

Speech Intelligibility and Communication-related Quality of Life in Tracheoesophageal Speakers

Swapna Sebastian¹, John Mathew², Rajan Sundaresan³, Mahasampath Gowri⁴, Rajiv Micheal⁵

ABSTRACT

Introduction: Communication plays a dynamic role in human life in developing a relationship with others. Laryngectomy can limit the effectiveness in communication and in turn result in limitation of activities and active participation in social life. Of the three methods for voice restoration after total laryngectomy followed today, tracheoesophageal (TE) speech which is a surgical voice restoration (SVR) method has become the standard of care. Literature review reveals that there are conflicting results regarding the quality of speech produced using TE speech.

Materials and methods: The present investigation was designed to explore the speech intelligibility and communication-related quality of life (QOL) in TE speakers and also to examine correlations between speech intelligibility scores and QOL in tracheoesophageal puncture (TEP) speakers.

Results: Speech intelligibility ratings of our patients revealed that on average the rating score was 2.13 which places them into the category—“connected speech could be understood with little effort”. Speech (word) intelligibility score revealed a mean of 94.73%. There was a positive correlation between speech (word) intelligibility score, and scores obtained on the speech intelligibility rating scale. Scores obtained on Self-Evaluation of Communication Experiences after Laryngectomy (SECEL) by our patients fall between the scores for well-adjusted and poorly adjusted according to original SECEL data. There was no positive correlation between speech intelligibility (word) scores or the speech intelligibility rating scale scores with SECEL.

Discussion/conclusion: Our study revealed that TE speech by SVR helps the patients in producing speech with sufficient intelligibility to communicate well with their family and friends but more challenging with strangers. The fact that no correlation was found between SECEL scores with the speech intelligibility measurements points toward the fact that speech intelligibility measures are assessed under quiet conditions and do not consider the effect of background noise in communication situations encountered in everyday environments. In addition, it reflects that even though good communication skills are important for socialization with the community around them, other factors like the self-esteem and person's personality, family, education, wealth, religious beliefs, and the environment may also contribute to the overall QOL and hence it is essential that these psychosocial aspects are also addressed during rehabilitation.

Keywords: Communication-related quality of life, Laryngectomy, Speech intelligibility.

International Journal of Phonosurgery & Laryngology (2020): 10.5005/jp-journals-10023-1190

INTRODUCTION

Total laryngectomy, a radical surgical procedure for advanced cancers of the larynx (primary or secondarily involved in the thyroid), leads to an inability to produce voice. Rehabilitation of such patients is a challenge and needs rehabilitation for a new method of voice production. Communication plays a dynamic role in human life in sharing information and knowledge as well as to develop relationships with others. According to the social model of disability that emerged in the United Kingdom in the 1960s, disability is viewed as a product of disabling environments, attitudes, and behaviors, as opposed to the impairment itself, and the “handicaps” of the individual. It detects what people can or cannot do in their daily lives, restrictions to activities, and social participation in the environment the people live in. As a result, a more holistic approach to assessment and intervention has emerged, with a greater focus on measuring the impact of communication difficulties on the individual's life.^{1,2} In 2001, the World Health Organization (WHO) proposed the International Classification of Functioning, Disability and Health (ICF)³ for marking human functioning and disability, as well as for measuring clinical outcomes. The ICF framework has been adopted for describing the consequences of communication disorders in social settings.^{4,5}

Of the three methods—esophageal speech, electrolarynx, and tracheoesophageal (TE) speech, followed today for voice restoration after total laryngectomy: (TE) speech which is a surgical

^{1,3,5}Department of Otorhinolaryngology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India

²Department of ENT, Apollo Hospital Muscat, Al Hamriya, Muscat, Sultanate of Oman

⁴Department of Biostatistics, Christian Medical College and Hospital, Vellore, Tamil Nadu, India

Corresponding Author: Swapna Sebastian, Department of Otorhinolaryngology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India, Phone: +91 9994630253, e-mail: swapnasanthoshchris@gmail.com

How to cite this article: Sebastian S, Mathew J, Sundaresan R, et al. Speech Intelligibility and Communication-related Quality of Life in Tracheoesophageal Speakers. *Int J Phonosurg Laryngol* 2020;10(2): 33–39.

Source of support: This study was supported by the fluid research grant of Christian Medical College, Vellore, India.

Conflict of interest: None

voice restoration (SVR) method has become the standard of care. Tracheoesophageal speech developed in the late 1970s by Blom and Singer⁶ in 1979 involves the insertion of a silicone voice prosthesis, or “valve”, into the TE wall. It is considered the “gold standard” for voice restoration after laryngectomy. On an exhalation, the speaker has to close the stoma at the neck with a finger, and the air is diverted to the upper esophagus, where the valve vibrates, creating

a voice. Literature review reveals that there are conflicting results regarding the quality of speech produced using TE speech. The advantages of rehabilitation with a tracheo-esophageal puncture (TEP) are short learning time, and use of the lungs as a source of air for phonation which helps in increasing the maximum phonation time when compared to other forms of rehabilitation and has been rated as more similar to normal speech.⁷⁻⁹ But, the acoustical and biophysical differences^{10,11} can affect the perceived quality of their speech and has been rated as “different” by listeners^{12,13} and as “more ugly, unsteady, weak, dull, breathy, and abnormal”,¹⁴ low pitched^{15,16} hoarse, and strained¹⁷⁻¹⁹ than non-laryngectomized controls.

We aimed to study the speech intelligibility and communication-related quality of life (QOL) in TE speakers and also to examine correlations between speech intelligibility scores and QOL in TEP speakers.

MATERIALS AND METHODS

This is an observational longitudinal study approved by the research ethics committee (Institutional Research Board Minute No. 9712). Written informed consent was obtained from all the subjects who participated in this study. Subjects, who underwent surgery for total laryngectomy with or without neck dissection followed by speech rehabilitation with TEP in the Department of ENT, participated in the study. All the subjects had completed at least 6 months post-surgery and had an experience of using TEP speech in the community. Subjects with hearing loss, any other structural deformity of the oral cavity, or neurological disease, previous head and neck surgery or tracheotomy, and previous history of any speech and language problems were excluded from the study.

Speech Intelligibility Assessments

Two main kinds of speech intelligibility assessments were used:

- Quantitative assessment using item identification.
- Qualitative assessment using a perceptual rating scale.

Quantitative assessment of speech intelligibility by means of item identification was done using a phonetically balanced wordlist. Speech stimuli consisted of real English words that had 66 consonant-vowel-consonants (CVC), monosyllabic words with each phoneme in the English language represented equally in both word-initial and word-final positions.⁵ Subjects were asked to repeat the words and the responses of the subjects were transcribed in international phonetic alphabets by a speech pathologist who had normal hearing based on the pure-tone audiological evaluation. Speech intelligibility was calculated by dividing the number of correctly transcribed words by the total number of words. Qualitative measurement (perceptual rating) of speech intelligibility was done for conversational speech using the Ali Yavur Jung National Institute of Hearing Handicapped (AYJNIHH) intelligibility rating scale (Appendix A) by two speech pathologists and the average score was taken. All the testing took place in a quiet room, free from background noise located at the speech pathology lab with the background noise level kept below 45 dB (A-weighted) as measured by a sound level meter.

The Self-Evaluation of Communication Experiences after Laryngectomy (SECEL)²⁰ which was developed using the ICF framework² was used to assess the communication-related QOL. The questionnaire consists of 35 items, (Appendix B), 34 of the items are grouped into three subscales. The first subscale, general (5 items), evaluates general attitudes toward the illness. The second subscale, environmental (14 items), assesses the patient experiences

his/her voice in different places and situations. The third subscale, attitudinal (15 items), measures self-perception and perception of others about the new voice. The rating of each item is done on a 4-point scale ranging from 0 (never) to 3 (always). The scores range from 0–15 for general, 0–42 for environmental, 0–45 for attitudinal, and 0–102 for total, respectively. A higher score indicates a poorer adjustment to social life. The item “Do you talk the same amount now as before your laryngeal cancer” does not have scoring but has three response categories—Yes/More/Less.

DATA ANALYSIS

The speech intelligibility score by word identification was obtained by dividing the number of correctly transcribed words by the total number of words.

Perceptual rating of speech intelligibility using AYJNIHH intelligibility rating scale was done on a 7-point Likert scale as follows:

A score of 0—normal, a score of 1—can understand without difficulty. However feels speech is not normal, a score of 2—can understand with little effort, a score of 3—can understand with concentration and effort, especially by a sympathetic listener, a score of 4—can understand with difficulty and concentration by family, but not by others, a score of 5—can understand with effort if the context is known, a score of 6—cannot understand at all, even when the context is known.

Calculation of the SECEL Scores

The item scores were calculated to obtain the following section scores:

- General score, maximum score—15
- Environmental score, maximum score—42
- Attitudinal score, maximum score—45 and
- Total score, the maximum score is 102.

Statistical Methods

The statistical analysis was done using the software SPSS 14.0.

RESULTS

The profiles of the TEP speakers revealed males to be more ($n = 14$, 93.3%) than females ($n = 1$, 6.66%) with a mean age of 61.6 years. These findings are in agreement with the literature that laryngeal cancer is prevalent among males with a mean age of more than 60 years.^{21,22} All the subjects were married.

Of the respondents, 5 (33.3%) were working and resumed work, and 10 (66.6%) were either retired or not working. Of the five patients who resumed work, two of them were professional voice users (one a preacher and the other a street vendor) who found their work more stressful posttreatment. They reported difficulties in raising the loudness of their voice, especially in noisy environments. They also reported that the glottic noise produced while speaking interfered with their speech intelligibility.

All subjects had completed high school education (100%) and some had an undergraduate degree (20%) (Table 1).

Speech Intelligibility

Speech intelligibility ratings of our patients on the AYJNIHH speech intelligibility rating scale revealed that on average the rating score was 2.13 with a standard deviation of 0.74 which places them into the category—“connected speech could be understood with little effort”. Cohen’s κ coefficient was done to find the inter-rater

Table 1: Profile of participants

Item	(%)
Sex	
Male	93.3
Female	6.66
Education	
High school	100
Graduate degree	20
Working	33.3
Undergone rehabilitation for communication and swallowing	100

Table 2: Scores obtained for the different tests administered

Variable	N	Mean	SD	Max
Speech intelligibility score (word recognition score)	15	94.73	2.58	100
Speech intelligibility rating scale (AYJNIHH) AYJNIHH scale	15	2.13	0.74	3
SECEL (communication-related quality of life)				
SECEL—general subscale	15	6.6	3.72	11
SECEL—environmental	15	23	7.17	35
SECEL—attitude	15	20.87	5.04	28
SECEL—total	15	49.13	9.28	62

reliability. The weighted κ score was 0.5545 (SE: 0.2553) which shows moderate agreement between the raters.

Speech (word) intelligibility score revealed a mean of 94.73% with a standard deviation of 2.58 (Table 2).

There was a positive correlation between speech (word) intelligibility score, and scores obtained on the speech intelligibility rating scale (correlation value 0.5158, p value 0.0267) (Table 3).

Communication-related Quality of Life

Analysis of our data revealed that the group mean score for total score on SECEL was 49.13 with a standard deviation of 9.28 (Table 2). According to the original SECEL data,²⁰ well-adjusted mean scores for the total score is 36 (SD = 12) and patients identified as poorly adjusted have greater than 60 on the total score. The results of our study suggest that the scores obtained by our patients fall between the scores for well-adjusted and poorly adjusted according to original SECEL data.

Mean overall results for the subscales of SECEL were as follows: general subscale = 6.6 (SD = 3.72), environment subscale = 23 (SD = 7.17), and attitude subscale = 20.87 (SD = 5.04). Based on the original SECEL data (21), well-adjusted patients have mean scores of 5.2 (SD = 2.8) on the general subscale, 18.0 (SD = 7.5) on the environment subscale, and 13.4 (SD = 7.3) on the attitude subscale (Table 2).

Majority (86%) of our patients communicated successfully with familiar people and with unfamiliar people (13%). Communication with people living in the same household was easier than interacting with unfamiliar/strangers. The most common disability was incompetence to communicate over the telephone (93.3%). The common form of entertainment was watching television. They also exhibited concerns in terms of difficulty in accepting their new physical appearance and uncertainty about the future during the interview.

Table 3: Correlation between (1) speech intelligibility (word) score and rating scale, (2) speech intelligibility rating scale and quality of life (SECEL), (3) speech intelligibility rating scale and quality of life (SECEL)

Variables compared	Correlation value	p value
1. Speech intelligibility score vs speech intelligibility rating scale	0.5158	0.0267
2. Speech intelligibility rating scale vs SECEL	0.2938	0.1941
3. Speech intelligibility score vs SECEL—total	0.1231	0.6621

All subjects responded “less” to the question, “Do you talk the same amount now as before your laryngeal cancer?” with Response alternatives: Yes/More/Less.

Neither the speech intelligibility (word) scores (correlation value 0.1231, p value 0.6621) nor the speech intelligibility rating scale scores (correlation value 0.2938, p value 0.1941) showed any positive correlation with SECEL.

DISCUSSION

Our study has been able to demonstrate that TE speech by SVR helps the patients in producing an intelligible speech with the positive correlation between speech (word) intelligibility and speech intelligibility rating scale. The majority of participants being males ($n = 14$, 93.3%) than females ($n = 1$, 6.66%) with a mean age of 61.6 years, they were able to re-integrate into normal social and work life with relatively fewer adjustment issues. But, there was a need for an increased effort to communicate with strangers compared to family members.

Speech intelligibility points toward the extent of precision and comprehensibility of a person’s speech by the listener. The speech intelligibility measurement is usually expressed as a percentage of a message that is understood correctly or using a rating scale.²³

Analysis of the data on speech intelligibility score by word identification revealed overall intelligibility of 94.73%. The percentage was calculated based on whole word scoring. These findings are in agreement with earlier studies by Pindzola and Cain²⁴ who reported an overall intelligibility score of 93.20%, 93% by Tardy-Mitzell et al.,¹² and 91.51% by Blom et al.²⁵

Qualitative analysis of the data revealed that vowels, nasals, liquids, and glides were most intelligible, with 0% errors. Errors were found to be more for fricatives and plosives followed by affricates. Speech intelligibility studies by Doyle et al.,²⁶ Doyle and Haaf²⁷ revealed overall intelligibility to be better for liquids (96.13%), glides (95.56%), and nasals (94.01%). Intelligibility of stops and fricatives have been reported to be affected more in TE speech.²⁸ The reason for this could be attributed to minimal constriction of the vocal tract during the production of vowels, nasals, liquids, and glides and maximum constriction of the vocal tract for the production of fricatives, plosives, and affricates, thus requiring more control by the PE segment on sound production of fricatives, plosives, and affricates.

Voiceless sounds were found to be substituted by voiced sounds. The possible explanation for this according to Searl and Carpenter²⁹ is that the reduced motor control and elasticity of the PE segment diminish the ability to quickly abduct and adduct and turn to voice “on and off” compared to the ability of the vocal cords to do it fast.

Speech intelligibility ratings of conversational speech using the AYJNIHH speech intelligibility rating scale revealed that on average the rating score was 2.13 with a standard deviation of 0.74 which places them in the category “connected speech could be understood with little effort”. However, it was found that even those patients who scored 100% speech intelligibility score for monosyllabic words did not get a normal score on a rating scale where the task was conversational speech. This points to the fact that the articulation of phonemes was less affected at the word level where the rate of speech is slow and effortful, the perception of speech by listeners as intelligible deteriorated at conversational speech. Similar findings of reduced intelligibility at sentence level compared to word-level have been reported by Mendelsohn et al.³⁰ This could be accounted for by the need for an increased rate of speech and coarticulatory effects in connected speech. Coarticulation refers to changes in speech articulation of the current speech segment (phoneme) due to neighboring speech sound (phoneme). Word recognition score measures articulatory adequacy of phonemes at a single point in time or over a brief temporal interval which is “slice-in-time” measures and needs not express the effectiveness of the speaker in making continuous speech intelligible for the listeners.

Quality of life is the overall happiness of a person to function in daily activities, work, and leisure. Communication plays a very important role in everyday life. Laryngectomy can limit the effectiveness in communication and in turn result in limitation of activities and active participation in different domains of life. The SECEL which was developed using the ICF framework was used to assess the ability of laryngectomy patients to participate in social life. All of our patients underwent speech and swallowing rehabilitation before going back to social life.

Both, the speech intelligibility (word) scores (correlation value 0.1231, *p* value 0.6621) and the speech intelligibility rating scale scores (correlation value 0.2938, *p* value 0.1941) did not show any positive correlation with SECEL. The reason for this disagreement is attributed to the fact that speech intelligibility measures are assessed under quiet conditions and do not consider the effect of background noise in communication situations encountered in everyday environments. These findings are in agreement with similar studies^{31–33} showing a weak relationship between intelligibility and self-reported communication outcomes. According to Law et al.,³³ high speech intelligibility does not always predict how well that person adjusts to his or her own communication abilities in everyday contexts. In addition, it could be a reflection of psychosocial factors and the personality of the individuals. Even though good communication skills nurture the ability to acclimatize to society, there could be other contributing factors also like the self-esteem and optimism of the person’s personality apart from speech intelligibility that determines the overall QOL. In preference to giving primary focus on the treatment of malignancy and regaining “functional voice”, it is essential that the psychosocial aspects are also addressed for having a better QOL. The administration of the QOL questionnaire regularly on these types of patients can help in planning areas that need intensive counseling for a better QOL.

The limitation of our study is that exclusion of patients with additional problems could have led to an underestimation of a problem in the communication-related QOL. Further research is recommended to obtain a clearer understanding of these aspects.

CONCLUSION

We found that for our patients, TE speech production using surgical restoration could produce speech with sufficient intelligibility to communicate well with their family and friends but more challenging with strangers. Speech intelligibility score by word identification revealed overall intelligibility of 94.73%. Speech intelligibility ratings of conversational speech placed them in the category “connected speech could be understood with little effort”. A positive correlation was found between speech (word) intelligibility scores and speech intelligibility rating scale scores. Scores obtained on SECEL by our patients fall between the scores for well-adjusted and poorly adjusted according to original SECEL data. Both, the speech intelligibility (word) scores and the speech intelligibility rating scale scores did not show any positive correlation with SECEL. Quality of life is a more complex aspect and has a wide range of multidimensional factors contributing to the general well-being of individuals rather than dependent on communication alone. Even though good communication skills are important for socialization with the community around them, other factors like the self-esteem and person’s personality, family, wealth, religious beliefs, and the environment may also contribute to the overall QOL and hence these psychosocial aspects must be also addressed during rehabilitation.

ACKNOWLEDGMENTS

The authors wish to thank Christian Medical College, Vellore for funding the study and all the patients who participated in this study.

STATEMENT OF ETHICS

This is an observational longitudinal study approved by the research ethics committee at the Christian Medical College, Vellore (Institutional Research Board Minute No. 9712). Written informed consent was obtained from all the subjects who participated in this study.

AUTHOR CONTRIBUTIONS

Dr Swapna Sebastian: conceptualization, methodology, investigation, and writing—original draft. Dr John Mathew: conceptualization, review, and editing. Dr Rajan Sunderesan: review and editing. Mahasampath Gowri: methodology, statistical analysis. Dr Rajiv Micheal: supervision, methodology, investigation, review, and editing.

REFERENCES

1. Verna A, Davidson B, Rose T. Speech-language pathology services for people with aphasia: a survey of current practice in Australia. *Int J Speech-Langu Pathol* 2009;11(3):191–205. DOI: 10.1080/17549500902726059.
2. World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva, Switzerland: World Health Organization; 2001.
3. Allen MJ, Yen WM. Introduction to Measurement Theory. Wadsworth; Belmont, CA 1979.
4. American Speech-Language-Hearing Association. Scope of Practice in Speech-Language Pathology. Rockville, MD: Author; 2001.
5. Weiss MS, Basili AG. Electrolaryngeal speech produced by laryngectomized subjects: perceptual characteristics. *J Speech Hear Res* 1985;28(2):294–300. DOI: 10.1044/jshr.2802.294.

6. Blom ED, Singer MI. Surgical-prosthetic approaches for postlaryngectomy voice restoration Keith RL, Darley FL, ed. *Laryngectomy Rehabilitation*. Houston: College Hill Press; 1979. pp. 251–276.
7. Baggs TW, Pine SJ. Acoustic characteristics: tracheo-esophageal speech. *J Commun Disord* 1983;16(4):299–307. DOI: 10.1016/0021-9924(83)90014-X.
8. Hillman RE, Walsh MJ, Wolf GT, et al. Functional outcomes following treatment for advanced laryngeal cancer. *Ann Otol Rhinol Laryngol* 1998;107:2–27.
9. Nieboer GLJ, De Graaf T, Scutte HK. Esophageal voice quality judgment by means of the semantic differential. *J Phon* 1988;16(4):417–436. DOI: 10.1016/S0095-4470(19)30519-4.
10. Jongmans P, Hilgers F, Pols C, et al. The intelligibility of tracheoesophageal speech, with an emphasis on the voiced-voiceless distinction. *Logoped Phoniatr Vocol* 2006;31(4):172–181. DOI: 10.1080/14015430500515732.
11. Bohnenkamp T. The effects of total laryngectomy on speech breathing. *Curr Opini Otolaryngol Head Neck Surg* 2008;16(3):200–204. DOI: 10.1097/MOO.0b013e3282fe96ac.
12. Finizia C, Hammerlid E, Westin T, et al. Quality of life and voice in patients with laryngeal carcinoma: a posttreatment comparison of laryngectomy (salvage surgery) versus radiotherapy. *Laryngoscope* 1998;108(10):1566–1573. DOI: 10.1097/00005537-199810000-00027.
13. Tardy-Mitzell S, Andrews ML, Bowman SA. Acceptability and intelligibility of tracheoesophageal speech. *Arch Otolaryngol* 1985;111(4):213–215. DOI: 10.1001/archotol.1985.00800060037002.
14. Van AsC, Hilgers F, Verdonck-de-Leeuw I, et al. Acoustic analysis and perceptual evaluation of tracheoesophageal prosthetic voice. *J Voice* 1998;12(2):239–248. DOI: 10.1016/S0892-1997(98)80044-1.
15. Casper JK, Colton RH. *Clinical manual for laryngectomy and head and neck cancer rehabilitation*. San Diego: Singular; 1993.
16. Trudeau MD, Qi Y. Acoustic characteristics of female tracheoesophageal speech. *J Spee Hear Disord* 1990;55(2):244–250. DOI: 10.1044/jshd.5502.244.
17. Most T, Tobin Y, Mimran RC. Acoustic and perceptual characteristics of esophageal and tracheoesophageal speech production. *J Commun Disord* 2000;33(2):165–180. DOI: 10.1016/S0021-9924(99)00030-1.
18. Kapusta-Shemie C, Dromey C. Acoustic and perceptual improvements in tracheoesophageal voice using a neck strap. *J Otolaryngol* 1999;28(2):102–104.
19. O’leary IK, Heaton JM, Clegg RT, et al. Acceptability and intelligibility of tracheoesophageal speech using Groningen valve. *Folia Phoniatr (Basel)* 1994;46(4):180–187. DOI: 10.1159/000266311.
20. Blood GW. Development and assessment of a scale addressing communication needs of patients with laryngectomies. *Am J Speech, Langu Pathol* 1993;2(3):82–90. DOI: 10.1044/1058-0360.0203.82.
21. Cattaruzza MS, Maisonneuve P, Boyle P. Epidemiology of laryngeal cancer. *Eur J Cancer B Oral Oncol* 1996;32B(5):293–305. DOI: 10.1016/0964-1955(96)00002-4.
22. Maier H, Tisch M. Epidemiology of laryngeal cancer: results of the heidelberg case-control study. *Acta Otolaryngol Suppl* 1997;527(sup527):160–164. DOI: 10.3109/00016489709124063.
23. Nicolosi L, Harryman E, Kresheck J. *Terminology of Communication Disorders*. 4th ed., Baltimore, MD: William and Wilkins; 1996.
24. Pindzola RH, Cain BH. Acceptability ratings of tracheoesophageal speech. *Laryngoscope* 1988;98(4):394–397. DOI: 10.1288/00005537-198804000-00007.
25. Blom ED, Singer MI, Hamaker RC. A prospective study of tracheoesophageal speech. *Archiv Otolaryngol Head aNeck Surg* 1986;112(4):440–447. DOI: 10.1001/archotol.1986.03780040080017.
26. Doyle PC, Danhauer JL, Reed CG. Listeners’ perceptions of consonants produced by esophageal and tracheoesophageal talkers. *J Speech Hear Disord* 1988;53(4):400–407. DOI: 10.1044/jshd.5304.400.
27. Doyle PC, Haaf RG. Perception of pre-vocalic and post-vocalic consonants produced by tracheoesophageal speakers. *J Otolaryngol* 1989;18(7):350–353.
28. Searl JP, Carpenter MA, Banta CL. Intelligibility of stops and fricatives in tracheoesophageal speech. *J Commun Disord* 2001;34(4):305–321. DOI: 10.1016/S0021-9924(01)00052-1.
29. Searl JP, Carpenter MA. Acoustic cues to the voicing feature in tracheoesophageal speech. *J Speech Lang Hear Res* 2002;45(2):282–294. DOI: 10.1044/1092-4388(2002)022.
30. Mendelsohn M, Morris M, Gallagher R. A comparative study of speech after total laryngectomy and total laryngopharyngectomy. *Arch Otolaryngol Head Neck Surg* 1993;119(5):508–510. DOI: 10.1001/archotol.1993.01880170032006.
31. Eadie TL, Day AMB, Sawin DE, et al. Auditory-perceptual speech outcomes and quality of life after total laryngectomy. *Otolaryngology Head Neck Surg* 2013;148(1):82–88. DOI: 10.1177/0194599812461755.
32. Evans E, Carding P, Drinnan M. The voice handicap index with post-laryngectomy male voices. *Int J Lang Commun Disord* 2009;44(5):575–586. DOI: 10.1080/13682820902928729.
33. Law IK-Y, Ma EP-M, Yiu EM-L. Speech intelligibility, acceptability, and communication-related quality of life in Chinese alaryngeal speakers. *Archiv Otolaryngol Head Neck Surg* 2009;135(7):704–711. DOI: 10.1001/archoto.2009.71.

APPENDIX A

Speech Intelligibility Rating Scale (Developed by Speech-language Pathology Department, AYJNIHH, 1984)

Score
0—Normal
1—Can understand without difficulty. However, feels speech is not normal
2—Can understand with little effort
3—Can understand with concentration and effort, especially by a sympathetic listener
4—Can understand with difficulty and concentration by family, but not by others
5—Can understand with effort if context is known
6—Cannot understand at all, even when context is known

APPENDIX B

Questionnaire Original SECEL in English

Self-evaluation of Communication Experiences after Laryngectomy (SECEL)*

Personal information

Name _____ Date of Birth ___/___/___

Sex: Male _____ Female _____ Race _____

Primary means of communication

Esophageal speech _____ Tracheoesophageal speech _____

Artificial larynx speech _____ Other _____

Education completed

Elementary school or less _____ Some high school _____ High school graduate _____

Some college _____ College graduate _____ Graduate school or more _____

Are you current employed

Part-time _____ Full time _____ Self-employed _____ Not employed _____ Retired _____

Unpaid employment (volunteer work) _____

What was (is) your occupation? _____

Marital status and whether this is the first, second, etc. marriage

Single _____ Married _____ (how long?) _____ Divorced _____ (how long?) _____

Separated _____ (how long?) _____ Widowed _____ (how long?) _____

Date of cancer diagnosis? _____

What type of surgery did you have?

Total laryngectomy _____ Partial laryngectomy _____, what was removed? _____

Radical neck dissection _____, left _____ or right _____ or both _____?

Other _____

Instructions

Here are 35 statements about experiences with communication after a laryngectomy. These experiences have been reported by laryngectomees. Read each of the statements carefully and please draw a CIRCLE around the number that describes you NOW or in the last 30 days. It does not mean the last year or things that happened many years ago. The following example shows you how.

	<i>Always</i>	<i>Often</i>	<i>Sometimes</i>	<i>Never</i>
1. Do you have trouble speaking to family and friends?	3	2	①	0
2. Do you feel that people interrupt you because of your speech?	3	②	1	0
1. Are you relaxed and comfortable around other people in speaking situations?	3	2	1	0
2. Would you describe yourself as a low-keyed, calm person?	3	2	1	0
3. Are you an active, "outgoing", talkative person?	3	2	1	0
4. Do you admit to the person you are speaking to that you had a laryngectomy?	3	2	1	0
5. Do you think your speech improves with the amount of time you use it?	3	2	1	0
6. Do you find that you frequent clubs, meetings, or lodges less often because of your speech?	3	2	1	0
7. Do you have difficulty having getting people's attention to speak?	3	2	1	0

Contd...

Contd...

	<i>Always</i>	<i>Often</i>	<i>Sometimes</i>	<i>Never</i>
8. Do you have difficulty yelling or calling out to people?	3	2	1	0
9. Do you find that people are unable to understand you?	3	2	1	0
10. Do you find you have to repeat things a number of times during conversations to be understood?	3	2	1	0
Do you have trouble with speaking:	3	2	1	0
11. In large groups of people?	3	2	1	0
12. In small groups of people?	3	2	1	0
13. With one person?	3	2	1	0
14. In different rooms of your house (apartment, residence)	3	2	1	0
15. In loud or noisy places?	3	2	1	0
16. On the telephone?	3	2	1	0
17. In the car, bus or while traveling?	3	2	1	0
Does your speech cause you to:				
18. Have difficulty when attending parties or social gatherings?	3	2	1	0
19. Use the telephone less often than you would like?	3	2	1	0
20. Feel left out when you are with a group of people?	3	2	1	0
21. Limit your social life or personal life?	3	2	1	0
Does your speech cause you to feel:				
22. Depressed?	3	2	1	0
23. Frustrated when talking to family and friends and they can't understand you?	3	2	1	0
24. Different or peculiar?	3	2	1	0
25. Do you hesitate to meet new people because of your speech?	3	2	1	0
26. Do you get left out of conversations because of your speech?	3	2	1	0
27. Do you avoid speaking with other people because of your speech?	3	2	1	0
28. Do people tend to fill in words or complete sentences for you?	3	2	1	0
29. Do people interrupt you while you are speaking?	3	2	1	0
30. Do people tell you that they can't understand you?	3	2	1	0
31. Do the people you speak with get annoyed with you because of your speech?	3	2	1	0
32. Do people avoid you because of your speech?	3	2	1	0
33. Do people speak to you differently because of your speech?	3	2	1	0
34. Do your family and friends fail to understand what it's like to communicate with this type of speech?	3	2	1	0
35. Do you talk the same amount now as before your laryngectomy?	Yes	More	Less	

*Questionnaire developed by Gordon Blood. Available at: Blood G. Development and assessment of a scale addressing the communication needs of patients with laryngectomies. *Am J Speech Lang Pathol.* 1993;2(3):82-90. <http://dx.doi.org/10.1044/1058-0360.0203.82>