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REVIEW

Communication changes with laryngectomy and impact on quality of life: a review

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Abstract

Purpose Patients with throat cancer at later stages often undergo total laryngectomy, a procedure that removes the larynx (voice box) and directly impacts the patient's ability to produce natural voice and communication. This narrative review aimed to explore how changes to communication following laryngectomy may impact quality of life (QoL) for patients.

Methods Literature searches were conducted using CINAHL, MEDLINE and PsychInfo databases for studies published between 2007 and 2018. The search terms (and derivatives) of laryngectomy AND communication AND quality of life were used. A synthesis and appraisal of the studies was conducted.

Results Twelve studies met the inclusion criteria and were included in this review. The two main themes identified relating to changes in communication and impact on QoL were *changes in communication competency* (immediate changes and communication option used) and *adaptation to change* (e.g. self-related factors and relationships with others). Regardless of the type of communication option used, participants in all studies reported negative changes in their communication competency and QoL post-laryngectomy. Voice-related factors and aesthetics of the communication option used were noted to influence self-ratings of QoL for the participants, rather than how well others understood them. Participants using tracheoesophageal speech (TES) consistently showed the highest self-reported QoL across the majority of studies. A model incorporating the findings from this review has been proposed which outlines how changes in communication post-laryngectomy may lead to an impact on QoL. Here, the factors of *changes in communication competency, self-perception* and *social engagement* impact each other and are also influenced by *adaptation to change*.

Conclusion This review has highlighted the complex nature of changes faced by patients following laryngectomy in relation to communication and QoL. The model linking communication changes to QoL may become a useful tool for researchers and clinicians in supporting the management of patients post-laryngectomy.

Keywords Quality of life · Communication · Laryngectomy · Voice · Review

Introduction

The ability to communicate is a fundamental human function. It enables expression of thought and opinion, allows us to understand each other, build and maintain relationships and contribute actively to our communities [1]. Patients with throat cancer who undergo head and neck surgery often experience challenges to communication which may impact quality of life (QoL). The World Health Organisation [2] defines QoL as 'a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment' (p. 1). Wilson and Cleary [3] further conceptualise QoL in their model, with QoL impacted by

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biological and physical factors, symptom status, functional status and general health perceptions of the individual. Each year, approximately 560,000 new cases of head and neck cancers are diagnosed worldwide [4]. Patients at later stages of throat cancer often undergo total laryngectomy (referred to in this paper as laryngectomy), where the physical structures of the neck are altered to remove the cancer. During the procedure, the larynx (voice box) is removed, which results in a disconnection between the airway and the mouth and nose. The airway is directed to the neck and a stoma (hole) is created for breathing [5]. Laryngectomy directly impacts the patient's ability to communicate due to the altered airway and removal of the larynx, leaving them with the inability to produce voice. This potentially impacts their QoL as their psychological state, level of independence and social relationships may be affected. Patients must learn to communicate in new ways, which can be difficult to master. As the larynx is completely removed, the communication options are limited to: (a) non-vocal communication; (b) esophageal speech (ES); (c) using an artificial larynx (AL); or (d) tracheoesophageal speech (TES).

Each of these options is associated with an artificial sounding voice that is noticeably different to the pre-surgery natural voice of the patient and specific challenges to communication are encountered by patients. Non-vocal communication such as mouthing words with no sound is very difficult for the listener to interpret, while using augmentative and alternative communication (AAC, e.g. writing or pictures) as the additional means can limit the flow of natural conversation [6]. Non-vocal communication is not typically used by patients as their primary mode of communication [7]. The ES option requires the patient to swallow air via the stoma and perform a belching-like action to vibrate the oesophagus (food pipe) at the pharyngoesophageal (PE) segment and create sound which is shaped in the mouth. This can be difficult to master and results in a sound that is low in pitch and short in duration. Some patients may also experience heartburn with this technique [7, 8].

The electrolarynx (EL) and pneumatic artificial larynx (PAL) are the two forms of AL communication. The EL device produces an electronic vibration and when held against the neck or cheek area, results in a robotic and monotonous sound that is shaped into speech when it reaches the mouth area [8]. Patients must take the device with them throughout the day, including spare batteries and multitasking can be challenging as one hand is needed to operate the device [9]. The PAL device is mainly used in Asia and consists of a cup and tube. The cup is placed over the stoma, and the air from the stoma is directed and vibrated through the tube. The tube is positioned in the mouth where sound is shaped into speech [10]. Although this option has been associated with the production of the most natural sounding pitch quality and intonation [7], patients find PAL to be less aesthetically pleasing as it requires the tube to be placed in the mouth for communication [10].

TES is currently the communication option of choice in most countries [7]. Surgically, a small opening is created between the trachea (windpipe) and oesophagus, and a voice prosthesis valve is placed in the opening. When the stoma is blocked, air is directed through the prosthesis, vibrated in the throat at the PE segment and then shaped in the mouth. The one-way nature of the voice prosthesis prevents food and drink passing from the oesophagus into the airway. To achieve voice, patients can occlude the stoma with their thumb or use a hands-free device to direct air through the prosthesis [7]. Although TES has been associated with the highest level of intelligibility for speakers compared to the other approaches, the sound quality is still rough, low in pitch and unclear compared to normal voice production [8, 9].

In most countries, patients learn to use one or more of the communication options listed above. The challenges commonly faced by patients across all options relate to the artificial quality of the sound produced that is very different to the natural, pre-laryngectomy voice and individual to each patient. This distinct difference and the lower intelligibility compared to pre-laryngectomy can make it difficult for the patient to communicate effectively with others as it impacts overall intelligibility. This is particularly problematic when the conversation partner is unfamiliar with the patient, or when communicating in more challenging environments such as in background noise or on the telephone [9].

The challenges faced by patients with head and neck cancer in general have been documented to impact QoL, particularly in relation to speech, pain and swallowing difficulties, although some improvements in QoL have been noted over time as patients begin to adjust to some of the changes [11]. To date, however, no studies have reviewed the impact of communication changes in QoL specifically for patients post-laryngectomy and considering all communication options available. The recent review by Summers [12] on participants using TES communication alone did provide some insights into the impact on QoL post-laryngectomy. Here, speech intelligibility as rated by unfamiliar listeners and voice-related QoL as rated by participants were not found to be linked. Further, three interdependent themes were suggested to influence the social interaction of the participants, these being functional and environmental difficulties (e.g. background noise), interactions with others (e.g. group interactions are difficult) and communication experiences impacting the individual (e.g. there is an emotional impact on participants as a result of their communication) [12]. Due to the paucity of studies in this area, further information is needed specifically relating to communication changes post-laryngectomy and the potential impact on QoL for patients across all communication options available. This

narrative review will explore how changes to communication post-laryngectomy may impact QoL from the patient's perspective.

Methods

This review follows the recommendations outlined by Green et al. [13] for conducting a narrative review. Literature searches were carried out for articles published between 2007 and 2018 to ensure that the types of communication options used were current, as were the findings. The electronic databases CINAHL, MEDLINE and PsychInfo were used, with search terms of laryngectomy AND communication AND quality of life. Restrictions were applied to publication dates only, with searches restricted to those between 2007 and 2018. The inclusion criteria were studies reporting on: patients with total laryngectomy; at least one of the communication options of ES, AL or TES; communication and QoL outcomes post-laryngectomy from the patient's perspective; original research (i.e. no reviews, short perspectives or discussion papers); and written in English.

After removing duplicates, all studies were screened for eligibility against the inclusion criteria for this review using the title and abstracts from the databases. The full-text articles were then assessed for study eligibility, and hand searches of their references were also conducted (no additional studies were found). Screening and assessment of eligibility was conducted by Investigator VCC and reviewed by Investigator GS, with full agreement achieved through discussion. From the original 88 articles identified via the databases, 61 articles were screened. Twenty-five full-text articles were then assessed for eligibility. From this, reviews, short perspective or discussion papers were excluded (n = 6), as were papers testing the validity of an instrument (n = 3) or including broader participant groups where data specific to patients with total laryngectomy could not be extrapolated (e.g. data grouped together for patients that had undergone total laryngectomy and other types of surgical intervention; n = 4). Overall, 12 studies were included in this review (see Fig. 1 for PRISMA flow diagram).

Data were then extracted from each study in Excel to include: article title, author names, year of publication and country, participant characteristics (sample size, age, gender, time post-laryngectomy surgery), communication methods used, study design and relevant outcomes (see Table 1 for study descriptions and main findings). A critical appraisal of the studies was also conducted, and the main limitations of the designs are identified in Table 1. The CASP checklists specific to the study designs (e.g. CASP Qualitative, Case Control Study and Cohort Study Checklist) were used to support the critical appraisal [14]. Data extraction and critical appraisal were conducted by Investigator VCC and reviewed by Investigator GS, with full agreement achieved through discussion. Investigators VCC and GS then worked together to determine the main themes from each of the studies included in this review [13] in relation to communication changes post-laryngectomy and impact on QoL. This included arriving at initial codes based on the study findings, grouping these codes into overarching themes and reviewing the themes for accuracy in determining the codes and study findings. Full agreement was achieved through discussion.

Discussion

From the review, two main themes were identified in relation to changes in communication post-laryngectomy and impact on QoL: (1) *changes in communication competency* (areas related to immediate changes and the communication option used); and (2) *adaptation to change* (self-related factors and relationships with others). These are represented in Fig. 2.

Theme 1: changes in communication competency

Immediate changes

Loss of communication competency post-laryngectomy was reported by participants in the study by Dooks et al. [15] (9 participants using TES) to impact highly on their interactions while in hospital. For example, the changes experienced immediately after laryngectomy surgery such as adapting to the change in breathing via the stoma and later, directing the air to the throat (TES communication) were found to impact on how well participants were understood by others such as the hospital staff, and their ability to express their needs as they would have prior to surgery. In these early stages, participants reported having to write everything down, which often left them feeling frustrated with their communication limitations [15].

Changes related to communication option used

General changes Changes in communication competency have been reported generally. Bickford et al. [16] explored the lived experiences of 12 participants with laryngectomy (9 participants using TES; 3 participants using ES). The general changes to communication that were reported included being less able to: (a) express aspects of their character and personality (e.g. communicating with greater effort and being less spontaneous); (b) use humour in a timely way during conversation (e.g. engaging with humour before the conversational topic changed); (c) be understood by unfamiliar listeners and perceived negatively by them (e.g. the reaction of others to the artificial sounding voice and participants being viewed as having reduced cognitive ability); and (d)

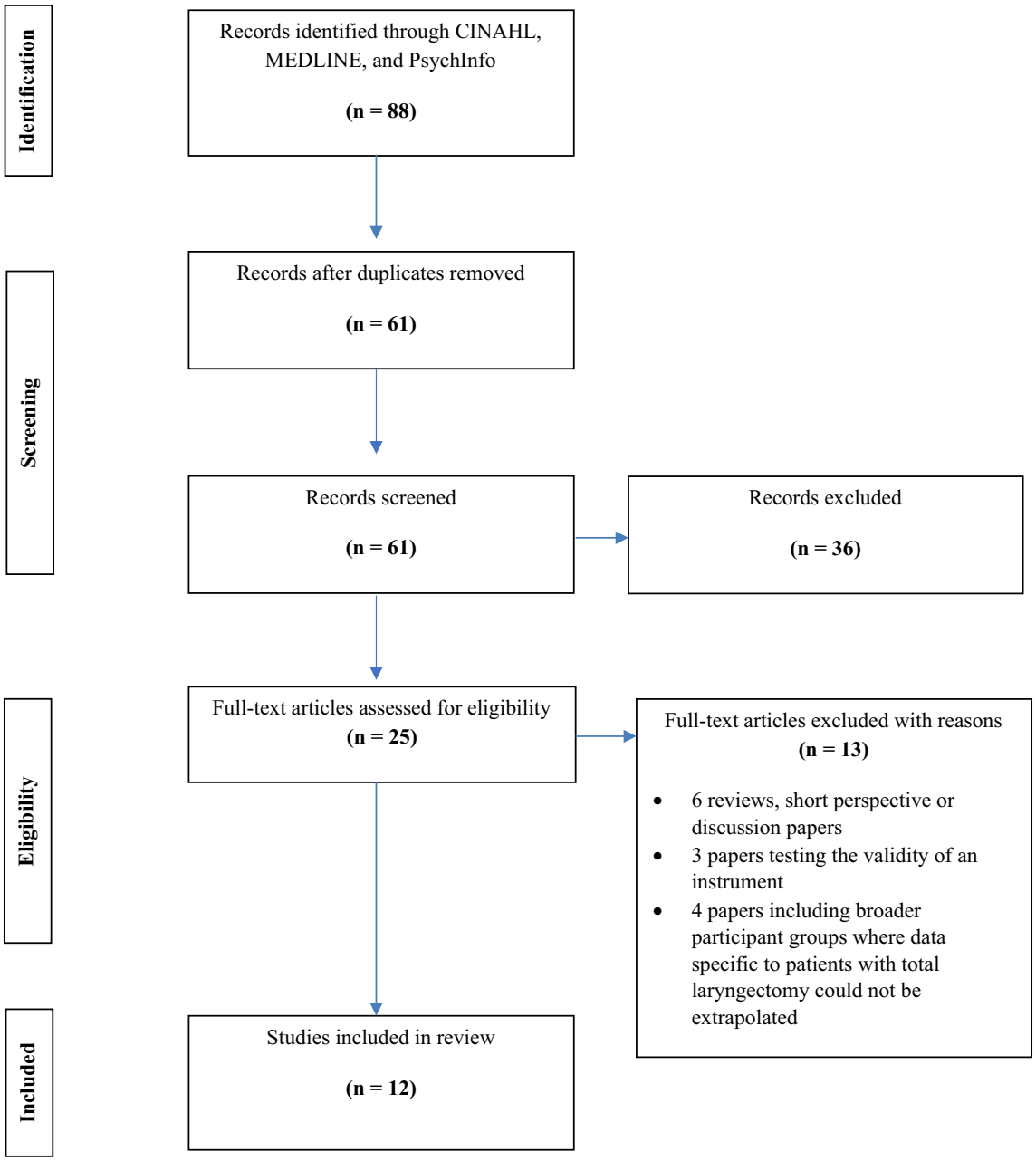

Fig. 1 PRISMA flow diagram

be understood in noisy environments. Due to these negative changes, the participants experienced avoidant behaviours during social interactions where communication was difficult for them (e.g. nodding to avoid small talk initiated by others or limiting their conversation), and feelings of loss of social status and avoiding social situations (e.g. preferring to help with the food preparation rather than mingling at a social event). Additionally, the participants reported going through a process of managing expectations of their communication ability (e.g. not expecting that communication interactions would improve with time); and having to cope and adapt to change. The changes were noted when socialising (e.g. mentally preparing prior and during the interaction, and having to let others know how they could better support the communication interaction), and to reactions of others (e.g. to the quality of the artificial voice or as participants blocked the stoma with the thumbs to communicate).

EL and ES Negative changes in communication competency have been reported in relation to the specific communication option used. Variability was found in the self-perceived voice-related QoL with EL. For example, in the study by Cox

Table 1 Descriptions and main findings of studies included in review

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
Dooks et al. [15], Canada	Investigate patient experiences post-laryngectomy as they reintegrate into their community	N = 9 (8M; 1F); 60–75 years Time post-surgery not reported Medical treatment other than laryngectomy = radiotherapy (N = 9); neck dissection with reconstructive flap (n = 1)	TES	Qualitative study, interpretive In-depth interviews Definition of QoL: not provided QoL Tool: none	Overarching theme emerged of 'constant accommodation to life with a laryngectomy' and 3 main themes including 'impact of cancer diagnosis', 'coping with illness: trying to live life like before' and 'transition to recovery' Areas of QoL impacted by communication changes: not reported	No information on proficiency of TES usage
Bickford et al. [16], Australia	Investigate the lived experiences of patients following laryngectomy	N = 12 (7M, 15F); *M* = 73 years, (range 57–75 years) Time post-surgery range 2–11 years (*M* not specified) Medical treatment other than laryngectomy = not specified	TES (n = 9), ES and other (n = 3)	Qualitative study, exploratory using constructivist grounded theory approach In-depth, semi-structured interviews, field notes and participant journals Definition of QoL: not provided QoL Tool: none	Emerging concept of participants 'identifying with the altered self', with changes noted physically, psycho-emotionally and in communication and influenced by personal and sociocultural factors Areas of QoL impacted by communication changes: social relationships	Questions not specified
Cox & Doyle [17], Canada	Investigate voice-related QoL for patients with laryngectomy using EL communication	N = 40 (25M; 15F); *M* = 62.4 years (range 41–83 years) Time post-surgery *M* = 4.5 years post-surgery (SD not specified; range 1–9.5 years) Medical treatment other than laryngectomy = not specified	EL	Quantitative, case series QoL Tool: Voice-Related Quality of Life measure (V-RQOL) Definition of QoL: not	Variability in self-perceived QoL despite all participants rated as highly intelligible, proficient and effective users of EL Perceived levels of QoL likely influenced by communication needs of individuals Areas of QoL impacted by communication changes: social-emotional functioning	Participants excluded if younger than 30 yrs or older than 85 yrs Variable time post-surgery not considered in analysis

Table 1 (continued)

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
de Araújo Pernambuco et al. [18], Brasil	Investigate the effect of swallowing on QoL for patients with laryngectomy	N = 15 (13M, 2F); *M* = 63 years Time post-surgery not reported Medical treatment other than laryngectomy = not specified	ES	Quantitative, case series QoL Tool: Swallowing and Quality of Life questionnaire (SWAL-QOL) Definition of QoL: not provided	Communication had a moderate to severe negative impact on QoL. This was affected by how others understood them and how participants felt that they communicated with others Areas of QoL impacted by communication changes: not reported	No specific questionnaire used to determine impact on communication
Pereira da Silva et al. [19], Portugal	Investigate the QoL of patients with laryngectomy	N = 34 (32M, 2 F); *M* = 62 years (range 37–78 years) Time post-surgery *M* = 3.09 years (*SD* and range not specified) Medical treatment other than laryngectomy = radiotherapy (n = 14); chemotherapy (n = 5)	TES (n = 15), ES (n = 7), non-vocal (n = 12)	Quantitative, cross-sectional QoL Tool: European Organization for Research and Treatment of Cancer (EORTC) QoL Core Questionnaire (QLQ-C30) Portuguese Self-Evaluation of Communication Experiences after Laryngeal Cancer questionnaire (P-SECEL) Definition of QoL: WHO [29] 'individual's perceptions of their position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns'	Across all participants as a group, global QoL was lower than the general population and patients with laryngeal or hypopharyngeal cancer Patients with ES or TES showed lower perception of communication impairment than the non-vocal group Patients in non-vocal group self-reported highest level of communication impairment Patients who received speech therapy reported lower communication impairment Areas of QoL impacted by communication changes: not reported	Type of communication not specified for non-vocal group No specific information on comparison group with laryngeal or hypopharyngeal cancer Type of speech therapy not specified

Table 1 (continued)

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
Law et al. [20], Hong Kong	Investigate speech intelligibility and acceptability and communication-related QOL	N = 49 (45M, 4 F); *M* = 65.4 years (range 40–77 years) Time post-surgery EL *M* = 5.23 years (*SD* 5.2 years; range 0.5–15.8 years) ES *M* = 10.03 years (*SD* 4.27 years; range 2–16.17 years) TES *M* 5.91 years (*SD* 4.27; range 1.67–15.08 years) PAL *M* 6.88 years (*SD* 5.04 years; range 0.58–16 years) Medical treatment other than laryngectomy = not specified	EL (n = 14) ES (n = 7) TES (n = 13) PAL (n = 15)	Quantitative, cross-sectional QoL Tool: Communication Activity and Participation After Laryngectomy (CAPAL) questionnaire Definition of QoL: not reported	PAL group showed significantly higher speech intelligibility and acceptability, followed by EL, TES, ES TES group showed significantly better QoL, followed by PAL, ES, EL Areas of QoL impacted by communication changes: communication activity limitation and communication participation restriction	Smaller size of participants using ES compared to other communication options
Robertson et al. [21], UK	Investigate the functional outcomes post-laryngectomy and impact on voice-related QoL	N = 179 (141 M, 38F); *M* = 68 years (range 41–90 years) Time post-surgery *M* = 8 years (*SD* not specified; range 1–27 years) Medical treatment other than laryngectomy = radiotherapy (n = 88)	TES (n = 156), EL (n = 6), ES (n = 6) Non-vocal mouthing (n = 11)	Quantitative, cross-sectional QoL Tools: Voice Symptom Scale (VoiSS) University of Washington Quality of Life questionnaire (UW-QOL) Definition of QoL: not reported	Patients using TES self-reported highest VoiSS scores compared to other communication options Male participants self-reported better overall QoL than female participants Participants who did not undergo radiotherapy self-reported better overall QoL Areas of QoL impacted by communication changes: not reported	Uneven participant numbers across communication options

Table 1 (continued)

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
Eadie et al. [22], USA	Investigate the link between speech intelligibility, acceptability and QoL post-laryngectomy	N = 25 (M = 20, F = 5); *M* = 63.3 years Time post-surgery *M* = 7.58 years (*SD* 7.99; range 1–33 years) Medical treatment other than laryngectomy = radiation (n = 18); radiation and chemotherapy (n = 5); not reported (n = 1)	TES (n = 16), ES (n = 2), EL (n = 7)	Quantitative, not specified QoL Tools: Voice Handicap Index-10 (VHI-10) University of Washington Quality of Life questionnaire (UW-QOL) Definition of QoL: not reported	On the UW-QOL speech domain, participants self-reported highest QoL using TES, followed by EL and ES Higher ratings for speech intelligibility and acceptability were made by unfamiliar listeners for ES, followed by TES and EL Areas of QoL impacted by communication changes: not reported	Information regarding participant recruitment not specified Uneven participant numbers across communication options; ES group did not form part of statistical analysis
Evans et al. [25], UK	Investigate voice-related QoL between participants using TES and non-TES communication	N = 53 M TES n = 26, mean age = 67 years (range 51–90 years) Non-TES n = 27 mean age = 74.7 years (range 54–88 years) Time post-surgery TES *M* = 5.9 years (*SD* 5.2 years; range not specified); non-TES *M* = 15.6 years (*SD* 11.6 years; range not specified) Medical treatment other than laryngectomy = not specified	TES (n = 26) Non-TES: ES (n = 12), EL (n = 11) Written communication (n = 2), Non-vocal mouthing (n = 2)	Quantitative, cross-sectional QoL Tool: Voice Handicap Index (VHI) Definition of QoL: not provided	No significant differences between TES and non-TES group overall for QoL QoL overall for both groups showed moderately severe impairment Areas of QoL impacted by communication changes: Participants with TES performed better on emotional domain than non-TES group	Female participants excluded from study

Table 1 (continued)

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
Kazi et al. [23], UK	Investigate voice-related QoL for participants post-laryngectomy	N = 54 (40M; 14 F); *M* = 63.4 years (range 37–84 years) Time post-surgery not reported Medical treatment other than laryngectomy = chemotherapy (n = 8); radiotherapy (n = 44)	TES	Quantitative, cross-sectional QoL Tools: Voice Handicap Index (VHI) Voice-Related Quality of Life questionnaire (V-RQOL) Definition of QoL: not provided	Most patients (53.7%) reported a 'fair to good' overall voice-related QoL on the V-RQOL Results from the VHI indicated that most participants reported minimal (37%) to moderate (37%) voice handicap Age, radiotherapy, and chemotherapy significantly affected functional aspects of QoL. Younger participants reported lower QoL Areas of QoL impacted by communication changes: functional, physical and emotional domains	Time post-laryngectomy not specified Participant inclusion and exclusion criteria not specified Duration of chemotherapy and radiotherapy and postoperative complications not specified
Chaves et al. [26], Brasil	Investigate communication-related QoL post-laryngectomy	N = 15 (13M; 2F); *M* = 62.8 years (range 47–73 years) Time post-surgery not reported Medical treatment other than laryngectomy = not specified	ES	Quantitative, cross-sectional QoL Tool: Protocol for the Evaluation of Communication Satisfaction of Patients after Total Laryngectomy Definition of QoL: WHO [2] 'individual's perceptions of their position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns'	Most participants reported lower QoL Areas of QoL impacted by communication changes: family relationship, social relationship, self-analysis and morphofunctional aspect Morphofunctional aspect had the greatest impact	Size of cohort unclear Time post-laryngectomy not specified

Table 1 (continued)

Study author, year, country	Objectives	Participants characteristics	Communication method	Design/method	Relevant outcomes	Limitations
Babin et al. [27], France	Investigate changes in QoL post-laryngectomy	N = 150 (141M, 9F); over 50 years of age (means and range not specified) Time post-surgery *M* = 6 years (*SD* and range not specified) Medical treatment other than laryngectomy = not specified	ES = 111; other communication option not specified	Quantitative, cross-sectional QoL Tool: Questionnaire developed for the study Definition of QoL: 'a subjective assessment that people make about the different aspects of their life in correlation to their health'	Areas of QoL impacted by communication changes: significant decrease in social activities outside the home Significant increase in solitary time No significant changes in marital status, and other social activities	Means and standard deviations not specified for participant demographics Other form of communication option not specified

M—male, F—female, *M* mean, *QoL* quality of life

and Doyle [17] on voice-related QoL, 25 percent of their 40 participants perceived their QoL to be low across the areas of physical and social-emotional functioning (e.g. in relation to communicating in background noise and unpredictability of the quality of the artificial voice produced), while the remainder reported less impact. The authors suggested that the self-perceived outcomes were influenced by the individual's communication requirements and were independent of the high levels of intelligibility and proficiency with the EL option that was rated for all participants by the speech pathologists in the study. For ES communication, de Araújo Pernambuco et al. [18] similarly reported that the majority of their 15 participants found the communication domain to have a moderate to severe negative impact on their self-ratings of QoL overall. Ratings were influenced by how well the participants perceived their communication to be with others (n = 11) and how well others understood them (n = 13).

Comparisons between ES, TES and non-vocal Pereira da Silva et al. [19] investigated the QoL of 34 participants that used either ES (n = 7), TES (n = 15) or were non-vocal (n = 12; communication strategy not specified). As a group, the participants reported lower global QoL (e.g. daily, family and social activities) than the general healthy population from normative data, and better QoL than patients with laryngeal or hypopharyngeal cancer that hadn't undergone laryngectomy (characteristics not specified). Of the three groups, QoL was highest for TES, followed by ES and the non-verbal groups. This similar pattern with the TES group reporting the least difficulties was observed for self-perceived communication difficulties which were reported on attitudinal measures (e.g. feeling left out in a group; avoiding speaking; perceiving that others speak to them differently) and environmental measures (e.g. the ability to get another person's attention; speaking in a group, on the phone or in noisy environments). It was also noted that those participants who had undergone speech therapy (91%; information regarding the type of intervention not specified) reported lower self-perceived communication difficulties on the environmental measure.

Comparisons between EL, ES, TES, PAL and non-vocal When comparing across all communication options, participants using TES consistently self-reported the highest QoL. However, variation was noted across the other approaches. For example, in Law et al.'s study [20], the participants using PAL self-rated highest overall communication-related QoL (e.g. speech impairment, communication activity limitation, communication participation restriction) after TES, followed by ES and EL. In Robertson et al.'s study [21], the self-ratings of overall voice-related QoL for EL and mouthing were higher than ES. In Eadie

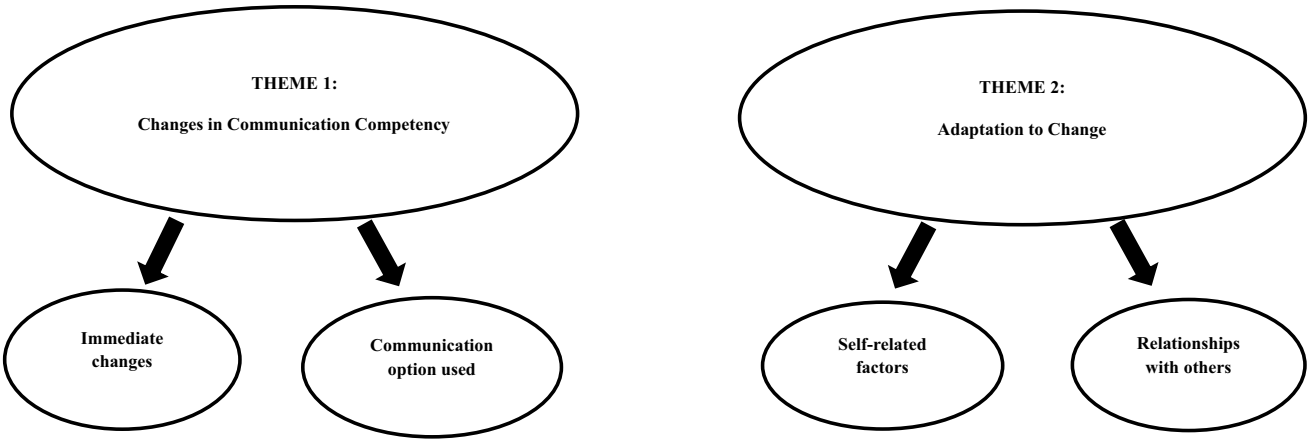

Fig. 2 Main themes in relation to changes in communication post-laryngectomy and impact on quality of life

et al.'s study [22], participants using EL self-rated highest overall voice-related QoL (functional, emotional, physical) after TES, followed by ES. While Evans et al. [25] found no significant differences between the TES and the non-TES groups for overall self-perceived voice-related QoL(functional, emotional, physical), with the voice handicap for both groups rated in the moderately severe range as impacting aspects of daily living.

In the studies above, voice-related factors (e.g. sound quality, difference to pre-surgery, effort of speaking) and aesthetics of the communication option were reported by participants to influence self-ratings of QoL, rather than how well others could understand them. For example, in Law et al.'s study [20], participants using PAL were rated significantly higher by unfamiliar listeners for speech intelligibility and acceptability, followed by those using EL, TES and ES. This differed to the highest self-ratings of QoL by the TES group. Similarly, Eadie et al. [22] noted that speech intelligibility and acceptability were rated more highly by unfamiliar listeners for ES, followed by TES and EL groups, whereas the highest self-ratings of QoL based on the speech domain were found for the TES group. Interestingly, for the ES speakers in these studies the factors influencing self-ratings of QoL were different to those for participants in the earlier de Araújo Pernambuco et al. [18] study where self-ratings were influenced by how others understood them.

Theme 2: adaptation to change

The findings from this review have suggested that *self-related factors* and *relationships with others* are likely to impact the patient's ability to adapt to the long-term *changes in communication competency* associated with laryngectomy, with impact on QoL (Fig. 2).

Self-related factors

Self-related factors identified included: the patient's age, gender, whether they had undergone additional cancer treatment (e.g. radiotherapy and chemotherapy) and resilience. Examples combining the factors of age, gender and cancer treatment were provided by Kazi et al. [23] who investigated the voice-related QoL of 54 participants using TES, many of whom had undergone additional cancer treatment (radiotherapy n = 44; chemotherapy n = 8). Age, radiotherapy and chemotherapy significantly impacted the functional aspects of QoL (e.g. being heard and understood in different environments), whereas age and chemotherapy significantly impacted on physical aspects of QoL (e.g. quality of the artificial voice). Only age significantly impacted on the emotional aspects of QoL (e.g. feelings triggered in relation to the quality of the artificial voice), with younger participants reporting lower QoL. It was suggested by the authors that the communication demand placed on individuals in the work and social settings was a relevant influential aspect, with younger participants having increased communication demand compared to older participants. Robertson et al. [21] similarly found lower self-rating of voice-related QoL for participants in their study who had undergone radiotherapy (88 of the 179 participants; specific information on communication approach not provided for this subgroup). In addition, female participants also reported significantly lower overall QoL than male participants, regardless of the communication option used.

Resilience was identified as another self-related factor and defined as the individual's ability to remain within or adjust back to a level of mental strength that is needed to overcome adversity [16]. In the context of laryngectomy, adversity was noted as the changes to communication competency post-laryngectomy and resilience as the way each patient accepted and adjusted to the adversity (e.g. coping

abilities and attitudes). The process of accepting and adjusting appears to be individual [16]. Many of the participants in the studies by Dooks et al. [15] and Bickford et al. [16] demonstrated resilience by actively trying to return to their prior routines, seeking social opportunities, having a 'never give up' attitude, or being conscious about managing the reactions of others and their expectations of their communication abilities. Others felt overwhelmed by the changes to their communication competency and avoided social engagement [16].

Relationships with others

Factors associated with *relationships with others* that were identified in this review included family, social roles and peer support. Family and social roles were explored by Chaves and colleagues [26] for 15 participants using ES in relation to the communication domains of family relationships (e.g. 'my family has no patience with me because of my speech') and social relationships (e.g. 'I can normally use my voice to communicate at work'). Both areas showed a negative impact on communication-related QoL. The authors noted that contributing factors to the negative impact were the perceived difficulties and frustrations of participants with not being understood by familiar and unfamiliar listeners, the difficulties faced when talking on the telephone, as well as the physical difficulties of talking. The use of writing as a means of communication had no impact on QoL.

Babin et al. [27] further reported that the changes to communication impacted on the social roles of the participants in their study (n = 75 using ES; n = 75 using options not specified). This included significant decreases in social activities post-laryngectomy outside the home (e.g. going to a café or restaurant, having dinner at a friend's house) and significant increases in solitary time (e.g. watching TV and owning a pet). However, no significant changes were noted for marital status and other social activities such as having dinner with friends at home and undertaking weekend or holiday trips.

In relation to peer support, Dooks et al. [15] described the experiences of their nine participants using TES communication. Participants expressed that their recovery was positively influenced by the support of others including family, friends, colleagues and strangers. Additionally, most participants either welcomed new technologies (e.g. Internet-based tools) or addressed their initial concerns using technology as participants valued this method in assisting them to connect and communicate with other patients worldwide. Technology options that allowed for written communication (e.g. chat function online) were also useful for maintaining social relationships, as many participants reported communication challenges via the phone and feeling isolated and unable to connect with others using just this option [15].

A new model linking communication changes to QoL

From this review, a model has been proposed that outlines how changes in communication post-laryngectomy may lead to an impact on QoL. Here, the main factors identified as *changes in communication competency* (identified previously as Theme 1), *self-perception* and *social engagement* directly impact on each other. Their relationships to each other and influence on QoL are explored below and highlighted in Fig. 3. The influences of *adaptation to change* (identified previously as Theme 2) on the main factors are also highlighted.

As outlined earlier (Theme 1), there are clear changes to communication that influence *communication competency* or the person's ability to interact using speech. Changes appear to occur with all of the communication options available and may suggest that currently, no option can return the individual to normal/near normal vocal quality and speech intelligibility. It is likely that *changes in communication competency* contribute to the patient's altered *self-perception* of their communication ability (Fig. 3). Examples of changes to *self-perception* noted in this review included the participants' beliefs that because of their communication difficulties, others view them as odd, socially incompetent (e.g. having difficulties engaging in conversation) or having reduced cognitive ability [16].

It is proposed that *self-perception* then impacts social engagement, as patients may begin to avoid social interactions and disengage socially. As a flow on effect, this negatively influences self-reported QoL. An example of a participant's journey in Bickford et al.'s [16] study helps to illustrate this flow of events. The participant identified that the loss of his natural voice and breathing difficulties experienced during speech (*changes in communication competency*) were very distressing and had impacted his ability to express traits of his personality in conversation (*self-perception*). This impacted his *social engagement* as he chose to no longer participate in his regular social activities such as attending the pub. A second example of changes in *social engagement* is from another participant in the same study who disengaged from routine situations that involved small talk, such as at the supermarket, choosing instead to just nod when the staff member at the checkout initiated conversation.

Influences on the main factors

Common to many of the studies reviewed was that *adaptation to change* (e.g. *self-related factors* and *relationships with others*; see Figs. 2, 3) can indirectly influence QoL through the main factors. *Self-related factors* (e.g. age, gender, resilience and cancer treatment) may have a direct

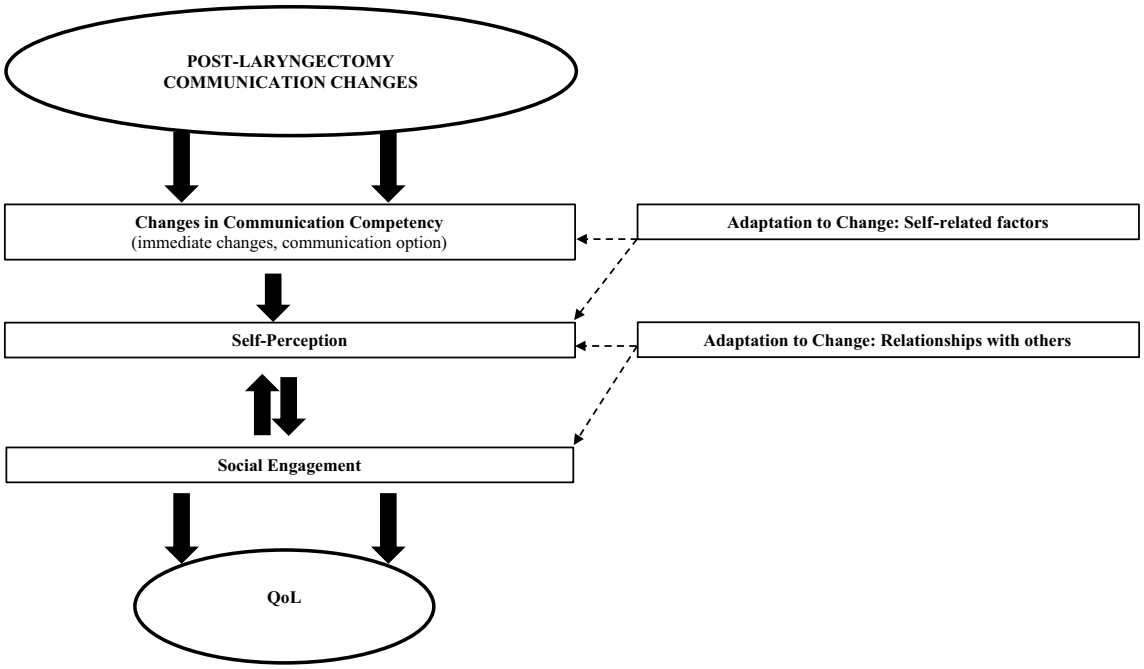

Fig. 3 Main factors impacting on QoL post-laryngectomy and influences on factors. *QoL* quality of life

impact on the *communication competency* of the individual. For example, additional cancer treatment received such as radiotherapy may physically cause fibrosis of the muscle tissues in the neck area and consequently affect the vibratory ability of the throat to produce sound [23, 28]. In this review, higher self-ratings of vocal quality were reported by participants that had not undergone chemotherapy or radiotherapy [21, 23]. Other *self-related factors* such as resilience may directly influence support seeking behaviours such as seeking help that are relevant to *self-perception*. Further, communication demand based on the patient's age may also negatively impact *self-perception* [23].

Relationships with others (e.g. family and social roles and peer support) may also influence the main factors. The *self-perception* of participants around their communication difficulties within the family and social environment may further influence *social engagement*. Another example from Bickford et al.'s study [16] helps to demonstrate this link where the participant chose to give up her favoured activity of babysitting because she felt unable to meet the communication demand of reading stories to her grandchildren as she had prior to laryngectomy. Some of the positive areas under *relationships with others* that were noted to influence *self-perception* included peer support such as sharing experiences with others in similar situations and problem solving how to overcome some of the difficulties together. Further, online support groups allowed for global connectivity which influenced social engagement, while written communication in online forums online positively supported *communication competency* as participants were able to communicate efficiently without the difficulties encountered verbally [15]. Lastly, the quality of the communication interaction was seen as a positive influence across all the main factors in situations where participants felt supported in conversations by their communication partners who were able to acknowledge their communication difficulties and tried to adjust their interactions using feedback from the person with laryngectomy [15, 16].

Limitations and future directions

The findings in this review came from the synthesis of the data presented in the included articles. However, it is possible that the search terms and databases used may have limited the identification of other relevant studies. While we aimed to review recent literature, it is possible that by confining the search to papers from 2007 and written in English, some additional studies may have been overlooked. Consequently, the model linking communication changes to QoL may evolve if other studies are included.

It is also possible that the participants included in this review do not entirely represent the wider population of patients with laryngectomy. This may be due to the methodological limitations of some of the studies such as the relatively small sample sizes, uneven participant groups using the different communication options and some of the participant demographic data not being specified (e.g. time post-laryngectomy, type of surgery, medical treatment

other than laryngectomy such as radiotherapy). Further, participant motivation and support received through services were not reported in many of the studies and may potentially influence the findings as participants who engage in services may have better self-perceived QoL than the general laryngectomy population.

The majority of studies included did not define QoL, used different tools to measure various aspects of QoL (e.g. voice-related QoL, communication-related QoL or global QoL), or only reported overall impact on QoL rather than the specific domains impacted. As a result, the findings may not be directly comparable between studies or clearly demonstrate the impact on QoL. Future research employing consistent definitions and measurement tools and looking deeper at the specific domains would provide further insight into the impact of communication changes on QoL.

This review allowed us to arrive at a meaningful model linking communication changes to QoL. In the future, it would be useful to test this model with participants reporting their experiences across areas represented in the model and in longitudinal studies examining their experiences before, immediately after laryngectomy and long term (e.g. beyond 1 year). Such studies will further inform the relationships between the factors and the influences of *adaptation to change*. This information may be useful during the counselling process with patients prior to surgery. It would also support health professionals to identify early the patients who may be impacted at certain stages of their recovery and to intervene with additional supports to aid QoL. Finally, adding further information to the model regarding the changes to physical appearance (e.g. in relation to the stoma) and swallowing would be useful in determining how the combined areas impact on each other and on QoL.

Conclusion

We aimed to explore how changes to communication following laryngectomy may impact QoL for patients. The two main themes identified included *changes in communication competency* and *adaptation to change*. Negative changes in communication competency and self-ratings of QoL were reported in all studies and were primarily influenced by self-perceived voice-related factors and aesthetics of the communication option used. TES speakers consistently self-rated higher QoL than other speakers. The model linking communication changes to QoL may be useful in assisting researchers and clinicians in the management of patients with laryngectomy.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Research involving human participants and/or animals This article does not contain any studies with human participants performed by any of the authors.

References

1. Fogle, P. T. (2013). *Essentials of communication sciences & disorders*. Clifton Park: Delmar, Cengage Learning.
2. World Health Organisation. (1997). Programme on mental health: WHOQOL measuring quality of life. http://www.who.int/mental_health/media/en/68.pdf. Accessed 10 January 2018.
3. Wilson, I. B., & Cleary, P. D. (1995). Linking clinical variables with health-related quality of life: A conceptual model of patient outcomes. *JAMA, 273*(1), 59–65.
4. Badr, H., Herbert, K., Reckson, B., Rainey, H., Sallam, A., & Gupta, V. (2016). Unmet needs and relationship challenges of head and neck cancer patients and their spouses. *Journal of Psychosocial Oncology*. https://doi.org/10.1080/07347332.2016.1195901.
5. Balm, A. J. M. (2014). Laryngeal and hypopharyngeal cancer: Intervention approaches. In E. Ward & C. As-Brooks (Eds.), *Head and neck cancer: Treatment, rehabilitation, and outcomes* (2nd ed., pp. 123–143). San Diego: Plural Publishing.
6. Brunner, T. H., DiFortuna, K., LeTang, M., Murphy, J., Stemplewicz, K., Kovacs, M., et al. (2016). Using technology to give patients a voice after surgery for head and neck cancer. *Clinical Journal of Oncology Nursing*. https://doi.org/10.1188/16.CJON.474-476.
7. Kapila, M., Deore, N., Palav, R. S., Kazi, R. A., Shah, R. P., & Jagade, M. V. (2011). A brief review of voice restoration following total laryngectomy. *Indian Journal of Cancer, 48*(1), 99–104.
8. Searl, J. P., & Reeves, S. I. (2014). Nonsurgical voice restoration following total laryngectomy. In E. Ward & C. As-Brooks (Eds.), *Head and neck cancer: Treatment, rehabilitation, and outcomes* (2nd ed., pp. 193–227). San Diego: Plural Publishing.
9. Carr, M., Schmidbauer, J. A., Majaess, L., & Smith, R. L. (2000). Communication after laryngectomy: an assessment of quality of life. *Otolaryngology-Head and Neck Surgery*. https://doi.org/10.1016/S0194-5998(00)70141-0.
10. Chen, H.-C., Mardini, S., & Yang, C.-W. (2006). Voice reconstruction using the free ileocolon flap versus the pneumatic artificial larynx: A comparison of patients' preference and experience following laryngectomy. *Journal of Plastic, Reconstructive & Aesthetic Surgery*. https://doi.org/10.1016/j.bjps.2006.06.005.
11. Morton, R. P., & Izzard, M. E. (2003). Quality-of-life outcomes in head and neck cancer patients. *World Journal of Surgery, 27*, 884–889.
12. Summers, L. (2017). Social and quality of life impact using a voice prosthesis after laryngectomy. *Current Opinion in Otolaryngology & Head and Neck Surgery*. https://doi.org/10.1097/MOO.0000000000000361.
13. Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: Secrets of the trade. *Journal of Chiropractic Medicine*. https://doi.org/10.1016/S0899-3467(07)60142-6.
14. CASP Checklists. Retrieved January 2, 2018 from https://casp-uk.net/casp-tools-checklists/.
15. Dooks, P., McQuestion, M., Goldstein, D., & Molassiotis, A. (2012). Experiences of patients with laryngectomies as they

reintegrate into their community. *Supportive Care in Cancer*. https://doi.org/10.1007/s00520-011-1101-4.
16. Bickford, J., Coveney, J., & Hersh, D. (2013). Living with the altered self: A qualitative study of life after total laryngectomy. *International Journal of Speech-Language Pathology*. https://doi.org/10.3109/17549507.2013.785591.
17. Cox, S., & Doyle, P. (2014). The influence of electrolarynx use on postlaryngectomy voice-related quality of life. *Otolaryngology Head and Neck Surgery*. https://doi.org/10.1177/0194599814524704.
18. de Araújo Pernambuco, L., de Oliveira, J., Regis, R., de Lima, R., de Lima, L., de Araújo, A., et al. (2012). Quality of life and deglutition after total laryngectomy. *International Archives of Otorhinolaryngology*. https://doi.org/10.7162/S1809-97772012000400006.
19. Pereira da Silva, A., Feliciano, T., Freitas, S., & Esteves, S. & Almeida e Sousa, C. (2015). Quality of life in patients submitted to total laryngectomy. *Journal of Voice*. https://doi.org/10.1016/j.jvoice.2014.09.002.
20. Law, I., Estella, P., & Yiu, E. (2009). Speech intelligibility, acceptability, and communication-related quality of life in Chinese alaryngeal speakers. *Archives of Otolaryngology, Head and Neck Surgery*. https://doi.org/10.1001/archoto.2009.71.
21. Robertson, S. M., Yeo, J. C., Dunnet, C., Young, D., & MacKenzie, K. (2012). Voice, swallowing, and quality of life after total laryngectomy: Results of the west of Scotland laryngectomy audit. *Head & Neck*. https://doi.org/10.1002/hed.21692.
22. Eadie, T. L., Day, A. M. B., Sawin, D. E., Lamvik, K., & Doyle, P. C. (2013). Auditory-perceptual speech outcomes and quality of life after laryngectomy. *Otolaryngology Head and Neck Surgery*. https://doi.org/10.1177/0194599812461755.
23. Kazi, R., de Cordova, J., Singh, A., Venkitaraman, R., Nutting, C., Clarke, P., et al. (2007). Voice-related quality of life in laryngectomees: Assessment using the VHI and V-RQOL Symptom Scales. *Journal of Voice*. https://doi.org/10.1016/j.jvoice.2006.05.008.
24. Marcovitz, S., Schrooten, W., Arntz, A., & Peters, M. (2015). Resilience as a predictor for emotional response to the diagnosis and surgery in breast cancer patients. *Psych-Oncology*. https://doi.org/10.1002/pon.3834.
25. Evans, E., Carding, P., & Drinnan, M. (2009). The Voice Handicap Index with post-laryngectomy male voices. *International Journal of Language and Communication Disorders*. https://doi.org/10.1080/13682820902928729.
26. Chaves, A., de Araújo Pernanbuco, L., Balata, P., Santos, V., Lima, L., Souza, S., et al. (2012). Limits on quality of life in communication after total laryngectomy. *International Archives of Otorhinolaryngology*. https://doi.org/10.7162/S1809-97772012000400009.
27. Babin, E., Beynier, D., Le Gall, D., & Hiticr, M. (2009). Psychosocial quality of life in patients after total laryngectomy. *Revue De Laryngologie Otologie Rhinologie, 130*(1), 29–34.
28. Kelly, L. E. (2014). Radiation and chemotherapy. In E. Ward & C. As-Brooks (Eds.), *Head and neck cancer: Treatment, rehabilitation, and outcomes* (2nd ed., pp. 57–86). San Diego: Plural Publishing.
29. The WHOQOL Group. (1994). The development of the World Health Organization quality of life assessment instrument (the WHOQOL). In J. Orley & W. Kuyken (Eds.), *Quality of life assessment: International perspectives*. Heidelberg: Springer.