Review Article

Early assessment of laryngeal dysfunction after thyroid surgery: a narrative review on detection and treatment considerations and the role of speech language pathology

Kristine Pietsch[1], Vaninder K. Dhillon[2]^

[1]Division of Speech Language Pathology, Department of Otolaryngology Head and Neck Surgery, Johns Hopkins University, Baltimore, MD, USA; [2]Division of Laryngology and Endocrine Head and Neck Surgery, Department of Otolaryngology Head and Neck Surgery, Johns Hopkins University, Bethesda, MD, USA

Contributions: (I) Conception and design: VK Dhillon; (II) Administrative support: VK Dhillon; (III) Provision of study materials or patients: Both authors; (IV) Collection and assembly of data: Both authors; (V) Data analysis and interpretation: Both authors; (VI) Manuscript writing: Both authors; (VII) Final approval of manuscript: Both authors.

Correspondence to: Vaninder K. Dhillon, MD. Division of Laryngology and Endocrine Head and Neck Surgery, Department of Otolaryngology Head and Neck Surgery, Johns Hopkins University, Bethesda, MD, USA. Email: vdhillo2@jhmi.edu.

Background and Objectives: Laryngeal function is an important quality of life (QOL) aspect after thyroid and parathyroid surgery that focuses on the functions of voice, swallow and breathing. These important functions may be altered secondary to nerve injury to the recurrent laryngeal nerve (RLN) and the superior laryngeal nerve (SLN), two branches of the vagus nerve, which traverse the surgical field during dissection. The dysfunction arising from injury to these branches can lead to a spectrum of voice, swallow and breathing disorders, that lead to increased morbidity for patients as well as poor QOL after surgery.

Methods: A literature review was performed using PubMed to search all original articles published in the English language over between 1998 and April 2022 that included terms such as 'voice', 'swallow', 'recurrent laryngeal nerve', 'superior laryngeal nerve', 'laryngeal dysfunction' in conjunction with 'thyroidectomy' and 'thyroid surgery'.

Key Content and Findings: This paper outlines the role of laryngeal examination, the importance in preoperative and post-operative assessment of voice, swallow and breathing especially in patients with persistent complaints, and the multidisciplinary approach of the Otolaryngologist and Speech Language Pathologist in the treatment of patients with laryngeal dysfunction after surgery. QOL parameters surrounding laryngeal dysfunction after endocrine head and neck surgery has not been well documented but there is an availability of measures that can be considered, and will be discussed.

Conclusions: Understanding the nuances of laryngeal function and the types of symptoms that may present early is important in understanding how to evaluate within a timely fashion, so that patients can be directed towards appropriate rehabilitation and interventions to improve their QOL.

Keywords: Voice; swallow; recurrent laryngeal nerve (RLN); superior laryngeal nerve (SLN); laryngeal dysfunction

Received: 30 May 2022; Accepted: 16 December 2022; Published online: 10 January 2023.

doi: 10.21037/aot-22-11

View this article at: https://dx.doi.org/10.21037/aot-22-11

^ ORCID: 0000-0001-7551-3634.

Introduction

Laryngeal function is an important aspect of any thyroid and parathyroid surgery. One of the major complications includes risk of vocal fold paralysis (VFP) with recurrent laryngeal nerve (RLN) injury after thyroid surgery. This can be either temporary or permanent based upon neurophysiologic timeline for recovery. On the other hand, other forms of dysfunction, described as partial laryngeal dysfunction by a recent American Head and Neck Society (AHNS) consensus statement, is where multiple states of dysfunction occur along a spectrum for RLN and superior laryngeal nerve (SLN) injury (1). The efferent and afferent pathways involved in partial neural dysfunction (PND) include partial RLN dysfunction and partial or complete SLN dysfunction (1). Symptomatology can manifest as vocal dysfunction, cough, globus sensation, throat pain or tickle and dysphagia among others.

The goal of this article is to discuss early detection of an altered larynx after thyroid surgery. Thyroid surgery in many ways is surgery to the larynx. The quality of life (QOL) surrounding laryngeal dysfunction after thyroid surgery is poor in part because of the spectrum of dysfunction that can exist due to injury to the RLN or SLN. This article will examine multiple aspects of laryngeal function important to voice, swallow and breathing, the role of laryngeal assessment, and treatment considerations when it comes to post-operative dysfunction. The role a laryngologist as well as a speech language pathologist can play in the management of laryngeal dysfunction is comprehensive and unique in the management of symptoms both short term and long term after thyroid surgery. We will highlight the role of speech language pathology (SLP) in that treatment algorithm in particular because of the dearth of literature on the subject for endocrine head and neck surgical patients. We present the following article in accordance with the Narrative Review reporting checklist (available at https://aot.amegroups.com/article/view/10.21037/aot-22-11/rc).

Methods

A PubMed search was completed on English only literature spanning the dates of 1998–2022. Types of literature included case series, case-controlled studies, cohort studies, randomized control studies and systematic reviews. Key words included 'voice', 'swallow', 'recurrent laryngeal nerve', 'superior laryngeal nerve', 'laryngeal dysfunction' in conjunction with 'thyroidectomy' and 'thyroid surgery'. Inclusion criteria included English only literature, case studies, case control studies, randomized control studies, systematic reviews. Exclusion criteria were non-English literature. *Table 1* provides a summary of the above.

Spectrum of laryngeal function

The spectrum of laryngeal function includes voice, swallow and breathing. It also encompasses everything in between including but not limited to cough, globus, throat irritation, sore throat, pain and hyperexcitability of the larynx. A VFP can be diagnosed on direct visualization of the larynx, but symptoms of PND are not necessarily visible. The clinical picture alongside the patient's symptoms should

Table 1 The search strategy summary

Items	Specification
Date of search	April 1 2022
Databases and other sources searched	PubMed
Search terms used	'Voice', 'swallow', 'recurrent laryngeal nerve', 'superior laryngeal nerve', 'laryngeal dysfunction' in conjunction with 'thyroidectomy' and 'thyroid surgery'
Timeframe	Any publication between 1998 and April 2022 was included
Inclusion and exclusion criteria	Inclusion criteria: English only literature, case studies, case control studies, randomized control studies, systematic reviews
	Exclusion criteria: non-English literature
Selection process	Both authors (K.P and V.K.D) were involved in the selection process of articles, and consensus was obtained prior to review of articles and data collection
Any additional considerations, if applicable	V.K.D. provided additional articles as needed

be acknowledged. If symptoms persist then a patient should be referred for direct visualization or evaluation with a laryngologist or speech language pathologist (1). The rates of VFP after thyroidectomy vary because of heterogeneity in laryngeal assessment, but some studies suggest rates of temporary VFP are 9.8% and permanent VFP are 2.3% (2). It is also significant to highlight rates of voice complaints after thyroidectomy, as many studies have noted discrepancy between subjective voice complaints and objective changes seen on examination. The sensitivity of dysphonia in predicting VFP ranged from 33% to 68% in two studies (3,4). Furthermore, there appears to be a high rate of patients presenting with dysphonia post-operatively in the absence of RLN injury, ranging from 16% to 87%, at least temporarily (5). With formal voice evaluations, 20% of patients in Li *et al.* expressed concerns regarding unpredictable voice clarity, difficulty being understood in a noisy room, and needing to strain to produce voice. These subjective long-term voice changes clearly impact a patient's day-to-day activities (6).

PND, identified as the spectrum of sensory and motor dysfunction related to the RLN and SLN, are not well reported and not entirely well known. It is estimated that rates of injury to the external branch of the SLN may be as high as 58% (7).

The prevalence of voice complaints post-thyroidectomy reflects the importance of laryngeal assessment. According to the 2020 AHNS consensus statement on laryngeal dysfunction, one of the primary reasons for a preoperative laryngeal examination is that it serves as medicolegal documentation of a baseline examination prior to surgery. It provides accountability for laryngeal function and dysfunction found after surgery (1).

What do we know regarding QOL for patients?

Validated metrics specific for laryngologic QOL post thyroidectomy have not been developed or universally published. QOL metrics within the voice and swallow realm have been adopted by studies looking at laryngeal dysfunction after thyroid surgery, but there is heterogeneity in reported data that must be viewed in context. In fact, dysphonia has not been evaluated as a QOL index (6). Furthermore, there is no standard diagnostic protocol for thyroidectomy-related swallowing impairment. QOL in patients relies on clinical history, a good voice and swallow evaluation, and direct visualization of the larynx. For the larger QOL metrics used in thyroid patients, such as THYPro and SF-36, there is little to no mention of voice/swallowing impairment. This critical component of thyroid surgery may require development and validation of a unique new metric all its own.

According to Kletzien *et al.*, out of 42 patients who were prospectively evaluated for subjective voice complaints post-thyroidectomy, over 50% had voice complaints as validated by known voice questionnaires one year post surgery (8). The methods by which QOL measures have been evaluated include a voice case history, Voice related Quality of Life (VRQOL), Voice handicap index-10 (VHI-10), Voice handicap index-30 (VHI-30), and dysphonia severity index (DSI). For professional voice users or those with high vocal demand, preoperative education on vocal hygiene, and voice changes that may occur, is also important in order to manage expectations (9).

Dysphagia or swallowing abnormalities post thyroidectomy has been reported as high as 80% within the first two weeks of surgery, and 17% at 6 months. Of those patients, only 8% qualified for swallow related studies (10). The use of the Eating Assessment Tool-10 (EAT-10), a validated questionnaire for dysphagia, can screen patients following thyroidectomy for dysphagia.

Pitch changes, a component of the voice case history, and a symptom also associated with potential SLN injury, has been studied through questionnaires. Solomon *et al.* found reduction in pitch range at 6 weeks, recovered some by 3 months but not back to baseline yet (11). Other studies like Robinson *et al.* found SLN paresis determined by electromyography (EMG) (12). The maximum phonation time and frequency range of phonation were decreased, mean air flow rate was increased when compared with normal population values. The jitter percent, shimmer percent, and noise-to-harmonic ratio were also increased in patients when compared with normative data (12).

Laryngeal assessment through direct visualization

Laryngeal examination through direct visualization is important, particularly preoperatively to determine vocal fold integrity when it comes to motor function, and many guidelines have endorsed the recommendation for laryngeal examination with transnasal endoscopy before thyroid surgery in certain cases. The American Thyroid Association (ATA), AHNS, National Comprehensive Cancer Network (NCCN) and American Academy of Otolaryngology (AAO) have endorsed the role of

Table 2 A Summary of laryngeal assessment tools

Type	Benefit
Direct laryngoscopy	Bright light (halogen) evaluation of larynx for mobility and mass/lesions
Videostroboscopy	Stroboscopic video evaluation of mucosal wave function, glottic closure, pliability

preoperative examinations for patients with preoperative voice changes, in high-risk patients such as those with prior neck or chest surgery, or in cases of thyroid malignancy (1). It is important to note that 30% of patients with a VFP may be asymptomatic and laryngeal examination prior to thyroid surgery is crucial for preoperative planning and consideration of potential post-operative complications if tumor is involved with the nerve (3,12). While voice may be the mainstay symptom of concern, swallowing changes prior to surgery, concerns for aspiration, are all important reasons for evaluation with laryngeal examination. Laryngeal examination is currently the gold standard for assessment of laryngeal function, namely vocal fold mobility. Laryngeal examination can take on two forms (I) direct laryngoscopy and (II) videostroboscopy. Videostroboscopy is the gold standard for evaluation of dysphonia or voice changes according to the AAO (1). Videostroboscopy may be better for subgroup singer population to evaluate baseline vocal function- there may be mucosal wave changes prior to surgery that should be noted. The difference between laryngoscopy and videostroboscopy is the light source. Laryngoscopy is purposeful for global evaluation of the larynx as well as mobility of bilateral true vocal folds in the assessment of abduction and adduction. Videostroboscopy allows for a freeze frame evaluation of vocal fold vibration, a component of vocal fold function that is related to mucosal wave function. Small lesions along the vocal fold, asymmetries in pliability and incomplete glottic closure are elements noted more sensitively on videostroboscopy (1). A summary of laryngeal assessment tools is in *Table 2*.

Laryngeal function in the form of motor injury leading to vocal fold motion impairment

Intraoperative injury to the RLN has been classified into multiple types including traction, thermal, compression, ischemia, clamping, transection. All of these subtypes of injury can lead to vocal fold motion impairment. Motion impairment exists on a spectrum, with VFP more commonly reported in the literature. Vocal fold paresis is partial weakness, where there is some degree of motion impairment but not the absence of it (13). Vocal fold paresis should be considered in any patient with voice symptoms that cannot be explained by true VFP. Dysphonia complaints associated with vocal fold paresis include mild hoarseness, increased phonatory effort, and limitation of pitch-all of which can get more pronounced when a person tries to project his or her voice, or after heavy voice use. Signs include loss of vocal range, soft voice, inability to project the voice, increased vocal roughness, and, sometimes, swallowing problems (13). Early recognition of VFP and/or symptomatic voice complaints is crucial and the AAOHNS guidelines indicate that a laryngeal examination should take place between 2 weeks and 2 months post-operatively for evaluation (14). The best clinical evaluation for paresis is through direct visualization with videostroboscopy. Unlike laryngoscopy, videostroboscopy allows for evaluation of mucosal wave and glottic closure that can facilitate a diagnosis of paresis in patients who may not overtly demonstrate mobility impairment. Other signs of impairment include glottic insufficiency, chasing wave, atrophy of the vocal fold on videostroboscopy. For patients with vocal fold paresis, Sulica *et al.* further encourages the use of EMG to verify paresis, although clinically this is not universally feasible (15).

The prognosis of vocal fold immobility, whether it be temporary or permanent, is beyond the scope of this article on early detection and assessment. It is possible that a patient can have full recovery of motion, no recovery and/or synkinesis. Synkinesis is beyond the scope of this article, but whose definition requires an understanding that there is some form of reinnervation of the vocal fold without full recovery of motion, and may lead to some recovery of symptoms for a patient.

Diagnosing partial laryngeal dysfunction

PND exists within the realm of dysfunctions related to RLN and SLN insult. The degree of that insult is not well understood, nor are the symptoms of partial dysfunction reported in a standardized fashion. Globus, cough, dysphagia, odynophagia and odynophonia may all

be symptoms. According to the 2020 AHNS consensus statement, the definition includes disorders of efferent or afferent pathways of the RLN or SLN exclusive of VFP seen on preliminary laryngoscopy, all of which may be clinically symptomatic (1). Diagnosis should be made based upon clinical presentation of symptoms, findings on laryngeal evaluation and, if persistent beyond 2 months (1), should prompt referral to an Otolaryngologist, Laryngologist and/or speech language pathologist. Direct visualization of the larynx, particularly the use of videostroboscopy, as well as adjunct tests including modified barium swallow studies, fluoroscopic swallow evaluations in office, and rehabilitative support with SLP involvement all play a role in current treatment for partial dysfunction.

Role of laryngology and SLP evaluation

The role of a laryngologist and speech language pathologist is to help in evaluation and treatment planning for patients with laryngeal concerns. This includes those of PND. While most Otolaryngology referrals are warranted for laryngologic concerns post-thyroidectomy, the sub-specialization of a laryngologist may allow for a more nuanced approach to the comprehensive evaluation from a laryngeal standpoint.

SLP colleagues are valuable assets in the multidisciplinary evaluation of patients both from an immediate post-operative standpoint but also in conjunction with an Otolaryngology or laryngology referral outpatient. The section on SLP evaluation and treatment will discuss the role rehabilitation can have in the road to recovery, and more importantly for a better QOL.

Laryngological evaluation of vocal fold immobility has its benefits in part because of the ability to perform videostroboscopy. Vocal fold paresis, glottic insufficiency and/or potential SLN injury can be better identified with videostroboscopy over laryngoscopy. The role of medialization procedures for the spectrum of unilateral vocal fold immobility and glottic insufficiency is invaluable not only in the treatment for dysphonia but also for mild cases, diagnostically, in that the treatment may unveil an underlying insufficiency. The risks of in-office medialization furthermore are low and patients may benefit from an in-office evaluation and treatment. The role of early medialization through injection laryngoplasty has been shown to allow for prevention of aspiration, improved vocal recovery and QOL (16). The role of intervention for bilateral vocal fold immobility is beyond the scope of this paper, but includes interventions to improve airway over voice.

Limitations and applicability of research

There is strong data to support the role of early laryngeal assessment preoperatively in thyroid and parathyroid surgery. It may provide information to help with operative planning, potential staging and prognosis of disease. In regards to the spectrum of laryngeal dysfunction, the applicability of literature on the treatment for the spectrum of symptoms as well as RLN and SLN dysfunction is limited. This article proposes a treatment algorithm that is in line with what has been described in laryngology as well as SLP literature, for endocrine head and neck surgery patients. This article hopes to enumerate the types of laryngeal symptoms and characteristic dysfunction that patients can experience immediately after surgery, in an effort to foster work up, early referral and treatment to improve QOL.

SLP role and treatment overview

The role of a SLP for laryngeal dysfunction after thyroid surgery is important in education, rehabilitation and continuity of care for patients. Speech pathology interventions for a multitude of symptoms encompass a variety of direct and indirect therapeutic techniques (17,18). As in other rehabilitation specialties, this includes a strong focus on education and counseling to empower patients and promote self-efficacy and adherence (19). Indirect approaches can include recommendations for modifying habits, environment and behaviors that influence a patient's symptoms, but don't involve traditional therapy "exercise". Vocal hygiene is the umbrella term employed for standard recommendations. Use of psychoeducational tools to facilitate behavioral change and adherence to recommendations—like those found in motivational interviewing or cognitive behavioral therapy—are common (20). On the other hand, direct interventions are exercises or compensatory strategies aimed at promoting appropriate and efficient function. Patients with dysphonia are taught exercises to alter respiration, phonation, resonance, and articulation to enhance vocal function and control (17,18), while the therapy focus for patients with chronic cough, globus, or induced laryngeal obstruction (ILO) is to learn maneuvers to alter or replace their hyperkinetic laryngeal behaviors and ultimately "reprogram" their response to triggers for these

behaviors using principles of neuroplasticity (21-23). Manual therapy such as circumlaryngeal massage or reposturing is commonly applied to manage extralaryngeal muscle tension that contributes to these symptom profiles (24). Swallowing exercises target increased strength and coordination of the oropharyngeal musculature to achieve improvements in safety and efficiency of oral intake, and compensatory strategies such as head position during a swallow can alter bolus flow to bypass temporarily or permanently dysfunctional anatomy (25).

Although research demonstrates the efficacy of speech therapy interventions for a variety of laryngeal dysfunctions, studies specific to thyroid patients are scarce (26).

Impact of RLN and SLN on swallowing function

When specifically looking at the impact RLN and SLN impairment has on swallow function after thyroid surgery, a few studies have assessed how coordination of the swallow may be significantly impacted and necessitate rehabilitation.

Gould *et al.* (27) evaluated oropharyngeal swallow in a pig model after RLN impairment and noted changes in performance, timing, and kinematics of oropharyngeal behavior that occurred not only during the swallow but also before initiation, with aspiration at worst 24–48 hours after initial nerve impairment. The delay in the onset in severe aspiration indicates simple failure of glottal closure is not responsible, but likely that RLN impairment triggers broader changes in sensory-motor coordination of the oropharyngeal system. It's possible that the delay in aspiration reflects individual learned behavior in response to abnormal sensation following lesion. The same group looking at the impact of unilateral SLN impairment also found similar global changes in oropharyngeal swallowing kinematics and an increase in silent aspiration from 0.7% to 41.5% (27).

Schiedermayer *et al.* (28) looked at swallowing studies from a heterogenous group of patients with recent unilateral vocal fold paralysis (UVFI) secondary to various etiologies. A delay in airway closure was the most common abnormality of swallowing pathophysiology, found in 62% of individuals regardless of UVFI etiology. However, this was not associated with aspiration as it occurred at similar frequencies in both aspirators and non-aspirators. Those with UVFI at greatest risk for aspiration were those with impaired pharyngeal function in addition to impaired vocal fold mobility. Individuals at greatest risk for vagal nerve injury involving the pharyngeal plexus and SLN represented the largest proportion of those who aspirated.

These findings highlight the importance of evaluation for swallowing impairment post thyroidectomy, especially in the case of known RLN or SLN impairment. An SLP can determine the utility of exercises versus compensatory strategies or diet modifications in the immediate post-operative period. Inpatient evaluation and referral for outpatient continuity of care allows for improved QOL for swallowing impairment.

SLP involvement in partial laryngeal dysfunction

SLP involvement in partial laryngeal dysfunction after thyroid surgery whereby motor function appears intact (i.e., normal vocal fold mobility) can be beneficial for patients with symptoms that result in irritable larynx symptoms of chronic cough, ILO, globus or sensory tickle (29). Medical treatments found effective in this patient population have evolved to include injection augmentation (30), SLN nerve blocks (31) and neuromodulators (32), and support sensorimotor changes in the laryngeal complex may be both the cause and primary mode of treatment for these symptoms. Behavioral intervention with SLP has been well supported for improvement in QOL for this spectrum of irritable larynx complaints (21-23), as well as a measured reduction in laryngeal sensitivity (33).

SLP treatment of functional (non-neural) laryngeal dysfunction

Adhesions of the skin, connective tissue and muscle at the thyroidectomy incision site have been demonstrated to impair laryngeal elevation (34), which has implications for pitch elevation, as well as swallowing function (35). Rehabilitation of this as well as prevention of anterior neck scarring may be a more effective way to improve laryngeal dysfunction post operatively (36). In a paper by Lee *et al.* (37) randomized patients were entered into a control and experimental group to measure the impact of wound adhesion on laryngeal complaints, and the potential impact of wound massage in mitigating these effects. The experimental group had significantly better recovery from surgical adhesion, reduced voice and swallowing impairments on QOL measures and subjective discomfort using a visual analog scale. Voice analysis demonstrated voice range and fundamental frequency measures that were significantly closer to pre-operative levels in the experimental group as compared to controls.

Table 3 A broad overview of QOL scales specific to patient complaints

Type of QOL parameter	Validated QOL scale that can be used
Thyroid specific	Thyroidectomy voice & swallowing-related questionnaire (TVQ)
Voice	Voice handicap index-10 (VHI-10)
	Voice related Quality of Life (VRQOL)
	Singing Voice Handicap-10 (SVHI-10)
Swallow	Eating Assessment Tool-10 (EAT-10)
	Dysphagia Handicap Index
	SWAL-QOL
Cough	Leicester cough questionnaire
	Cough Severity index (CSI)
Globus	Newcastle Laryngeal Hypersensitivity Questionnaire
	Vocal Tract Discomfort Scale
Induced laryngeal obstruction	Dyspnea Index
	Exercise-Induced Laryngeal Obstruction Dyspnea Index (EILODI)

QOL, quality of life.

These findings suggest that a standardized protocol for manual therapy implemented with SLP could substantially improve QOL outcomes for voice, swallowing, and anterior neck discomfort. Post-operative scarring can also lead to functional voice disorders, seen in muscle tension dysphonia.

The simple overuse of an inefficient system, somatic response to stress, compensatory strain that develops in response to sensory changes, temporary inflammation, and/or reduced vocal fold closure can lead to muscle tension dysphonia (MTD) which can be temporary or persistent post-thyroidectomy (38,39). MTD can develop as a maladaptive response to any of the previously delineated impacts of thyroid surgery (40). Treatment of MTD is individualized and dependent on a patient's unique muscle tension patterns and responsiveness to therapeutic prompts, but includes the therapeutic options described above.

The SLP assessment algorithm

Speech pathologists (SLPs) use many of the same evaluation tools as their laryngology colleagues, relying heavily on detailed history, laryngoscopy or videostroboscopy, and QOL questionnaires when assessing patient voice, swallow as well as well as partial dysfunction like the irritable larynx symptoms of ILO, dysphagia, globus, and chronic cough (*Table 3*). Dysphagia assessments can include clinical evaluation or "bedside" swallow, fiberoptic endoscopic evaluation of swallowing and videofluoroscopic swallowing studies.

Perceptual assessments can be made for voice using assessment methods like GRBAS and CAPE-V which are validated. Other forms of assessment that are adjuncts to evaluating vocal function include acoustic and aerodynamic evaluation which includes measurements of fundamental frequency, physiologic pitch range, and maximum phonation time (41,42). Information acquired from aerodynamic assessments allows for inferences to be made regarding glottic closure and efficiency (43) and may help to better elucidate the impact of subtle vocal fold weakness in a more natural context than during indirect laryngoscopy.

In the absence of dysphonia complaint, acoustic and aerodynamic measurements are also frequently used in the assessment of chronic refractory cough and ILO, with evidence of abnormalities in vocal function as compared to healthy controls (43). There is a dearth in published data on the voice characteristics of patients with a primary complaint of globus (44), though it is common for other laryngeal complaints to co-occur with laryngeal discomfort (45).

Excessive paralaryngeal tension is considered a hallmark of functional laryngeal disorders (46). Visual observations of alignment and muscle activation patterns at rest and

during speech tasks combined with palpation of extrinsic laryngeal muscles is commonly employed by SLPs to obtain information about tension, pain, and range of motion. Insufficient target anatomical structures and lack of categorization are hypothesized to contribute to poor validity and reliability of rating scales (47,48), however a newly developed laryngeal palpatory scale (49) appears promising for use in future research.

SLP counseling and the role of a multidisciplinary team

Face-to-face presurgical counseling sessions for cancer patients demonstrate benefits for anxiety, satisfaction, knowledge, and health care costs (50). It is within the scope of practice of speech pathologists to counsel patients regarding current or potential communication or swallowing impairments. Given the frequency of functional impact of thyroid treatment on these systems, SLPs are a helpful health care professional to contribute to the pre-treatment education and counseling.

Special populations that may benefit from this counseling include singers and vocal professionals for whom any mild change in vocal function could present serious challenges.

Randolph *et al.* (51) followed 27 professional singers who underwent thyroidectomy with RLN and EBSLN monitoring with normal signals during their surgeries. In the recovery period, patients reported vocal fatigue, reduced high range, reduced pitch control and modulation, and reduced vocal strength, however all resumed singing voice exercises within weeks of surgery and ultimately returned to performing, reporting normal vocal function on average 2.5 months after surgery. Objective data on the post-operative utility of voice therapy is absent from the literature, however this small sample suggests that use of the voice in post operative period may be beneficial for return to function.

The importance of SLP involvement is not only in the ability to rehabilitate the patient's deficits when it comes to the larynx after thyroid surgery. It is also in the multidisciplinary way patient care is centered. QOL for patients when it comes to laryngeal function after thyroid surgery can take weeks to months to years to assess because the symptoms for many of these patients do not resolve in the immediate post operative period. That means that a multidisciplinary team is required to follow these patients and individual care. It may also be prudent to consider having voice professionals see SLP prior to surgery for preoperative counseling. Therefore, a team which involves the endocrine surgeon, endocrinologist, laryngologist and a SLP is essential for best outcomes for our patients.

Conclusions

Laryngeal function encompasses a wide spectrum of function that incorporates voice, swallow, breathing, all of which may be altered and disrupted after thyroid and parathyroid surgery. The nuances of laryngeal function are not fully understood, but have been documented as indicators of poor QOL for patients after surgery. Therefore early identification, examination and treatment for laryngeal dysfunction should be considered in order to improve QOL outcomes for our patients, and appropriate referral and placement of patients into multidisciplinary treatment plan can help in the immediate post operative period.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Annals of Thyroid* for the series "Improved Quality of Life after Thyroid Surgery". The article has undergone external peer review.

Reporting Checklist: The authors have completed the Narrative Review reporting checklist. Available at https://aot.amegroups.com/article/view/10.21037/aot-22-11/rc

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://aot.amegroups.com/article/view/10.21037/aot-22-11/coif). The series "Improved Quality of Life after Thyroid Surgery" was commissioned by the editorial office without any funding or sponsorship. VKD served as the unpaid Guest Editor of the series and serves as an unpaid editorial board member of *Annals of Thyroid* from July 2021 to June 2023. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are

appropriately investigated and resolved.

References

1. Dhillon VK, Randolph GW, Stack BC Jr, et al. Immediate and partial neural dysfunction after thyroid and parathyroid surgery: Need for recognition, laryngeal exam, and early treatment. Head Neck 2020;42:3779-94.
2. Jeannon JP, Orabi AA, Bruch GA, et al. Diagnosis of recurrent laryngeal nerve palsy after thyroidectomy: a systematic review. Int J Clin Pract 2009;63:624-9.
3. Randolph GW, Kamani D. The importance of preoperative laryngoscopy in patients undergoing thyroidectomy: voice, vocal cord function, and the preoperative detection of invasive thyroid malignancy. Surgery 2006;139:357-62.
4. Farrag TY, Samlan RA, Lin FR, et al. The utility of evaluating true vocal fold motion before thyroid surgery. Laryngoscope 2006;116:235-8.
5. Sinagra DL, Montesinos MR, Tacchi VA, et al. Voice changes after thyroidectomy without recurrent laryngeal nerve injury. J Am Coll Surg 2004;199:556-60.
6. Li C, Lopez B, Fligor S, et al. Long-term voice changes after thyroidectomy: Results from a validated survey. Surgery 2021;170:1687-91.
7. Nouraei SAR, Allen J, Kaddour H, et al. Vocal palsy increases the risk of lower respiratory tract infection in low-risk, low-morbidity patients undergoing thyroidectomy for benign disease: A big data analysis. Clin Otolaryngol 2017;42:1259-66.
8. Kletzien H, Macdonald CL, Orne J, et al. Comparison Between Patient-Perceived Voice Changes and Quantitative Voice Measures in the First Postoperative Year After Thyroidectomy: A Secondary Analysis of a Randomized Clinical Trial. JAMA Otolaryngol Head Neck Surg 2018;144:995-1003.
9. Al-Yahya SN, Muhammad R, Suhaimi SNA, et al. Selective Laryngeal Examination: Sensitivity of Endocrine Surgeons in Screening Voice Abnormality. J Voice 2020;34:811.e13-20.
10. Krekeler BN, Wendt E, Macdonald C, et al. Patient-Reported Dysphagia After Thyroidectomy: A Qualitative Study. JAMA Otolaryngol Head Neck Surg 2018;144:342-8.
11. Solomon NP, Helou LB, Makashay MJ, et al. Aerodynamic evaluation of the postthyroidectomy voice. J Voice 2012;26:454-61.
12. Robinson JL, Mandel S, Sataloff RT. Objective voice measures in nonsinging patients with unilateral superior laryngeal nerve paresis. J Voice 2005;19:665-7.
13. Kamani D, Darr EA, Randolph GW. Electrophysiologic monitoring characteristics of the recurrent laryngeal nerve preoperatively paralyzed or invaded with malignancy. Otolaryngol Head Neck Surg 2013;149:682-8.
14. Ivey CM. Vocal Fold Paresis. Otolaryngol Clin North Am 2019;52:637-48.
15. Sulica L, Blitzer A. Vocal fold paresis: evidence and controversies. Curr Opin Otolaryngol Head Neck Surg 2007;15:159-62.
16. Bhattacharyya N, Kotz T, Shapiro J. Dysphagia and aspiration with unilateral vocal cord immobility: incidence, characterization, and response to surgical treatment. Ann Otol Rhinol Laryngol 2002;111:672-9.
17. Gartner-Schmidt JL, Roth DF, Zullo TG, et al. Quantifying component parts of indirect and direct voice therapy related to different voice disorders. J Voice 2013;27:210-6.
18. Van Stan JH, Roy N, Awan S, et al. A taxonomy of voice therapy. Am J Speech Lang Pathol 2015;24:101-25.
19. van Leer E, Hapner ER, Connor NP. Transtheoretical model of health behavior change applied to voice therapy. J Voice 2008;22:688-98.
20. Behrman A. Facilitating behavioral change in voice therapy: the relevance of motivational interviewing. Am J Speech Lang Pathol 2006;15:215-25.
21. Birring SS, Floyd S, Reilly CC, et al. Physiotherapy and Speech and Language therapy intervention for chronic cough. Pulm Pharmacol Ther 2017;47:84-7.
22. Khalil HS, Bridger MW, Hilton-Pierce M, et al. The use of speech therapy in the treatment of globus pharyngeus patients. A randomised controlled trial. Rev Laryngol Otol Rhinol (Bord) 2003;124:187-90.
23. Shaffer M, Litts JK, Nauman E, et al. Speech-Language Pathology as a Primary Treatment for Exercise-Induced Laryngeal Obstruction. Immunol Allergy Clin North Am

2018;38:293-302.
24. Mathieson L. The evidence for laryngeal manual therapies in the treatment of muscle tension dysphonia. Curr Opin Otolaryngol Head Neck Surg 2011;19:171-6.
25. Carnaby GD, Harenberg L. What is "usual care" in dysphagia rehabilitation: a survey of USA dysphagia practice patterns. Dysphagia 2013;28:567-74.
26. Yu WV, Wu CW. Speech therapy after thyroidectomy. Gland Surg 2017;6:501-9.
27. Gould FDH, Lammers AR, Mayerl CJ, et al. Specific Vagus Nerve Lesion Have Distinctive Physiologic Mechanisms of Dysphagia. Front Neurol 2019;10:1301.
28. Schiedermayer B, Kendall KA, Stevens M, et al. Prevalence, incidence, and characteristics of dysphagia in those with unilateral vocal fold paralysis. Laryngoscope 2020;130:2397-404.
29. Wu Y, Fang Q, Xu C, et al. Association between postoperative cough and thyroidectomy: a prospective study. BMC Cancer 2019;19:754.
30. Litts JK, Fink DS, Clary MS. The effect of vocal fold augmentation on cough symptoms in the presence of glottic insufficiency. Laryngoscope 2018;128:1316-9.
31. Dhillon VK. Longitudinal Follow-up of Superior Laryngeal Nerve Block for Chronic Neurogenic Cough. OTO Open 2021;5:2473974X21994468.
32. Wei W, Liu R, ZhangTong Y, et al. The efficacy of specific neuromodulators on human refractory chronic cough: a systematic review and meta-analysis. J Thorac Dis 2016;8:2942-51.
33. Ryan NM, Vertigan AE, Bone S, et al. Cough reflex sensitivity improves with speech language pathology management of refractory chronic cough. Cough 2010;6:5.
34. Gohrbandt AE, Aschoff A, Gohrbandt B, et al. Changes of Laryngeal Mobility and Symptoms Following Thyroid Surgery: 6-Month Follow-Up. World J Surg 2016;40:636-43.
35. Jeon MK, Kang SJ, Sun H. Platysma flap with z-plasty for correction of post-thyroidectomy swallowing deformity. Arch Plast Surg 2013;40:425-32.
36. Thomas JR, Somenek M. Scar revision review. Arch Facial Plast Surg 2012;14:162-74.
37. Lee JS, Kim JP, Ryu JS, et al. Effect of wound massage on neck discomfort and voice changes after thyroidectomy. Surgery 2018;164:965-71.
38. Desjardins M, Apfelbach C, Rubino M, et al. Integrative Review and Framework of Suggested Mechanisms in Primary Muscle Tension Dysphonia. J Speech Lang Hear Res 2022;65:1867-93.
39. Gilmour GS, Nielsen G, Teodoro T, et al. Management of functional neurological disorder. J Neurol 2020;267:2164-72.
40. Fujiki RB, Thibeault SL. Examining Relationships Between GRBAS Ratings and Acoustic, Aerodynamic and Patient-Reported Voice Measures in Adults With Voice Disorders. J Voice 2021. [Epub ahead of print]. pii: S0892-1997(21)00074-6. doi: 10.1016/j.jvoice.2021.02.007.
41. Patel RR, Awan SN, Barkmeier-Kraemer J, et al. Recommended Protocols for Instrumental Assessment of Voice: American Speech-Language-Hearing Association Expert Panel to Develop a Protocol for Instrumental Assessment of Vocal Function. Am J Speech Lang Pathol 2018;27:887-905.
42. Thomson SL, Mongeau L, Frankel SH. Aerodynamic transfer of energy to the vocal folds. J Acoust Soc Am 2005;118:1689-700.
43. Dornelas R, Casmerides MCB, da Silva RC, et al. Clinical Parameters of the Speech-Language Pathology Assessment of the Chronic Cough: A Scoping Review. J Voice 2022. [Epub ahead of print]. pii: S0892-1997(21)00438-0. doi: 10.1016/j.jvoice.2021.12.012.
44. Buckley DP, Vojtech JM, Stepp CE. Relative Fundamental Frequency in Individuals with Globus Syndrome and Muscle Tension Dysphagia. J Voice 2021. [Epub ahead of print]. pii: S0892-1997(21)00347-7. doi: 10.1016/j.jvoice.2021.10.013.
45. Vertigan AE, Kapela SM, Franke I, et al. The Effect of a Vocal Loading Test on Cough and Phonation in Patients With Chronic Cough. J Voice 2017;31:763-72.
46. Van Houtte E, Van Lierde K, Claeys S. Pathophysiology and treatment of muscle tension dysphonia: a review of the current knowledge. J Voice 2011;25:202-7.
47. Khoddami SM, Ansari NN, Jalaie S. Review on Laryngeal Palpation Methods in Muscle Tension Dysphonia: Validity and Reliability Issues. J Voice 2015;29:459-68.
48. Stepp CE, Heaton JT, Braden MN, et al. Comparison of neck tension palpation rating systems with surface electromyographic and acoustic measures in vocal hyperfunction. J Voice 2011;25:67-75.
49. Jafari N, Salehi A, Meerschman I, et al. A Novel Laryngeal Palpatory Scale (LPS) in Patients with Muscle Tension Dysphonia. J Voice 2020;34:488.e9-488.e27.
50. Waller A, Forshaw K, Bryant J, et al. Preparatory education for cancer patients undergoing surgery: A systematic review of volume and quality of research

output over time. Patient Educ Couns 2015. [Epub ahead of print]. pii: S0738-3991(15)00229-3. doi: 10.1016/j.pec.2015.05.008.

51. Randolph GW, Sritharan N, Song P, et al. Thyroidectomy in the professional singer-neural monitored surgical outcomes. Thyroid 2015;25:665-71.

doi: 10.21037/aot-22-11

Cite this article as: Pietsch K, Dhillon VK. Early assessment of laryngeal dysfunction after thyroid surgery: a narrative review on detection and treatment considerations and the role of speech language pathology. Ann Thyroid 2023;8:2.