

Systematic Review of Voice and Speech Outcomes Following Non- Surgical Cancer Treatments

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ABSTRACT

Voice and speech impairments are prevalent among patients undergoing non-surgical treatments for head and neck cancers, including radiotherapy, chemotherapy and chemoradiotherapy. These deficits negatively affect communication, social participation and quality of life. Existing reviews are often outdated, limited in scope or lack quantitative synthesis (Jacobi & van der Molen, 2010; Heijnen et al., 2016; Sahoo et al., 2024). This systematic review synthesizes recent evidence on the prevalence, severity and recovery trajectories of voice and speech impairments following non-surgical cancer treatments and evaluates the effectiveness of rehabilitation interventions. Twenty eligible studies ($n = 1,245$ patients) were analyzed. Data were extracted from patient-reported outcomes, acoustic analyses, and instrumental assessments. Findings were synthesized narratively and quantitatively. During treatment, 65–80% of patients experienced clinically significant impairments. Partial recovery occurred in 40–55% within 1–2 months, while full restoration was achieved by only 20–30% at six months. Acoustic abnormalities persisted in 50–70%, though 30–40% improved after structured rehabilitation. Speech intelligibility was affected in 40–60% of cases, with recovery in about 35% at six months. Rehabilitation interventions improved outcomes by 15–35%. Poorer recovery correlated with higher radiation dose (>66 Gy), advanced tumor stage, older age, and smoking. Non-surgical cancer treatments lead to substantial and often persistent communication impairments. Standardized assessment, individualized therapy, and long-term monitoring are essential to optimize recovery and quality of life.

Keywords: voice, speech, head and neck cancer, chemoradiotherapy, radiotherapy, voice rehabilitation

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I. INTRODUCTION

Head and neck cancers (HNCs) constitute a significant proportion of global cancer incidence, affecting critical structures responsible for phonation and articulation. Non-surgical treatments such as radiotherapy, chemotherapy and their combination (chemoradiotherapy) are frequently employed to preserve anatomical integrity and avoid surgical morbidity. However, these modalities often cause damage to mucosal, muscular and neural tissues, leading to dysphonia, dysarthria and related speech and voice deficits.

Voice and speech changes can severely affect communication efficacy, emotional well-being and social participation. Despite their clinical importance, systematic evidence on post-treatment communication outcomes remains fragmented. Earlier reviews (e.g., Jacobi & van der Molen, 2010; Heijnen et al., 2016) have highlighted the need for standardized assessment and longitudinal follow-up, but most data remain outdated or limited to specific tumor sites. Moreover, recent therapeutic advancements warrant a renewed synthesis of the evidence base.

This review systematically examines recent research (2010–2024) on voice and speech outcomes following non-surgical cancer treatment, quantifying prevalence, severity, recovery patterns, and the impact of rehabilitation.

II. METHODS

2.1 Search Strategy

A systematic search was conducted across PubMed, Scopus, Web of Science and CINAHL for studies published between January 2010 and March 2024. Keywords and MeSH terms included: voice, speech, head and neck cancer, radiotherapy, chemoradiotherapy, chemotherapy, rehabilitation and acoustic analysis. Reference lists of included studies and relevant reviews were also manually screened.

2.2 Inclusion and Exclusion Criteria

Inclusion criteria:

- Adult participants (≥ 18 years) diagnosed with head and neck cancer.
- Received non-surgical treatment (radiotherapy, chemotherapy or chemoradiotherapy).
- Reported quantitative or qualitative voice and/or speech outcomes.
- Peer-reviewed articles in English.

Exclusion criteria:

- Surgical interventions (e.g., laryngectomy).
- Case reports, conference abstracts or reviews without original data.
- Studies focusing solely on swallowing or non-communicative outcomes.

2.3 Data Extraction

Reviewers independently extracted data on sample characteristics, cancer site, treatment type, outcome measures and follow-up duration. Voice measures included acoustic parameters (F0, jitter, shimmer, HNR) and perceptual ratings (GRBAS). Speech outcomes were assessed through intelligibility scores and patient-reported instruments (VHI, EORTC-H&N35, CAPE-V).

2.4 Quality Assessment

The methodological quality of included studies was assessed using the Newcastle–Ottawa Scale for observational studies and the PEDro scale for interventional designs. Discrepancies were resolved through consensus.

2.5 Data Synthesis

Due to heterogeneity in outcome measures and follow-up periods, a narrative synthesis was conducted, supplemented with descriptive statistics on prevalence, mean score changes and effect sizes of rehabilitation interventions.

III. RESULTS

3.1 Study Characteristics

Twenty studies met inclusion criteria, encompassing 1,245 participants (mean age: 57 years; 68% male). Treatment modalities included radiotherapy alone (40%), chemoradiotherapy (45%) and chemotherapy alone (15%). Follow-up durations ranged from immediate post-treatment to 12 months.

3.2 Prevalence and Severity of Impairments

During active treatment, 65–80% of patients exhibited clinically significant voice and speech impairments. Common symptoms included hoarseness, breathiness, reduced loudness and articulatory imprecision.

3.3 Recovery Patterns

Partial recovery of voice and speech was observed in 40–55% of patients within 1–2 months post-treatment. However, only 20–30% achieved full functional recovery by six months. Persistent abnormalities were noted particularly in cases with high-dose (>66 Gy) radiation or laryngeal tumor involvement.

3.4 Acoustic and Perceptual Outcomes

Acoustic measures revealed increased jitter and shimmer values, and decreased harmonic-to-noise ratios (HNR) in 50–70% of patients. Approximately 30–40% demonstrated improvement after structured rehabilitation programs.

3.5 Speech Intelligibility

Speech intelligibility deficits were reported in 40–60% of patients. Recovery within six months was achieved in approximately 35%, though residual articulatory imprecision and resonance changes persisted.

3.6 Rehabilitation Efficacy

Structured voice therapy and speech exercises - especially those targeting resonance, breath support and articulatory precision - improved voice and speech outcomes by 15–35% compared to non-intervention groups. Early initiation (within one month post-treatment) yielded superior recovery.

3.7 Predictors of Poorer Outcomes

Factors associated with delayed or incomplete recovery included:

- High radiation dose (>66 Gy)
- Advanced tumor stage (T3–T4)
- Age >60 years
- Continued tobacco use
- Lack of adherence to rehabilitation

IV. DISCUSSION

The findings demonstrate that non-surgical cancer treatments, while organ-preserving, frequently result in substantial and persistent communication impairments. Radiation-induced fibrosis, mucosal dryness and neuromuscular dysfunction contribute to phonatory instability and reduced articulatory control. These outcomes corroborate previous literature emphasizing the long-term functional cost of radiotherapy and chemoradiotherapy.

Rehabilitation interventions - particularly those led by Speech Language Pathologists - show measurable benefit. Multimodal approaches incorporating vocal hygiene, resonant voice therapy and respiratory control exercises appear most effective. However, the variability in intervention design and reporting limits meta - analytic quantification.

Longitudinal data suggest gradual improvement over months, yet complete normalization remains uncommon. These findings underscore the need for early, preventive and continuous voice care integrated into oncology protocols.

V. CLINICAL IMPLICATIONS

- Early assessment: Voice and speech evaluations should be performed pre-treatment and monitored regularly throughout therapy.
- Individualized therapy: Programs tailored to tumor site, radiation dose and patient - specific deficits yield better outcomes.
- Interdisciplinary collaboration: Close coordination between Oncologists, Radiologists and Speech Language Pathologists enhances functional outcomes.
- Patient education: Counseling on vocal hygiene, hydration and smoking cessation is vital for long - term recovery.
- Standardization: Unified assessment metrics (e.g., VHI, CAPE-V, acoustic analysis) should be adopted across studies to facilitate comparison.

VI. LIMITATIONS

This review is limited by heterogeneity in methodologies, small sample sizes in some studies and variable follow-up durations. Publication bias and lack of randomized controlled trials further constrain generalizability. Future research should employ standardized protocols, larger samples and long term follow-up to establish evidence-based rehabilitation guidelines.

VII. CONCLUSION

Non-surgical cancer treatments for head and neck malignancies frequently result in significant, persistent voice and speech impairments that compromise quality of life. Early and structured rehabilitation can substantially improve outcomes, though complete recovery remains limited in many cases. A coordinated, multidisciplinary approach involving Oncologists and Speech Language Pathologists is essential for optimizing communication function and psychosocial well-being.

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