaps - access procedure for transtracheal oxygen therapy
- Admit to Recovery Room with transfer orders to the floor
- Allergies
- Consult pulmonologist
- Vital signs; q 1 hour times 4, then q 4 hours
- Elevate head of bed 45 degrees
- Out of bed with assistance only
- Diet: start with liquids, advance to soft regular diet as tolerated
- IV fluids @ 100 cc/hr. Cap IV when taking PO liquids
- Pain management to be determined by physician
- Hydroxyzine hydrochloride mg IM q 3 hours prn nausea
- Cephalexin 250 mg PO qid
- Guaifenesin LA 1200 mg PO bid
- Benzonatate (Tessalon) 2 tabs tid prn cough
- Steroids
- Restart anticoagulants on post-op day one
- Resume other pre-op medications
- Orders for respiratory therapy
- Oxygen: Trach mist with nasal cannula and/or mask to keep titrated to O₂ saturation > 92-94 %
- Suction stent prn with an 8 French suction catheter
- Lidocaine 1% liquid (not viscous) - instill 1 cc in stent q 3 hours prn cough
- Medications via nebulizer
Extensive experience with TTO suggests that a prophylactic antibiotic (effective against staphylococcus) is beneficial for seven days following the procedure. The existing body of literature about antibiotic prophylaxis does not address the special considerations of cartilage. Failure to administer antibiotics for these longer periods may result in tracheal chondritis two or three weeks later.

As the tracheal anesthesia wears off, most patients develop some degree of cough. The severity of the cough is assessed after the procedure and a cough suppression plan is designed. Patients with a low FEV₁ or interstitial lung disease are at higher risk to cough. Brisk coughing is rare when patients are allowed to accommodate the foreign body before the transtracheal catheter is inserted. Patients should be instructed to control any urge to cough, because it may result in respiratory fatigue or subcutaneous emphysema. Tessalon or Benzonatate, 2 tablets 3 times a day and PRN, are dispensed as needed. Additionally one to two cc of 1% liquid lidocaine (without epinephrine) can be instilled into the stent every 3 hours as needed for cough which may help augment the oral cough suppressant. In some cases it may be necessary to instill the topical lidocaine more often, or use a stronger percentage (i.e. 2%).

Once stabilized, the patient is discharged from the Recovery Room and transferred to the floor. The patient may be out of bed with assistance only and diet may be advanced from liquids to soft regular diet as tolerated. Oxygen saturations and respiratory status are monitored, and suctioning as needed is done via the stent with an 8 French suction catheter to facilitate secretion clearance. The site around the stent is kept as clean and dry as possible using a cotton tipped applicator and 3% hydrogen peroxide, and a standard trach dressing.

Discharge is planned for the following day after the stent is removed and the transtracheal catheter is inserted. Families should be reminded to bring the patient’s full portable oxygen system for discharge the next day.

Transtracheal Systems, Inc. provides the FastTract™ System Pack (Surgical Kit with 9 cm or 11 cm catheter [catalog number T-10SP-9 or T-10SP-11] to facilitate the procedure, the overnight stay and the stent-to-transtracheal catheter change over). A sterile 4.8 mm FastTract™ Tracheal Punch, a sterile 4.7 mm OD polyurethane FastTract™ Stent and a soft tracheostomy tube holder are furnished for the procedure. Three 8 French suction catheter kits are provided, and the sterile wire guide, two bead chain necklaces and a wire suture scissors are for use at the stent-to-transtracheal catheter change-over. In addition, the System Pack also provides one catheter single pack (9 or 11 cm), one catheter 2-pack (9 or 11 cm), one hose (H-2050), one cleaning kit (CK-6), a patient reference manual and one FastTract Post Procedure Care for Patients DVD, part number V-3.
Initiation of TTO and the Immature Tract

Transtracheal oxygen therapy is normally initiated the morning after the FastTract™ procedure. The FastTract™ procedure facilitates early initiation of transtracheal oxygen therapy, before a fully mature tract has occurred. This is due to the structure and integrity of the tract that has been created by the surgeon. The transtracheal tract established by the FastTract™ procedure normally takes about 10-14 days to completely mature (heal). This time period varies slightly according to the healing characteristics of each individual patient.

The stent is exchanged for a functioning transtracheal catheter on post-op day one. Transtracheal oxygen flow rates are titrated at rest and with activity, and an arterial blood gas or SaO₂ is obtained at rest per physician order. The patient and the significant other are instructed about cleaning in place and observed through a cleaning cycle to confirm proper technique. Security routines to assist in avoiding lost tracts are reviewed with the patient prior to discharge.

The next 2-3 weeks is spent assessing tract maturity, fine tuning patient cleaning protocols and avoiding and treating mucus balls and tract problems. Support and encouragement for the patient during this time while the patient is adjusting to transtracheal oxygen therapy is equally important.

Prior to the post-op day one visit by the pulmonologist or otolaryngologist, back-up supplies for the initiation of transtracheal oxygen should be available from the Respiratory Therapy Department. Remember that the catheters, hose, cleaning kit and a patient training video are provided in the patient section of the FastTract™ System Pack. These supplies should follow the patient from the operating room to the floor.

### Supplies Required for Stent-to-Catheter Change-Over

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<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>transtracheal catheter</td>
<td>3% hydrogen peroxide</td>
<td>protective glasses</td>
</tr>
<tr>
<td>cleaning rod</td>
<td>Opsite, Duoderm or Tegaderm</td>
<td>examination gloves</td>
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<tr>
<td>transtracheal oxygen hose</td>
<td>TTS saline or unit dose vials</td>
<td>nasal prongs</td>
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<tr>
<td>bead chain necklace</td>
<td>water soluble lubricant</td>
<td>O2 adapter</td>
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<tr>
<td>wire suture scissors</td>
<td>cotton tipped applicators</td>
<td>bubble humidifier</td>
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<tr>
<td>wire guide</td>
<td>4x4 gauze</td>
<td>facial tissues</td>
</tr>
<tr>
<td>1% lidocaine</td>
<td>luer taper syringe with needle</td>
<td></td>
</tr>
<tr>
<td>oximeter</td>
<td>Patient Training video (V-3)</td>
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It is recommended to start with the 11 cm transtracheal catheter. It is our protocol to obtain both a PA and Lateral CXR to confirm stent placement relative to the carina. Ideally, the catheter should be located 2-4 cm above the carina. Catheters are also available in 9 and 13 cm lengths should a different length be clinically desired.
The patient is positioned in the semi-Fowlers position with nasal cannula arranged to arrive from behind. The physician, respiratory therapist, or nurse puts on protective glasses and gloves, and the aerosol set-up is discontinued. The transtracheal catheter package is opened, and a small amount of water-soluble lubricant is placed on the catheter tip. The bead chain necklace is assessed for initial proper fit. Make sure that two fingers can gently rest between the neck and the chain. The chain is then cut to the appropriate length, and the previously-measured necklace is passed through the eyelets of the flange. Suction the stent with an 8 French suction catheter, per hospital policy. Draw up 2 cc’s of 1% plain lidocaine into the luer taper syringe and remove the needle from the syringe.

Hand the patient a facial tissue and warn of an incipient cough, bad taste and globus sensation which will be caused by the injection of the local anesthetic. Remind the patient not to eat or drink anything for one hour following the lidocaine injection.

Quickly inject the lidocaine into the stent. If the patient does not cough, ask the patient to cough in order to better distribute the lidocaine throughout the tracheal lumen. Wait about one minute. Clean around the stent with cotton tipped applicators and diluted 3% hydrogen peroxide, and remove the trach ties from both sides of the stent.

Insert the flexible end of the wire guide to the black reference mark at 11 cm and withdraw the stent over the wire guide. Have an assistant hold the wire guide with the black reference mark at the level of the skin. Lubricate the transtracheal catheter and pass it, with the pre-threaded necklace, over the wire guide twirling it 360 degrees into the tract. When the flange comes to rest against the skin, the wire guide is removed and the necklace clasp connected. Make certain that the SCOOP logo on the flange is upright and readable. Place a 4x4 gauze pad under the flange prior to taping. A 2-inch piece of clear plastic tape (Opsite, Duoderm or Tegaderm) is placed on both sides of the flange over the bead chain necklace (immediately to the left and right) to help avoid inadvertent dislodging of the catheter. This is usually only necessary for the first week or two.

To ensure that the catheter is correctly seated, you may visualize the catheter with a penlight to confirm catheter placement in the trachea. Using a syringe filled with saline and the needle removed, connect the luer taper syringe to the catheter and withdraw the plunger. If air flow backs freely, the catheter should be in correct position. A CXR can be done if positive confirmation or catheter tip position is desired.

Take the previously-selected transtracheal oxygen hose and attach the security clip to the top of the lower body clothing at the right hip. Pass the supple hose segment under the upper body clothing and connect to the catheter via the luer taper connector.

A pulse oximeter is placed on the patient’s finger, and the transtracheal oxygen hose is connected to the oxygen source. Initially, the flow rate is turned down to half the nasal cannula flow rate. The nasal cannula is removed and the patient is titrated on transtracheal oxygen to an oxygen saturation > 92-94% . Adequate oxygenation and ventilation may be confirmed with an arterial blood gas, per physician order.

Using the patient’s portable oxygen source and an oximeter, ambulate the patient to determine the necessary activity flow rate. All TTO patients should have 3 flow rates documented: a resting TTO flow rate, an activity TTO flow rate and a nasal cannula flow rate.

Have the patient (and if possible, the patient’s significant other) view the “Cleaning in Place” segment of the Patient Training video. Show the patient how to clean in place, and then observe the
patient cleaning in place to ensure proper technique. Cleaning in place should be done twice daily (BID). It should be recommended that the patient clean the catheter at 8:00AM and 4:00PM so that a respiratory therapist, physician or nurse can easily be contacted should the patient have questions or problems. In addition, the patient is given the transtracheal package insert with the enclosed written “Cleaning in Place” instructions. Canisters of pressurized catheter cleaning solution or unit dose vials of saline may be used by the patient for internal catheter cleaning.

Remind the patient of possible air loss and secretions from the stoma while it is healing, and possible difficulty speaking for the first few days. Normal voice strength and quality should return in time. The patient can apply gentle pressure to the transtracheal catheter flange to make phonation easier. Reassure the patient that the stoma will close around the catheter during the healing process. The patient may also experience intermittent blood tinged sputum for a few days following the procedure.

Apply a sterile gauze dressing around the stoma and tape in place to catch any drainage that might occur. Instruct the patient to use the gauze for 2 or 3 days while the stoma is healing.

Review normal security routines with the patient to help ensure against lost tracts. A properly fitted necklace should not be modified by the patient. The supple upper segment of the transtracheal oxygen hose must be worn under upper body clothing, especially in bed. Patients who wear nightgowns should fashion a cloth belt to which the security clip can be attached under the gown.

The patient should be instructed that inadvertent dislodgement of the catheter may possibly result in a lost tract. Should this occur, the patient should attempt to reinsert the catheter but for no longer than 5 minutes before calling the physician’s office or emergency room. If the patient is unsuccessful in reinserting the catheter, help should be sought immediately. The nasal cannula should be worn at the prescribed flow rate and transtracheal supplies carried to the physician’s office or emergency room. (In this manner, the physician, respiratory therapist or nurse will be better prepared for the patient’s arrival.)

It should be noted that in an attempt to reinsert the catheter or during violent coughing, a “cephalad catheter” may ensue. When this occurs, the catheter passes upward through the vocal cords rather than downward into its normal intratracheal position. The patient will experience severe coughing and discomfort and will have difficulty with phonation. If this is the case, the patient should be instructed to gently, but quickly, remove the catheter and try inserting again (with NO oxygen flowing through it) paying special attention to direct the catheter straight back, so that it will follow the natural curve of the posterior tracheal wall. If the patient has any questions regarding proper catheter position, he or she should call the physician’s office for further instructions. If necessary, a chest x-ray can be ordered.

Before discharging your patient, make a follow-up appointment within 3 to 5 days for a first catheter stripping and evaluation. Review the Patient Reference Manual carefully with the patient. Make sure the patient has all the necessary prescriptions, appropriate antibiotics, cough suppressant, mucoevacuent and analgesics for discharge. Patients should be seen twice a week during the first two weeks following the procedure. A best case scenario would thus be appointments set on a Monday/Thursday or Tuesday/Friday schedule. Notify the patient’s homecare company of any liter flow changes and provide a prescription for appropriate catheter and hose replacement every 90 days.
Mucus Balls

Review the signs and symptoms of a mucus ball with the patient, including increasing or severe cough, severe or worsening dyspnea and increased wheezing. If any of these symptoms occur, the patient should be seen for a catheter stripping.

Mucus Ball Clinical Presentations

- Cough, increasing or severe
- Dyspnea, increasing or severe
- Wheezing, increasing or severe

A mucus ball is an accumulation of inspissated mucus which adheres to the anterior and lateral surface of the catheter, just above the tip. Symptomatic mucus balls occur in 10-20% of patients while their transtracheal tract is maturing, and they are cleaning in place. They generally disappear when the tract is fully healed. At that point daily removal strips the mucus off the catheter, allowing it to be expectorated. In many patients, the trachea adapts, and mucus balls spontaneously diminish in frequency during the two weeks or so the tract is healing. Although mucus balls can cause a tickle cough, dyspnea or wheezing, they rarely result in airway obstruction. The pathogenesis of their formation is related to the volume of dry gas introduced into the lower airway and baseline secretions. Patients with low FEV$_1$ and weak cough are less able to generate the glottic blast to dislodge mucus balls and are at relatively greater risk. Ineffective cleaning, inadequate humidification, failure to periodically strip the catheter along with insufficient systemic hydration are iatrogenic factors which predispose a patient to mucus ball formation. The transtracheal team should maintain a high index of suspicion during the first weeks following the procedure, and mucus balls, which form in spite of adequate cleaning and humidification, should be immediately recognized and treated.

The risk of forming mucus balls must be assessed when the patient returns for the first follow-up visit to the physician. This is usually scheduled during the week immediately following the procedure. The risk of mucus ball formation may be greater in the immediate post-op period due to the higher volume of room air introduced through the stoma as the tract matures.

If there is a small to moderate amount of mucus on the tip of the catheter following a catheter stripping, the cleaning schedule is increased to 3 times a day (TID), and the patient returns in 3-4 days for a catheter stripping and evaluation. Review the cleaning procedure and ensure that the patient has proper humidification on the stationary oxygen system. If the patient’s flow rate is greater than 1 L/min., a high-quality 2 psi pop-off humidifier for the stationary oxygen source is recommended. The patient requiring flows up to 6 L/min. might benefit from a bubble humidifier with a 6 psi pop-off (Salter Labs Model #7600). Patients requiring higher flows (> 5-6 Lpm) or more humidity may require a servo controlled heated humidifier (Vapotherm or Fisher Paykel). These humidifiers can be obtained from the homecare provider.

If the patient coughs out a mucus ball after catheter stripping, increase cleaning in place to 4 times a day (QID) and start a mucoevacuent, such as Mucinex (Guaifenesin) 1200 mg BID. Review cleaning and humidification with the patient and have him/her return in 3-4 days for another catheter stripping and evaluation.

The initial cleaning and stripping protocol permits escalation or de-escalation based on actual clinical evaluation. The adequacy of cleaning should be assessed during each post procedure visit. Mucus balls can be treated in all patients, but a few with poor cough, copious secretions and high flow rates may need intense supervision.
which may include QID cleaning in place, use of a servo-heated humidifier and twice weekly catheter stripping throughout the entire healing period. The transtracheal team must master the art of preventing, recognizing and treating mucus balls.

Subsequent scheduled and unscheduled visits should always include a check of the bead chain necklace fitting, appearance and maturity of the tract, catheter stripping and oximetry. These can often be accomplished in about 10 minutes. The frequency of monitoring should remain flexible and be adjusted according to actual clinical evaluation. The following table summarizes the steps involved in stripping the transtracheal catheter.

### Follow-Up Visits

**About 10 minutes**

1. Check necklace fitting
2. Check appearance and maturity of tract
3. Strip catheter over wire guide
4. Check for persistent air leak
5. Check oxygen saturation by oximetry

### Catheter Stripping Protocol

1. Patient uses nasal cannula during stripping
2. Clean crusts from tract opening
3. Instill 2 cc of 1% plain lidocaine into catheter
4. Insert wire guide to 11 cm mark
5. Remove soiled catheter
6. Assistant holds wire at black reference mark
7. Wash catheter and apply water soluble jelly
8. Reinsert transtracheal catheter and connect necklace
9. Place 2 inch piece of Opsite, Duoderm, Tegaderm or tape over the bead chain necklace on each side of the flange
10. Reconnect catheter and remove nasal cannula

### Catheter Dislodgement

Dislodgment of the catheter during tract maturation rarely results in closure of the tract, but lost tracts are a problem that require immediate attention. The physician should have a sterile catheter and wire guide available for possible emergent use. In the event of dislodgment, the patient must be seen immediately, and the physician should attempt to reinsert the transtracheal catheter using a small amount of sterile water-soluble jelly or viscous lidocaine on the catheter tip. If this is not successful after a few minutes, an attempt to pass a transtracheal wire guide should be made. Local anesthetic is not injected since it tends to distort tissues. Prolonged attempts at recovering the tract are not advised, since the wire guide may make numerous false tracts. Prolonged attempts to reestablish a lost tract can cause subcutaneous air. If the tract cannot be recovered, the patient goes home on nasal cannula, and an elective procedure may be scheduled for a later date.

Tract healing and maturation is the most challenging period of time for both the patient and the transtracheal team, because minor morbidity is most likely to occur at this time, and the patient is learning to adjust to the
The Mature Tract

The new opening created by the FastTract™ Procedure is nearly healed between 10-14 days following the procedure itself. A customized cleaning protocol for each patient is desirable, because it takes into consideration liter flow, mucus production, underlying lung disease, the patient’s level of comfort with catheter removal and insertion, and the ability to generate an effective cough. A cleaning routine should include cleaning in place as necessary. The frequency may easily be increased or decreased based on the patient’s clinical symptomology. Removal for cleaning can be done as often as twice a day to as little as once a week. **Daily or twice daily catheter removal reduces risk of mucus ball formation and is recommended.** Patients who do not experience mucus balls may prefer to remove the catheter for cleaning less frequently. A customized cleaning protocol is essential for each patient to maximize safety and efficiency.

By the beginning of the third week post-op, the patient’s tract can be evaluated to determine if it is fully matured (healed). The patient, seated in the procedure chair with head rest, is interviewed regarding changes in sputum, cough, mucus balls, dyspnea, wheezing or any tract problems. Vital signs are taken; body weight and pedal edema are assessed, and a resting oxygen saturation is checked. The tract opening is evaluated for erythema, granulation tissue, induration or any residual air leak. The bead chain necklace is observed for appropriate fit.

**Catheter Cleaning Guidelines**

- **Cleaning in place**
  - clean in place at 8AM, 4PM and prn
  - cleaning frequency may be increased or decreased based on the patient’s clinical symptomology
  - feeble or anxious patients may prefer cleaning in place
  - tender tracts - minimize further tract trauma
  - patient preference

- **Removal for cleaning**
  - remove catheter as often as twice a day at 8AM and 4PM
  - do not remove more than BID
  - remove catheter once a day, every other day or once a week based on the patient’s symptomology
  **Daily or twice daily catheter removal reduces risk of mucus ball formation and is recommended.**
A new transtracheal catheter is prepared by placing a small amount of water-soluble lubricant on the catheter tip, and the bead chain necklace is threaded through the flange. The patient is given facial tissues and warned of incipient cough. Two cc of 1% plain lidocaine are instilled into the transtracheal catheter. (A wire guide is immediately available, but it’s use is optional at this point). After a 1 minute wait, the transtracheal catheter is removed assessing tract maturity during removal and reinserterion. A second clean transtracheal catheter is inserted into the tract. If the catheter slips easily into place, there is no difficulty with the external opening lining up with the internal tract, and the tract is not too wide and gaping, the tract is defined as mature. The patient can be now advanced to catheter removal and reinserterion as the preferred cleaning technique. If the physician or respiratory therapist has any difficulty with the aforementioned, or if the patient is not psychologically prepared for daily catheter exchange, the patient will continue to clean in place for two more weeks and another attempt can be made at that time.

As the patient progresses, reassess their oxygen flow rate by oximetry titration at rest and with activity. Have the patient view the “Removal for Cleaning” segment in the Patient Training DVD. The patient should then demonstrate the “Correct Removal for Cleaning” sequence using the second catheter.

Helpful tips for the patient include the following suggestions: Hold the catheter near the tip within the last inch so that it gives more control during insertion. Insert the catheter straight back and not at an angle. It should follow the tract’s path and slip easily into place. Twirl the catheter when inserting. Some coughing is normal during insertion. If coughing occurs, continue advancing the catheter. Do not to force the catheter in, because once the catheter is inserted, the coughing should subside.

Review the possibility of the occasional cephalad catheter displacement. Sometimes the catheter is displaced in an upward direction. When this happens, the catheter is placed through the vocal cords. This causes a very uncomfortable feeling and a severe continuous cough, and the patient may be unable to talk. This can happen for several reasons. The catheter might have been angled slightly upward instead of straight back, or a strong cough at the time of insertion may have angled the catheter upward. If this occurs, gently remove the catheter and focus on directing the catheter straight back, at which point the catheter should follow the tract path and slip easily into place. The coughing will subside, and the patient’s speaking voice will return. Always insure that no oxygen is flowing through the catheter when attempting to replace the catheter into the trachea.

Customize the patient’s cleaning and changing protocol according to clinical course as well as his or her ease with catheter exchange. The patient should clean and/or change the catheter BID. Encourage the patient to do the cleaning and changing protocols between 8:00AM and 4:00PM, so that if any questions or problems arise, it would be easier to get in touch with a knowledgeable respiratory therapist, physician or nurse.

There are several suggested customized cleaning protocols. Patients may remove the transtracheal catheter once a day and clean in place once a day. Some patients may choose to remove the catheter 3 times a week with BID cleaning in place on the other days. Other patients who have very little mucus production or are anxious may choose to only remove the catheter once or twice a week with cleaning in place the rest of the time.

Cleaning in excess of BID should always be done using the “in place” method. Excessive removal and reinserterion may traumatize the tract and result in tenderness or chondritis.
Although the FastTract™ procedure reduces the incidence of tract problems, it is important to be able to identify and treat the problems appropriately. A variety of tract problems may be seen during the first few weeks and months following the FastTract™ procedure. Erythema may be caused by maceration, abrasion, granulation tissue, contact hyper-sensitivity, Candida albicans and bacterial cellulitis. Maceration and abrasion may result from a necklace which is too tight or a tightly buttoned collar. A cuff of granulation tissue may be seen in some patients. Granulation tissue is a bright red and friable mass of capillaries, fibroblasts and inflammatory cells. In the event that the granulation tissue is exuberant and is associated with minor bleeding, simple cautery with an AgNO₃ stick or excision and cautery will correct the problem. Candida is usually an iatrogenic complication from broad spectrum antibiotic ointments. Other factors which predispose to Candida include oral steroids, oral antibiotics and diabetes mellitus. The best protection against Candida is a clean dry tract. Contact hyper-sensitivity can occur with chlorhexidine residues on the catheter and other substances which the patient may be applying to the tract. The catheter should only be cleaned with antibacterial soap. Bacterial cellulitis is especially uncommon but would be treated with antibiotics. Tracheal chondritis is a unique problem which merits further explanation.

Cartilage is also a unique tissue, because it is less vascular and has a tendency to become colonized by bacteria and behave like a foreign body. The reader is reminded of the earlier discussion justifying the prolonged use of antibiotic prophylaxis around the time of the procedure. Clinically, about 10% of patients develop a deep indurated lump around the tract several weeks after the procedure. The lump is often tender but is not fluctuant as an abscess would be. The bacteriology is unclear, but the knot appears to be a regional inflammatory response to colonization of exposed tracheal cartilage. Treatment with oral antibiotics, such as Cipro or Keflex 250 mg TID-QID (or a newer antibiotic of choice effective against Staphylococcus aureus), for an additional 3 weeks is usually effective.

Late tract problems may appear months or years following the procedure. Abrasion, maceration, contact hyper-sensitivity and Candida albicans are uncommon, because the patient has usually learned proper tract care by this time. Problematic scar tissue develops in about 5% of patients and causes problems inserting the catheter or visible keloids. Visible keloids differ from granulation tissue because of their late appearance (pink rather than red color and keratinized surface). Factors which appear to result in excessive scar tissue include cricothyroid membrane punctures, exposure of cartilage during the procedure, excessive catheter removal for cleaning (>BID) and patient predisposition. Small keloids at lower puncture sites sometimes respond to repeated injection of small amounts of depo-steroid (e.g. Kenalog, Depomedrol) directly into the keloid. The Fast Tract™ procedure is useful as both a primary method of tract creation and a revision procedure for tract problems already incurred with the needle wire guide technique. Large keloids and chronic tract problems which do not respond to simpler methods may be successfully treated with the Fast Tract™ procedure. Virtually all patients who have been on TTO long enough to develop complications will elect to have the Fast Tract™ procedure rather than return to nasal cannula.

Patients will be reassured to know that if improvement of their medical condition allows discontinuation of transtracheal oxygen therapy, the Fast Tract™ procedure may be reversed. In most cases, removal of the transtracheal catheter and placement of a light dressing over the tract will lead to complete closure of the tract in a period of a few days.
The Mature Tract

If the tract does not completely close, surgical closure can be performed in the operating room under local anesthetic and monitored anesthetic care. Lidocaine 1% with epinepherine 1:100,000 is infiltrated around the remaining tracheocutaneous tract. Cutting cautery is used to completely resect the epithelial connection between the trachea and the skin. The strap muscles and subcutaneous tissue are mobilized and reapproximated at the midline with interrupted absorbable sutures, such as 3-0 Vicryl. After subcuticular skin closure, steristrips are placed. This procedure can be performed on an outpatient basis. Cosmetic revision of depressed tract scars can be performed in a similar manner.

In summary, transtracheal oxygen therapy offers the typical oxygen patient many benefits over the conventional nasal cannula and is the best method for delivering ambulatory oxygen therapy 24 hours per day. This booklet summarizes the current Fast TractTM program and addresses of most of the problems encountered earlier in the evolution of this new technology.

### Summary of Transtracheal Tract Problems

<table>
<thead>
<tr>
<th>Problems</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maceration</td>
<td>Adjust necklace</td>
</tr>
<tr>
<td>Abrasion</td>
<td>Adjust necklace</td>
</tr>
<tr>
<td>Granulation tissue</td>
<td>AgNO3 cautery</td>
</tr>
<tr>
<td>Contact hyper-sensitivity</td>
<td>Avoid “lotions &amp; potions”</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>Avoid antibiotic ointment</td>
</tr>
<tr>
<td>Cellulitis</td>
<td>Antibiotic</td>
</tr>
<tr>
<td>Tracheal chondritis</td>
<td>Antibiotics (3 weeks)</td>
</tr>
</tbody>
</table>

### References

**Safety and Efficacy**


**Increased Exercise Tolerance**


**Reduced work of breathing**


**Transtracheal oxygen and reduced hospitalizations**


**Transtracheal Therapy in Chronic Respiratory Failure**

For additional copies of this guide or for ordering information concerning transtracheal products, call or write to:

Transtracheal Systems, Inc.
14 Inverness Drive East, Suite H-100
Englewood, Colorado 80112