The primary function: redirect air by allowing it through the tracheostomy on inspiration. The tracheostomy is closed on expiration, redirecting the expired air through the glottis and upper airway.

During the past decades:
- Speaking valve manufacturers: restored positive airway pressure, improved speech production, improved swallowing function with reduction of aspiration, improved cough strength, reduced time needed to achieve weaning from mechanical ventilator or decanulation and improved olfaction.
- Current literature: facilitate use of breathing strategies of high level tetraplegic patients.

<table>
<thead>
<tr>
<th>Neurological</th>
<th>Pulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular dystrophy</td>
<td>Tracheomalacia</td>
</tr>
<tr>
<td>Guillain-Barré syndrome</td>
<td>Mild tracheal stenosis</td>
</tr>
<tr>
<td>Myasthenia gravis</td>
<td>Nonobstructive laryngeal tumor</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>Pulmonary fibrosis</td>
</tr>
<tr>
<td>Amyotrophic lateral sclerosis</td>
<td>Failure to wean</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td>Central hypoventilation syndrome</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>Sleep apnea</td>
</tr>
<tr>
<td>Quadruplegia</td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td></td>
</tr>
<tr>
<td>Closed head injury</td>
<td></td>
</tr>
</tbody>
</table>

- The tracheostomy tube should not be more than two thirds the size of the tracheal lumen
- Transition to a cuffless tracheostomy tube before prolonged speaking valve.
### Table 1. Characteristics of currently available speaking valves

<table>
<thead>
<tr>
<th>Speaking Valve</th>
<th>Mechanical characteristics</th>
<th>Attachment to trachea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montgomery Tracheostomy</td>
<td>Thin silicone diaphragm design; includes a &quot;cough release&quot; mechanism</td>
<td>Fits on 15-mm hub</td>
</tr>
<tr>
<td>Speaking Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Montgomery VENT-TRACH Speaking</td>
<td>Silicone diaphragm design; for use with ventilator</td>
<td>Fits in line between 15-mm hub and ventilation equipment (22 mm)</td>
</tr>
<tr>
<td>Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMV 2020 Tracheostomy</td>
<td>Biased closed position silicone diaphragm with &quot;positive closure&quot; design</td>
<td>Fits on 15-mm hub</td>
</tr>
<tr>
<td>speaking valves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMV 2000, 2001 (Purple) &amp;</td>
<td>Lightweight biased closed position silicone diaphragm &quot;positive closure&quot; design; can be</td>
<td>Fits in line between 15-mm hub and ventilation equipment</td>
</tr>
<tr>
<td>007 (Aqua)</td>
<td>used with ventilator (can order with O2 adapter)</td>
<td></td>
</tr>
<tr>
<td>Shiley Phonate Speaking Valve</td>
<td>Lightweight silicone diaphragm design valve, with hinged cap (O2 port available)</td>
<td>Fits on 15-mm hub</td>
</tr>
<tr>
<td>Shikani–French Speaking</td>
<td>Ball valve design; naturally in open position during inspiration and at rest</td>
<td>Fits on 15-mm hub; will also fit onto standard Jackson trach</td>
</tr>
<tr>
<td>Valve [7**]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hood speaking valves</td>
<td>Ball valve design; also, silicone diaphragm designs available</td>
<td>Fits on 15-mm hub</td>
</tr>
</tbody>
</table>

- Kistner
- Montgomery
- Olympic
- PMV

- Passy-Muir valve, Shiley Phonate valve, Montgomery speaking valve and Kistner speaking valve: flapper valve
- Olympic speaking valve: disk valve
- Passy-Muir valve: bias-closed valve (closed at all time except on inspiration)
- The rest are bias-open valve (open at all time except on expiration)
- Kistner valve: significant higher pressure to airway
- Passy-Muir valve (< 2 cm H2O): required higher pressure required to open

New mechanical style of speaking valve
Ball valve
Attachment to most available inner or outer tracheostomy tube cannulas
Lower airflow resistance than the Passy-Muir and shiley valve
→ comfort and tolerance of the valve and better quality

**Comparison of commercially available speaking valve:**

**Perceptual improvement of speech quality:**
- Leder: Passy-Muir and Montgomery ranked better than the Kistner and Olympic valve
- The Passy-Muir valve with the best speech quality

**Air loss during speech expiration:**
- Zajac et al.: Olympic trach-Talk (the most) and Montgomery Vent-Tach exit air loss during speech expiration ➔ impact respiratory and muscular effort level required for speaking.
- Resistance to airflow: relative similar resistance characteristics among Montgomery Vent-Trach, Passy-Muir Aqua, Passy-Muir Purple; Montgomery Speaking valve, Olympic trach-Talk, Shiley Phonate Speaking Valve, Mallinckrodt Medical.

**Impact of speaking valve on swallowing function:**
- Tracheostomy:
  * decreased subglottic pressure
  * decrease the adductor vocal fold reflex
  * impairment of laryngeal elevation and decompression of the normal subglottic pressure during swallowing ➔ inhibit swallowing mechanic
- Speaking valve: reduce aspiration and swallowing dysfunction related to tracheostomy
  * Factors: improved subglottic air pressure ➔ clearing secretions
    - Increased airflow through the larynx and upper airway ➔ restore glottic reflex mechanism
    - Improved of laryngeal sensation ➔ better ability to expel material, either through throat or cough from the laryngeal vestibule
- Lichtman et al: improved olfaction and secretion management
  * smells are sensed upon exhalation as air is redirected into the upper passage (decreased odor threshold compared to nontracheotomized patients)
- Recent research: mixed result
- Debra M. Suiter: Tracheostomy patients: tolerate thin liquids when the valve in place.
decreased incidence of aspiration in conjunction with increased penetration
Use of the valve will not always improve swallowing physiology
The potential for exacerbating oral and pharyngeal residue increased of post swallowing aspiration
Elpern et al: Examinated effects of the Passy-Muir Valve resulted in significantly reduced occurrences of aspiration.
Aspiration occurrences were not entirely eliminated but were reduced significantly with application of the PMV
Eibling and Gross: Peak positive subglottic pressure of 10 cm H2O during swallowing with PMV Improve swallowing efficiency and reduce aspiration
Leder et al: Incidence of aspiration is not affected by occlusion status of the trache, either via a Passy-Muir spaking valve or manual occlusion.
subglottic air pressure allow for improved cough strength, increased efficiency of airway clearance, it may not be the most important factor involved in eliminating aspiration.
Logemann et al: occlusion of the tracheostomy tube may positively impact some swallowing biomechanics. Ex: hyoid and laryngeal movement
Leder and Ross in a recent comparison: no causal relation between tracheostomy and aspiration was exhibited.
Overall, results of current research on the impact of tracheostomy tube occlusion on aspiration have been mixed.
Speaking valve is only one among many factors to consider relative to improving swallowing function and safety.

Impact of Speaking valve on speech and communication:
Voice production is complex activity: coordination of breathing, laryngeal function and orofacial movement.
Communication and voice difficulties are associated with tracheostomy
Tracheostomy cuff is fully inflated aphony
Use of a speaking valve eliminate the need for hand occlusion allows for verbal communication for patients not able to tolerated plug.
1993 Deirdre Jackson et al: The Passy-Muir valve used in children: medically stable, adequate airway above the tracheostomy, adequate cognitive awareness
Tracheostomy coupled with mechanical ventilation, phonation is achieved by the ventilator.

The natural flow of verbal expression is interrupted due to the rapidly changing subglottic air pressure associated with ventilator cycle.

Isaki and Hoit: The three most common speech or voice problem associated with tracheostomy and mechanical ventilation:

- Difficulty with regulating speech loudness
- Decreased speech duration
- Problems with vocal quality

Use of the Passy-Muir valve allows for independent vocalization with improved and more consistent loudness level and voice quality.

Tippett and Siebens question the necessary of using a speaking valve: it is unclear whether it "achieves more effective phonation and clearance of the upper airway than cuff deflation along.

Hoit et al. and Banzett: adjustment of ventilator setting (decreased inspiratory flow and addition of positive end-expiratory pressure) increases loudness consistency and improved voice quality.

- Lengthened inspiratory time (Ti) and positive end-expiratory pressure (PEEP) improved speech time, loudness, voice quality and articulation.
- High PEEP (15 cm H2O) identical to that produced with a one-way valve.
- High PEEP is safe and less expensive than a one-way valve (with a one-way valve, inflation of the tracheostomy tube cuff or occlusion of the upper airway could be fatal and harmful).
- Speaking valve and PEEP both may establish positive airway pressure in the lung improving communication in mechanically ventilated patients.
Impact of speaking valve on weaning from mechanical ventilator:

- Frey and Wood: weaning from mechanical ventilation may be augmented via the PMV because of decreased anxiety, improved cough strength and improved oxygen saturation.
- Leder: no change in the maintenance of respiration as measured by oxygen saturation.
- Lichtman et al: decreased secretion and improved olfaction with use of the Passy-Muir speaking valve, but no difference in arterial oxygenation.

Many factors impact the ability to weaning from mechanical ventilation: the primary cause of the respiratory failure, primary diagnosis or disease, medical stability, respiratory muscle strength, nutrition, duration of ventilatory support and medication, psychologic factor.

Use of speaking valves for facilitation of breathing strategies for patients with high level tetraplegia

- Patients with respiratory muscle paralysis: benefit from breathing strategies such as glossopharyngeal breathing.
- Glossopharyngeal breathing: a form of positive pressure breathing designed to increased ventilation for patients with respiratory muscle paralysis:
  # using the oral and pharyngeal structures to trap air into the oral cavity and pump into the lungs.
  # one of the primary benefits: as a back up method of breathing in the event of equipment failure, with potential to generate cough air to speak or cough.
  # before training glossopharyngeal breathing: ventilator patient were trained with building tolerance for tracheostomy plugging for a few minutes.
- Speaking valve: successfully stack breaths via glossopharyngeal breathing, withoung loss of air expired through the tracheostomy.
- Develped tolerance for a cuffless tracheostomy tube with use of a speaking valve 24 hours a day.

Candidacy and caveats

- One of the most important criteria for trial speaking valve: tolerate full cuff deflation.
- Inflation of the trachea cuff with a speaking cuff on the tracheostomy tube result in severe barotraumas.
- Some patients may exhibit difficulty with tolerance of the speaking valve because of the change in airflow or heavy secretion.

Contraindication: laryngeal or pharyngeal dysfunction, end-stage pulmonary disease, airway obstruction, medical or pulmonary instability, laryngectomy or increased airway resistance, tracheostomy tube with a diameter too large, bilateral vocal cord paralysis, inflated cuffed tracheostomy, excessive pulmonary secretions.

Conclusions

- Speaking valve use may positively impact functional communication, some swallowing biomechanics and airway clearance
- Eliminate aspiration is variable among individuals
- No evidence supports use of the speaking valve to reduce time needed for weaning from mechanical ventilation.
- Supporting the functional use of breathing strategies: glossopharyngeal breathing for patients with high-level respiratory muscle paralysis
- Transition to a cuffless tracheostomy tube before prolong speaking valve is recommended.

Reference: