

## **Tracheostomy tubes and swallowing**

### Guidance from the literature

**Disclaimer:** This document is a review of the available literature published after 1995. The purpose of the document is to identify a consensus opinion about the influence of a trach on swallowing physiology, if any. This document does not provide clinical guidance. The reader is advised to consult the literature reviewed here and any other available literature to form a personal opinion to guide clinical decision making.

While it is sometimes assumed that swallowing is adversely affected in a patient with a tracheostomy tube (trach), the evidence in the literature is divided on how a trach may or may not change swallowing function. Changes in swallowing associated with the presence or absence of a trach, a deflated or inflated cuff, and the use of a Passy-Muir valve (PMV) are inconsistent across most studies<sup>1-7</sup>.

There are many theories as to why the presence of a trach, particularly one with an inflated cuff, may result in changes in swallowing. However, since these theories have yet to be definitively proven as evidenced by the wide range of opinions in the studies reviewed, they must still be considered as conjecture. It is possible that other factors, and not the trach itself, may be the cause of dysphagia with some patients.

Many patients with a compromised medical status resulting in the need for a trach could have dysphagia as a result of their general medical status, regardless of whether or not a trach is placed. In many circumstances, the "underlying neurological and medical etiology of the dysphagia may override the issue of the tracheotomy tube status."<sup>2</sup>

Several authors theorize that the presence of a trach tube changes swallowing physiology.<sup>4, 7-10</sup> Multiple physiological functions, such as pharyngeal transit time, bolus transit time, hyoid movement, and pharyngeal activity duration, have been measured with cuffs inflated, cuffs deflated, and with trachs occluded. However, the findings of how swallowing physiology is altered by the presence of a trach or inflated cuff have been inconsistent, and based on the literature reviewed in this summary, no definitive generalizations can be made about changes in swallowing physiology as a result of trach status.

#### Passy-Muir Valves/ Cuff deflation:

In the studies reviewed, the use of a PMV impacted the swallowing more often and more significantly than cuff deflation alone. As Suiter points out, deflating the cuff alone does not restore normal subglottic pressure which may explain why cuff deflation created less of a change in swallowing than expected in some studies.<sup>7</sup>

In the studies reviewed, using a PMV often resulted in reduced frequency of aspiration but rarely eliminated aspiration. In general it appears that when using a PMV, patients may have improvements when swallowing thin liquids more so than other consistencies. Some studies report that when aspiration wasn't eliminated, it was "reduced" using a PMV. However, this reduction was not quantifiably measured in the studies reviewed.<sup>1</sup>

One notion that is widely accepted is that the presence of a trach with an inflated cuff may alter subglottic pressure and subsequently have a negative effect on swallowing. There are several theories as to how a cuffed trach can change swallowing. Gross suggests that the cuff may alter the stimulation of the subglottic pressure receptors resulting in a change to the swallow physiology. It is proposed that these receptors influence recruitment of the pharyngeal lower motor neurons during swallowing which impact the force, speed, and duration of muscle contractions. Gross also speculates that in normal conditions these receptors trigger a specific segmental swallowing reflex in the brain stem. The presence of a trach cuff may alter the length of time that the receptors are without stimulation and impact the swallowing physiology.<sup>4</sup>

Ding and Logemann suggest that clinicians should assess patients in multiple trach conditions to determine whether or not cuff deflation or trach occlusion impacts swallowing with that individual patient.<sup>9</sup> From the standpoint of making diet recommendations, it is important to note that if cuff deflation or use of a PMV improves the swallow for a particular consistency during an MBS, it may not always result in the ability to safely tolerate this consistency during all PO attempts.

It has been proposed that “there is not a single mechanism whereby subglottic air pressure enhances swallowing velocity, but rather, that there is a combination of factors”<sup>8</sup> It is possible that it is this complexity of how a trach tube may or may not affect swallowing that makes it difficult to obtain conclusive research findings.

Another factor that could contribute to the varied findings in the research is that none of the studies reviewed used the same methods for evaluating the impact of trachs, cuffs, and occlusion on swallowing function. Because of this, the wide range of findings about the correlation between trachs and swallowing may be due to differing variables in the studies.

In conclusion, clinicians are advised to evaluate the potential impact that cuff deflation or a PMV has on swallowing on a case by case basis. Just as one particular compensatory strategy does not reduce swallowing dysfunction for every patient, alterations in the trach status do not result in changes in swallowing for all patients. It is possible that altering the trach status may impact swallowing, but this should be assessed individually with each patient.

## **FULL TEXT ARTICLES REVIEWED**

1. Dettelbach MA, Gross RD, Mahlmann J, Eibling DE. *Effect of the Passy-Muir Valve on aspiration in patients with tracheostomy.* Head Neck. 1995 Jul-Aug; 17(4):297-302.

**OBJECTIVE.** To assess potential benefit of a Passy-Muir Speaking Valve (PMV) in decreasing aspiration in patients with a tracheostomy. **BACKGROUND.** Many patients with tracheostomy exhibit clinically significant aspiration. It has been previously noted that aspiration can often be reduced or eliminated by plugging or removing the tracheostomy tube. Some patients, however, do not tolerate removal or plugging of their tracheostomy tube, which then leads to persistent aspiration. We postulated that a one-way speaking valve may restore more normal subglottic and glottic air flow and

reduce aspiration. METHODS. Alert patients with a tracheostomy and clinical evidence of aspiration were eligible for study. Eleven patients with tracheostomy and known aspiration were studied with a modified barium swallow. Radiographic examination was used to evaluate the presence and amount of aspiration while patients swallowed both with and without a PMV in place on their tracheostomy tube. RESULTS. Aspiration was reduced (or eliminated) during swallowing in all 11 patients when they wore a PMV, when compared to swallowing with an open (unvalved) tube. This improvement was achieved with liquids, semisolids, and pureed consistencies. CONCLUSION. This study demonstrates that a Passy-Muir speaking valve facilitated swallow and reduced aspiration in patients with a tracheostomy and known aspiration.

Discussion: This study was not blinded and the authors appeared to assume that the trach would impact dysphagia prior to the study. There was no objective measure of how much aspiration changed with a PMV, just that it "decreased". One patient used a head turn in conjunction with the PMV to decrease aspiration which distorts the impact of the PMV alone.

2. Donzelli J, Brady S, Weslin M, Theisen M. *Effects of the removal of the tracheotomy tube on swallowing during the fiberoptic endoscopic exam of the swallow (FEES).* Dysphagia. 2005 Fall; 20(4):283-9.

This study investigated the effects, if any, that the presence of a tracheotomy tube has on the incidence of laryngeal penetration and aspiration in patients with a known or suspected dysphagia. This was a prospective, repeated-measure design study. A total of 37 consecutive patients with a tracheotomy tube underwent a fiberoptic endoscopic evaluation of swallowing (FEES). Patients were first provided with pureed food boluses with the tracheotomy tube in place. The tracheotomy tube was then removed and the tracheostoma site was covered with gauze and gentle hand pressure was applied. The patients were then evaluated without the tracheotomy tube in place with additional puree. Aspiration status was in agreement with and without the tracheotomy tube in place in 95% (35/37) of the patients. The two patients who demonstrated a different swallowing pattern with regard to aspiration demonstrated aspiration only when the tracheotomy tube was removed. Laryngeal penetration status was in agreement with and without the tracheotomy tube in place in 78% (29/37) of the patients. For the majority of the patients, the removal of the tracheotomy tube made no difference in the incidence of aspiration and/or laryngeal penetration. Results of this study do not support the clinical notion that the patient's swallowing function will improve once the tracheotomy tube has been removed.

Discussion: All the patients in this study had occluded trachs. Other studies reviewed in this summary suggest that it is the *unoccluded* trachs that most impact subglottic pressures and are the greatest detriment to swallowing in patients with dysphagia. That may explain why there were no significant differences noted in this study.

3. Elpern EH, Borkgren Okonek M, Bacon M, Gerstung C, Skrzyński. *Effect of the Passy-Muir tracheostomy speaking valve on pulmonary aspiration in adults.* Heart Lung. 2000 Jul-Aug; 29(4):287-93.

**PURPOSE:** We determined instances of aspiration in adults with tracheostomies and investigated the effect of the Passy-Muir tracheostomy speaking valve on occurrences of aspiration. **METHODS:** Adults with tracheostomies scheduled for videofluoroscopic swallowing examinations who met inclusion criteria were enrolled. According to study protocol, 6 presentations of thin liquids were recorded, 3 with and 3 without the Passy-Muir tracheostomy speaking valve. If a cuffed tube was present, the cuff was deflated fully for all presentations. **RESULTS:** Seven of 15 subjects aspirated material on 1 or more presentations of thin liquid. Five subjects aspirated material only with the Passy-Muir tracheostomy speaking valve off, whereas 2 subjects aspirated material with and without the valve. No subject aspirated material while the valve was on exclusively. Aspiration was significantly less frequent with the Passy-Muir tracheostomy speaking valve on than with it off. **CONCLUSIONS:** Clinically unapparent aspiration occurs commonly in patients with tracheostomies. An expiratory occlusive valve can reduce, though not eliminate, occurrences of aspiration. **CLINICAL IMPLICATION:** The benefit of the Passy-Muir tracheostomy speaking valve should be evaluated in selected patients who aspirate liquid.

**Discussion:** Only thin liquid consistency was tested (this consistency showed the greatest impact from a PMV during other studies). Aspiration was not entirely eliminated but was reduced with the use of a PMV. When the patients who did not aspirate either with or without the PMV are eliminated, the sample size is very small (7).

4. Gross RD, Mahlmann J, Grayhack, JP. *Physiologic effects of open and closed tracheostomy tubes on the pharyngeal swallow.* Ann Otol Rhinol Laryngol. 2003 Feb;112(2):143-52.

Studies linking aspiration and dysphagia to an open tracheostomy tube exemplify the possibility that the larynx may have an influence on oropharyngeal swallow function. Experiments addressing the effects of tracheostomy tube occlusion during the swallow have looked at the presence and severity of aspiration, but few have included measurements that capture the changes in swallowing physiology. Also, hypotheses for the importance of near-normal subglottic air pressure during the swallow have not been offered to date. As such, the aim of this study was to compare the depth of laryngeal penetration, bolus speed, and duration of pharyngeal muscle contraction during the swallow in individuals with tracheostomy tubes while their tubes were open and closed. The results of this series of experiments indicate that within the same tracheostomized patient, pharyngeal swallowing physiology is measurably different in the absence of subglottic air pressure (open tube) as compared to the closed tube condition.

**Discussion:** Very small sample size (only 4 patients- 2 of which did not have dysphagia). The 3 participants who wore the PMV all day showed the greatest differences. It was hypothesized that it is the *length of time* the subglottic receptors have a lack of stimulation from the change in subglottic air pressure that may impact the swallowing.

5. Leder, Steven B. PhD; Ross, Douglas A. MD. *Investigation of the Causal Relationship Between Tracheotomy and Aspiration in the Acute Care Setting.* Laryngoscope. 110(4):641-644, April 2000.

Objective: To investigate the causal relationship, if any, between tracheotomy and incidence of aspiration in the acute care setting. Study Design: Prospective, consecutive. Patients and Methods: Twenty adult patients evaluated between February 1997 and October 1999 participated. Criteria for inclusion were a dysphagia evaluation before tracheotomy, subsequent tracheotomy and placement of a tracheotomy tube, and then a repeat dysphagia evaluation after tracheotomy prior to decannulation. This permitted the causal relationship between tracheotomy and incidence of aspiration to be investigated. Differences between duration of tracheotomy placement and age were analyzed with the Student t test and for nonparametric nominal data the [chi]2 test was applied.

Results: No causal relationship between tracheotomy and aspiration was exhibited, as 19 of 20 (95%) subjects exhibited the same aspiration status before and after tracheotomy. All 12 (100%) subjects who aspirated before tracheotomy also aspirated after tracheotomy and 7 of 8 (88%) subjects who did not aspirate before tracheotomy also did not aspirate after tracheotomy ( $P > .05$ ). In addition, no significant differences were observed between aspiration status and days since tracheotomy or age ( $P > .05$ ). Conclusion: In the acute care setting, no causal relationship between tracheotomy and aspiration status was exhibited.

Discussion: The authors appeared to assume that trachs do not impact swallowing prior to the study— this may have impacted the study results. One observation that the authors make is that some previous studies stating a relationship between trachs/swallowing were flawed because there was no pre-trach swallow evaluation. They looked at presence/absence of aspiration only. Changes may have been detected if he looked at *quantity* of aspiration.

6. Leder SB. *Effect of a one-way tracheotomy speaking valve on the incidence of aspiration in previously aspirating patients with tracheotomy.* Dysphagia. 1999 Spring; 14(2):73-7.

The purpose of the present study was to investigate the incidence of aspiration in previously aspirating patients with tracheotomy after use of a one-way tracheotomy tube speaking valve. Twenty consecutive inpatients from the acute care setting of a large urban tertiary care teaching hospital were included. All subjects had objective documentation of aspiration by a fiberoptic endoscopic evaluation of swallowing prior to placement of a one-way tracheotomy speaking valve, from 2 to 7 days of valve use with intelligible speech production, and no surgery to the upper aerodigestive tract except tracheotomy. Results indicated that incidence of aspiration was not affected by use of a one-way tracheotomy speaking valve. These results are in agreement with previous observations that subjects either aspirated or swallowed successfully regardless of tracheotomy tube occlusion status. Also, no significant differences were found between aspiration status and time since tracheotomy, time off ventilator, or duration of valve use. It was concluded that use of a one-way speaking valve provided mostly nondeglutitive benefits and should not be considered to promote successful swallowing for patients with tracheotomy in the acute care setting.

Discussion: This study looked only at presence/absence of aspiration; it did not assess changes in the quantity of aspiration that may have occurred with/without a PMV.

Patients were only given 2 trials during the study, one of puree and one of a liquid (unspecified level of thickness). Some changes may have been noted if more trials had been administered.

7. Debra M. Suiter, Gary H. McCullough, Pamela W. Powell. *Effects of Cuff Deflation and One-Way Tracheostomy Speaking Valve Placement on Swallowing Physiology*. Dysphagia Vol. 18, Number 4 Oct 2003.

**Abstract:** This study examined the effects of tracheostomy cuff deflation and one-way speaking valve placement on swallow physiology. Fourteen nonventilator-dependent patients completed videofluoroscopic swallow studies (VFSS) under three conditions: (1) cuff inflated, (2) cuff deflated, and (3) one-way valve in place. Four additional patients with cuffless tracheostomy tubes completed VFSS with and without the one-way valve in place. All swallows were analyzed for the severity of penetration/aspiration using an 8-point penetration–aspiration scale. Seven preselected swallow duration measures, extent of hyolaryngeal elevation and anterior excursion, and oropharyngeal residue were also determined. Scores on the penetration–aspiration scale were not significantly affected by cuff status, i.e., inflation or deflation. However, one-way valve placement significantly reduced scores on the penetration–aspiration scale for the liquid bolus. Patients who are unable to tolerate thin liquids may be able to safely take thin liquids when the valve is in place. However, one-way valve placement may not be beneficial for all patients. Clinicians who complete VFSS with tracheostomized patients should include several bolus presentations with a one-way speaking valve in place before making any decisions regarding the use of the valve as a means to reduce aspiration.

**Discussion:** This study appeared to be the least biased of the studies reviewed in this summary. In trials where only the cuff deflation status was changed (no occlusion or PMV) there were changes in swallowing physiology (hyoid elevation and pharyngeal transit) but no changes in penetration/aspiration or residue. It was suspected that the lack of swallowing changes was because there is no change in subglottic pressure with deflation alone. No explanation was given for why cuff deflation alone would result in physiology changes. In trials where a PMV was used (compared to cuff inflated), there was decreased penetration/aspiration but increased residue. It was felt that maybe what would have been aspirated without the PMV was now only residue with the valve in place. There were no changes in swallowing physiology with the PMV in place. In trials where a PMV was used (compared to cuff deflated), there was a decrease in penetration/aspiration of thin liquids only. No change in residue or swallowing physiology. In comparing all trials, it was noted that some patients got worse with puree when the cuff was deflated or a PMV was used. But no patients got worse with thin liquids in these trial conditions. Given these findings, it was felt that the mechanism by which a PMV may improve swallowing remains unclear.

8. Eibling DE, Gross RD. *Subglottic air pressure: a key component of swallowing efficiency*. Ann Otol Rhinol Laryngol. 1996 Apr; 105(4):253-8.

The relationship between tracheostomy and swallowing dysfunction has been long recognized. Often this dysfunction is manifested by aspiration, for which a number of etiologic factors may be responsible. Disruption of glottic closure has been previously

demonstrated in association with the presence of an indwelling tracheostomy tube. The plugging or removal of the tracheostomy tube, or the use of an expiratory air valve, has been demonstrated to decrease aspiration and improve swallowing function.

Measurement of subglottic pressure through an indwelling tracheostomy tube during swallowing demonstrated pressure peaks occurring concomitant with swallowing and laryngeal elevation. This presentation will review the evidence supporting the role of subglottic pressure rise in swallowing efficiency. Current investigational activity will be reviewed, and new areas for study will be suggested.

Discussion: Paper is a discussion of theories about subglottic air pressure only. Many of the assumptions that are stated about swallowing are outdated (i.e. a UES dilatation will decrease aspiration) Authors appear somewhat biased in the presentation of information

9. Ding R, Logemann JA. *Swallow physiology in patients with trach cuff inflated or deflated: a retrospective study.* Head Neck. 2005 Sep; 27(9):809-13

BACKGROUND: Past research has suggested that medical diagnosis and trach cuff conditions may contribute to swallow physiology changes in patients with tracheostomy. This study attempts to investigate the differences in swallow physiology between patients with trach cuff-inflated and trach cuff-deflated conditions with respect to four medical diagnostic categories: neuromuscular disorder, head and neck cancer, respiratory diseases, and general medical diagnosis. METHODS: Retrospective database analysis of videofluoroscopic study results in 623 patients with tracheostomies with trach cuff-inflated or cuff-deflated conditions. Swallow disorders were examined for each patient. RESULTS: The frequencies of reduced laryngeal elevation and silent aspiration were found to be significantly higher in the cuff-inflated condition than the cuff-deflated condition. Significant swallow physiology changes were also found to be significantly different among various medical diagnostic categories. CONCLUSIONS: It is important to evaluate changes in swallow physiology under both the trach cuff-inflated and cuff-deflated conditions to fully assess swallow function. (c) 2005 Wiley Periodicals, Inc.

Discussion: A large sample size, but no patients were assessed in both cuff inflated and cuff deflated condition. The only statistical findings between the cuff inflated/cuff deflated groups were a change in laryngeal elevation and the incidence of aspiration being silent in nature when it was present. It was speculated that an inflated cuff blocks the expiratory air flow through the larynx which results in decreased sensitivity for detecting aspiration.

10. Terk AR, Leder SB, Burrell MI. *Hyoid bone and laryngeal movement dependent upon presence of a tracheotomy tube.* Dysphagia. 2007 Apr; 22(2):89-93. Epub 2007 Feb 8

The aim of this prospective, consecutive study was to investigate the biomechanical effects, if any, of the presence of a tracheotomy tube and tube cuff status, tube capping status, and aspiration status on movement of the hyoid bone and larynx during normal swallowing. Seven adult patients (5 male, 2 female) with an age range of 46-82 years (mean = 63 years) participated. Criteria for inclusion were no history of cancer of or surgery to the head and neck (except tracheotomy), normal cognition, normal

swallowing, and ability to tolerate decannulation. Digital videofluoroscopic swallowing studies were performed at 30 frames/s and with each patient seated upright in the lateral plane. Variables evaluated included maximum hyoid bone displacement and larynx-to-hyoid bone approximation under three randomized conditions: tracheotomy tube in and open with a 5-cc air-inflated cuff; tracheotomy tube in and capped with deflated cuff; and tracheotomy tube out (decannulated). Differences between maximum hyoid bone displacement and larynx-to-hyoid approximation (cm) based on presence/absence of a tracheotomy tube, tube cuff status, and tube capping status were analyzed with the Student's t test. Reliability testing with a Pearson product moment correlation was performed on 21% of the data. No significant differences ( $p > 0.05$ ) were found for both maximum hyoid bone displacement and larynx-to-hyoid bone approximation during normal swallowing based on tracheotomy tube presence, tube cuff status, or tube capping status. Intraobserver reliability for combined measurements of maximum hyoid displacement and larynx-to-hyoid approximation was  $r = 0.97$  and interobserver reliability for the absence of aspiration was 100%. For the first time with objective data it was shown that the presence of a tracheotomy tube did not significantly alter two important components of normal pharyngeal swallow biomechanics, i.e., hyoid bone movement and laryngeal excursion. The hypothesis that a tracheotomy tube tethers the larynx thereby preventing hyoid bone and laryngeal movement during normal swallowing is not supported.

Discussion: All the participants had normal swallowing. So the presence of a trach showed there was no change in the swallowing biomechanics in normals. It may be that a trach can impact the severity of a swallowing disorder in an individual with a trach that has dysphagia.

11. Leder SB, Joe JK, Hill SE, Traube M. *Effect of tracheotomy tube occlusion on upper esophageal sphincter and pharyngeal pressures in aspirating and nonaspirating patients.* *Dysphagia.* 2001 Spring; 16(2):79-82.

The biomechanics of the pharyngeal swallow in patients with a tracheotomy tube were investigated with manometry. Upper esophageal sphincter (UES) and pharyngeal pressure recordings were made with and without occlusion of the tracheotomy tube. Criteria for selection were ability to tolerate tracheotomy tube occlusion for both 5 minutes prior to and during the first manometric analysis, absence of surgery to the upper aerodigestive tract other than tracheotomy, and no history of oropharyngeal cancer or stroke. Aspiration was determined objectively by fiberoptic endoscopic evaluation of swallowing (FEES) immediately prior to manometric recording. Eleven adult individuals with tracheotomy participated; 7 swallowed successfully and 4 exhibited aspiration on FEES. The results indicated no significant effect of tracheotomy tube occlusion on UES or pharyngeal pressures in either aspirating or nonaspirating patients. It was concluded that the biomechanics of the swallow as determined by UES and pharyngeal manometric pressure measurements were not changed significantly by tracheotomy tube occlusion in aspirating or nonaspirating patients. These results support previous observations that subjects either aspirated or swallowed successfully regardless of tracheotomy tube occlusion status.



Discussion: Subjects had only dry swallows; no boluses used. Other studies showed changes in pressure depending on which bolus is presented. The reason for no significant findings in this study may be the limited type of swallow (dry only) assessed.

### ABSTRACTS REVIEWED:

12. Leder, SB. *Incidence and type of aspiration in acute care patients requiring mechanical ventilation via a new tracheotomy.* Chest. 2002 Nov;122(5):1721-6.

**STUDY OBJECTIVES:** To investigate the incidence of aspiration and type of aspiration (overt or silent) in patients requiring mechanical ventilation via a new tracheotomy, i.e., within the previous 2 months. **DESIGN:** Prospective, consecutive. **SETTING:** Urban, tertiary, acute care hospital. **PATIENTS:** Fifty-two adult inpatients referred for a swallow evaluation between March 1999 and December 2001. **Measurements and results:** Fiberoptic endoscopic evaluation of swallowing was used to determine incidence and type of aspiration. Aspiration was defined as evidence of food material in the airway below the level of the true vocal folds, with silent aspiration defined as no overt symptoms of aspiration (e.g., coughing or choking). Thirty-five of 52 patients (67%) did not aspirate, and 17 of 52 patients aspirated (33%). Fourteen of the 17 patients (82%) who aspirated were silent aspirators. Patients who aspirated were significantly older (mean age, 73 years; range, 48 to 87 years) than those who did not aspirate (mean age, 59 years; range, 20 to 83 years;  $p < 0.05$ ). Patients who aspirated were post tracheotomy for significantly less time (mean, 14 days; range, 3 to 48 days) than those who did not aspirate (mean, 23 days; range, 1 to 62 days) [ $p < 0.05$ ]. No significant difference was observed regarding the duration of translaryngeal intubation for aspirators (mean, 14 days; range, 0 to 31 days) vs. nonaspirators (mean, 14 days; range, 0 to 29 days;  $p > 0.05$ ). **CONCLUSIONS:** Two thirds of patients requiring short-term mechanical ventilation via a new tracheotomy swallowed successfully. When aspiration occurred, it was predominantly silent aspiration. It is important to consider age, number of days post tracheotomy, functional reserve, and clinical judgment of recovery rate before performing a swallow evaluation in this population. Specifically, swallowing success will occur most frequently in patients  $< 70$  years old, with optimal timing for a successful swallow outcome at approximately 3 weeks post tracheotomy in patients  $> 70$  years old and 1 week in patients  $< 70$  years old, and in conjunction with improving medical and respiratory status.

13. Seidl RO, Nusser-Müller-Busch R, Ernst A. *The influence of tracheotomy tubes on the swallowing frequency in neurogenic dysphagia.* Otolaryngol Head Neck Surg. 2005 Mar; 132(3):484-6.

**OBJECTIVES:** To compare the swallowing frequency in patients with neurogenic dysphagia with or without tracheotomy tubes (TT) to assess the underlying mechanisms of dysphagia to improve rehabilitation strategies. **STUDY DESIGN AND SETTING:** Prospective study, 10 patients (64 +/- 7 years) with neurogenic dysphagia. Glasgow Coma Scale (GCS) less than 8 points, tracheotomy due to the dysphagia 2 weeks before the examination. The swallowing frequency (1 or less over 5 min) was assessed over 5 consecutive days with or without TT. **RESULTS:** The swallowing frequency increased after removal of the TT. These findings did not influence the GCS or the Coma

Remission Scale. Over a 5-day period, the frequency of swallowing was increased.  
**CONCLUSION:** TTs decisively influence the swallowing behavior of vegetative patients. This phenomenon could be based on an improved sensitivity under re-established physiological expiration. We strongly favor removing the TT or deflating the cuff of the TT under therapeutic conditions in a rehabilitation therapy setting.

14. Leder SB, Joe JK, Ross DA, Coelho DH, Mendes J. *Presence of a tracheotomy tube and aspiration status in early, post surgical head and neck cancer patients.* Head Neck 2005 Sep;27(9):757-61.

**BACKGROUND:** We sought to investigate the effects, if any, that the presence of a tracheotomy tube has on aspiration status in early, post surgical head and neck cancer patients. **METHODS:** Twenty-two consecutive adult, postoperative head and neck cancer patients were prospectively evaluated with fiberoptic endoscopic evaluation of swallowing (FEES) under three conditions: (1) tracheotomy tube present, (2) tracheotomy tube removed and tracheostoma covered with gauze sponge; and (3) tracheotomy tube removed and tracheostoma left open and uncovered. For each condition, the endoscope was first inserted transnasally to determine aspiration status during FEES and then inserted through the tracheostoma to corroborate aspiration status by examining the distal trachea inferiorly to the carina. Three experienced examiners determined aspiration status under each condition and endoscope placement. **RESULTS:** There was 100% agreement on aspiration status between FEES results and endoscopic examination through the tracheostoma. Specifically, 13 of 22 patients (59%) swallowed successfully and nine of 22 (41%) aspirated. There was also 100% agreement on aspiration status for tracheotomy tube present, decannulation and tracheostoma covered by gauze sponge, and decannulation and tracheostoma left open and uncovered. **CONCLUSIONS:** Neither presence of a tracheotomy tube nor decannulation affected aspiration status in early, post surgical head and neck cancer patients. The clinical impressions that a tracheotomy or tracheotomy tube increases aspiration risk or that decannulation results in improved swallowing function are not supported. Rather, need for a tracheotomy indicates comorbidities (e.g., respiratory failure, trauma, stroke, advanced age, reduced functional reserve, and medications used to treat the critically ill) that by themselves predispose patients for dysphagia and aspiration.

15. [Article in Japanese] Ohmae Y, Adachi Z, Isoda Y, Maekawa H, Kitagawa Y, Karaho T, Tanabe T, Kitahara S [*Effects of one-way speaking valve placement on swallowing physiology for tracheostomized patients: impact on laryngeal clearance*] Nippon Jibiinkoka Gakkai Kaiho. 2006 Jul;109(7):594-9.

Tracheostomy placement affects swallowing function, increasing the risk of aspiration. Recent studies suggest that because of increased risk of swallowing disturbance associated with tracheostomy, one-way speaking valve placement may help to reduce aspiration in tracheostomized patients. We hypothesize that airflow exhaled through the laryngeal cavity using the one-way speaking valve may improve the clearance of residual bolus from the upper airway, thus preventing bolus penetration and aspiration. We studied the effects of one way speaking valve placement on laryngeal clearance and swallowing physiology. Videoendoscopic and videofluoroscopic swallowing were

examined in 16 patients with the tracheostomy, and swallowing was compared with and without the one-way speaking valve in place. Valve placement significantly improved laryngeal clearance and the incidence of penetration during swallowing. Placement did not, however, significantly affect pharyngeal bolus residue, laryngeal elevation, pharyngeal delay or aspiration. Factors associated with the resumption of oral feedings were sufficient laryngeal elevation during swallow and the prevention of laryngeal penetration and aspiration. We concluded that one-way speaking valve placement improves laryngeal clearance and prevents laryngeal penetration, resulting in better oropharyngeal swallowing physiology and oral feeding.

16. Donzelli J, Brady S, Wesling M, Theisen M. *Secretions, occlusion status, and swallowing in patients with a tracheotomy tube: a descriptive study.* Ear Nose Throat J. 2006 Dec; 85(12):831-4.

We conducted a prospective, descriptive study of 400 tracheotomized patients to investigate the relationships between (1) levels of accumulated oropharyngeal secretions and laryngeal penetration/aspiration status, (2) secretion levels and tube-occlusion status, and (3) tube-occlusion status and aspiration status. Assessments of secretion status were quantified with the use of a 5-point rating scale. All evaluations were made by fiberoptic endoscopic evaluation of swallowing. We found that patients with higher secretion levels were more likely to aspirate than were patients with lower secretion levels. Also, patients who tolerated placement of a tube cap had the lowest mean secretion level, and those who tolerated only light finger occlusion had the highest; likewise, most patients with normal secretion levels tolerated a capped tube, and a plurality of patients with profound secretion levels tolerated only light finger occlusion. Finally, no significant differences were observed with respect to occlusion status and aspiration rates.

17. Jeri A. Logemann, PhD; Barbara Roa Pauloski, PhD; Laura Colangelo, MS. *Light digital occlusion of the tracheostomy tube: A pilot study of effects on aspiration and biomechanics of the swallow* Head Neck 20: 52-57, 1998.

**Method:** Eight treated head and neck cancer patients were studied, six of whom had undergone surgical treatment for oral or laryngeal cancer and two who had undergone high-dose chemotherapy and radiotherapy for laryngeal cancer. Videofluorographic studies of oropharyngeal swallowing were accomplished on 3-mL boluses of liquid in seven patients and 3-mL boluses of paste in three patients, first with the tracheostomy not occluded and then with it lightly digitally occluded by the patient. Videofluorographic studies of swallow were examined for observations of aspiration and residue.

Biomechanical analysis of each liquid swallow was also completed.

**Results** Four of the seven patients aspirated on thin liquids with the tube unoccluded. Aspiration was eliminated with the tracheostomy digitally occluded in two of these four patients. One of the patients also aspirated on paste with the tube unoccluded, and the aspiration was eliminated with the tube occluded. A third patient who aspirated on thin liquid had no change when the tube was occluded, and one patient's swallow worsened with the tube occluded on liquid. There were significant changes in five measures of swallow biomechanics on liquids with the tube occluded: (1) duration of base of tongue contact to the posterior pharyngeal wall was reduced, (2) maximal laryngeal elevation

increased, (3) and (4) laryngeal and hyoid elevation at the time of initial cricopharyngeal opening increased, and (5) onset of anterior movement of the posterior pharyngeal wall relative to the onset of cricopharyngeal opening began later.

Conclusions Light digital occlusion of the tracheostomy tube appears to be a safe procedure, because most biomechanics of swallow are positively affected, perhaps because of the increased resistance provided by the closed trachea. However, not all patients received benefit from tube occlusion, indicating that each patient must be evaluated individually to determine whether or not tube occlusion improves their swallow.

### **MISCELLANEOUS TOPICS RELATED TO TRACHS AND SWALLOWING:**

18. Frank U, Mäder M, Sticher H. *Dysphagic patients with tracheotomies: a multidisciplinary approach to treatment and decannulation management.* Dysphagia. 2007 Jan;22(1):20-9. Epub 2006 Oct 6.

In 2000 a multidisciplinary protocol for weaning dysphagic patients from the tracheotomy tube and a decannulation decision chart created according to principles of the F.O.T.T.(R) Concept (Face and Oral Tract Therapy) were introduced in the Swiss Neurological Rehabilitation Centre REHAB in Basel. In the present study we introduce these guidelines and present an evaluation of the treatment and decannulation procedure. We retrospectively compared data from patients before and after introduction of the multidisciplinary procedure with regard to mean cannulation times and success of decannulation. Furthermore, we analyzed the rehabilitation progress of the group who underwent multidisciplinary treatment as well as the participation of the speech language therapist. The results show that the treatment introduced to improve swallowing functions and wean patients from the tracheotomy tube led to a fast and safe decannulation of our patients. The mean length of cannulation time was reduced significantly. After decannulation the patients showed clear functional improvements. Interdisciplinary treatment using the approach discussed in this study can be considered efficient and an important basis for further functional progress in the rehabilitation process.

19. Higgins DM, Maclean JC. *Dysphagia in the patient with a tracheostomy: six cases of inappropriate cuff deflation or removal.* Heart Lung. 1997 May-Jun;26(3):215-20.

Patients with trachs have altered motor and sensory functions that may decrease their swallowing efficiency. Failure to recognize disorders in deglutition may result in dangerous complications including aspiration and death. Assessment of dysphagia is especially important in the patient transferred from the intensive care unit to the ward-- where resources are less abundant. We present six cases in which cuff deflation or change of tracheostomy tube were undertaken without documented swallowing assessment. In these cases each patient was found to be aspirating and required the cuff to be reinflated, or a cuffed tube to be reinstated when assessed by the multidisciplinary team. Dysphagia management in the patient with a tracheostomy should be approached from a multidisciplinary point of view so that appropriate decisions can be made regarding changes in management and the decannulation process.

20. Steven B. Leder, Stephen M. Cohn, Beth A. Moller. *Fiberoptic Endoscopic Documentation of the High Incidence of Aspiration following Extubation in Critically Ill Trauma Patients*. *Dysphagia*. 13:4, August 1998.

**Abstract:** The purpose of this study was to investigate the incidence of aspiration following extubation in critically ill trauma patients. This prospective pilot study included 20 consecutive trauma patients who required orotracheal intubation for at least 48 hours. All subjects underwent a bedside transnasal fiberoptic endoscopic evaluation of swallowing at 24 - 2 hr after extubation to determine objectively aspiration status. Aspiration was defined as the entry of a blue dyed material into the airway below the level of the true vocal folds, with silent aspiration occurring in the absence of any external behavioral signs such as coughing or choking. Aspiration was identified in 9 of 20 (45%) subjects and 4 of these 9 (44%) were silent aspirators. Therefore, silent aspiration occurred in 20% of the study population. Eight of the 9 (89%) aspirating subjects resumed an oral diet from 2–10 days (mean, 5 days) following extubation. All subjects had no evidence of pulmonary complications. It was concluded that trauma patients after orotracheal intubation and prolonged mechanical ventilation have an increased risk of aspiration. An objective assessment of dysphagia to identify aspiration may reduce the likelihood of pulmonary complications after extubation.