Maximizing Intelligibility in Individuals with Alaryngeal Speech

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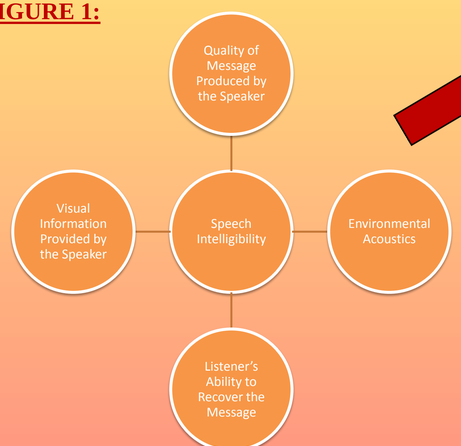
BACKGROUND:

Each year, over 10,000 people are diagnosed with laryngeal cancer in the United States. Treatment protocol for carcinoma of the larynx often involves total laryngectomy, which is the surgical removal of the larynx. After this surgical procedure, it is critical that the affected individual acquires an alternate form of voice to maintain quality of life (McColl, 2006, p. 605). Laryngectomees can achieve voice restoration using the following alaryngeal speech methods: esophageal (ES), electrolaryngeal (EL), and tracheosophageal (TE) speech (Law, Ma, & Yiu, 2009, p. 704). Numerous studies have reported that alaryngeal speech has a reduced level of intelligibility in comparison to laryngeal speech (Evitts, Portugal, Dine, & Holler, 2009, p. 92). Researchers have published written works on this issue that have made suggestions for maximizing intelligibility in individuals using alaryngeal speech.

FIGURE 1:



Jones, R. (n.d.). Speech intelligibility papers. Retrieved from http://www.meyersound.com/support/papers/speech/

Speech Intelligibility is "the degree to which the speaker's intended message is recovered by the listener" (Watson & Schlauch, 2009, p. 163).

FIGURE 2:

Factors Reducing Speech Intelligibility

Many of the factors affecting the intelligibility of one mode of alaryngeal speech will also affect the other modes.

EL:

- Lack of fundamental frequency variation in most electrolarynges (Watson & Schlauch, 2009, p. 162)
- Competing noise giving off externally from the electrolayrnx (Watson & Schlauch, 2009, p. 162)

ES:

- Extraneous facial movements made by the speaker (Evitts, Portugal, Dine, & Holler, 2009, p. 99)

TE:

- Background noise produced by the tracheostoma (Miralles & Cervera, 1995)
- Activation of the Lombard effect (McColl, 2006, p. 605)

TE & ES:

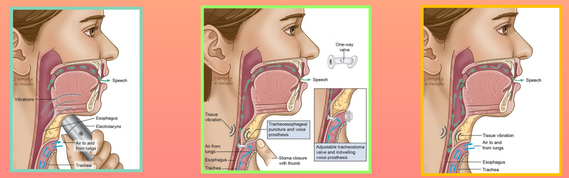
- Vibratory characteristics of the pharyngoesophageal segment (Searl et al., 2001, 317)

EL, ES, & TE:

- Age group of listeners (Clark, 1985, p. 60)
- Surgical reconfiguration of the vocal tract may result in articulation and resonance deficits (McColl, 2006, p. 613)
- Confusion of voiced and voiceless phonemes (Searl et al., 2001, p. 317)

FIGURE 3:

EL Speech | **TE Speech** | **ES Speech**



Gregory, J., & Holoski, K. (n.d.). Head and Neck Cancer Guide. (n.d.). Speech and swallowing rehabilitation. Retrieved from http://www.headandneckcancerguide.org/adults/cancer-diagnosis-treatments/surgery-and-rehabilitation/surgeries-to-aid-breathing-and-eating/speech-and-swallowing-rehabilitation/

TE Speech is Superior to Other Methods:

TE speech is consistently reported as having the greatest level of intelligibility in comparison to EL and ES speech (McColl, Fucci, Petrosino, Martin, & McCaffrey, 1998, p. 280). Speech-language pathologists should provide their laryngectomees with information on the intelligibility of each alaryngeal mode of speech before they make the decision to acquire a new voice (Evitts & Searl, 2006, p. 1387).

Maximizing Intelligibility with EL Speech:

- Evitts et al. (2009) found that the addition of visual information to EL talkers' speech samples increased the listeners' understanding of the messages. Therefore, individuals using an electrolarynx should make themselves visible when communicating with others (p. 92).
- Watson and Schlauch (2009) found that EL speech had a higher level of intelligibility in background noise when the speaker used variable intonation in comparison to a constant fundamental frequency. Based on these findings, it may be beneficial for speech-language pathologists to train those using electrolarynges how to use variable fundamental frequency when speaking. In addition, EL speakers can enhance their speech intelligibility by speaking at a slower rate, overemphasizing their oral movements, and properly placing their electrolarynx to reduce the amount of extraneous noise it produces (p. 162).

Maximizing Intelligibility with TE Speech:

- McColl (2006) hypothesized that participants in his study fell victim to the Lombard effect. TE speakers modified the characteristics of their speech in response to background noise, which negatively impacted their intelligibility. It is likely that the intelligibility of TE speech could be improved in noise if speakers were taught to override the Lombard effect. Speech therapy would focus on increasing the duration of words, providing rich semantic and syntactic cues to the listener, and decreasing the distance between the speaker and the listener in noisy conditions. It also may be beneficial for TE speakers to carry a recent generation electrolarynx or a personal amplification system when environmental conditions become excessively loud (p. 610-614).
- Additionally, Evitts et al. (2009) found that when speech samples produced by TE speakers were presented with visual information in addition to audio information, the listeners' understanding of the message was increased. This indicates that TE speakers should make themselves visible when speaking to others (p. 92).

Maximizing Intelligibility with ES Speech:

- Evitts et. al (2009) found that listeners understood speech produced by ES speakers better when they heard the speech stimuli in the absence of visual information. This suggests that it may be beneficial for speech-language pathologists to inform an ES speaker's frequent communication partners that the facial movements ES speakers make to take in air could interfere with their perception of the spoken message. Therefore, they should not heavily rely on visual cues when perceiving the ES speaker's speech (p. 99).

Maximizing Intelligibility with All Alaryngeal Speech Methods:

- According to Clark (1985) based on the average age of layrngectomees, it is likely that a laryngectomee's spouse has decreased hearing sensitivity, which increases his or her difficulty of understanding speech. Because of this, it may be beneficial for an alaryngeal speaker and his or her spouse to receive aural rehabilitation counseling (p. 60-65).
- In addition, the precision of articulation and resonance is typically compromised after a total laryngectomy, due to the reconfiguration of the vocal tract. Therefore, providing articulation therapy to laryngectomees in which he or she is taught how to compensate for the alterations of the vocal tract, may improve his or her speech intelligibility (McColl, 2006, p. 613).
- Among all three alaryngeal speech modes, the listener often confuses the voicing feature of phonemes. This is likely due to limitations of the electrolarynx and the neoglottis in TE and ES speech. Previous studies have suggested that this may be due to the vibratory properties of the pharyngeal-esophaegeal segment. However, further research is needed to determine what other aspects are involved in the perception of voicing. Until this deficit is repaired, listeners should be trained to focus on the linguistic and contextual cues of the spoken message (Searl et al., 2001, p. 317).

Conclusion:

Post-laryngectomy, it is essential that patients restore their voice in order to maintain their quality of life. An individual can acquire EL, ES, or TE speech. Unfortunately, alaryngeal speech has a reduced level of intelligibility in comparison to laryngeal speech. Many of the factors contributing to this lower level of intelligibility overlap among the different alaryngeal speech methods. Researchers have suggested different ways in which the intelligibility of alaryngeal speech can be maximized.