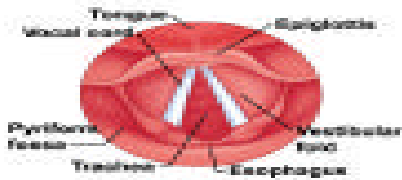


Cancer of the larynx (voice box) is one of the most common cancers of the upper airway. Over 10,000 new laryngeal cancers are diagnosed each year, and about 5000 people with this disease will die each year. There is a very strong association between this cancer and tobacco and/or alcohol use. The larynx is almost cylindrical in shape and is made up of various segments of cartilage surrounded by fibrous membranes. The larynx contains the vocal cords (Figure 2), which are important for speech.

Fig2.



There are three main ways to speak following removal of the larynx. **Electrolaryngeal Speech:** Speech is produced using a small hand-held device, approximately 4 inches in length and 1 inch in diameter, that has a vibrating diaphragm. In order to speak with an intraoral electrolarynx, such as the Cooper-Rand, the intraoral tube is placed into the mouth approximately 1 inch and angled toward the roof of the mouth. A small button is pushed causing the diaphragm to vibrate which provides vibration similar to that of the vocal cords. The speaker articulates as he/she did prior to surgery.

Esophageal Speech: Speech is produced by air being injected into the esophagus and allowing it to escape in a controlled manner to produce short bursts of speech. **Tracheoesophageal Speech (TEP):** Speech is produced by covering the stoma with a thumb, finger or hands free valve. By occluding the stoma air is channeled through the prosthesis and into the esophagus. The exhaled air passes through the esophagus, the pharynx and out of the oral and nasal cavities. During the TEP surgical procedure the surgeon loosened the muscles of the upper esophageal sphincter (also called UES, it's the valve that closes to keep food and liquids in the esophagus from refluxing back in to the pharynx), allowing it to vibrate when air passes thru it. Vibration of the UES produces very intelligible speech in most patients. A speech-language pathologist

will provide instruction to assist the patient to achieve a good occlusion of the stoma, and counsel the patient and family regarding stoma, and prosthesis care.

Total laryngectomy patients lose their ability to produce voice due to the removal of the voice-box during surgery. These patients are forced to choose a form of alaryngeal speech to regain their oral communication. A widespread form of alaryngeal speech involves the use of an electrolarynx (EL), which is a buzzer-type device that delivers sound to the neck, eventually producing speech out of the mouth. A recent study showed that the top two problems with commercial electrolarynx devices, according to the users, are the inconvenience of use, and the monotonicity of the speech produced (Hellman et al., VA rehab grant). Before being able to speak or respond to a question, a typical EL user has to reach into his pocket for the device and lit it up against the neck surface, which can easily cause frustration and bring about undesirable attention. Furthermore, EL devices generally produce speech that is of a constant fundamental frequency. In English, the fundamental frequency (F_0) contour is the main correlate of intonational stress, and is one of the main cues for contrastive stress (Gandour and Weinberg, 1982, 1983 and references therein). Therefore, that lack of a dynamically varying F_0 destroys a substantial amount of pertinent information that is normally conveyed through speech.

In an attempt to offer a better EL System, a prototype portable interface has been developed to process electromyographic signals from any skeletal muscle to control the frequency and the trigger of commercial EL devices. When combined with a neck-strapped version of the EL, and an EMG signal from a neck muscle, the interface allows for hands-free EL speech, and offers dynamic fundamental frequency control. The EMG-EL interface is expected to improve the user's ability to convey prosodic information, in addition to making the EL more practical and less conspicuous to use.