

## CHAPTER V

### CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

Speech-language pathologists and laryngectomees are the groups most closely associated with artificial larynx devices. While speech therapists are the professionals who often prescribe such devices, laryngectomees are the ones who ultimately use these devices on a daily basis for communication. Because these two populations deal with the artificial larynx from differing perspectives, it is useful to compare these groups.

Hillman (2000) contends that a better understanding is needed regarding the impact that the laryngectomy surgery brings upon the patient.

The first section of this chapter will list the conclusions gleaned from the research. In the second section, a discussion of the findings is given. Subsequent sections will address recommendations for speech-language pathologists, manufacturers, and further research.

#### Conclusions

1. Many therapists feel that the artificial larynx is an important tool to be used as a back-up speech device even when other primary speech modalities such as tracheoesophageal puncture are used.

2. Many laryngectomees are left to obtain the device on their own.
3. The greatest perceived causes of artificial larynx failure according to both groups include excessive shock, battery or charger difficulties, and exposure to liquids.
4. Artificial larynx devices perform an average of 3.7 years before problems begin.
5. The greatest changes that occur to an artificial larynx over time include decreased volume, decreased battery life, more distortion, and cutting out.
6. The most important quality features and characteristics of artificial larynx devices for speech-language pathologists include comfort of use, neck seal pressure, volume range, good sound quality, and easy to use.
7. The most important device features and characteristics for laryngectomees include volume range, ease of use, and sound quality.
8. More speech therapists than laryngectomees found weight, button size, overall device size, seal pressure, comfort, ease of use, and sound quality to be very important.
9. More laryngectomees than therapists consider pitch, ease of procurement, cost, ease of battery replacement, good inflection, and power to be very important.
10. The most recommended and used artificial larynx in the United States is the Servox. Second to the Servox, is the TruTone, and finally, the Romet artificial larynx.

11. Most speech-language pathologists and laryngectomees are satisfied with the artificial larynx devices they recommend or use.
12. The devices with the greatest reliability according to therapists and laryngectomees are the Servox and TruTone.

### Discussion

Many of the findings in this research correspond with scientific information offered in the literature. In regards to the practices of therapists in advising their patients on artificial larynx devices, some of the practices found in this study coincide with those suggested by Salmon (1986) in her protocol. From a survey administered to both laryngectomees and their spouses, Salmon helped determine the therapy needs of this group. Based on survey responses, Salmon developed a checklist. The protocol was developed to help direct the speech-language pathologist when working with laryngectomees and their family on a pre and postoperative level. When asked what information laryngectomees should have prior to their surgery, the most frequently occurring response was “information about the different ways to communicate after surgery.” (p.280) As ways to increase encouragement, many of the respondents indicated the following: 1) being visited by a laryngectomee, 2) being told that an artificial larynx can be used, 3) being told that they will resume a normal life, 4) being told about financial assistance, 5) hearing that they will be able to return to work, 6) hearing that surgery will be painless, 7) that they will need to be patient with themselves after surgery and, 8) hearing that they will learn to cope. In keeping with the needs of the laryngectomee, Salmon reports that the role of the speech-language pathologist should

include the selection of the artificial larynx. The current research indicates that many laryngectomees are being assisted in the selection and training process.

Besides the instruction of the artificial larynx, Salmon (1999b) contends that postoperative therapy include a discussion of the advantages and disadvantages of the various brands. The current research dovetails with Salmon's suggestions. Not only does it help to define device features and characteristics, but it also indicates which ones are most important to laryngectomees and therapists. Importantly, Salmon reports that many laryngectomees are faced with the selection process without the aid of a speech-language pathologist. According to laryngectomees in this study, many procured their devices independent of a therapist.

As a replacement for a lost organic larynx, the artificial larynx returns the laryngectomee into the mainstream of life. If the artificial larynx should fail for any given reason, communication is likely to be dramatically reduced. Lerman (1991) warned that dropping or banging the artificial larynx can cause failure. Additionally he cautioned that exposure to moisture can result in failure. In the current study, the leading causes of perceived artificial larynx failure according to both groups are:

1. the device being dropped, bumped, or exposed to excessive shock,
2. the battery or charger failure, and
3. exposure to water, moisture, or chemicals.

To a lesser degree, other factors indicated by both groups included:

1. poor overall reliability of the device, and
2. getting excessively dirty.

This information largely corresponds with that written by Lerman. In terms of quality characteristics and features, Barney (1958) contends that the artificial larynx should be reliable with trouble free operation for long periods of time. Barney reports that the device should have output that resembles the quality, volume, and pitch of the normal voice. He also states that the device should be hygienically acceptable and inexpensive to purchase and operate. Many of Barney's thoughts are supported in the current research 45 years after they were first written. Barney's reference to "hygienically acceptable" likely refers to the pneumatic devices which required placement on the tracheostoma and in the mouth.

Based on recommendations offered by a given therapist, laryngectomees are often provided with information on a device or the actual device. Even so, laryngectomees perceive certain factors and characteristics to be more important than therapists. One may be inclined to consider these facets more seriously from laryngectomees because they are derived from the population who actually use the devices on a daily basis. Device volume and power were important to laryngectomees in this study. This coincides with Barney's (1958) historic recommendations that the device be as loud or louder than normal speech. Since speech with an artificial larynx tends to be lower in volume than normal speech, one can appreciate this perception which also has implications for speech therapists. While in a quiet environment, artificial larynx devices generally offer enough volume to be easily heard. When placed in a noisy environment such as traffic noise, multiple conversations, around the television, or many other situations, laryngectomees find that the devices do not have adequate volume. This may be largely different from the quiet therapy or hospital room where the patient is trained

using the device. Therapy involving the artificial larynx may be improved by alternating the venues where training occurs.

Talk time is the time that a battery will provide usable service between replacement or recharging. The ability to talk for long periods of time before needing to replace the battery is observed by laryngectomees in the present study. Like cellular or wireless telephones, an artificial larynx will provide only a limited amount of service before the batteries need to be charged or replaced. There is a clear advantage to having a device that provides longer talk time.

Battery replacement was an important feature to laryngectomees. Most of the devices that are currently manufactured use a battery that is held in place under spring tension. Because of this, the user is required to position the battery and fasten the retaining cap. This entails a certain amount of coordination which may be difficult for those with arthritis, weakened finger strength, lowered coordination, or poor vision. Interestingly, the most prominently used device, the Servox, utilizes a charger that charges the battery while in the device. Coupled with the notion, however, that devices lack adequate talk time, laryngectomees likely find themselves having to remove and replace batteries on a regular basis which may be challenging to some individuals.

Device weight and comfort were important aspects to both groups of respondents. The devices currently manufactured are approximately five to seven ounces (Communicative Medical, Inc., 1999). As device weight decreases, it can be logically inferred that ease and comfort of use increases. This idea, along with new manufacturing materials, accounts for the lighter devices observed in recent years. Laryngectomees rated such characteristics as ease of procurement and cost of artificial larynx devices as

very important. When faced with the initial acquisition, a replacement or repair, the laryngectomee needs to interact, on some level, with the manufacturer or a distributor. Lerman (1991) contends that a malfunctioning device causes a negative effect on the patient and family. Communication and interaction that is out of the ordinary tends to be more difficult for laryngectomized persons. This may be especially so where the therapist furnished the initial device some years prior and no longer has contact with the patient. Or where the device has completely failed, the laryngectomee may not be able to communicate over the telephone with a distributor or another source of assistance. If the patient and/or family members are illiterate, it may prove even more challenging for the device to be sent in for repair. Making matters more complicated, the artificial larynx is considered a specialized device and relatively few repair facilities exist throughout the country. Unlike a cellular telephone that can be repaired in most big cities, the artificial larynx will likely need to be shipped out of the local area for repair. Facilities such as RadioShack or hearing aid dealers typically cannot assist laryngectomees with artificial larynx device repairs.

Respondents indicated that cost was a very important characteristic. The vast majority of the laryngectomee respondents indicated that they were retired. With retirement comes fixed incomes. While Medicare and other insurers will cover some of the cost of an artificial larynx, many suppliers will not accept insurance or Medicare payments because the allowable reimbursement is exceedingly low. In many cases, patients do not have insurance. Therefore, if the patient is forced to pay out of pocket for a device, it may be burdensome or unattainable. A growing number of states are offering artificial larynx devices free of charge to laryngectomees through disability taxes

collected by telephone companies. This trend follows communication equipment supplied to the deaf and hearing impaired populations. Importantly, this finding has implications for speech-language pathologists who release their patients without furnishing them with a device, or making certain that they obtain one. Some laryngectomees may never secure the needed device at all due to financial restrictions. And if family members find that they can marginally do without the device in their own personal environment, there will be no pressure from family members to secure a device. The result is limited communication outside the home and the likelihood of a reclusive existence.

In many instances, the laryngectomee is being provided with a device (likely the Servox) deemed appropriate by the therapist. Rated as very important characteristics by therapists, sound quality, button size, and ease of use emerged at the top. Hence, in many cases laryngectomees are being provided with a device that has been first scrutinized by the therapist in these areas. This notion may explain why these areas were not more highly rated by laryngectomees.

On average, speech-language pathologists reported that a given device will last just over 4 years before breakdowns occur. Laryngectomee respondents, on the other hand, indicated that the device lasts 3.7 years. This information has implications for the five year replacement rule set fourth by Medicare and the insurers who follow Medicare guidelines. With the knowledge that devices are failing earlier than 5 years, it may be prudent for third party payers to adjust their replacement schedule. Laryngectomees may find this data especially useful so they can be prepared cognitively and financially when

replacement or repair time comes. Even so, it may be prudent for laryngectomees to have a back-up device available in preparation for when their primary device fails.

Singh & Kent (2000) define reliability as the extent that an instrument provides the same results with repeated administration. When applied to an artificial larynx, reliability can then be viewed in terms of the consistency of the controls, pitch, volume, and sound quality. As mentioned earlier, Barney (1958) reports that the artificial larynx should be reliable and trouble free for long periods of time. The current research shows that device reliability is negatively altered in terms of:

1. decreased volume,
2. more distortion,
3. batteries not lasting, and
4. the sound production of the device cuts out.

Interestingly, most of the above changes involve the sound quality of the device. Barney reports that output volume and sound quality need to parallel normal speech.

Battery function is a very important aspect of the artificial larynx. Artificial larynx manufactures (Griffin Labs, 1999; Romet, 1999; Siemens, 1999b) devote a substantial portion of their operating manuals to battery care. The majority of both groups were either very satisfied or satisfied with the talk time that their artificial larynx batteries offered. Interestingly, a larger portion of speech therapists were very unsatisfied or unsatisfied with battery talk time compared to a small portion of the laryngectomee respondents. This difference also parallels a reliability issue. Lerman (1991) suggests that many problems affecting the artificial larynx involve the battery. When the respondents listed the perceived negative changes that occurred over time, a smaller

portion of laryngectomees indicated that either the batteries and/or the charger were responsible factors. Conversely, a larger portion of speech therapists indicated this same factor. Why would this difference be exceedingly stark between the groups? One explanation may entail the expectations that therapists have regarding artificial larynx devices. Speech-language pathologists may expect that the battery life for such devices should be longer. Another explanation may include that laryngectomees learn the limits of their equipment and therefore optimize the function of the devices they use. For example, laryngectomees may learn to keep an extra recharged battery on their person to readily exchange with a depleted one when necessary. Still another idea is considered. Speech therapists store their devices in between trials with their patients. While being stored, which can be days, months, or years, the batteries lose their charge. Many a therapist has had a battery lose its charge in the middle of therapy which is a moderate frustration. Keenly recalling these frustrating moments, therapists may more negatively view battery life and talk time.

Regarding the timeframe and way patients obtained their devices, differences between the groups is observed and the implications are mixed. While the majority of laryngectomees are being supplied with a device in a timely manner, some are not and many are not being offered the opportunity to experiment with more than one brand of device. Salmon (1999a) contends that laryngectomees should be afforded information and trials with several devices to see which one is most suitable. Only a small portion of the laryngectomee respondents indicated that they had the chance to try more than one device. When one considers that the Servox is the most recommended device, it becomes more apparent that laryngectomees have restricted exposure to other equipment

that may be more suitable to their communication needs. Shanks (2001) reports that the tracheoesophageal prosthesis has become very popular. With this, it is possible that the artificial larynx is receiving less exposure and education in the rehabilitation process.

When looking at satisfaction ratings involving the training received, a small portion of laryngectomees were either somewhat unsatisfied or unsatisfied with the training they received. Comparatively, about one third of speech-language pathologists indicated that they were unsatisfied to some degree with their training. Shanks (2001) explains that laryngectomees are becoming less dependent on laryngectomee clubs and more dependent on the therapist and laryngologist. This is the result of the tracheoesophageal prosthesis and the reduced support of the American Cancer Society. In part, this may explain some of the dissatisfaction associated with laryngectomee training for both groups. Since laryngectomee clubs were an important part of this study, it may also explain the smaller amount of laryngectomees who participated in this study. Hypothetically, the laryngectomees who attend club meetings are more social and expressive than those who do not. In fact, many of the laryngectomee respondents in the study reported that they were heavy talkers. As such, it is plausible that they would be more satisfied with their training which is likely to be continued at the club meetings. On the other hand, reclusive laryngectomees who do not attend meetings and did not complete the survey, may be undocumented and very unsatisfied with their training.

Regarding a few inquiries on the instruments, laryngectomees had a more difficult time answering some questions. This may, in part, be a reflection of the educational differences or cognitive status between the groups. While all of the speech-language pathologists held graduate degrees, most of the laryngectomee respondents only held

high school educations. Additionally, many laryngectomees have a long history of alcohol and tobacco abuse which may impact cognitive function.

As previously discussed, the Servox Inton substantially overshadows the other devices in terms of recommendations and use. Overall, the majority of laryngectomees and therapists are satisfied and rate their machines with good to excellent reliability. This largely equates to the Servox device, however. Interestingly, the device that had the poorest reliability according to laryngectomees was the NuVois Model II. Compared to the Servox, the NuVois Model II is more recent in the market place and it is plausible that some reliability issues have not been worked out by the manufacturer.

The current study has filled a gap in the current literature. Hillman (2000) acknowledges that there is a need to expand the current information about surgical procedures, artificial larynx devices, and the people who use them. He states that methods are needed to measure the functional impact of laryngectomy on voice, speech, and quality of life. Additionally, Hillman reports that advances in technology should focus their attention on improving alaryngeal communication and particularly the artificial larynx. Lerman (1991) contends that malfunction of the artificial larynx has a negative affect on the laryngectomee and his or her family. When a device fails, deficits in communication are immediately observed on a partial or complete basis. A malfunctioning device may impair speech, call undue attention to the user, or completely restrict communication.

This study set out to determine the perceptions of speech therapists and laryngectomees in regards to artificial larynx reliability. Several findings from this study

are consistent with previously written material that theorizes reliability and quality aspects of the artificial larynx (Barney, 1958; Lerman, 1991).

Speech-language pathologists and laryngectomees are differing groups of people who deal with artificial larynx devices. While speech therapists often prescribe equipment to their patients, it is the laryngectomee who uses such equipment. Because of this difference, both of these groups view the artificial larynx from differing perspectives. Naturally, the artificial larynx is used outside the therapy room. As a communication tool used in countless situations, therapists largely rely on the “in-therapy” experience and patient feedback to determine the suitability of the device(s) they are prescribing. But such exposure is limited. Once the laryngectomee leaves the therapy setting, he or she is no longer in communication with the therapist.

The features and characteristics associated with an artificial larynx thought to be important by the therapist may have insignificant or reduced value to the actual user. Likewise, manufacturers of artificial larynx devices may not fully understand what the laryngectomee user prefers in a machine. The current study helps to shed light in this area and offers valuable information regarding these aspects.

### Recommendations For Speech-Language Pathologists

Based on the current research, certain aspects of the artificial larynx device may be more important to the laryngectomee. As a result, some recommendations are offered to speech therapists who work with laryngectomees.

As a way to increase talk time, the therapist may obtain information regarding battery care and charging instructions from the instruction manual, or from the

manufacturer or distributor. This information can be a focus of therapy and shared with the patient. Salmon (1999b) contends that the therapist should familiarize their patients with the controls of the device. This concept can carry over to battery care so patients may fully understand charging and maintenance procedures for the most talk time possible for a given device. During the device/education process, therapists can also instruct the laryngectomee where repairs can be performed when problems occur.

Volume and pitch have been identified as important features of an artificial larynx device (Barney, 1958) and also correspond to the current investigation. As such, therapists may select devices that have wide volume, and pitch capabilities. Therapy may also include techniques to increase volume and total communication. Such strategies may include device positioning, volume adjustment, battery care education, exaggerated articulation, use of body language and gestures, and increased eye contact. Additionally, therapy may be conducted in a variety of environments that vary in background noise.

Therapists can maintain two or more different devices and offer patients the opportunity to trial more than one artificial larynx device during the rehabilitation process. Salmon (1999a) contends that no one can predict with certainty which device will work best for a given patient. If the patient is afforded the opportunity to trial more than one device, there is a higher chance that the device he or she selects will be satisfactory. Continuing this idea one step further, therapists should assure that the devices they offer for trial are in good working condition. Lerman (1991) contends that therapists should be well versed in the equipment they recommend so they may adequately demonstrate their features.

Once a device has been selected, the therapist should coordinate the purchase of a device on the patient's behalf. Patient respondents indicated that ease of procurement and cost are important factors when obtaining a device. Speech therapists have several available options to assist their patients through the procurement process. These include coordination with the hospital's purchasing department while the patient has in-patient status and insurance coverage; coordination with telephone companies (in some states); and coordination with family members, vendors and distributors. Typically the speech-language pathologist is in the best position to be an advocate for the patient (Salmon, 1999a). Laryngectomy patients should not be released from the therapists' care without first securing a modality for speech communication.

#### Recommendations For Manufacturers

Barney (1958), nearly 50 years ago, made recommendations for an electronic artificial larynx. These recommendations still apply today but may not be optimized for patient use. Barney suggests that, 1) the device should be reliable with trouble free operation for long periods of time, 2) that the output speech quality and pitch inflection should emulate normal speech, 3) that the device should be small and unobtrusive, 4) that the output speech volume be equal to that of a normal speaker and, 5) that the device should be inexpensive with a low operating cost. Coinciding with Barney's recommendations, and based on the present research, several recommendations can be presented to manufacturers. These include continued efforts to create artificial larynx devices that are lighter weight and easy to handle. Both speech-language pathologists and laryngectomees indicated the importance of devices that are comfortable to use.

Considerations in the manufacturing design may include the use of softer, more flexible materials especially where skin contact is made. Other recommendations include the development of devices that are more powerful and louder so as to penetrate through competing noise. Laryngectomees require a device that is functional in a variety of settings. While most devices are satisfactory in a quiet setting, some are more challenged in a louder setting.

Laryngectomees desire a device with greater inflection and pitch range so as to approximate more normal speech. Grant (1997) showed that relative and harmonic intensity and dynamic frequency range were factors that approximated normal speech in the TruTone device. As such, manufacturers can further develop devices for more normal sounding speech. Finally, manufacturers can continue the development of devices that have longer talk time and the ability to easily change batteries.

#### Recommendations for Future Research

Knowledge obtained from additional studies regarding artificial larynx devices would be beneficial to speech-language pathologists, allied health care professionals, and manufacturers. Hillman (2000) contends that continued information is needed regarding alaryngeal speech devices and laryngectomees. Suggestions for additional research include the following:

1. Replicate the study with a larger population of laryngectomees to include individuals not in a laryngectomee club.
2. Design a qualitative study that explores the person-machine relationships between artificial larynx devices and the laryngectomees who use them.

3. Conduct physical and acoustic measurements of artificial larynx devices that are currently available.
4. Design a study that explores the actual, specific, failure points of artificial larynx devices.

