

## **Aspiration in patients with tracheostomies**

Cameron, J L; Reynolds, J; Zuidema, G D

The authors studied the incidence of aspiration in patients with tracheostomies or endotracheal tubes in place. They applied 4 drops of 1% solution to Evans blue dye on the patient's tongue every 4 hours, while carrying on the usual tracheostomy care. The presence of the dye upon suctioning was considered evidence of aspiration.

Of the 61 patients with a tracheostomy tube in place, 69 percent had a positive dye test within 30 hours. Within this group of patients 3 factors, considered to be contribute to aspiration, were evaluated: (1) the presence of a nasogastric tube, (2) the mental status of the patient, and (3) the presence of a tracheal cuff. It appeared that none of these factors had a significant effect on the incidence of aspiration. Of the 25 patients who had an oral endotracheal tube, none had a positive dye test. The study averaged 16 hours. The authors assumed that the normal glottic closing mechanism was not interfered with as much in this group of patients as in the tracheostomy patients.

Aspiration after tracheostomy is a frequent cause of fever, atelectasis, bronchopneumonia and, at times, death. The authors of this study, however, could not determine retrospectively in this group of patients whether the progressions of pulmonary disease in their patients were due to aspiration, or whether earlier progressions of pulmonary disease had necessitated the tracheostomies.

## **Characteristics of Dysphagia in Elderly Patients Requiring Mechanical Ventilation**

Lori A. Davis, EdD, CCC-SLP and Suzanne Thompson Stanton, MA, CCC-SLP

Department of Communication Disorders, University of Tulsa, Tulsa, Oklahoma, USA

### **Abstract:**

The purpose of this study was to describe the swallowing characteristics of elderly patients requiring mechanical ventilation with tracheostomy admitted to a long-term, acute-care hospital. The study was conducted through retrospective record review of patients on mechanical ventilation who had received a Modified Barium Swallow Study (MBSS) during their hospitalization. In a period from 1994 to 2002, 58 patients met the inclusion criteria. The study examined the results of both the clinical and the MBSS evaluations and compared the results and recommendations of the two examinations. Data were obtained from the MBSS records to describe the group in terms of dysphagia symptoms, frequency and occurrence of aspiration, respiratory status, and demographic variables. Parametric and nonparametric statistics were used to determine differences between the evaluations and any significant associations between aspiration and demographic variables, pharyngeal symptoms, and cognitive deficits. Significant differences were found between diet recommendations before and after the MBSS, and significant associations were found between aspiration and three pharyngeal symptoms. Although aspiration and especially silent aspiration occurred frequently in this group, most individuals were able to begin some level of oral intake after the MBSS evaluation. Due to the lack of reliable clinical evaluation measures, the MBSS is necessary for differential diagnosis of dysphagia and dietary recommendations for these individuals.

## **Deglutitive aspiration in patients with tracheostomy: Effect of tracheostomy on the duration of vocal cord closure**

Reza Shaker<sup>1,2,3,4</sup>, Mary Milbrath<sup>3</sup>, Junlong Ren<sup>1,2</sup>, Bruce Campbell<sup>1,3</sup>, Robert Toohill<sup>1,3</sup>, Walter Hogan<sup>1,2,4</sup>

<sup>1</sup> MCW Dysphagia Institute, Medical College of Wisconsin and VA Medical Center, Milwaukee, Wisconsin, USA

<sup>2</sup> Division of Gastroenterology, Department of Medicine, Medical College of Wisconsin and VA Medical Center, Milwaukee, Wisconsin, USA

<sup>3</sup> Department of Otolaryngology and Human Communication, Medical College of Wisconsin and VA Medical Center, Milwaukee, Wisconsin, USA

<sup>4</sup> Department of Radiology, Medical College of Wisconsin and VA Medical Center, Milwaukee, Wisconsin, USA

### **Background/Aims:**

Deglutitive aspiration in patients with tracheostomy has been attributed to impaired laryngeal movement, loss of protective laryngeal reflexes, and uncoordinated laryngeal closure. The aim of this study was to determine the effect of tracheostomy on the duration of deglutitive vocal cord closure.

### **Methods:**

Using concurrent videoendoscopy, respirography, and submental electromyography, deglutitive vocal cord closure and its temporal relationship with deglutitive apnea was compared between patients with tracheostomy and normal volunteers.

### **Results:**

Between-group comparison showed that the duration of vocal cord adduction/abduction in patients with tracheostomy was significantly shorter than that of normal volunteers ( $P < 0.05$ ). Contrary to normal volunteers, in patients with tracheostomy, 5-mL water swallows significantly increased the duration of vocal cord adduction/abduction compared with that of dry swallows ( $P < 0.05$ ). In addition, in patients with tracheostomy, deglutitive apnea and submental electromyography were not coordinated with vocal cord kinetics.

### **Conclusions:**

Although the vocal cords close completely during swallowing in patients with tracheostomy, their duration of closure is significantly shorter compared with normal volunteers. Coordination of deglutitive vocal cord kinetics, apnea, and submental electromyography is altered in patients with tracheostomy. Contrary to normal controls, duration of deglutitive vocal cord closure in patients with tracheostomy is modified by the presence of liquid bolus.

## **Disturbance of swallowing after tracheostomy**

Feldman SA, Deal CW, Urquhart W.

Department of Surgery, Queen Elizabeth Hospital, Birmingham 15, United Kingdom. University Surgical Clinic, Graz, Austria.

### **Abstract:**

MOST patients with a tracheostomy can swallow food and fluids normally, but sometimes, when a cuffed tracheostomy tube has been inserted, they complain of difficulty in swallowing (Robbie and Feldman 1963). We describe here 3 patients who had a disordered swallowing-reflex after tracheostomy. The disorder resulted in food and fluid entering the larynx and producing tracheal soiling. X-ray studies of the swallowing reflex showed that the disorder resembled in its effects the results of bulbar paralysis although no neurological deficit was present. In all 3 patients the trachea was dilated: this may have been caused by the accumulation of aspirated fluid and food above the cuff of the tracheostomy tube producing tracheomalacia and dilatation.

## **Effect of tracheotomy on laryngeal function**

Buckwalter JA, Sasaki CT

## **Effect of Decannulation on Pharyngeal and Laryngeal Movement in Post-Stroke Tracheostomized Patients**

Soo Jin Jung, M.D., Deog Young Kim, M.D., Ph.D., Yong Wook Kim, M.D., Ph.D.,  
Yoon Woo Koh, M.D., Ph.D.<sup>1</sup>, So Young Joo, M.D., Eun Sung Kim, OTR, M.S.<sup>2</sup>

Department and Research Institute of Rehabilitation Medicine,

1. Otorhinolaryngology Medicine,

2. Research Institute of Rehabilitation Medicine, Yonsei University College of Medicine, Seoul  
120-752, Korea

### **Objective:**

To investigate effects of tracheostomy tube on the movement of the hyoid bone and larynx during swallowing by quantitative analysis of videofluoroscopic swallowing study.

### **Method:**

19 adult stroke patients with tracheostomies, who met the criteria of decannulation participated. Serial videofluoroscopic swallowing studies were done over 14 days before decannulation, within 24 hours before decannulation, within 24 hours after decannulation, and over 14 days after decannulation. The kinematic parameter such as pharyngeal transition time, stage transition duration, maximal hyoid bone movement, and maximal laryngeal prominence movement were obtained by 2-D quantitative analysis of videofluoroscopic swallowing study.

### **Results:**

Pharyngeal transition time and stage transition duration were not significantly changed all the time. The maximal hyoid bone movement and maximal laryngeal prominence just after decannulation were improved significantly compared to just before decannulation ( $p < 0.05$ ), especially on vertical movement.

### **Conclusion:**

The hypothesis that a tracheostomy tube disturbs the hyoid bone and laryngeal movement during swallowing may be supported by this study.

## **Effects of the Removal of the Tracheotomy Tube on Swallowing During the Fiberoptic Endoscopic Exam of the Swallow (FEES)**

Joseph Donzelli, MD,<sup>1</sup> Susan Brady, MS, CCC-SLP,<sup>2</sup> Michele Wesling, MA, CCC-SLP,<sup>2</sup> and Melissa Theisen, MA, CCC-SLP<sup>2</sup>

<sup>1</sup>Otolaryngology, Head & Neck Surgery, Ltd., Naperville, Illinois; and <sup>2</sup>Department of Speech Language Pathology, Marianjoy Rehabilitation Hospital, Wheaton, Illinois, USA

### **Abstract**

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.

## Impact of tracheostomy on swallowing performance in Duchenne muscular dystrophy

Terzi N, Prigent H, Lejaille M, Falaize L, Annane D, Orlikowski D, Lofaso F.

Service de Réanimation Médicale, CHU de Caen, 14000 Caen, France.

### Abstract:

Mechanical ventilation has improved survival in patients with Duchenne muscular dystrophy (DMD). Over time, these patients experience upper airway dysfunction, swallowing impairments, and dependency on the ventilator that may require invasive mechanical ventilation via a tracheostomy. Tracheostomy is traditionally believed to further impair swallowing. We assessed swallowing performance and breathing-swallowing interactions before and after tracheostomy in 7 consecutive wheelchair-bound DMD patients, aged 25+/-4 years, over a 4-year period. Chin electromyography, laryngeal motion, and inductive respiratory plethysmography recordings were obtained during swallowing of three water-bolus sizes in random order. Piecemeal deglutition occurred in all patients over several breathing cycles. Half the swallows were followed by inspiration before tracheostomy. Total bolus swallowing time was significantly shorter ( $P=0.009$ ), and the number of swallows per bolus significantly smaller ( $P=0.01$ ), after than before tracheostomy. Invasive ventilation via a tracheostomy may improve swallowing.



## **Incidence and type of aspiration in acute care patients requiring mechanical ventilation via a new tracheotomy**

Leder SB.

Department of Surgery, Section of Otolaryngology, Yale University School of Medicine, New Haven, CT 06504, USA.

### **Study Objectives:**

To investigate the incidence of aspiration and type of aspiration (overt or silent) in patients requiring mechanical ventilation via a new tracheotomy, ie, 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 (eg, 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.

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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.

## **Incidence of tracheal aspiration in tracheotomized patients in use of mechanical ventilation**

Mariana de Almeida Simão<sup>1</sup>; Camila Albuquerque Nobre Alacid<sup>1</sup>; Katia Alonso Rodrigues<sup>2</sup>; Christiane Albuquerque<sup>3</sup>; Ana Maria Furkim<sup>4</sup>

<sup>1</sup>Qualifono - Serviços em Fonoaudiologia, Rio de Janeiro, RJ

<sup>2</sup>Fono Safe, Rio de Janeiro, RJ

<sup>3</sup>Hospital São Paulo, Universidade Federal de São Paulo, SP

<sup>4</sup>Hospital Universitário Pedro Ernesto, Rio de Janeiro, RJ

<sup>5</sup>Universidade Tuiuti do Paraná, Curitiba, PR., Brasil

### **Context:**

Many patients in use of mechanical ventilation show clinical complications due to tracheal aspiration. Assessment and early methods are necessary, so that preventive and safety measures apply to this patients

### **Objective:**

To study the incidence of tracheal aspiration of saliva in tracheotomized patients treated in intensive care unit using two modes of mechanical ventilation and with different sedation levels.

### **Method:**

Prospective study with 14 tracheotomized non-neurological patients using mechanical ventilation. The sample was divided into two groups based on ventilation mode: pressure support ventilation and pressure controlled ventilation. Those two groups were subdivided into two others according to sedation level. The speech pathology evaluation was completed via the blue dye test in order to analyze the incidence of tracheal aspiration of saliva.

### **Results:**

Sedation levels and mechanical ventilation time related to tracheal aspiration were not statistically significant in this study. On the other hand, ventilation mode and tracheal aspiration showed statistical significance, and there was a higher incidence of tracheal aspiration in the pressure controlled ventilation mode.

### **Conclusion:**

It was possible to observe a significant relationship between tracheal aspiration incidence and pressure controlled ventilation mode, which means the inclusion of those patients in the risk group for oropharyngeal dysphagia and their insertion in prevention protocols. The relationship

between tracheal aspiration and sedation level, as well as tracheal aspiration and mechanical ventilation, were not statistically significant in this sample, needing further research.

## **LIGHT DIGITAL OCCLUSION OF THE TRACHEOSTOMY TUBE: A PILOT STUDY OF EFFECTS ON ASPIRATION AND BIOMECHANICS OF THE SWALLOW**

Jeri A. Logemann, PhD,<sup>1</sup> Barbara Roa Pauloski, PhD,<sup>1</sup> Laura Colangelo, MS<sup>2</sup>

<sup>1</sup> Department of Communication Sciences and Disorders, Northwestern University, 2299 North Campus Drive, Evanston, Illinois 60208

<sup>2</sup> Northwestern University Medical School, Lurie Cancer Center, Chicago, Illinois

### **Abstract:**

Background: This study examined the effects of digital occlusion of the tracheostomy tube versus no occlusion on oropharyngeal swallowing in head and neck cancer patients.

### **Methods:**

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.

## **Post-Tracheostomy Aspiration**

Reeve H. Betts, M.D.

### **Exerpt:**

The management of patients with decreased pulmonary efficiency and excessive bronchial secretions is often facilitated by the use of a tracheostomy. This is frequently done at the completion of a long or difficult operation, but it is also being used more and more to improve the medical management of certain patients with pulmonary problems. The aid of the various respirators to assist or control respiration has been of great benefit. A cuffed endotracheal tube or tracheostomy tube with attached balloon is necessary for the unconscious patient and often used for the conscious patient during the acute phase of treatment.

## **Pulmonary aspiration in mechanically ventilated patients with tracheostomies.**

E H Elpern, M G Scott, L Petro and M H Ries

Rush-Presbyterian-St. Luke's Medical Center, Chicago.

### **Abstract**

The purpose of this descriptive study was to evaluate feeding aspirations in adult patients receiving long-term mechanical ventilatory support, including the incidence of aspirations, the frequency of silent (clinically inapparent) aspirations, and differences between aspirators and nonaspirators. Aspiration data were determined by review of videofluoroscopic (VF) tapes of modified barium swallow procedures performed on 83 medically stable patients admitted to a chronic ventilator unit. Demographic and clinical variables were obtained from review of subjects' medical records. Forty-two subjects (50 percent) aspirated during VF testing and 37 of 48 (77 percent) aspirations were silent. Subjects who aspirated were significantly older than those who did not aspirate ( $p = 0.007$ ). Swallowing disorders were common, particularly disturbances of the pharyngeal phase. We conclude that feeding aspiration is seen frequently in patients with tracheostomies receiving prolonged positive pressure mechanical ventilation. Advanced age increases the risk of aspiration in this population. Episodes of aspiration are not consistently accompanied by clinical symptoms of distress to alert the bedside observer to their occurrence.

## **Secretions, occlusion status, and swallowing in patients with a tracheotomy tube: a descriptive study.**


Donzelli J, Brady S, Wesling M, Theisen M.

Otolaryngology-Head & Neck Surgery, Ltd., Naperville, IL, USA.

### **Abstract:**

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.



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## **Swallowing Dysfunction after Tracheostomy**

P. C. BONANNO, M.D.

The Institute of Reconstructive Plastic Surgery, New York University Medical Center

### **Excerpt:**

Occasionally the presence of a tracheostomy tube will have an adverse effect upon swallowing. Previous reports of such an effect conclude that this was the result of esophageal compression either by a distended trachea or interference with the normal physiology of deglutition.

## Swallowing dysfunction in patients receiving prolonged mechanical ventilation

Tolep K, Getch CL, Criner GJ.

Department of Medicine, Temple University School of Medicine, Philadelphia, USA.

### Abstract:

Several studies have suggested that swallowing dysfunction and pulmonary aspiration occur in patients receiving prolonged ventilation. However, the incidence of swallowing dysfunction, its rate of resolution, and the sensitivity of tests used to characterize swallowing abnormalities are not well defined. The goals of our study were to evaluate swallowing function in this group of patients by (1) defining the specific swallowing abnormalities that occur in this patient population, (2) comparing the sensitivity of bedside evaluations to modified barium swallow with videofluoroscopy (MBS/VF), (3) performing endoscopic evaluation of the upper airway to characterize glottic function during swallowing, (4) evaluating the relationship between swallowing dysfunction and neuromuscular disorders, and (5) studying the temporal resolution of swallowing abnormalities. Swallowing function was evaluated in 35 patients receiving prolonged ventilation (ie, > or = 3 weeks) admitted to a specialized rehabilitation unit dedicated to the care of patients requiring prolonged ventilation. The average age of the 35 patients was 61 +/- 15 years. The total duration of intubation at the time of the initial swallowing evaluation was 29 +/- 34 days via a cuffed tracheostomy tube and 15 +/- 9 days via an endotracheal tube. Neuromuscular disorders were present in 16 patients (45%). Thirty-four percent of the patients had at least one swallowing abnormality detected by bedside examination. Results of bedside swallowing examination were abnormal in 31% of patients with a neuromuscular disorder and 37% of patients without a neuromuscular disorder. MBS/VF was abnormal in 83% of patients (85% in patients with and 80% in patients without a neuromuscular disorder). Results of early (< 1 month) repeated MBS/VF examinations usually remained unchanged; however, in a small group of patients, later studies (> or = 1 month) revealed significant improvement. In 50% of patients who underwent direct laryngoscopy, important abnormalities were found that contributed to swallowing dysfunction. Our data show that patients requiring prolonged mechanical ventilation have a high incidence of swallowing abnormalities, regardless of the presence or absence of neuromuscular disorders. MBS/VF and direct laryngoscopy can provide useful information about laryngeal action and swallowing dysfunction, and can facilitate the implementation of corrective actions to prevent respiratory complications.

## **Swallowing in Patients with Tracheotomies**

Murray, Kathleen A.; Brzozowski, Loraine A.

### **Abstract:**

Swallowing and respiration are well-coordinated and interdependent functions. When one of these processes is impaired, the ramifications may be negative for the other. This article describes the mechanics of normal swallowing, the disorders of swallowing, the effects of tracheotomy and mechanical ventilation on swallowing, and the procedures used to assess and treat swallowing. Combining a basic understanding of these concepts with practical management can increase safe and efficient oral intake in patients with artificial airways.

## **The influence of tracheotomy tubes on the swallowing frequency in neurogenic dysphagia**

Ranier O. Seidl<sup>1</sup>, MD, Ricki Nusser-Müller-Busch<sup>2</sup>, and Arne Ernst, MD, PHD<sup>1</sup>

<sup>1</sup>Department of Otolaryngology at UKB

<sup>2</sup>Department of Speech and Language Therapy (Dr Nusser-Müller-Busch), Free University of Berlin, Berlin, Germany.

### **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.

## Tracheostomy and Dysphagia: A Complex Association

Rita L. Bailey

Illinois State University

### **Excerpt:**

Tracheotomy is a surgical incision directly into the anterior aspect of the trachea for the purpose of establishing an artificial airway. A tube is placed into the surgically created opening to maintain the airway, resulting in what is typically referred to as a tracheostomy (Bissell, 2000). The tube type and size specifications vary and are determined by medical personnel according to patient factors, including size and medical needs. An artificial airway is often required for respiratory disturbances, such as primary lung disease, systemic disease with secondary lung involvement, neuromuscular disease, central nervous system depression, trauma, diseases complicated by extremes of age, mechanical obstruction, and recurrent aspiration (Bach & Ishikawa, 2000; Fornataro-Clerici & Roop, 1997b).

Several complications have been associated with the tracheostomy procedure. These include operative complications, such as subcutaneous or mediastinal emphysema, hemorrhage, respiratory complications, injury to the recurrent laryngeal nerve and/or thyroid gland, cardiac arrest, and mechanical problems related to placement of the stoma (McClelland, 1965; Meade, 1961; Stauffer & Silvestri, 1982; Stauffer, Olson, & Petty, 1981). Additional peri-operative complications include formation of granulation tissue, stenosis, tracheomalacia, tracheoinnominate-artery fistula, ventilator-associated pneumonia, and aspiration (Epstein, 2005). Although the tracheostomy procedure is far from risk free, there are several advantages associated with tracheostomy tube use versus oral or nasal intubation. These include increased comfort for patients, reduced airway resistance, easier secretion removal, decreased risk of vocal fold damage, and potential for phonation and oral nutrition (Fornataro-Clerici & Roop, 1997a).