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REVIEW

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Tracheoesophageal puncture and quality of life after total laryngectomy: A systematic review and meta-analysis

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Abstract

Objective: Total laryngectomy (TL) is a standard induction treatment for laryngeal cancer. Patients have shown decreased quality of life (QOL) following laryngectomy potentially due to its impact on communication. This study is a systematic review of the effects of TEP on QOL in TL patients.

Methods: Data was extracted from PubMed, Ovid Medline, and Web of Science. A systematic review of literature assessing QOL after TEP within the last decade was conducted using PRISMA methodology. The initial search yielded 71 publications filtered to 15 after removing duplicates, non-English publications, and title screening. Two researchers independently reviewed abstracts, and 11 articles were retained. After a full article review, 6 examined QOL in TEP patients.

Results: The studies concluded that post-TL, patients with TEP experienced improved QOL than before the procedure or non-TEP alternatives for speech. The collective sample size yielded 253 patients. Meta-analysis demonstrated significant improvement in QOL described by the University of Washington—Quality of Life Index ($p < .0001$) and insignificant improvement defined by the Voice Handicap Index ($p = .07$). Several additional indices were included in the articles, all of which indicated improved QOL in TL patients post-TEP. These scales could not undergo meta-analysis due to their presence in only 1 study each.

Conclusion: TEP is a valuable intervention in improving patient QOL and satisfaction following TL. There is no standardized tool for describing QOL in TL patients, so the authors recommend tools be chosen based on the specific aspects of QOL they represent.

Level of evidence: 2a.

KEYWORDS

laryngeal cancer, quality of life, total laryngectomy, tracheoesophageal puncture

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1 | INTRODUCTION

Approximately 185,000 people worldwide are diagnosed with laryngeal cancer each year, making it the most prevalent head and neck malignancy.[1,2] The condition currently harbors a mortality rate of 1.66 deaths per 100,000 people, which has increased by 5% in the past 3 decades.[3] This may be partly due to a desire for laryngeal preservation, prolonging the time between diagnosis and surgery. An estimated 60% of laryngeal cancers originate from the glottis, while 35% originate in the supraglottic region. The remaining cases develop below the vocal cords or involve multiple laryngeal regions.[2] Depending on the disease's location, extent, and medical sensitivity, total laryngectomy (TL) may be necessary in certain patients. Though less invasive surgical approaches, such as partial or supraglottic laryngectomy, may be appropriate for limited local invasion, TL is considered the gold standard treatment for advanced tumor burden.[4] Patients will often undergo adjuvant or neoadjuvant radiation and/or chemotherapy to target the malignancy aggressively.[4,5]

Several comorbid conditions may arise after TL, such as dysphagia, sialorrhea, hyposmia or anosmia, tracheostomy, and inability to speak.[6] These vital functions significantly impact patients' psychosocial quality of life (QOL), especially regarding speech. Loneliness, mental health, and sense of belonging can deteriorate amongst individuals with poor speech intelligibility.[7–11] A 2007 study by Kazi et al. identified speech, appearance, and activity as the most essential issues following TL based on patient self-reporting.[12]

Treatment of patients with laryngeal cancer goes well beyond tumor resection, requiring a well-rounded, interdisciplinary approach that maximizes tumor resection while minimizing resulting physical and psychosocial comorbidities. Voice restoration is a critical point of attention for head and neck surgeons to reduce the negative psychosocial impacts of tumor resection. Restorative voice technologies are diverse, including placement of an electrolarynx, pneumatic artificial larynx, esophageal voice, and tracheoesophageal shunt prosthesis.[13] The most common voice prosthesis following TL is tracheoesophageal speech, facilitated by a tracheoesophageal shunt prosthesis.[13] This requires the surgical insertion of a one-way valve through a tracheoesophageal puncture (TEP). As a result, the stoma redirects air when blocked into the esophagus, producing vibrations of the upper esophageal sphincter and resultant sound production.[13] TEP arguably allows patients to deliver the most fluent and natural-sounding voice compared to other voice prosthetics, improving speech intelligibility and forming longer sentences.[14] This systematic review and meta-analysis aims to analyze the impact of TEP voice restoration on post-TL patient QOL.

2 | METHODS

A systematic review assessing QOL in patients with TEP was conducted on the following databases: PubMed, Ovid Medline, and Web of Science. To be included in the review, studies were required to represent participants who had undergone TL followed by TEP with QOL outcome measures. Only original, peer-reviewed, full-text articles published since 2013 were used. Studies were excluded if they were written in a non-English language, were not peer-reviewed, or did not explicitly analyze QOL in TEP patients. Abstracts, posters, and presentations were excluded, as well.

The article selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology (Figure 1).[15] The initial search yielded 71 studies, which were reduced to 67 after the exclusion of duplicates, abstracts, and non-English articles. Articles were then screened by title, yielding a total of 15. Two researchers (authors R.B. and S.E.O.) independently screened articles by abstract to minimize bias. Disagreements were resolved through collaborative discussion and review of the inclusion criteria. This yielded 11 articles, which were further reduced to the final sample of 6 following full-text screening.

A seventh study was considered as it addressed patient QOL in terms of the University of Washington QOL index (UW-QOL) and functional assessment of cancer therapy head and neck scale.[16] However, it was ultimately excluded due to the reporting of results as the percent of patients who responded to each question of the above indices rather than providing mean scores of the surveys.[16] There was also no comparison to a non-TEP control.[16]

3 | RESULTS

A total of 6 studies were eligible for inclusion in this systematic review (Table 1).[17–22] The studies represented 253 patients with an average age of 62.3 years.

Six different indices were used to quantify and describe life quality, limiting formal meta-analysis. Additionally, Patel et al.[18] did not include standard deviations, so approximate standard deviations were calculated assuming a normal distribution. More than one study described QOL with the UW-QOL and the voice handicap index (VHI).[17,18,21] As seen in Figure 2, UW-QOL demonstrated significant improvement in QOL of post-TL patients with TEP compared to those without TEP (mean difference = 16.77; 95% CI = 9.29–24.26; $p < .0001$). A higher score on the UW-QOL indicates improved QOL.

Although favoring TEP, VHI showed no significant difference in QOL compared to patients without TEP (mean difference = −21.94; 95% CI = −45.51 to 1.64; $p = .07$), as shown in Figure 3. A lower score on the VHI indicates less handicap and, therefore, improved QOL.

Composite VHI appeared to have a greater significance favoring TEP than the three individual subsections which are outlined in Figure 4: functional (mean difference = −5.05; 95% CI = −11.64 to 1.54; $p = .13$), physical (mean difference = −7.66; 95% CI = −17.87 to 2.55; $p = .14$), and emotional (mean difference = −6.35; 95% CI = −13.64 to 0.94; $p = .09$).

Additional scales used to describe patient QOL were the voice-related QOL questionnaire (V-RQOL), short form 36-item health survey (SF-36), World Health Organization QOL scale (WHOQOL), and MD Anderson dysphagia index (MDADI). All referenced studies individually reported improved QOL with TEP following TL as described by the indices above.

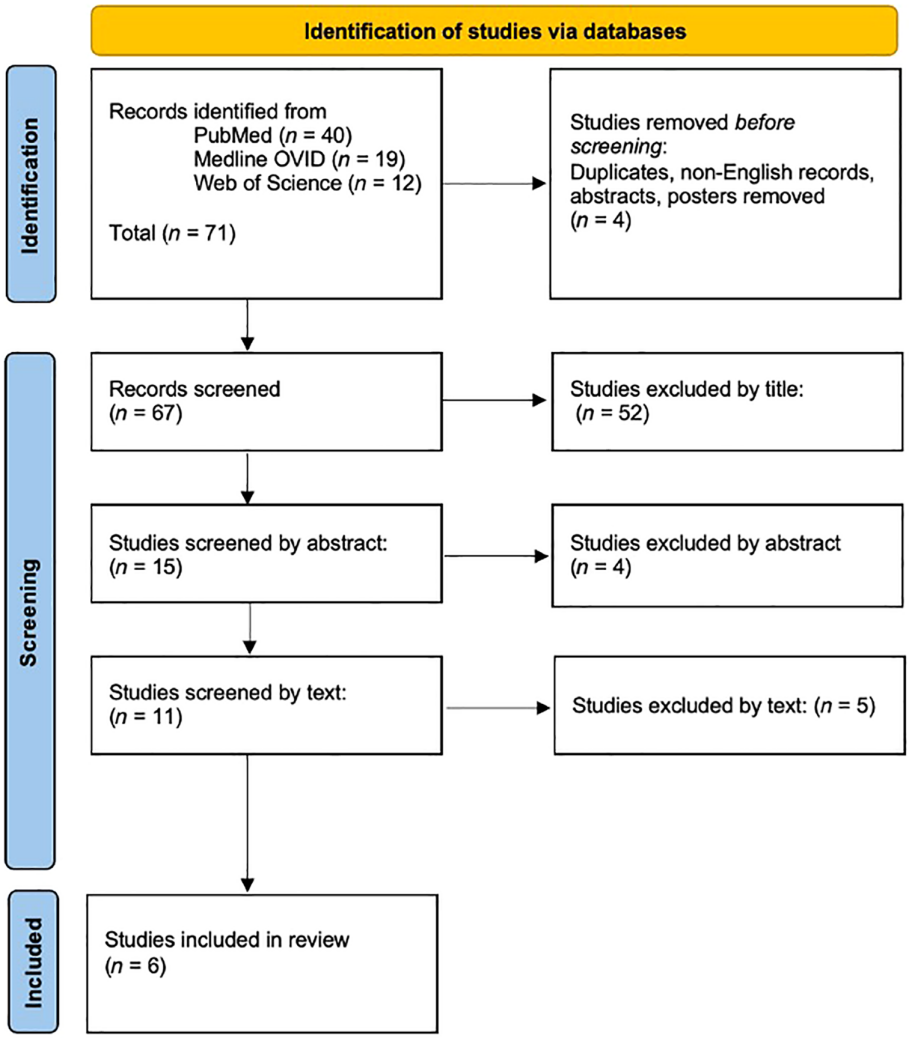

FIGURE 1 PRISMA flow diagram of systematic review.[15]

TABLE 1 Selected studies for analysis.

Author (year)	Study type	Number of patients	Quality of life measure(s) used	Quality of life after TEP
Cocuzza et al. (2020)[19]	Prospective cohort study	39	V-RQOL VHI	Significantly improved compared to no TEP
Massaro et al. (2021)[20]	Prospective cohort study	51	VHI-10 V-RQOL	Significantly improved compared to no TEP
Galli et al. (2019)[21]	Case series	42	SF-36	Significantly improved compared to the baseline
Tsao et al. (2022)[17]	Retrospective cohort study	38	VHI UW-QOL	Significantly improved compared to no TEP
Polat et al. (2015)[22]	Prospective cohort study	34	WHOQOL	Significantly improved compared to the baseline
Patel et al. (2018)[18]	Cross-sectional study	49	VHI MDADI UW-QOL	Significantly improved compared to no TEP

Abbreviations: MDADI, MD Anderson Dysphagia Index; SF-36, short form 36-item health survey; TEP, tracheoesophageal puncture; UW-QOL, University of Washington quality of life index; VHI, voice handicap index; V-RQOL, voice-related quality of life questionnaire; WHOQOL, World Health Organization quality of life scale.

4 | DISCUSSION

This systematic review analyzed six independent studies relating to the impact of TEP on the QOL of TL patients.[17–22] Studies agreed that post-laryngectomy patients with TEP had improved QOL than before prosthesis or non-TEP speech alternatives. Using six different QOL indices made it challenging to consolidate results for meta-analysis. UW-QOL and VHI results could undergo meta-analysis due

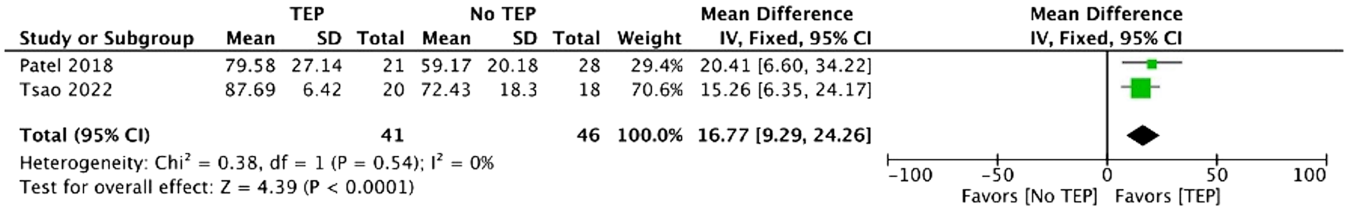

FIGURE 2 Impact of tracheoesophageal puncture on University of Washington quality of life index.

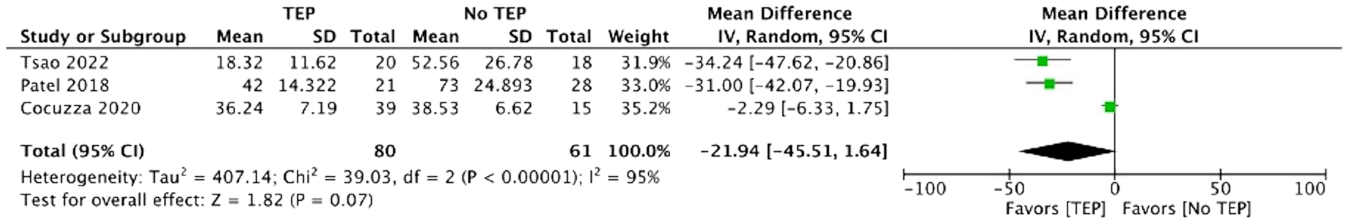

FIGURE 3 Impact of tracheoesophageal puncture on the voice handicap index composite score.

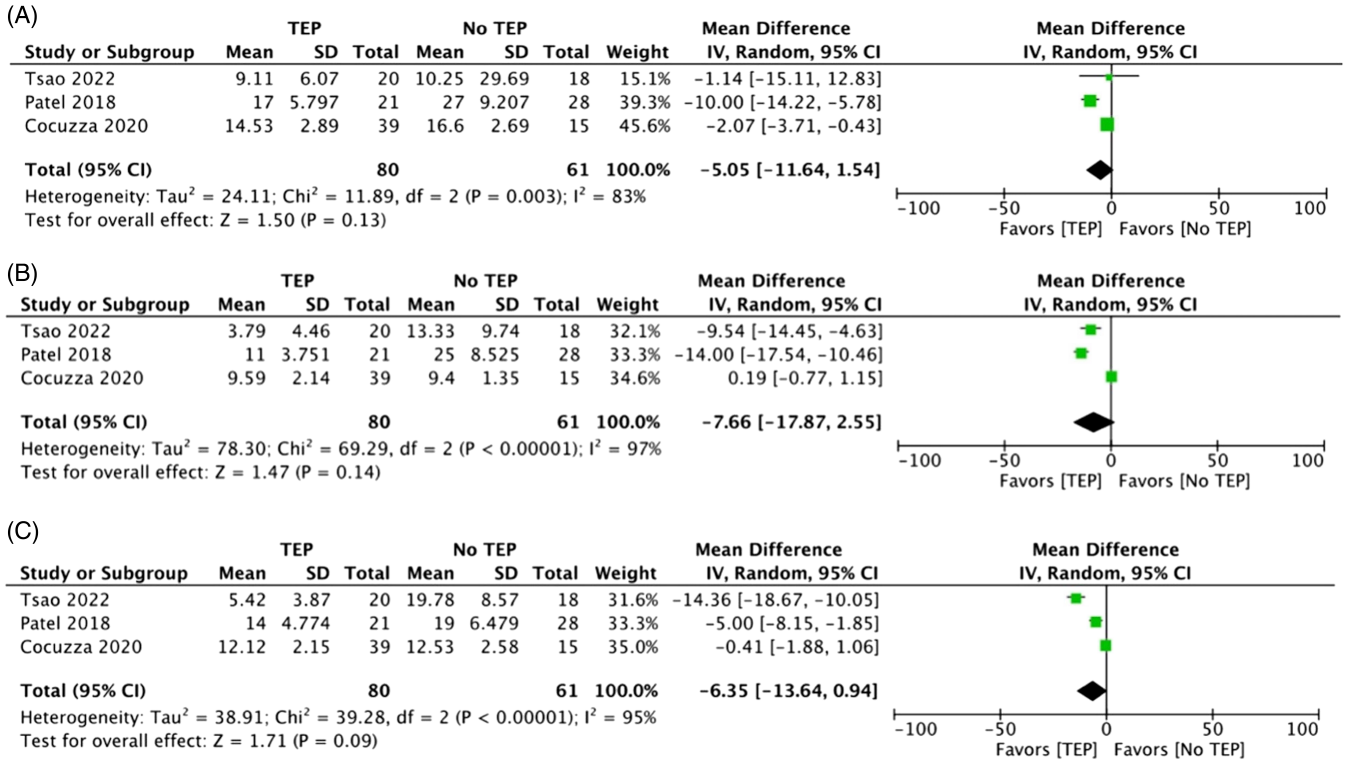

FIGURE 4 Impact of TEP on subsections of voice handicap index including: (A) functional, (B) physical, and (C) emotional.

to their reporting in two or more studies.[17–22] UW-QOL was reported by two studies, with collective results confirming a significantly improved score in TL patients with TEP compared to those without TEP.[17,18] Composite VHI showed improvement following TEP based on collective data between three studies, but this was not significant.[17,18,21] However, the *p*-value was lower for the composite VHI than the individual functional, physical, and emotional VHI components. Additional indices used were V-RQOL, SF-36, WHOQOL, and MDADI, all demonstrating improved QOL in TL patients with TEP.

QOL is a subjective topic on various scales, and different approaches are used to define the representative variables. This study highlights inconsistency when assessing patient QOL as a wide range of indices were used between studies. Determining more specific guidelines for QOL-related indices may help better define the nuances of TEP's impact on QOL measures.

The UW-QOL is a 12-item questionnaire with responses ranging from 0 (worst possible response) to 100 (best possible response). The domains can be categorized into two significant subcategories: physical and social–emotional function.[23,24] This scale assesses factors beyond voice-related symptoms such as pain, appearance, activity, recreation, swallowing/chewing, speech, taste, and mood to create a complete picture of related patient experiences following head and neck cancers.[25] While the V-RQOL and UWQOL both describe QOL by physical functioning and social–emotional domains, V-RQOL is a voice specific tool. This can serve as beneficial particularly for the post-laryngectomee patient population. These tests also differ in the way in which the test is administered. For example, the UW-QOL gives a participant five phrases to choose from per topic, such as pain, each of which are scored.[24] In contrast, the V-RQOL provides a statement and asks a participant to score the frequency of their problem themselves on a scale of 1–5.[26] Thus, the format of the V-RQOL can pose greater concern for survey bias if participants are given a numerical scale, in comparison to the UW-QOL where participants are given statements whose associated score they are unaware of. In this format, 1 indicates "normal health," and a score of 5 represents a severe problem. The total score ranges from 0 to 100, where 0 indicates an inferior quality of life, and 100 indicates an excellent one.[26] The VHI is a 30-item questionnaire with scores ranging from 0, indicating a vocal impairment almost certainly not noticeable, to 120, indicating certainly noticeable impairment. Based on patient responses, the scores are stratified with grade ranges of higher score values representing more significant impairment.[27] This scale describes voice-related QOL via functional, physical, and emotional impairments of voice loss from a patient's subjective viewpoint.[28] Thus, VHI is voice-specific, offering a narrow understanding of an intervention. In contrast, UW-QOL is broader in describing QOL overall, and V-RQOL provides holistic knowledge related to daily activities involving voice. Importantly, both the V-RQOL and VHI tools were validated in patients with a functional larynx. This is important when determining their utility as instruments measuring QOL in the TL population.

Voice handicap is an obstacle for TL patients but has not been demonstrated as predictive of QOL.[29] Previous literature has also called into question the feasibility of VHI use in this population. For example, it has been shown that UW-QOL, the European Organization for Research and Treatment of Cancer Core Quality of Life Questionnaire (EORTC QLQ-C30), and EORTC QLQ Head and Neck (EORTC QLQ-H&N35), were most correlated and fit to use in assessing QOL of TL patients.[30] Considering their similarities in index design, the voice-specific indices of VHI and V-RQOL have also been highly correlated but not interchangeable, promoting further discussion surrounding the validity of voice-specific indices as proxies for QOL.[31] Since QOL describes a subjective experience, its analysis uses patients' scaled responses to questions that reflect aspects of their daily living. With high variability in individual values, it is essential to note that there is no gold standard to compare QOL with scales' utility varying on a case-by-case basis.[32] While VHI is a commonly used index in various clinical conditions that affect voice, such as COVID-19, stroke, or spasmodic dysphonia,[32–34] the findings of this study suggest that overall, TEP can be considered to improve the QOL for TL patients.

Based on the findings of this review, we suggest that healthcare professionals seek to inform patients about the rehabilitative benefits of TEP in improving communication and overall well-being. The UW-QOL emerged as especially useful for identifying the impact of TEP in TL patients. This is due to its comprehensive evaluation of physical, functional, and emotional health, which also showed significantly improved scores in TL patients with TEP. Most importantly, this study promotes adopting a patient-centered approach for those who have undergone TL. Patient input and self-reporting are vital in designing a treatment plan for TL patients, and QOL scales may help define what aspects of life are valued by the patient. By doing so, the clinical sphere can use this information to maximize outcomes of post-laryngectomy patients and be directed by the goal of enhancing their QOL via TEP.

This study is the first formal systematic review and meta-analysis assessing the impact of TEP on patient QOL despite widespread use of the procedure in hospital settings. Evidence-based medicine is an integral part of providing informative patient-centered care, particularly in the field of head and neck surgery. Thus, this review thoroughly demonstrates the quantifiable effects of TEP on QOL total laryngectomy patients. Following PRISMA guidelines, the systematic review study design allowed for a relatively large, multi-institutional patient sample. Performing meta-analysis on two QOL scales allowed for greater strength and confidence in the related conclusions. The limitations of this study include the fact that various incompatible tools were used to quantify QOL. This limited the depth of possible meta-analysis. Additionally, excluding abstracts, presentations, and non-English works may have ruled out potentially relevant studies.

5 | CONCLUSION

Overall, this review confirms that TEP voice restoration following TL can significantly improve patient QOL as described by the UW-QOL index. TEP was not found to significantly enhance patient QOL as described by VHI, a voice-specific tool focusing on vocal impairment. Several other scales were represented in the literature, with individual studies all indicating significant improvements in QOL following TEP. Future research may compare scales and better define their specific roles in monitoring TL patients. Additionally, future research may be performed on the impact of timing and the type of vocal prosthesis on long-term QOL.

AUTHOR CONTRIBUTIONS

Raika Bourmand and Sofia E. Olsson contributed to data collection, manuscript writing, and editing. Arman Fijany contributed to statistical analysis.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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