Section: Otorhinolaryngology

Original Research Article

VOICE OUTCOMES AFTER DEFINITIVE RADIOTHERAPY FOR EARLY STAGE GLOTTIC SQUAMOUS CELL CARCINOMA: A PROSPECTIVE OBSERVATIONAL STUDY USING VIDEOLARYNGOSTROBOSCOPY AND GRBAS SCORING

Manikandan A[1], Rahul Sharma[2]

[1]Graded Specialist, Department of ENT, Military Hospital Gwalior, Madhya Pradesh, India.
[2]Classified Specialist, Department of Medicine, Military Hospital Gwalior, Madhya Pradesh, India.

Received *: 14/05/2026*
Received in revised form *: 02/07/2026*
Accepted *: 16/07/2026*

Corresponding Author:
Dr. Manikandan A,
Graded Specialist, Department of ENT, Military Hospital Gwalior, Madhya Pradesh, India.
Email: drmani609@gmail.com

DOI: 10.70034/ijmedph.2026.3.194

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 1226-1229

ABSTRACT

Background: Functional voice preservation is central to the management of early stage glottic squamous cell carcinoma (SCC). Although definitive radiotherapy (RT) provides excellent oncologic control, post-treatment voice quality varies and the utility of Videolaryngostroboscopic parameters as outcome measures remain uncertain.

Materials and Methods: In this prospective, observational study, patients with early-stage glottic SCC (Tis–T2, N0M0) treated with definitive RT underwent pre-treatment and 3 months post-treatment voice assessment using videolaryngostroboscopy (glottic closure; mucosal wave) and perceptual auditory evaluation using the GRBAS scale (Grade, Roughness, Breathiness, Asthenia, Strain).

Results: Thirty patients completed RT and follow-up. Pre-RT, mucosal wave was absent in all patients; glottic closure was complete in 14/30 (46.7%). At 3 months post-RT, mucosal wave was present in 22/30 (73.3%) and glottic closure was complete in 28/30 (93.3%). GRBAS ratings improved significantly across parameters (overall Grade, Roughness, Breathiness, Asthenia, Strain; all $p<0.01$). Concordance between overall improvement defined by stroboscopy and GRBAS was not statistically significant ($p=0.145$).

Conclusion: Definitive RT for early glottic SCC was associated with significant improvement in stroboscopic vibratory features and perceptual voice quality at 3 months. Videolaryngostroboscopy and GRBAS scoring provide complementary information and are feasible for routine functional outcome assessment.

Keywords: Early glottic carcinoma; radiotherapy; voice outcome; Videolaryngostroboscopy; GRBAS.

INTRODUCTION

Early-stage glottic squamous cell carcinoma (SCC) commonly presents with dysphonia and is frequently diagnosed before regional or distant spread. Definitive radiotherapy (RT) and surgical approaches both achieve high local control and laryngeal preservation rates; therefore, functional outcomes, particularly voice quality, are often pivotal in treatment selection.[1] Despite generally favorable recovery after RT, persistent dysphonia is reported in a subset of patients, and long-term abnormalities have been described. Voice disability has functional, emotional, psychological and social effect on individual's daily life and should not be underestimated.[2,3]

Voice outcomes may be evaluated using complementary domains: (i) laryngeal imaging to characterize vibratory physiology and (ii) auditory-perceptual ratings to capture clinically meaningful voice quality. Videolaryngostroboscopy is widely considered the clinical reference standard for

assessing vocal fold vibration during phonation, with glottic closure and mucosal wave being the commonly reported videolaryngoscopic parameters.[4,5] The GRBAS scale is a validated auditory-perceptual tool that rates overall severity and specific qualities (grade, roughness, breathiness, asthenia, strain) on an ordinal scale.[6,7] Videolaryngostroboscopy and auditory-perceptual ratings are complementary approaches for characterizing post-treatment voice. Stroboscopy provides information on vibratory physiology (e.g., glottic closure and mucosal wave), whereas GRBAS captures perceptual severity and quality,[8,9] together, they support clinically meaningful functional outcome assessment after laryngeal cancer treatment.[10]

Aim: To quantify changes in voice outcomes before and after definitive RT for early stage glottic SCC using videolaryngostroboscopy (glottic closure and mucosal wave) and GRBAS perceptual scoring, and to examine agreement between these outcome measures.

MATERIALS AND METHODS

Study design and setting: This prospective, observational, non-randomized study was conducted in the Department of Otorhinolaryngology at a tertiary care hospital for a period of 18 months after approval by the institutional ethics committee.

Participants: Consecutive adults with early-stage glottic carcinoma (Tis–T2, N0M0) planned for definitive RT were enrolled after counseling regarding treatment options. Informed and written consent was obtained from all the participants. Clinical staging was established by endoscopic examination and contrast-enhanced CT neck, with histopathologic confirmation on microlaryngoscopic biopsy. Exclusion criteria included advanced or recurrent disease, prior laryngeal surgery or head-and-neck irradiation, co-existing laryngeal disorders likely to confound assessment, inadequate glottic visualization, and treatment or follow-up default.

Baseline evaluation and blinding: After written informed consent, participants were assigned study identifiers. Baseline assessment included standardized history (including smoking and alcohol exposure), ENT examination, endoscopic assessment of tumor extent and vocal fold mobility, contrast-enhanced CT neck for staging, and microlaryngoscopic biopsy for histopathologic confirmation. Voice assessments were performed by independent observers using study identifiers to minimize bias.

Voice outcome assessment: Voice was assessed at baseline (pre-RT) and at 90–95 days after RT completion. Videolaryngostroboscopy: Stroboscopy was performed with the participant seated comfortably, using topical oropharyngeal anesthesia as required, with a neck microphone for fundamental frequency detection and a 70° rigid telescope for visualization. With the vocal folds in full view, participants completed standardized phonatory tasks (sustained vowel /e/ at low, mid-range, and high pitch and at varying loudness). Examinations were recorded and archived for later review. Outcomes were glottic closure (complete/incomplete) and mucosal wave (present/absent, defined a priori). Where feasible, assessments were performed using archived recordings and study identifiers to support blinding and consistency. Auditory-perceptual assessment: A second blinded observer rated voice using the GRBAS scale (Grade, Roughness, Breathiness, Asthenia, Strain; rated 0–3 for each domain). Ratings were based on sustained vowel phonation and standardized sentence reading performed in a quiet room, with the same tasks used pre- and post-RT to improve comparability.

Definitive treatment and follow-up: After staging confirmation, participants received definitive RT. At 90–95 days post-RT, they underwent repeat ENT examination to exclude residual disease and repeat stroboscopy and GRBAS assessment; pre- and post-RT outcomes were compared.

Statistical analysis: Pre- and post-RT categorical outcomes (glottic closure and mucosal wave) were compared using chi-square testing. GRBAS domain scores (ordinal data) were compared pre- and post-RT using a non-parametric paired test (Wilcoxon signed-rank test). A two-sided p value <0.05 was considered statistically significant.

RESULTS

All 30 participants completed definitive radiotherapy without interruption and underwent pre-treatment and 3 months post-treatment voice assessment. No treatment failure was detected at the 3 months review. Baseline characteristics: Mean age was 61.2 years (range 47–72); 29/30 (96.7%) were male. Hoarseness was the presenting symptom in all patients with a mean symptom duration of 2.4 months (range 1–12 months). The factors are represented in [Table 1].

Table 1: Baseline demographic and clinicopathologic characteristics.

Characteristic	Value (n=30)
Age, years	Mean 61.2 (range 47–72)
Sex	Male 29 (96.7%); Female 1 (3.3%)
Symptom duration (hoarseness)	Mean 2.4 months (range 1–12)
Smoking status	Smokers 26 (86.7%); Non-smokers 4 (13.3%)
Alcohol use	Yes 21 (70.0%); No 9 (30.0%)
Histology	Well differentiated SCC 19 (63.3%); Moderately differentiated SCC 11 (36.7%)
Clinical stage	cT1aN0M0 - 15 (50.0%); cT1bN0M0 - 5 (16.7%); cT2N0M0 - 10 (33.3%)

Voice Outcomes: Stroboscopic and Perceptual voice outcomes improved at 3 months after radiotherapy [Table 2–3].

Videolaryngostroboscopy: Pre-radiotherapy, mucosal wave was absent in all patients (0/30), and glottic closure was complete in 14/30 (46.7%). At 3 months post-radiotherapy, mucosal wave was present in 22/30 (73.3%) and glottic closure was complete in 28/30 (93.3%). The factors are represented in [Table 2].

Table 2: Videolaryngostroboscopic outcomes before and 3 months after radiotherapy.

Outcome	Pre-RT (n=30)	Post-RT, 3 months (n=30)
Mucosal wave present	0 (0%)	22 (73.3%)
Complete glottic closure	14 (46.7%)	28 (93.3%)

GRBAS (perceptual) outcomes: All GRBAS domains demonstrated improvement at 3 months post-radiotherapy compared with baseline. The factors are represented statistically in [Table 3].

Table 3: GRBAS perceptual ratings before and 3 months after radiotherapy.

GRBAS domain	Pre-RT distribution (n)	Post-RT distribution (n)	p value
Grade	Mild 3; Moderate 18; Severe 9	Normal 4; Mild 17; Moderate 4; Severe 5	0.000027
Roughness	Mild 4; Moderate 18; Severe 8	Normal 5; Mild 14; Moderate 7; Severe 4	0.000804
Breathiness	Mild 6; Moderate 14; Severe 10	Normal 5; Mild 15; Moderate 7; Severe 3	0.001851
Asthenia	Mild 7; Moderate 14; Severe 9	Normal 5; Mild 14; Moderate 7; Severe 4	0.008929
Strain	Mild 2; Moderate 19; Severe 9	Normal 5; Mild 14; Moderate 5; Severe 6	0.000045

Agreement between outcome measures: At 3 months post-RT, improvement on stroboscopic parameters was observed in 20/30 (66.7%) patients, while 9/30 (30.0%) had static/partial improvement and 1/30 (3.3%) worsened. By GRBAS scale, 24/30 (80.0%) improved, 5/30 (16.7%) were unchanged, and 1/30 (3.3%) worsened. The difference between the two outcome measures was not statistically significant (p=0.145).

T stage and voice outcome: Improvement was more frequent in T1a disease (14/15 improved) than in T1b (2/5 improved) or T2 disease (3/10 improved); the remaining patients in each group had static or worsened outcomes. The factors are represented in [Table 4].

Table 4: T stage and overall voice outcome at 3 months post-radiotherapy. *Not improved includes static/partial improvement and worsened outcomes.

T stage	Improved, n/N (%)	Not improved*
T1a	14/15 (93.3%)	1/15
T1b	2/5 (40.0%)	3/5
T2	3/10 (30.0%)	7/10

DISCUSSION

This prospective study evaluated short-term voice outcomes after definitive radiotherapy for early stage glottic SCC using complementary measures (videolaryngostroboscopy and GRBAS). At 3 months, most patients demonstrated recovery of mucosal wave and improved glottic closure [Table 2], alongside significant improvement across GRBAS domains [Table 3]. However, overall improvement classifications derived from stroboscopy and GRBAS did not show statistically significant agreement (p=0.145), supporting the concept that physiologic and perceptual outcomes capture overlapping but non-identical constructs.

Baseline characteristics in this cohort (mean age 61.2 years; male predominance; high prevalence of smoking and alcohol exposure) are consistent with prior epidemiologic reports.[11-13] Hoarseness was seen in all patients and enabled early presentation, as commonly described in glottic malignancy.

Most tumors were well differentiated SCC (63.3%), which is comparable to other studies.[14]

Stroboscopic improvement after radiotherapy has been reported in multiple studies of early glottic cancer.[15-18] In our cohort, mucosal wave recovered in 73.3% and complete glottic closure improved to 93.3% at 3 months. Restoration of vibratory symmetry and mucosal pliability after tumor control may explain the observed return of mucosal wave.[18]

Perceptual voice quality also improved significantly across GRBAS domains [Table 3], consistent with prior radiotherapy series reporting post-treatment improvement in voice-related measures.[19-21]

Although both domains improved, the lack of significant agreement between stroboscopy-based and GRBAS-based overall outcome categorization (p=0.145) suggests that combining physiologic imaging and perceptual assessment provides a more complete functional profile than either measure alone.

Limitations: This single-center study had a modest sample size and did not include a surgical comparator or non-cancer control group. GRBAS ratings are inherently subjective and may be influenced by inter- and intra-observer variability despite blinding. Stroboscopy can be limited by patient tolerance, secretion burden, and brief phonation time, which may restrict detailed assessment in some cases.

CONCLUSION

Definitive radiotherapy for early stage glottic SCC was associated with meaningful short-term improvement in both videolaryngostroboscopic parameters (mucosal wave and glottic closure) and perceptual voice quality (GRBAS) at 3 months. Given the incomplete agreement between these measures, incorporating both stroboscopic assessment and standardized perceptual scoring may provide the most informative evaluation of functional voice outcomes in routine follow-up. Clinical implication: Routine combined stroboscopy and perceptual scoring at follow-up can support structured patient counseling about expected voice recovery and help identify patients who may benefit from targeted voice therapy or closer surveillance.

REFERENCES

1. Schultz P. Vocal fold cancer. European Annals of Otorhinolaryngology, Head and Neck diseases.2011; 128(6): 301-308.
2. Merrill RM, Anderson AE, Sloan A. Quality of life indicators according to voice disorders and voice-related conditions. Laryngoscope. 2011;121(9):2004-10.
3. Merrill RM, Tanner K, Merrill JG, McCord MD, Beardsley MM, Steele BA. Voice symptoms and voice-related quality of life in college students. Ann Otol Rhinol Laryngol. 2013;122(8):511-9.
4. Tsunoda K, Soda Y, Tojima H, Shinogami N, Ohta Y, Nibu K et al. Stroboscopic observation of the larynx after radiation in patients with T1 glottic carcinoma. ActaOtolaryngol suppl. 1997;527:165-6.
5. Hocevar-Boltezar I, Zargi M, Honocodeevar-Boltezar I. Voice quality after radiation therapy for early glottic cancer. Arch Otolaryngol Head Neck Surg 2000;126:1097-100.
6. Hirano M: Clinical examination of voice, Wien/New York, Springer-Verlag, 1981
7. Stoicheff ML. Voice following Radiotherapy. The Laryngoscope. 1975;85:608-618.
8. Dejonckere PH, Crevier L, Elbaz E, Marraco M, Millet B, Remacle M, Woisard V. Quantitative rating of videolaryngostroboscopy: factor analysis of the vibratory characteristics. In: Dejonckere PH, Peters H (Eds). Communication and its Disorders: A Science in Progress. Nijmegen University Press, Nijmegen, (1999) pp. 170–171.
9. Speyer R, Wieneke GH, Kersing W, Dejonckere PH. Accuracy of measurements on videostroboscopic images of the vocal folds. Ann Otol Rhinol Laryngol. 2005;114:443–450
10. Focht KL, Martin-Harris B, Bonilha HS. Stroboscopic Parameters Reported as Voice Outcome Measures in Patients Treated for Laryngeal Cancer: A Systematic Review. Journal of medical speech-language pathology. 2013;21(3):5
11. Sadiq MA, SafaNoury MA. Carcinoma of Larynx A Clinical Study. Medical Journal of Babylon.2014; 6:3.
12. Mendenhall WM, Parsons JT, Stringer ST, Cassisi NJ, Million RR. T1-T2 vocal cord carcinoma: a basis for comparing the results of radiotherapy and surgery. Head and Neck Surg 1988;10: 373-7.
13. Milovanovic J, Jotic A, Djukic V, Pavlovic B, Trivic A, Krejovic-Trivic S et al. Oncological and Functional Outcome after Surgical Treatment of Early Glottic Carcinoma without Anterior Commissure Involvement. BioMed Research International Volume 2014, Article ID 464781, 7 pages.
14. De Stefani E, Boffetta P, Deneo-Pellegrini H, Brennan P, Correa P, Oreggia F, et al. Supraglottic and glottic carcinomas: epidemiologically distinct entities. Int J Cancer. 2004; 112: 1065-1071.
15. Rydell R, Schalen L, Fex S, Elner A. Voice evaluation before and after laser excision vs. radiotherapy of T1A glottic carcinoma. Acta Otolaryngol 1995; 115: 560-5.
16. Wedman J, Heidmal JH, Elstad I, Olofsson J. Voice results in patients with T1a glottic cancer treated by radiotherapy or endoscopic measures. Eur Arch Otorhinolaryngol 2002; 259:547-50.
17. Adams G, Burnett R, Mills E, Penniment M. Objective and subjective changes in voice quality after radiotherapy for early (T1 or T2, N0) laryngeal cancer: a pilot prospective cohort study. Head Neck 2013;35(3):376-80.
18. Quarteiro AL, Dedivitis RA, Pfuetzenreiter EG Jr. Videolaryngostroboscopic analysis of patients submitted to radiation therapy for the treatment of glottic cancer. Braz J Otorhinolaryngol 2010;76(1):44-50.
19. Verdonck-de Leeuw IM, Keus RB, Hilgers FJ, Koopmans-van Bienum FJ, Grevens AJ, de Jong JM et.al. Consequences of voice impairment in daily life for patients following radiotherapy for early glottic cancer; voice quality, vocal function and vocal performance; Int.J.Radiat.Oncol.Biol.Phys 1999;44:1071-8.
20. Verdonck-de Leeuw IM, Hilgers FJ, Keus RB, Koopmans-van Bienum FJ, Grevens AJ, de Jong JM et.al. Multidimensional assessment of voice characteristics after radiotherapy for early glottic cancer. Laryngoscope; 1999;109:241-8.
21. Dagli AS, Mahieu HF, Festen JM. Quantitative analysis of voice quality in early glottic laryngeal carcinomas treated with radiotherapy. Eur.Arch.Otorhinolaryngol. 1997;254:78-80.