

Review article

Breaking the Silence: Innovative Approaches to Voice Rehabilitation and Communication for Laryngectomized Patient

Dina Rujević¹, Mirjana Petrović Lazić²

¹General Hospital Novi Pazar, Department of Neurology, Novi Pazar, Serbia

²University of Belgrade, Faculty for Special Education and Rehabilitation, Belgrade, Serbia

SUMMARY

Introduction. Laryngectomy is a surgical procedure for the removal of the larynx, either entirely (total laryngectomy) or partially (partial laryngectomy). Rehabilitation of laryngectomy patients is a complex process that involves physical, psychological, and social aspects. To improve the quality of life of laryngectomy patients, rehabilitation consists of several phases that include learning alternative ways of speaking, breathing and swallowing exercises, and psychological support. It is important to emphasize that rehabilitation is a long-term process that requires continuous support for patients to achieve the best results. With the right approach and professional help, rehabilitation can significantly improve the quality of life of laryngectomy patients. This paper aims to review relevant literature in order to present the possibilities of verbal communication in patients after laryngectomy.

Methods. The methods used in this study include searching websites such as www.pubs.asha.org, www.cjcrn.org, www.scielo.org, www.journals.ekb.eg, www.biomedcentral.com, and www.dovepress.com for the papers published in Serbian and English from 2018 to 2022.

Overview. This paper provides an overview of speech rehabilitation in laryngectomy patients, various methods of treating larynx cancer, and a review of current literature in the field of laryngectomy.

Conclusion. After total laryngectomy, patients need to undergo intensive speech rehabilitation to regain the ability of verbal communication. This process requires a multidisciplinary approach, including various specialists such as speech therapists, phoniatrists, oncologists, surgeons, and psychologists.

Keywords: larynx cancer, laryngectomy, communication, vocal rehabilitation

Corresponding author:

Dina Rujević

e-mail: dinarujevic@gmail.com

INTRODUCTION

Communication is the process of transferring a message from one person to another. It encompasses both non-verbal and verbal forms of expression. Speech, as a form of communication, holds great significance as it allows us to convey our needs, desires, emotions, thoughts, and perspectives about the world. Effective communication skills are essential for a good quality of life, irrespective of age. Communication is an inherent activity that we engage in constantly, often unconsciously, as we convey information in a comprehensible manner.

The larynx, also known as the voice box, is a tubular organ located in the neck and is part of the respiratory system. In addition to its role in respiration, the larynx plays a vital and irreplaceable role in voice production. When we breathe, the vocal cords are separated, allowing air to freely pass into the trachea and lungs. However, during speech or singing, the vocal cords come together in the middle of the larynx, vibrate, and produce sound, thus creating our voice. Laryngeal carcinoma, also known as laryngeal cancer, is a malignant tumor that develops in the tissues of the larynx.

PREDISPOSING FACTORS FOR THE OCCURRENCE OF LARYNX TUMORS

Risk factors for laryngeal cancer include: smoking, alcohol abuse, poor nutrition, gastroesophageal reflux, human papillomavirus (HPV), weakened immune system, occupational exposure, gender, age.

Research conducted globally consistently demonstrates a strong correlation between smoking and alcohol consumption and the increased risk of developing epithelial laryngeal cancer (1).

METHODS IN THE TREATMENT OF LARYNX CANCER

Treatment methods for larynx cancer

The choice of therapy depends on the histological type of the malignant tumor, the degree of histological malignancy, regional and distant spread of the tumor, general condition of the patient, and pa-

tient's motivation to accept the proposed type of treatment (2).

Conservative surgery involves removing the tumor while preserving the basic integrity of the larynx (3). This includes cordectomy, the removal of one vocal cord without compromising the integrity of the larynx (4).

Radical surgery involves total laryngectomy. Total laryngectomy is an extensive and radical procedure in which the larynx, prelaryngeal muscles, and hyoid bone are completely removed. It can also be an extended laryngectomy, in which the base of the tongue, pharynx, trachea, thyroid gland, and prelaryngeal soft tissue including the skin are removed (5).

Palliative surgeries are surgical methods that alleviate and prolong the life of patients with larynx cancer where cure cannot be achieved with familiar treatment methods (6). This includes reducing tumor mass to relieve pain, removing recurrence around the tracheostoma or in the trachea, tracheotomy, and gastrostomy (7).

Reconstructive surgeries are intended to alleviate the handicap associated with total laryngectomy. They involve removing diseased parts of the larynx, reconstructing it from the remaining healthy parts, and forming a so-called neolarynx while preserving basic functions such as breathing and speaking (8).

Total laryngectomy is a radical procedure that results in permanent loss of the voice box, which serves as the generator and part of the resonator of the voice, and where the basic laryngeal tone is created (9).

Radiation therapy

Radiation therapy uses high-energy rays or particles to destroy cancer cells. Malignant cells, which divide and grow rapidly, are particularly vulnerable to radiation. External beam radiation therapy, commonly used for laryngeal cancer treatment, involves directing radiation from outside the body towards the cancer. This treatment is typically administered in daily fractions over a seven-week period, with two days off each week. Hyperfractionated radiation therapy divides the total radiation dose into smaller fractions.

Possibilities of verbal communication in laryngectomized patients

Methods of speech rehabilitation

Cancer patient treatment is complex, involving diagnosis, therapy, and rehabilitation. Laryngectomized patients require comprehensive rehabilitation, including medical, phoniatric, and psychosocial support. They have options for speech rehabilitation: esophageal speech, electrolarynx, and tracheoesophageal speech.

Esophageal voice and speech

Esophageal voice and speech is one of the best and most natural ways of establishing speech function. Rehabilitation requires a longer period of time and is carried out under the supervision of a speech therapist-vocal therapist. Esophageal speech requires the entry (swallowing) of air into the area of the upper esophagus, which, by its controlled exit, passes through the muscles of the pharyngo-esophageal segment and causes vibrations that create speech. This method of alaryngeal speech communication is considered to require the most time to master. Its disadvantages include a longer period of time required for learning, sporadic speech, reduced speed, height, and intensity of speech, frequent changes in height and intensity (increased jitter and shimmer) (10). There are several methods that allow the creation of an air reservoir in the esophagus:

The swallow breathing method is the oldest and is recommended for patients who cannot apply other techniques. With this method, the patient swallows air, which relaxes the cricopharyngeal muscle and enters the upper part of the esophagus. The air must be immediately expelled out to cause the vibration of the pharyngo-esophageal segment. It is important to distinguish between uncontrolled air escaping from the stomach (belching) and air going out from the upper part of the esophagus needed for phonation (11).

The injection method involves injecting air from the oral cavity and throat into the esophagus using the lips, cheeks, and tongue. It is necessary to first create glottal pressure, where air is "pushed" behind the tongue towards the oral cavity. Then, by moving the tongue towards the pharyngeal wall, air is pushed lower towards the upper part of the esophagus, creating consonants. This method redu-

ces speech intelligibility, as a small amount of air is inserted into the esophagus, creating intense tracheal and pharyngeal noise (8).

The aspiration method allows for the most effective esophageal speech. This method involves the ability to swallow air into the upper part of the esophagus, i.e. during inspiration; negative pressure in the thoracic cavity acts on the walls of the esophagus, allowing air to be inserted into its cavities. The air stored in the esophagus is expelled through the pseudoglottis and is voiced. This created voice is formed in the pharynx and oral cavity.

With the suction method, air is pushed into the esophagus with movements of the base of the tongue or by pressing the tip of the tongue against the alveolar extension. With this method, air is retained in the upper part of the esophagus, easily released, and the filling of the air reservoir in the esophagus is done quickly. The effectiveness of esophageal speech can be influenced by local and general factors.

Local factors are: pseudoglottis form, pharynx width, presence or absence of the hyoid bone, scars in the area of the esophageal inlet, radiation consequences, tumor recurrences.

General factors are: patient's mental state, intelligence, age, general diseases, patient's occupation, motivation to contact with the environment, therapist's ability to conduct rehabilitation (12).

Laryngeal prostheses

When a patient is unable to master the technique of esophageal speech, they need to be trained to use laryngeal prostheses. Artificial larynges are divided into two groups according to:

1. the way the source of vibration is filled:
 - pneumatic,
 - electronic prostheses.
2. the location where it is placed to produce sound in the oral cavity:
 - tube-type in the mouth,
 - dental.

Pneumatic prostheses

To produce voice, they use air from the lungs, which enters the prosthesis through an air cover that can be implanted in the patient's stoma. To speak, the patient needs to place the mouthpiece into their mouth and speak (13).

Electronic prostheses

Electronic prostheses are battery-powered artificial larynges. The quality of voice they produce depends on the acoustic characteristics of each airway prosthesis, as well as the degree to which the patient's tissue has been surgically modified.

Transcervical artificial larynx is essentially an electronic vibrator placed on the outside of the neck, and its vibrations activate the air in the pharyngeal and oral cavities. Articulatory movements develop the corresponding sounds. This type of larynx is most commonly used in our environment, and the patient works with the healthcare provider to find an adequate location on the neck to place the device (14).

The transoral artificial larynx functions by transferring vibrations from the vibrator through a single tube to the oral cavity. It is primarily utilized by patients who have undergone radiation therapy and are unable to use a transcervical device due to changes in the neck.

The intraoral artificial larynx, on the other hand, is a laryngeal device consisting of a small plastic tube connected to a handheld transmitter. This device allows for electronic tone production in the oral cavity. Patients using this type of prosthesis need to be cautious not to obstruct the end of the tube with their tongue or cheek. This type of prosthesis is lightweight, easy to use, and can be employed immediately after surgery (15).

Dental type is a type of artificial electrolarynx where both the generator and sound source are integrated into a specially designed acrylic dental appliance. This type eliminates tube blockage, which is common in the tube-in-mouth type of artificial larynx (16).

Proper breathing is essential for utilizing an external speech prosthesis called an electrolarynx. If breathing is not coordinated and calm, it becomes impossible to produce a sound signal. The advantage of this method of speech rehabilitation is that it can be used immediately after surgery, has a faster and more efficient implementation compared to esophageal speech rehabilitation, requires a relatively short learning period, and is easy to learn. Electronic laryngeal prostheses are available in appropriate sizes, they are reliable, affordable for patients, easy to handle, and allow for adjusting specific speech characteristics according to the speaker's needs, such as pitch, volume, and intonation (17).

However, electromechanical speech cannot achieve the intensity of esophageal speech, produces a tiring sound, making it unnatural and conspicuous for the environment (18).

Tracheoesophageal shunt

Tracheoesophageal shunt represents a surgical method for establishing speech after laryngectomy. It consists of creating a small opening between the esophagus and trachea during the operation only. The patient closes the stoma with a finger when exhaling, and the air from the trachea passes through the opening to the esophagus, causing vibrations of the pseudo-glottis, which produces a tone that the mouth shapes (10).

Multiple surgical techniques create the shunt, categorized by the opening's location:

1. High tracheo-pharyngeal shunt;
2. Low tracheo-pharyngeal shunt;
3. Tracheo-esophageal shunt.

There are several types of tracheoesophageal prostheses, which are very popular worldwide and widely used in the rehabilitation of laryngectomized patients' voice (18).

CHALLENGES IN VOICE REHABILITATION AFTER LARYNGECTOMY

Some of the issues in the practical voice rehabilitation following laryngectomy include:

Fungal infections and biofilm formation on speech prostheses: Patients who use speech prostheses may experience fungal infections, such as candidiasis, in the area around the prosthesis. Additionally, biofilm formation on the prosthesis can lead to complications and reduce its effectiveness in facilitating speech.

Botulinum toxin injections: In certain cases, botulinum toxin injections may be used to manage spasms or excessive muscle contractions in the laryngeal area. However, the appropriate dosage and administration of botulinum toxin require careful consideration to avoid potential adverse effects and ensure optimal vocal function (19).

Swallowing and swallowing-related issues: Laryngectomy can significantly impact swallowing function, leading to difficulties in eating and swallowing safely. Dysphagia (difficulty swallowing) and aspiration (food or liquid entering the airway)

are common challenges that may require specialized rehabilitation techniques and modifications in diet and swallowing techniques (20).

Voice prosthesis maintenance: Patients with a voice prosthesis need to maintain regular care and cleaning of the prosthesis to prevent complications such as leakage, blockage, or infection. Proper hygiene practices and regular follow-ups with health-care professionals are essential for the effective use of voice prostheses.

Loss of natural voice: Laryngectomy results in the permanent loss of the natural voice. While alternative methods of communication such as electrolaryngeal speech or electronic speech devices can be used, adapting to a new mode of communication can be challenging for patients.

Physical changes and limitations: Removal of the larynx can lead to physical changes in the neck area and breathing. Patients may face challenges such as difficulty breathing, coughing issues, or airway circulation problems. These changes can affect physical endurance and daily activities.

Acoustic characteristics of alternative speech methods: Alternative speech methods after laryngectomy, such as electrolaryngeal speech or electronic speech devices, have specific acoustic characteristics that may differ from natural voice. Adjusting to a new mode of expression and understanding speech expression can be challenging for patients and conversational partners (21).

REVIEW THROUGH CONTEMPORARY LITERATURE

Recent research highlights the significance of continuous epidemiological monitoring in the diagnostic process. This monitoring relies on reliable data sources and serves as a foundation for implementing preventive measures and early diagnostic interventions for patients at higher risk of developing laryngeal cancer (22).

Immediate speech rehabilitation is vital after

total laryngectomy as it greatly affects the patient's quality of life. Studies show that patients often rely on alternative forms of communication, such as gestures and writing, especially if they cannot regain verbal communication (23).

Voice loss is a significant concern for patients after total laryngectomy, influencing their communication abilities. Esophageal speech is the standard, but many patients cannot achieve it. As an alternative, vocal prostheses like Provox® are commonly used. Studies confirm the safety and effectiveness of Provox® in postoperative laryngectomy patients (23).

Total laryngectomy significantly affects a person's quality of life due to the loss of voice, an essential communication tool. Comparisons between patients using esophageal speech and tracheoesophageal speech demonstrate that the latter group experiences a better quality of life. This difference is particularly evident in assessing communication-related quality of life (24).

After total laryngectomy, patients face difficulties in making phone calls, which is a major challenge for them (25). Noisy environments and crowded places increase anxiety levels, causing some patients to withdraw and avoid communication by staying at home for a period of time (26).

CONCLUSION

For laryngectomy patients establishing verbal communication, returning to family, profession, and social environment requires planned and organized work of teams of different professionals, in which not everyone is currently involved enough. Rehabilitation is more effective and successful if it is conducted in the hospital where the patient was operated on. High-quality esophageal speech is the most humane form of communication for laryngectomized patients. In addition to providing complete comfort and safety, it is much more cost-effective than other methods of establishing vocal communication after laryngectomy.

References

1. Aupérin A. Epidemiology of head and neck cancers: an update. *Curr Opin Oncol* 2020; 32(3):178-86.
<https://doi.org/10.1097/CCO.0000000000000629>
2. Obid R, Redlich M, Tomeh C. The Treatment of Laryngeal Cancer. *Oral Maxillofac Surg Clin North Am* 2019; 31(1):1-11.
<https://doi.org/10.1016/j.coms.2018.09.001>
3. Koroulakis A, Agarwal M. Laryngeal Cancer. 2022. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023.
4. Bodd MH, McCammon SD. Laryngeal Cancer and the End of Life (As We Know It). *Otolaryngol Clin North Am* 2023;56(2):403-12.
<https://doi.org/10.1016/j.otc.2022.11.005>
5. Okafor S, Awaonusi OO, Watts TL, Cannon TY. Salvage Surgery. *Otolaryngol Clin North Am* 2023; 56(2):323-31.
<https://doi.org/10.1016/j.otc.2022.12.002>
6. Kahmke R, Sajisevi M. Larynx Cancer: Reconstructive Options. *Otolaryngol Clin North Am* 2023; 56(2):333-43.
<https://doi.org/10.1016/j.otc.2022.11.002>
7. Weber F, Schuss U, Sittel C. Möglichkeiten und Grenzen der Palliativchirurgie im Kopf-Hals-Bereich [Possibilities and limitations of palliative surgery in head and neck cancer patients]. *HNO* 2020; 68(7):498-502.
<https://doi.org/10.1007/s00106-020-00817-0>
8. Gates GA, Ryan W, Cooper JC Jr, et al. Current status of laryngectomy rehabilitation: I. Results of therapy. *Am J Otolaryngol* 1982; 3(1):1-7.
[https://doi.org/10.1016/S0196-0709\(82\)80025-2](https://doi.org/10.1016/S0196-0709(82)80025-2)
9. Hoffmann TK. Total Laryngectomy-Still Cutting-Edge? *Cancers (Basel)* 2021; 13(6):1405.
<https://doi.org/10.3390/cancers13061405>
10. Cocuzza S, Maniaci A, Grillo C, et al. Voice-Related Quality of Life in Post-Laryngectomy Rehabilitation: Tracheoesophageal Fistula's Wellness. *Int J Environ Res Public Health* 2020; 17(12):4605.
<https://doi.org/10.3390/ijerph17124605>
11. Ueha R, Magdayao RB, Koyama M, et al. Aspiration prevention surgeries: a review. *Respir Res* 2023; 24(1):43.
<https://doi.org/10.1186/s12931-023-02354-0>
12. Iype EM, Janardhanan D, Patil S, et al. Voice Rehabilitation After Laryngectomy: A Regional Cancer Centre Experience and Review of Literature. *Indian J Otolaryngol Head Neck Surg* 2020; 72(4):518-23.
<https://doi.org/10.1007/s12070-019-01707-w>
13. Galli A, Giordano L, Biafora M, et al. Voice prosthesis rehabilitation after total laryngectomy: are satisfaction and quality of life maintained over time? *Acta Otorhinolaryngol Ital.* 2019; 39(3):162-8.
<https://doi.org/10.14639/0392-100X-2227>
14. Quadri MFA, Alamir AWH, John T, et al. Effect of prosthetic rehabilitation on oral health-related quality of life of patients with head and neck cancer: a systematic review. *Transl Cancer Res* 2020; 9(4):3107-18.
<https://doi.org/10.21037/tcr.2019.12.48>
15. Mella MH, Chabrilac E, Dupret-Bories A, et al. Transoral Robotic Surgery for Head and Neck Cancer: Advances and Residual Knowledge Gaps. *J Clin Med* 2023; 12(6):2303.
<https://doi.org/10.3390/jcm12062303>
16. Sharpe G, Camoes Costa V, Doubé W, et al. Communication changes with laryngectomy and impact on quality of life: a review. *Qual Life Res* 2019; 28(4):863-77.
<https://doi.org/10.1007/s11136-018-2033-y>

17. Tang JA, McCarroll L, Schmalbach CE. Voice Restoration and Quality of Life in Larynx Cancer. *Otolaryngol Clin North Am* 2023; 56(2):361-70.
<https://doi.org/10.1016/j.otc.2022.11.003>
18. Massaro N, Verro B, Greco G, et al. Quality of Life with Voice Prosthesis after Total Laryngectomy. *Iran J Otorhinolaryngol* 2021; 33(118):301-9.
<https://doi.org/10.22038/ijorl.2021.53724.2832>
19. Brook I, Goodman JF. Tracheoesophageal Voice Prosthesis Use and Maintenance in Laryngectomees. *Int Arch Otorhinolaryngol* 2020; 24(4):e535-e538.
<https://doi.org/10.1055/s-0039-3402497>
20. Harris BN, Hoshal SG, Evangelista L, Kuhn M. Reconstruction technique following total laryngectomy affects swallowing outcomes. *Laryngoscope Investig Otolaryngol* 2020; 5(4):703-7.
<https://doi.org/10.1002/lio2.430>
21. Azizli E, Alkan Z, Koçak I, Yiğit Ö. Voice Onset Time in Patients Using Speech Prosthesis After Total Laryngectomy. *J Voice* 2022; 36(6):879.e1-879.e4.
<https://doi.org/10.1016/j.jvoice.2020.09.018>
22. Nocini R, Molteni G, Mattiuzzi C, Lippi G. Updates on larynx cancer epidemiology. *Chin J Cancer Res* 2020; 32(1):18-25.
<https://doi.org/10.21147/j.issn.1000-9604.2020.01.03>
23. Abdel-Haleem A, Hasan E, Roushdy M, Abdel-Wahab M. Evaluation of Post Total Laryngectomy Voice Rehabilitation by Provox®2 Voice Prosthesis (preliminary study). *EJNSO* 2019; 5(2):9-21.
<https://doi.org/10.21608/ejnso.2019.57904>
24. Tsao CK, Marchi F, Kang CJ, et al. Comprehensive Evaluation of Vocal Outcomes and Quality of Life after Total Laryngectomy and Voice Restoration with J-Flap and Tracheoesophageal Puncture. *Cancers (Basel)* 2022; 14(3):544.
<https://doi.org/10.3390/cancers14030544>
25. Wang XT, Shan CG. [The progress of voice restoration after total laryngectomy]. *Lin Chuang Er Bi Yan Hou Tou Jing Wai Ke Za Zhi* 2019; 33(7):677-81.
<https://doi.org/10.13201/j.issn.1001-1781.2019.07.026>
26. Kotake K, Kai I, Iwanaga K, et al. Effects of occupational status on social adjustment after laryngectomy in patients with laryngeal and hypopharyngeal cancer. *Eur Arch Otorhinolaryngol* 2019; 276(5):1439-46.
<https://doi.org/10.1007/s00405-019-05378-9>

Article info

Received: April 14, 2023

Revised: June 26, 2023

Accepted: August 26, 2023

Online first: February 2, 2024

Prekidanje tišine: inovativni pristupi rehabilitaciji glasa i komunikacije kod bolesnika podvrgnutih laringektomiji

Dina Rujević¹, Mirjana Petrović-Lazić²

¹Opšta bolnica Novi Pazar, Odeljenje za neurologiju, Novi Pazar, Srbija

²Univerzitet u Beogradu, Fakultet za specijalnu edukaciju i rehabilitaciju, Beograd, Srbija

SAŽETAK

Uvod. Laringektomija je hirurški postupak odstranjivanja grkljana, bilo u celini (totalna laringektomija), bilo delimično (parcijalna laringektomija). Rehabilitacija bolesnika podvrgnutih laringektomiji predstavlja složen proces koji uključuje fizičke, psihološke i socijalne aspekte. Radi poboljšanja kvaliteta života ovih bolesnika sprovodi se rehabilitacija; ona se sastoji iz nekoliko faza, koje obuhvataju učenje alternativnih načina govora, vežbe disanja i gutanja i psihološku podršku. Važno je naglasiti da je rehabilitacija dugotrajan proces koji zahteva kontinuiranu podršku bolesnicima, sa ciljem postizanja što boljih rezultata. Uz pravi pristup i stručnu pomoć, rehabilitacija može značajno poboljšati kvalitet života bolesnika podvrgnutih laringektomiji.

Cilj. Cilj ovog rada bio je da se sačini pregled relevantne literature kako bi se prikazale mogućnosti verbalne komunikacije kod bolesnika kojima je izvršena laringektomija.

Metode. Relevantna literatura prikupljena je pretraživanjem sledećih internet stranica: www.pubs.asha.org, www.cjcrn.org, www.scielo.org, www.journals.ekb.eg, www.biomedcentral.com, www.dovepress.com. U obzir su uzeti radovi objavljeni na srpskom i engleskom jeziku u periodu od 2018. do 2022. godine.

Pregled. Ovaj rad pruža pregled istraživanja o govornoj rehabilitaciji bolesnika nakon sprovedene laringektomije i raznim metodama lečenja karcinoma larinksa, kao i pregled savremene literature o laringektomiji.

Zaključak. Nakon obavljene totalne laringektomije, trebalo bi sprovesti intenzivnu rehabilitaciju govora kako bi se ovim bolesnicima vratila sposobnost verbalne komunikacije. Ovaj proces zahteva multidisciplinarni pristup koji uključuje različite specijaliste: logopede, fonijatre, onkologe, hirurge i psihologe.

Ključne reči: karcinom grkljana, laringektomija, komunikacija, vokalna rehabilitacija