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Original Research Article

HYBRID SIMULTANEOUS INTEGRATED BOOST (SIB) TECHNIQUE IN LOCALLY ADVANCED TONGUE CANCER: A PROSPECTIVE STUDY

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ABSTRACT

Background: Locally advanced carcinoma of the oral tongue often presents with bulky primary disease and extensive nodal involvement, leading to poor control rates and functional morbidity. Intensified radiotherapy techniques aim to improve tumour response while maintaining acceptable toxicity. This study aimed to evaluate the feasibility, tolerance, acute toxicity profile, and preliminary tumour response of a hybrid SIB-IMRT technique in patients with Stage IVA–IVB carcinoma of the anterior two-thirds of the tongue. **Materials and Methods:** This prospective study was conducted at Dharan Hospital, Salem, between September 2020 and August 2024. Ten patients with Stage IVA–IVB squamous cell carcinoma of the oral tongue received Phase I 3D-CRT (36 Gy in 18 fractions) followed by Phase II SIB-IMRT delivering 28.8 Gy (2.4 Gy/fraction) to high-risk PTV and 20 Gy (2 Gy/fraction) to low-risk PTV, with concurrent cisplatin. Outcomes were compared with a matched retrospective control group. **Result:** All patients were male, with a median age of 43.7 years, and all had tobacco exposure. Ventral tongue was the most common subsite, and all presented with N2b–N3 nodal disease. Radiotherapy completion was 100%, with a mean treatment interruption of 7.2 days. Three cycles of cisplatin were completed in 50% of patients. Grade III mucositis occurred in 40%, Grade II–III dysphagia in 50%, and Grade III neutropenia in 20%. Primary tumour response was seen in 40% of patients, and nodal response in 80%, compared with 30% and 50% in controls. Loco-regional control was 40% versus 30%, without statistical significance (p = 0.639). **Conclusion:** The hybrid SIB-IMRT approach is feasible with manageable acute toxicity and favourable nodal response. However, it does not provide a clear advantage in loco-regional control or survival over conventional treatment. Larger studies with longer follow-up are required.

INTRODUCTION

Oral cancer is the sixth most common malignancy worldwide. Tongue Squamous cell carcinoma (SCC) are the most reported cancer. The majority of oral cavity cancers are diagnosed at an advanced stage, with nearly 85% presenting in Stages III–IV. Early-stage disease (Stages I–II) for approximately 45% of cases of oral tongue SCC.[1] Advanced oral tongue cancer outcomes remain unsatisfactory, and the recurrence is common, and improvements in survival been limited, even with aggressive surgical resection followed by adjuvant therapy. Wide tongue surgery often results in significant speech and swallowing difficulties, leading to functional impairment and reduced quality of life.[2] Therefore, the achievable tumour control while protective tongue function is preferred whenever possible.

Concurrent chemoradiation is the standard treatment for unresectable head and neck cancers. However, it schedules frequently yield suboptimal local control due to tumour repopulation during prolonged treatments.[3] Delays or prolonged radiotherapy are associated with reduced locoregional control and poorer survival outcomes. Completing treatment within the planned time is important, as interruptions are associated with poorer disease control.[4] Bulky primary tumours and large nodal disease in head and neck cancer are harder to control and show higher recurrence rates, even with standard treatment.[5]

In head and neck cancer, Intensity-Modulated Radiotherapy (IMRT) delivers the prescribed dose to the tumour while limiting radiation exposure to nearby normal tissues. This provides better protection of organs at risk than conventional radiotherapy.[6] Simultaneous integrated boost (SIB) IMRT allows a higher radiation dose to be delivered to the visible

tumour in each treatment session while keeping the dose to nearby normal organs within safe limits.[7] SIB-IMRT delivers a higher effective radiation dose to the tumour while keeping the overall treatment time short, offering a biological advantage over sequential boost techniques without extending the treatment course.[8] Clinical experience has shown that moderately hypo-fractionated IMRT with a SIB can be safely delivered in head and neck cancer, with manageable side effects and satisfactory tumour control.[9]

In many Indian centres, delivering full-course IMRT is difficult due to limited machine availability, heavy patient workload, and higher treatment costs when compared with 3D-CRT.[10] There is limited evidence on the use of SIB-IMRT for advanced oral tongue cancer, especially in centres with limited resources. Therefore, this study aimed to evaluate the feasibility, tolerance, acute toxicity profile, and preliminary tumour response of a hybrid SIB-IMRT technique in patients with Stage IVA–IVB carcinoma.

MATERIALS AND METHODS

This was a prospective single-arm interventional study conducted on 10 patients with Stage IVA–IVB SCC of the tongue treated at Dharan Hospital, Salem, between September 2020 and August 2024 were included.

Inclusion Criteria

Patients aged 30–60 years with ECOG performance status 0–2 and non-metastatic Stage IVA or IVB SCC of the anterior two-thirds of the tongue were included.

Exclusion Criteria

Patients with prior radiotherapy or chemotherapy, non-squamous histology, parotid gland disease, connective tissue disorders, or uncontrolled medical conditions were excluded.

Methods: Patients were assigned to two groups. The study group comprised ten patients treated with a hybrid radiotherapy technique. A matched retrospective control group included ten patients who received conventional chemoradiation. Matching was done for age, tumour stage, nodal status, and treatment intent. Clinical, treatment-related, toxicity, and response data were collected.

Baseline examination included clinical, direct laryngoscopy, dental assessment, blood investigations, renal and liver function tests, and contrast-enhanced computed tomography of the head and neck. Immobilisation was achieved using a thermoplastic head–neck–shoulder mask with an intraoral bite block. Planning computed tomography scans were performed for all patients. Treatment consisted of Phase I 3-D conformal radiotherapy (36 Gy in 18 fractions), followed by Phase II SIB-IMRT delivering 28.8 Gy (2.4 Gy per fraction) to high-risk PTV and 20 Gy (2 Gy per fraction) to low-risk PTV over 12 fractions. Concurrent cisplatin was administered at standard dosing intervals.

Acute toxicities were assessed weekly twice using Radiation Therapy Oncology Group criteria. Tumour response was evaluated six weeks after completion of treatment using Response Evaluation Criteria in Solid Tumours, followed by monthly follow-up.

Statistical analysis: Data were analysed using SPSS v29. Continuous variables were presented as mean ± standard deviation or median (range), and categorical variables as frequencies and percentages. Comparisons were performed using the chi-square or Fisher's exact test for categorical variables and Student's t-test for continuous variables. A p-value < 0.05 was considered statistically significant. As this was a feasibility study, no formal sample size calculation or multivariable adjustment was performed, and missing data were handled by complete-case analysis.

RESULTS

All ten patients were male, with a median age of 43.7 years. Tobacco exposure was present in all cases, with chewing tobacco in five patients (50%), smoking in four (40%), and combined habits in one (10%). The ventral tongue was the most commonly involved subsite, observed in seven patients (70%). Tumour size ranged from 5 × 3 cm to 8 × 7 cm, and all patients had advanced nodal disease, with nodal status between N2b and N3 [Table 1]. Baseline demographic and disease characteristics of the retrospective control group were comparable to the study group.

Table 1: Baseline patient and disease characteristics (n=10)

Variable		Value
Number of patients		10
Median age		43.7 years
Sex		100% male
Tobacco habits	Chewing	5
	Smoking	4
	Both	1
Tumour size		5 × 3 cm to 8 × 7 cm
Common subsite		Ventral tongue (7 patients)
Nodal status		N2b to N3

Mucositis was the most frequent acute toxicity, with Grade III severity observed in four patients (40%). Dysphagia of Grade II–III severity occurred in five patients (50%). Dermatitis was predominantly with Grade I reactions seen in six patients (60%), while two patients (20%) developed Grade III skin toxicity.

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Hematologic toxicity was limited, with Grade III neutropenia occurring in two patients (20%) [Table 2].

Treatment interruptions were observed in the cohort, with a mean treatment break of 7.2 days (range 3–12 days). Five patients (50%) received all three planned cycles of cisplatin, while four patients (40%) completed two cycles, and one patient (10%) received a single cycle. Radiotherapy completion was 100% [Table 3].

Table 2: Acute treatment-related toxicity profile

Toxicity	Grade I	Grade II	Grade III	Grade IV
Mucositis	4	2	4	0
Dysphagia	3	2	3	0
Dermatitis	6	2	2	0
Neutropenia	0	0	2	0

Table 3: Treatment compliance and interruptions

Parameter	Value
Mean treatment break	7.2 days (range 3–12)
3 cycles of cisplatin	5
2 cycles of cisplatin	4
1 cycle cisplatin	1
Radiotherapy completion	100%

Table 4: Tumour response and loco regional control outcomes

Outcome	Hybrid SIB-IMRT	Control	P value
Primary tumour response	40%	30%	0.639
Nodal response	80%	50%	
Loco regional control	40%	30%	

Primary tumour response was observed in four of ten patients (40%) and nodal response in eight of ten patients (80%) in the hybrid group, compared with three of ten patients (30%) and five of ten patients (50%) in the control group. No significant differences were observed between the two groups (p = 0.639) [Table 4].

DISCUSSION

Radiotherapy was completed in all patients, although treatment breaks and incomplete chemotherapy were noted. Acute toxicities were mainly mucosal and manageable. While nodal response was better with the hybrid technique than with conventional chemoradiation, loco-regional control and survival outcomes were comparable. The approach did not show a clear clinical advantage beyond nodal response.

All patients were male, median age 43.7 years, tobacco users; ventral tongue primaries predominated; all presented with nodal disease (N2b–N3). A study done by Saikia et al. reported that the study included 20 patients with a male predominance (70%). Right-sided tongue lesions were more common (65%). Most patients presented with T2 disease (70%), while nodal involvement was limited, with 85% having N0–N1 disease and only 15% presenting with N2b disease, without N3 involvement.[11] This study supports demographic similarity and confirms tongue cancer male predominance, while contrasting nodal burden highlights our cohort's more advanced disease, justifying intensified treatment and response evaluation.

In our study, acute mucositis was the most common toxicity; dysphagia requiring nutritional support was frequent, while hematologic toxicity remained limited. Similarly, Ghosh et al., in a large study shows that acute mucositis was frequent, with Grade III–IV toxicity in 47.7% of patients (Grade III 33.8%, Grade IV 13.9%). Dermatitis Grade III–IV occurred in 35.9%. Emesis Grade ≥III was uncommon (6.6%). Hematologic toxicity was limited, with Grade III–IV leukopenia in 5.9% and Grade III anaemia in 1.4%, while thrombocytopenia and acute kidney injury were predominantly low grade.[12] Dragan et al. show that severe acute side effects were common during treatment. Grade 3 dysphagia occurred in 44% of patients, oral and/or oropharyngeal mucositis in 40%, and dermatitis in 21%. Late side effects were less frequent and mainly included xerostomia in 42% of patients, dysgeusia in 23%, and dysphagia in 8%, suggesting acceptable long-term tolerability.[13] These studies strengthen our observations by showing comparable acute toxicity patterns, dominated by mucositis and dysphagia, with low rates of severe hematologic effects, supporting the tolerability of this treatment approach.

Our study shows that all patients completed planned radiotherapy regardless of interruptions; concurrent cisplatin was variably completed, with some patients unable to finish all cycles. Similarly, Subramaniam et al. found that radiotherapy was completed by all patients (100%), though treatment interruptions occurred, with a mean break of 7 days (range 2–12).[14] This supports our findings by showing full radiotherapy completion rather than interruptions, indicating that treatment feasibility is maintained even when breaks and incomplete chemotherapy occur in routine clinical practice.

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In this study, the hybrid SIB-IMRT technique showed improved nodal response and modest loco-regional control compared with conventional treatment, without statistical significance. Similarly, Mishra et al., in an IMRT-based oral cavity series, isolated nodal failure occurred in 5%, but 3-year loco-regional control was significantly lower in N2–N3 patients (57%) compared with N0–N1 disease (91%), suggesting that dose-intensified IMRT improves nodal response but offers only limited benefit in overall loco-regional control.[15] Grover et al. in a randomised comparison, SIB-IMRT and sequential IMRT produced similar objective response rates (72% vs 72.5%), thus in field failures and survival were similar, showing no loco-regional advantage.[16] These studies align with our findings, showing that higher-dose IMRT improves nodal response but fails to produce clear gains in loco-regional control or survival, particularly in patients with advanced nodal disease.

Limitations: The study was limited by a small sample size, short follow-up, retrospective controls, treatment interruptions, variable chemotherapy compliance, and a single-centre design, reducing statistical power and limiting assessment of long-term outcomes and broader applicability.

Clinical implication: Hybrid SIB-IMRT is feasible with acceptable toxicity but offers limited advantage over conventional treatment, warranting selective use rather than routine utilisation.

CONCLUSION

The hybrid SIB-IMRT approach is feasible in locally advanced tongue cancer, with acceptable acute toxicity and good treatment completion. Improved nodal response was observed, but gains in loco-regional control and survival were limited. Larger prospective studies with longer follow-up are needed to define its clinical value. Future work should focus on patient selection, treatment compliance, and strategies to reduce interruptions. Integration of improved systemic therapy may further enhance outcomes.

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