Section: Radiation Oncology

Original Research Article

COMPARISON BETWEEN INTENSITY MODULATED RADIATION THERAPY WITH OR WITHOUT SIMULTANEOUS INTEGRATED BOOST IN LOCALLY ADVANCED ORAL CAVITY CARCINOMAS.

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ABSTRACT

Background: The aim is to compare between intensity modulated radiation therapy with or without simultaneous integrated boost in locally advanced oral cavity carcinomas in patients admitted/visited to hospital.

Materials and Methods: The present study entitled was conducted in Department of Radiation oncology, Gandhi Medical College and associated Hamidia Hospital (GMC & HH), Bhopal (M.P) and Jawaharlal Nehru Cancer Hospital (JNCH), Bhopal (M.P), on a total of 54 patients of advanced oral cavity carcinomas.

Results: After means follow up with patients' comparison between intensity modulated radiation therapy with or without simultaneous integrate boost was done and noted details in tables.

Conclusion: The study concluded that there were no statistically significant differences in demographic distributions, clinical characteristics, acute and long-term toxicities, and post-treatment responses between the two groups treated with and without Simultaneous Integrated Boost (SIB) in locally advanced oral cavity carcinomas. Both treatment modalities demonstrated similar efficacy and safety profiles.

Keywords: Clinical outcomes, head and neck cancer, intensity-modulated radiotherapy, sequential, simultaneous integrated boost.

INTRODUCTION

Cancer stands as a prominent global cause of mortality. Timely access to early detection and treatment could annually rescue millions of cancer patients from premature death and distress.[1] The impact of cancer is especially pronounced in low and middle-income countries, where it poses a significant public health challenge, leading to elevated rates of morbidity and mortality.[2]

Globally, there are about 377,000 new cases of oral cavity cancer (OCC) each year, constituting 2% of all cancer cases, and resulting in over 177,000 deaths, accounting for 1.8% of all cancer-related deaths.[3] The incidence of oral cavity squamous cell carcinoma (OSCC) exhibits significant geographical variations, with approximately two-thirds of cases occurring in developing countries.[4]

Numerous studies affirm the safety and efficacy of SIB-IMRT for head and neck cancer (HNC), offering advantages such as (1) reduced treatment duration; (2) increased biologically equivalent dose (BED) to the tumor, with doses per fraction slightly exceeding 2 Gy; and (3) more precise dose distributions compared to Sequential-IMRT (SEQ-IMRT), which involves a large-field phase and a boost phase.[5,6]

In conclusion, there remains a lack of robust evidence regarding the advantages and disadvantages of SIB-IMRT. Therefore, our current prospective and observational study aims to compare intensity-modulated radiation therapy with or without simultaneous integrated boost in patients with locally

advanced oral cavity carcinomas. The goal is to obtain more credible evidence regarding dosimetric analysis and toxicity assessment of the SIB-IMRT technique.

MATERIALS AND METHODS

This prospective observational study entitled was conducted in Department of Radiation oncology, Gandhi Medical College and associated Hamidia Hospital (GMC & HH), Bhopal (M.P) and Jawaharlal Nehru Cancer Hospital (JNCH), Bhopal (M.P), on a total of 54 patients of advanced oral cavity carcinomas from 1st July to 30th Dec-2023. Patients of advanced oral cavity carcinomas undergoing radiation in Radiation Oncology Department at GMC and JNCH, Bhopal

Inclusion Criteria

- Histopathologically confirmed case of Oral cavity Squamous Cell Carcinoma
- KPS score ≥ 70
- Patient not received any radiotherapy previously
- Age group between 18 to 60 year.
- Patient giving consent for study.

Exclusion Criteria

- Chronically ill patients
- Patients who do not give consent for the study
- KPS score < 70
- Patients below 18yr age and above 60yr age

RESULTS

[Table 1] illustrates the distribution of the study population diagnosed with oral cavity cancer across two treatment techniques group: with Simultaneous Integrated Boost (SIB) and without SIB according to age groups. The study included a total of 54 patients, equally divided between the two groups (27 patients each). The age distribution among patients in the SIB group showed that 12.96% (n=7) were under 40 years, 20.37% (n=11) were between 41 and 50 years, 7.41% (n=4) were between 51 and 60 years, 7.41% (n=4) were between 61 and 70 years, and 1.85% (n=1) were over 70 years. Similarly, in the group without SIB, 14.81% (n=8) of patients were under 40 years, 14.81% (n=8) were between 41 and 50 years, 11.11% (n=6) were between 51 and 60 years, 7.41% (n=4) were between 61 and 70 years, and 1.85% (n=1) were over 70 years. The comparison of age distributions between the two groups yielded a p-value of 0.9187, indicating no statistically significant difference in the age distribution of patients undergoing treatment with and without SIB.

Table 1: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Age Groups

	Technique				
	With SIB		Without SIB		P Value
Age Group (Year)	N	%	N	%	
<40 year	7	25.93	8	29.63	
41-50 year	11	40.74	8	29.63	0.9187
51-60 year	4	14.81	6	22.22	
61-70 year	4	14.81	4	14.81	
>70 year	1	3.70	1	3.70	
All	27	100.00	27	100.00	

Table 2: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Sex

	Technique				
	With SIB		Without SIB		P Value
Sex	N	%	N	%	
Female	4	14.81	2	7.41	0.3909
Male	23	85.19	25	92.59	
All	27	100.00	27	100.00	

[Table 2] presents the distribution of the study population diagnosed with oral cavity cancer according to sex and treatment technique: with Simultaneous Integrated Boost (SIB) and without SIB. Among the patients receiving SIB, 14.81% (n=4) were female, and 85.19% (n=23) were male. In the group without SIB, 7.41% (n=2) were female, and 92.59% (n=25) were male. The comparison of sex distribution between the two groups yielded a p-value of 0.3909, indicating no statistically significant difference in the sex distribution of patients undergoing treatment with and without SIB.

Table 3: Distribution of Study Population of Oral Cavity Cancer between Two Technique According to Sex

	Technique				
	With SIB		Without SIB		P Value
Religion	N	%	N	%	
Hindu	24	88.89%	26	96.30%	
Muslim	3	11.11%	1	3.70%	0.3032
All	27	100.00%	27	100.00%	

[Table 3] details the distribution of the study population diagnosed with oral cavity cancer according to religion and treatment technique: with Simultaneous Integrated Boost (SIB) and without

SIB. The study included a total of 54 patients, evenly split between the two treatment groups (27 patients each). The comparison of religious distribution between the two groups produced a p-value of 0.3032, indicating no statistically significant difference in the religious composition of patients undergoing treatment with and without SIB.

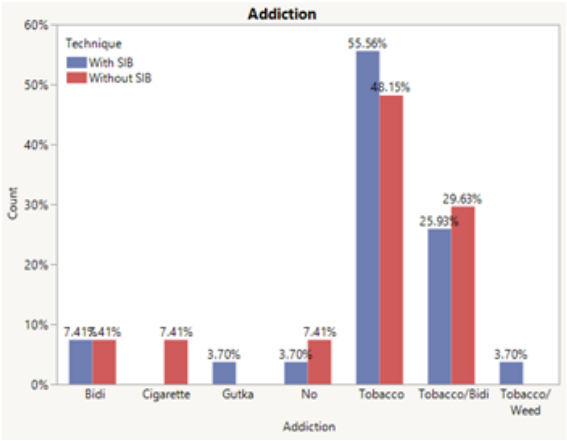
Table 4: Distribution of Study Population of Oral Cavity Cancer between Two Technique According to Residence

	Technique				
	With SIB		Without SIB		P Value
Residence	**N**	**%**	**N**	**%**	
Rural	18	66.67%	20	74.07%	0.5549
Urban	9	33.33%	7	25.93%	
All	27	100.00%	27	100.00%	

[Table 4] illustrates the distribution of the study population diagnosed with oral cavity cancer according to residence and treatment technique: with Simultaneous Integrated Boost (SIB) and without SIB. The study involved 54 patients, equally divided between the two treatment groups (27 patients each). The comparison of residence distribution between the two groups yielded a p-value of 0.5549, indicating no statistically significant difference in the residential status of patients receiving treatment with and without SIB.

Table 5: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Addiction

	Technique				
	With SIB		Without SIB		
Addiction	**N**	**%**	**N**	**%**	**P Value**
Bidi	2	7.41%	2	7.41%	
Cigarette	0	0.00%	2	7.41%	
Gutka	1	3.70%	0	0.00%	
No	1	3.70%	2	7.41%	0.6036
Tobacco	15	55.56%	13	48.15%	
Tobacco/Bidi	7	25.93%	8	29.63%	
Tobacco/Weed	1	3.70%	0	0.00%	
All	27	100.00%	27	100.00%	



[Table 5] details the distribution of the study population diagnosed with oral cavity cancer according to addiction and treatment technique: with Simultaneous Integrated Boost (SIB) and without SIB. The study included 54 patients, evenly divided between the two treatment groups (27 patients each). In the SIB group, 7.41% (n=2) of patients reported addiction to bidi, 3.70% (n=1) to gutka, 3.70% (n=1) had no addiction, 55.56% (n=15) to tobacco, 25.93% (n=7) to both tobacco and bidi, and 3.70% (n=1) to both tobacco and weed. No patients in this group reported cigarette addiction. In the group without SIB, 7.41% (n=2) of patients reported addiction to bidi, 7.41% (n=2) to cigarettes, 7.41% (n=2) had no addiction, 48.15% (n=13) to tobacco, 29.63% (n=8) to both tobacco and bidi, and no patients reported addiction to gutka or tobacco and weed. The comparison of addiction types between the two groups yielded a p-value of 0.6036, indicating no statistically significant difference in the addiction profiles of patients undergoing treatment with and without SIB.

Table 6: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Family History

	Technique				
	With SIB		Without SIB		
Family History	**N**	**%**	**N**	**%**	**P Value**
No	25	92.59%	26	96.30%	
Yes (Father)	1	3.70%	1	3.70%	0.6006
Yes (Mother)	1	3.70%	0	0.00%	
All	27	100.00%	27	100.00%	

[Table 6] presents the distribution of the study population diagnosed with oral cavity cancer according to family history and treatment technique: with Simultaneous Integrated Boost (SIB) and without SIB. In the SIB group, 92.59% (n=25) of patients had no family history of cancer, while 3.70%

(n=1) reported a family history of cancer in their father, and 3.70% (n=1) in their mother. In the group without SIB, 96.30% (n=26) of patients had no family history of cancer, and 3.70% (n=1) reported a family history of cancer in their father. No patients in this group reported a family history of cancer in their mother.

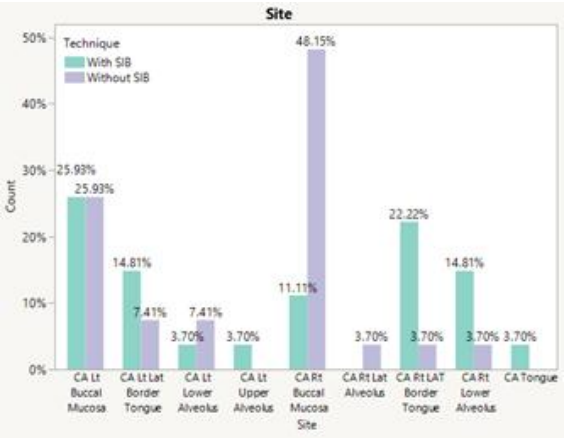
Table 7: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to KPS

	Technique				
	With SIB		Without SIB		
KPS	N	%	N	%	P Value
70	7	25.93%	7	25.93%	
80	20	74.07%	20	74.07%	1.0000
All	27	100.00%	27	100.00%	

[Table 7] illustrates the distribution of the study population diagnosed with oral cavity cancer according to the Karnofsky Performance Status (KPS) score and treatment technique: with Simultaneous Integrated Boost (SIB) and without SIB. In both the SIB and non-SIB groups, 25.93% (n=7) of patients had a KPS score of 70, and 74.07% (n=20) had a KPS score of 80. The comparison of KPS scores between the two groups resulted in a p-value of 1.0000, indicating no statistically significant difference in the KPS scores of patients receiving treatment with and without SIB.

Table 8: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Site

	Technique				
	With SIB		Without SIB		P Value
Site	N	Total	N	Total	
CA Lt Buccal Mucosa	7	25.93%	7	25.93%	
CA Lt Lat Border Tongue	4	14.81%	2	7.41%	
CA Lt Lower Alveolus	1	3.70%	2	7.41%	
CA Lt Upper Alveolus	1	3.70%	0	0.00%	
CA Rt Buccal Mucosa	3	11.11%	13	48.15%	0.0707
CA Rt Lat Alveolus	0	0.00%	1	3.70%	
CA Rt LAT Border Tongue	6	22.22%	1	3.70%	
CA Rt Lower Alveolus	4	14.81%	1	3.70%	
CA Tongue	1	3.70%	0	0.00%	
All	27	100.00%	27	100.00%	

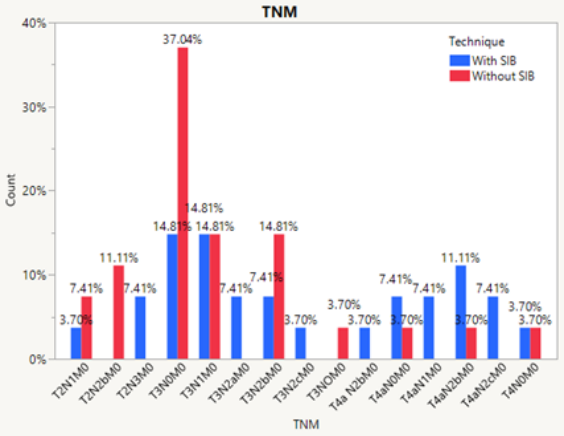


[Table 8] presents the distribution of the study population with oral cavity cancer categorized by site and treatment technique. Among the notable findings, the left buccal mucosa exhibited a prevalence of 25.93% in both SIB and non-SIB groups, while the left lateral border of the tongue was noted in 14.81% with SIB versus 7.41% without SIB. Similarly, differences were observed in other sites such as the right buccal mucosa and lateral border of the tongue, with varying percentages between the two treatment techniques. Statistical analysis using the P value suggests no significant difference in distribution between SIB and non-SIB groups across most sites, except for a trend noted in the right buccal mucosa (P = 0.0707).

Table 9: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to TNM

	Technique				
	With SIB		Without SIB		P Value
TNM	N	%	N	%	
T2N1M0	1	3.70%	2	7.41%	
T2N2bM0	0	0.00%	3	11.11%	
T2N3M0	2	7.41%	0	0.00%	
T3N0M0	4	14.81%	10	37.04%	
T3N1M0	4	14.81%	4	14.81%	
T3N2aM0	2	7.41%	0	0.00%	
T3N2bM0	2	7.41%	4	14.81%	
T3N2cM0	1	3.70%	0	0.00%	0.1686
T3NOM0	0	0.00%	1	3.70%	
T4a N2bM0	1	3.70%	0	0.00%	
T4aN0M0	2	7.41%	1	3.70%	

T4aN1M0	2	7.41%	0	0.00%	
T4aN2bM0	3	11.11%	1	3.70%	
T4aN2cM0	2	7.41%	0	0.00%	
T4N0M0	1	3.70%	1	3.70%	
All	27	100.00%	27	100.00%	



[Table 9] presents the distribution of the study population diagnosed with oral cavity cancer according to the site of cancer and the treatment technique, with Simultaneous Integrated Boost (SIB) and without SIB. In the SIB group, 25.93% (n=7) of patients had cancer in the left buccal mucosa, 14.81% (n=4) in the left lateral border of the tongue, 3.70% (n=1) in the left lower alveolus, 3.70% (n=1) in the left upper alveolus, 11.11% (n=3) in the right buccal mucosa, 0.00% (n=0) in the right lateral alveolus, 22.22% (n=6) in the right lateral border of the tongue, 14.81% (n=4) in the right lower alveolus, and 3.70% (n=1) had cancer in the tongue. In the group without SIB, 25.93% (n=7) of patients had cancer in the left buccal mucosa, 7.41% (n=2) in the left lateral border of the tongue, 7.41% (n=2) in the left lower alveolus, 0.00% (n=0) in the left upper alveolus, 48.15% (n=13) in the right buccal mucosa, 3.70% (n=1) in the right lateral alveolus, 3.70% (n=1) in the right lateral border of the tongue, 3.70% (n=1) in the right lower alveolus, and 0.00% (n=0) had cancer in the tongue. The p-value for the comparison of cancer sites between the two groups was 0.0707, indicating no statistically significant difference in the distribution of cancer sites between patients treated with and without SIB.

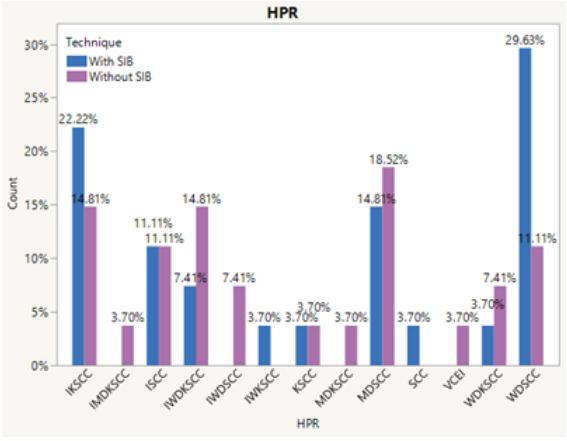
Table 10: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Stage

	Technique				
	With SIB		**Without SIB**		**P Value**
Stage	**N**	**%**	**N**	**%**	
III	11	40.74%	19	70.37%	0.5300
IV	16	59.26%	8	29.63%	
All	27	100.00%	27	100.00%	

[Table 10] displays the distribution of the study population diagnosed with oral cavity cancer categorized by cancer stage and treatment technique, comparing Simultaneous Integrated Boost (SIB) with treatment without SIB. In the SIB group, 40.74% (n=11) of patients were diagnosed with Stage III cancer, while 59.26% (n=16) were diagnosed with Stage IV cancer. In contrast, among patients treated without SIB, 70.37% (n=19) were diagnosed with Stage III cancer, and 29.63% (n=8) were diagnosed with Stage IV cancer.

Table 11: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to HPR

	Technique				
	With SIB		**Without SIB**		**P Value**
HPR	**N**	**%**	**N**	**%**	
IKSCC	6	22.22%	4	14.81%	0.5475
IMDKSCC	0	0.00%	1	3.70%	
ISCC	3	11.11%	3	11.11%	
IWDKSCC	2	7.41%	4	14.81%	
IWDSCC	0	0.00%	2	7.41%	
IWKSCC	1	3.70%	0	0.00%	
KSCC	1	3.70%	1	3.70%	
MDKSCC	0	0.00%	1	3.70%	
MDSCC	4	14.81%	5	18.52%	
SCC	1	3.70%	0	0.00%	
VCEI	0	0.00%	1	3.70%	
WDKSCC	1	3.70%	2	7.41%	
WDSCC	8	29.63%	3	11.11%	
All	27	100.00%	27	100.00%	



[Table 11] presents the distribution of oral cavity cancer cases according to histopathological report (HPR) among patients treated with Simultaneous Integrated Boost (SIB) compared to those treated without SIB. In the SIB treatment group: The most common histopathological reports were WDSCC (29.63%), followed by MDSCC (14.81%) and IKSCC (22.22%). Other reports included ISCC (11.11%), IWDKSCC (7.41%), IWKSCC (3.70%), KSCC (3.70%), and SCC (3.70%). In the group treated without SIB: The distribution of histopathological reports included WDSCC (11.11%), MDSCC (18.52%), IWDKSCC (14.81%), and other less frequent reports such as IKSCC (14.81%), ISCC (11.11%), IWDSCC (11.11%), and WDKSCC (7.41%). The comparison between the two groups showed a non-significant p-value of 0.5475, indicating no statistically significant difference in the distribution of histopathological reports between patients treated with SIB and those treated without SIB.

Table 12: Dosimetric Analysis of Study Population of Oral Cavity Cancer Between Two Technique

Variable	With SIB			Without SIB					
	n	Mean	SD	n	Mean	SD	Difference	95% CI	P a
TOTAL DOSE GY	27	60.0000	0.0000	27	60.0000	0.0000	0.0000	0.0000 to 0.0000	1.0000
NO. OF FRACTIONS	27	30.0000	0.0000	27	30.0000	0.0000	0.0000	0.0000 to 0.0000	1.0000
BRAIN STEM MAX GY	27	30.4852	6.5695	27	24.6778	5.2480	-5.8074	-9.0545 to -2.5603	0.0007
BRAIN STEM MIN GY	27	2.5111	1.0610	27	2.2000	0.7835	-0.3111	-0.8204 to 0.1982	0.2258
BRAIN STEM MEAN GY	27	11.9037	3.3052	27	10.2926	3.7514	-1.6111	-3.5419 to 0.3197	0.1001
Parotid GLAND MAX GY	27	34.3333	6.8708	27	33.9741	10.1734	-0.3593	-5.1001 to 4.3816	0.8797
Parotid GLAND MIN GY	27	4.5704	2.1851	27	5.7741	3.0316	1.2037	-0.2394 to 2.6468	0.1002
Parotid GLAND MEAN GY	27	19.8852	3.4084	27	17.6296	4.6421	-2.2556	-4.4796 to -0.03153	0.0470
Spinal CORD MAX GY	27	32.2815	4.1390	27	33.9259	5.2425	1.6444	-0.9350 to 4.2239	0.2065
Spinal CORD MIN GY	27	0.5481	0.4902	27	0.2519	0.1341	-0.2963	-0.4926 to -0.1000	0.0038
Spinal CORD MEAN GY	27	17.4185	3.3342	27	15.8296	3.4123	-1.5889	-3.4313 to 0.2535	0.0895

a T-test

Total Dose and Number of Fractions: Both treatment groups received an identical total dose of 60.000 Gy delivered in 30 fractions, with no variability observed in either parameter (Mean = 60.000 Gy, SD = 0.000 for both groups). Statistical analysis confirmed no significant difference between the groups (p = 1.0000).

Brain Stem Dosimetry: The maximum dose to the brain stem was significantly higher in the SIB group (Mean = 30.485 Gy, SD = 6.569) compared to the non-SIB group (Mean = 24.678 Gy, SD = 5.248), with a statistically significant p-value of 0.0007. However, the minimum and mean doses to the brain stem did not show significant differences between the two groups. The minimum dose was 2.511 Gy (SD = 1.061) for the SIB group and 2.200 Gy (SD = 0.784) for the non-SIB group (p = 0.2258). The mean dose was 11.904 Gy (SD = 3.305) for the SIB group and 10.293 Gy (SD = 3.751) for the non-SIB group (p = 0.1001).

Parotid Gland Dosimetry: For the parotid gland, the maximum dose did not differ significantly between the SIB group (Mean = 34.333 Gy, SD = 6.871) and the non-SIB group (Mean = 33.974 Gy, SD = 10.173), with a p-value of 0.8797. The minimum dose to the parotid gland was slightly lower in the SIB group (Mean = 4.570 Gy, SD = 2.185) compared to the non-SIB group (Mean = 5.774 Gy, SD = 3.032), but this difference was not statistically significant (p = 0.1002). The mean dose to the parotid gland was significantly lower in the SIB group (Mean = 19.885 Gy, SD = 3.408) than in the non-SIB group (Mean = 17.630 Gy, SD = 4.642), with a p-value of 0.0470.

Spinal Cord Dosimetry: The maximum dose to the spinal cord did not show a significant difference between the SIB group (Mean = 32.282 Gy, SD = 4.139) and the non-SIB group (Mean = 33.926 Gy,

SD = 5.243), with a p-value of 0.2065. However, the minimum dose to the spinal cord was significantly higher in the SIB group (Mean = 0.548 Gy, SD = 0.490) compared to the non-SIB group (Mean = 0.252 Gy, SD = 0.134), with a p-value of 0.0038. The mean dose to the spinal cord did not differ significantly between the SIB group (Mean = 17.419 Gy, SD = 3.334) and the non-SIB group (Mean = 15.830 Gy, SD = 3.412), with a p-value of 0.0895.

Table 13: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Acute Toxicity Assessment

	Technique				
	With SIB		Without SIB		P Value
Toxicity Assessment Acute	**N**	**%**	**N**	**%**	
DYSPHAGIA GR-1	1	3.70%	0	0.00%	
MUCOSITIS GR-1	13	48.15%	11	40.74%	
MUCOSITIS GR-2	12	44.44%	15	55.56%	0.5219
MUCOSITIS GR-3	0	0.00%	1	3.70%	
ORAL PAIN GR-2	1	3.70%	0	0.00%	
All	27	100.00%	27	100.00%	

[Table 13] illustrates the distribution of acute toxicity assessments among patients with oral cavity cancer treated with Simultaneous Integrated Boost (SIB) compared to those treated without SIB. In the SIB treatment group: Dysphagia Grade 1 was reported in 3.70% of patients. Mucositis Grade 1 affected 48.15% of patients, while Grade 2 affected 44.44%. Comparison of acute toxicity assessments between the two groups yielded a non-significant p-value of 0.5219, indicating no statistically significant difference in the incidence of acute toxicities such as mucositis and dysphagia between patients treated with SIB and those treated without SIB. This suggests similar acute toxicity profiles across both treatment modalities.

Table 14: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Toxicity Assessment at 3Month

	Technique				
	With SIB		Without SIB		P Value
Toxicity Assessment 3M	**N**	**% of Total**	**N**	**% of Total**	
DYSPHAGIA GR-1	2	7.41%	1	4.17%	
MUCOSITIS GR-1	10	37.04%	3	12.50%	
NECK OEDEMA	3	11.11%	4	16.67%	
NFC	10	37.04%	13	54.17%	0.2192
TOOTH PAIN GR-1	0	0.00%	2	8.33%	
TOOTH PAIN GR-2	1	3.70%	0	0.00%	
XEROSTOMIA	1	3.70%	0	0.00%	
XEROSTOMIA GR-2	0	0.00%	1	4.17%	
All	27	100.00%	24	100.00%	

[Table 14] presents the distribution of toxicity assessments at 3 months among patients with oral cavity cancer treated with Simultaneous Integrated Boost (SIB) compared to those treated without SIB. Dysphagia Grade 1 was reported in 7.41% of patients. Mucositis Grade 1 affected 37.04% of patients. Neck edema was reported in 11.11% of patients. Neck Fresh Complaint (NFC) was observed in 37.04% of patients. Tooth pain Grade 2 and xerostomia were each reported in 3.70% of patients. Tooth pain Grade 1 and xerostomia Grade 2 were each reported in 0.00% of patients. In the group treated without SIB: Dysphagia Grade 1 was reported in 4.17% of patients. Mucositis Grade 1 affected 12.50% of patients. Neck edema was reported in 16.67% of patients. NFC was observed in 54.17% of patients. Tooth pain Grade 1 and Grade 2 were reported in 8.33% and 0.00% of patients, respectively. Xerostomia Grade 2 was reported in 4.17% of patients. Comparison of toxicity assessments at 3 months between the two groups yielded a non-significant p-value of 0.2192, indicating no statistically significant difference in the incidence of toxicities such as dysphagia, mucositis, neck edema, NFC, tooth pain, and xerostomia between patients treated with SIB and those treated without SIB.

Table 15: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Toxicity Assessment at 6Month

	Technique				
	With SIB		Without SIB		P Value
Toxicity Assessment 6M	**N**	**%**	**N**	**%**	
DYSPHAGIA GR-1	1	4.00%	0	0.00%	
FIBROSIS AT BM	1	4.00%	0	0.00%	
NECK OEDEMA	2	8.00%	1	4.35%	0.2612
NFC	21	84.00%	18	78.26%	

TOOTH PAIN GR-1	0	0.00%	3	13.04%	
XEROSTOMIA GR-1	0	0.00%	1	4.35%	
All	25	100.00%	23	100.00%	

[Table 15] details the distribution of the study population diagnosed with oral cavity cancer according to the toxicity assessment at six months for two treatment techniques: with Simultaneous Integrated Boost (SIB) and without SIB. In the group treated with SIB, 4.00% (n=1) of patients experienced Dysphagia Grade-1, while no patients (0.00%) in the non-SIB group reported this condition. Neck oedema was noted in 8.00% (n=2) of patients receiving SIB, compared to 4.35% (n=1) in the non-SIB group. The parameter "No Fresh Complaints (NFC)" was reported by 84.00% (n=21) of patients in the SIB group and 78.26% (n=18) in the non-SIB group. Tooth pain Grade-1 was not present in the SIB group (0.00%), whereas it was reported by 13.04% (n=3) of patients in the non-SIB group. Additionally, Xerostomia Grade-1 was absent in the SIB group (0.00%) and reported in 4.35% (n=1) of the non-SIB group. Comparison of toxicity assessment at six months between the two groups yielded a non-significant p-value of 0.2612, indicating no statistically significant difference in the incidence of toxicities between patients treated with SIB and those treated without SIB.

Table 16: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Toxicity Assessment at 12Month

	Technique				
	With SIB		Without SIB		P Value
Toxicity Assessment 12M	**N**	**%**	**N**	**%**	
NECK OEDEMA	1	4.55%	1	4.35%	0.9746
NFC	21	95.45%	22	95.65%	
All	22	100.00%	23	100.00%	

[Table 16] details the distribution of the study population diagnosed with oral cavity cancer according to the toxicity assessment at 12 months for two treatment techniques: with Simultaneous Integrated Boost (SIB) and without SIB. Neck Oedema, reported in 4.55% (n=1) of patients in the SIB group and 4.55% (n=1) in the non-SIB group also. No Fresh Complaints (NFC), found in 95.45% (n=21) of patients in the SIB group and 95.65% (n=22) in the non-SIB group. A p-value of 0.9746 indicating no statistically significant difference in the between patients treated with SIB and those treated without SIB.

Table 17: Distribution of Study Population of Oral Cavity Cancer Between Two Technique According to Post Treatment Response at Different Time Interval

		Technique				
		With SIB		Without SIB		P Value
Post Treatment Response		**N**	**%**	**N**	**%**	
After Completion	Complete Response	24	88.89%	27	100.00%	
	Partial Response	3	11.11%	0	0.00%	0.0774
	All	27	100.00%	27	100.00%	
After 3M	Complete Response	24	88.89%	24	88.89%	
	Partial Response	2	7.41%	0	0.00%	0.2231
	Residual Disease	1	3.70%	3	11.11%	
	All	27	100.00%	27	100.00%	
After 6M	Complete Response	22	84.62%	23	95.83%	
	Residual Disease	4	15.38%	1	4.17%	0.1910
	All	26	100.00%	24	100.00%	
After 12M	Complete Response	22	100.00%	23	100.00%	--
	All	22	100.00%	23	100.00%	

[Table 17] presents the distribution of the study population diagnosed with oral cavity cancer according to the post-treatment response at different time intervals for two treatment techniques: with Simultaneous Integrated Boost (SIB) and without SIB.

Post-Treatment Response after Completion:

- In the SIB group, 88.89% (n=24) of patients achieved a complete response, while in the non-SIB group, 100.00% (n=27) achieved a complete response. The partial response was observed in 11.11% (n=3) of the SIB group and in 0.00% (n=0) of the non-SIB group. Resulting a p-value of 0.0774 indicating no statistically significant difference between the groups.

Post-Treatment Response After 3 Months:

- Both groups had 88.89% (n=24) of patients with a complete response. In the SIB group, 7.41% (n=2) had a partial response compared to none in the non-SIB group. Residual disease was noted in 3.70% (n=1) of the SIB group and 11.11% (n=3) of the non-SIB group. The p-value was 0.2231 indicating no statistically significant difference between the groups.

Post-Treatment Response After 6 Months:

- Complete response rates were 84.62% (n=22) in the SIB group and 95.83% (n=23) in the non-SIB

group. Residual disease was present in 15.38% (n=4) of the SIB group and 4.17% (n=1) of the non-SIB group. Resulting a p-value of 0.1910 indicating no statistically significant difference between the groups.

Post-Treatment Response After 12 Months:

- Both groups showed a 100.00% complete response, with 22 patients in the SIB group and 23 patients in the non-SIB group.

Overall, the table demonstrates the post-treatment response rates at various intervals, and outcomes shows that no statistically significant difference between the two treatment techniques regard to post-treatment Responses.

DISCUSSION

Head and neck cancer presents a significant global public health challenge, with Asia bearing 57.5% of the global burden.[7] In India, it constitutes 30% of all cancer cases, predominantly presenting at locally advanced stages due to prevalent tobacco consumption habits such as bidi smoking, tobacco chewing, and cigarette smoking.[8]

The study included a total of 54 patients, which were equally divided between the two groups (27 patients each). The age distribution among patients in the both group showed that majority of patients were belongs to middle aged. In SIB group,12.96% (n=7) were under 40 years, 20.37% (n=11) were between 41 and 50 years, 7.41% (n=4) were between 51 and 60 years, 7.41% (n=4) were between 61 and 70 years, and 1.85% (n=1) were over 70 years. Similarly, in the group without SIB, 14.81% (n=8) of patients were under 40 years, 14.81% (n=8) were between 41 and 50 years, 11.11% (n=6) were between 51 and 60 years, 7.41% (n=4) were between 61 and 70 years, and 1.85% (n=1) were over 70 years. Among the patients receiving SIB, 14.81% (n=4) were female, and 85.19% (n=23) were male. These findings concordant to previous study, in terms of gender distribution, males develop head and neck cancer more frequently, with a ratio of almost 3:1 compared to females.[9]

Among religion, in the group treated with SIB, 88.89% (n=24) of patients were Hindu, and 11.11% (n=3) were Muslim. In the group without SIB, 96.30% (n=26) of patients were Hindu, and 3.70% (n=1) were Muslim. In the SIB group, 66.67% (n=18) of patients resided in rural areas, and 33.33% (n=9) resided in urban areas. Tobacco smoking, alcohol consumption,[10] and human papilloma virus (HPV) infection,[11] were found to be the main causes of oropharyngeal carcinoma. The comparison of these variables between the two groups resulted in a p-value of >0.05, indicating no statistically significant difference in the patients receiving treatment with and without SIB.

Comparison of acute toxicity assessments between the two groups yielded a non-significant p-value of 0.5219, suggesting no statistically significant difference in toxicity profiles between the two treatments. At 3 months, Dysphagia Grade 1 affected 7.41% of SIB-treated patients, Mucositis Grade 1 affected 37.04%, Neck Edema was reported in 11.11%, and Neck Fresh Complaint (NFC) was observed in 37.04%. In contrast, in the non-SIB group, Dysphagia Grade 1 affected 4.17% of patients, Mucositis Grade 1 affected 12.50%, Neck Edema was reported in 16.67%, NFC was affected in 54.17%, and Tooth Pain Grade 1 affected 8.33% of patients. Xerostomia Grade 2 was reported in 4.17% of patients. Comparison of toxicity at 3 months between the groups yielded a non-significant p-value of 0.2192. At 6 months, Dysphagia Grade 1 was observed in 4.00% of SIB-treated patients, Fibrosis at BM in 4.00%, and Neck Edema in 8.00%. No fresh complaints (NFC) were reported in 84.00%. In the non-SIB group, no cases of Dysphagia Grade 1 or Fibrosis at BM were reported, with Neck Edema in 4.35%, and NFC in 78.26%. Tooth Pain Grade 1 was reported in 13.04% of patients, and Xerostomia Grade 1 in 4.35%. Comparison of toxicity at 6 months between the groups yielded a non-significant p-value of 0.2612. At 12 months, Neck Edema was reported in 4.55% of patients in both the SIB and non-SIB groups, with NFC in 95.45% and 95.65%, respectively. The comparison yielded a non-significant p-value of 0.9746.

The post-treatment response across different time points for two treatment methods indicate that following completion of treatment, 88.89% (n=24) of patients in the SIB group achieved complete response compared to 100.00% (n=27) in the non-SIB group. Partial response was seen in 11.11% (n=3) of the SIB group and 0.00% (n=0) of the non-SIB group, resulting in a non-significant p-value of 0.0774. At 3 months post-treatment, both groups showed 88.89% (n=24) complete response. Partial response was observed in 7.41% (n=2) of the SIB group and none in the non-SIB group. Residual disease was noted in 3.70% (n=1) of the SIB group and 11.11% (n=3) of the non-SIB group, yielding a non-significant p-value of 0.2231. At 6 months, complete response rates were 84.62% (n=22) in the SIB group and 95.83% (n=23) in the non-SIB group. Residual disease was present in 15.38% (n=4) of the SIB group and 4.17% (n=1) of the non-SIB group, resulting in a non-significant p-value of 0.1910. By 12 months, both groups exhibited 100.00% complete response, with 22 patients in the SIB group and 23 patients in the non-SIB group.

Both treatment groups received a total dose of 60.000 Gy delivered in 30 fractions, with no variability in either parameter (Mean = 60.000 Gy, SD = 0.000), and no significant difference between the groups (p = 1.0000). For brain stem dosimetry, the maximum dose was significantly higher in the SIB group (Mean = 30.485 Gy, SD = 6.569) compared to the non-SIB group (Mean = 24.678 Gy, SD = 5.248) with a p-value of 0.0007. However, the minimum and mean doses to the brain stem did not significantly differ, with minimum doses at 2.511 Gy (SD = 1.061) for

the SIB group and 2.200 Gy (SD = 0.784) for the non-SIB group (p = 0.2258), and mean doses at 11.904 Gy (SD = 3.305) for the SIB group and 10.293 Gy (SD = 3.751) for the non-SIB group (p = 0.1001). For the parotid gland, there was no significant difference in the maximum dose between the SIB group (Mean = 34.333 Gy, SD = 6.871) and the non-SIB group (Mean = 33.974 Gy, SD = 10.173) (p = 0.8797). The minimum dose was slightly lower in the SIB group (Mean = 4.570 Gy, SD = 2.185) compared to the non-SIB group (Mean = 5.774 Gy, SD = 3.032), but this was not statistically significant (p = 0.1002). The mean dose was significantly lower in the SIB group (Mean = 19.885 Gy, SD = 3.408) compared to the non-SIB group (Mean = 17.630 Gy, SD = 4.642), with a p-value of 0.0470. For spinal cord dosimetry, there was no significant difference in the maximum dose between the SIB group (Mean = 32.282 Gy, SD = 4.139) and the non-SIB group (Mean = 33.926 Gy, SD = 5.243) (p = 0.2065). The minimum dose was significantly higher in the SIB group (Mean = 0.548 Gy, SD = 0.490) compared to the non-SIB group (Mean = 0.252 Gy, SD = 0.134) (p = 0.0038). The mean dose did not significantly differ, with the SIB group at 17.419 Gy (SD = 3.334) and the non-SIB group at 15.830 Gy (SD = 3.412) (p = 0.0895).

CONCLUSION

The study concluded that there were no statistically significant differences in demographic distributions, clinical characteristics, acute and long-term toxicities, and post-treatment responses between the two groups treated with and without Simultaneous Integrated Boost (SIB) in locally advanced oral cavity carcinomas. Both treatment modalities demonstrated similar efficacy and safety profiles.

REFERENCES

1. World Health Organization. Cancer Control: Knowledge in to Action, WHO Guide for Effective Programmes: Early Detection; 2007. Introduction to the Cancer Control Series.; 2007.
2. Parkin DM, Bray F, Ferlay J, Jemal A. Cancer in Africa 2012. Cancer Epidemiol Biomarkers Prev. 2014;23(6):953-966. doi:10.1158/1055-9965.EPI-14-0281
3. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209-249. doi:10.3322/caac.21660
4. Badwelan M, Muaddi H, Ahmed A, Lee KT, Tran SD. Oral Squamous Cell Carcinoma and Concomitant Primary Tumors, What Do We Know? A Review of the Literature. Curr Oncol. 2023;30(4):3721-3734. doi:10.3390/curroncol30040283
5. Orlandi E, Palazzi M, Pignoli E, Fallai C, Giostra A, Olmi P. Radiobiological basis and clinical results of the simultaneous integrated boost (SIB) in intensity modulated radiotherapy (IMRT) for head and neck cancer: A review. Crit Rev Oncol Hematol. 2010;73(2):111-125. doi:10.1016/j.critrevonc.2009.03.003
6. Franceschini D, Paiar F, Meattini I, et al. Simultaneous integrated boost-intensity-modulated radiotherapy in head and neck cancer. Laryngoscope. 2013;123(12):E97-103. doi:10.1002/lary.24257
7. Gupta B, Johnson NW, Kumar N. Global Epidemiology of Head and Neck Cancers: A Continuing Challenge. Oncol. 2016;91(1):13-23. doi:10.1159/000446117
8. Kulkarni MR. Head and Neck Cancer Burden in India. Int J Head Neck Surg. 2013;4(1):29-35. doi:10.5005/jp-journals-10001-1132
9. Sankaranarayanan R, Black RJ, Swaminathan R, Parkin DM. An overview of cancer survival in developing countries. IARC Sci Publ. 1998;(145):135-173.
10. Subapriya R, Thangavelu A, Mathavan B, Ramachandran CR, Nagini S. Assessment of risk factors for oral squamous cell carcinoma in Chidambaram, southern India: A case-control study. Eur J Cancer Prev. 2007;16(3):251-256. doi:10.1097/01.cej.0000228402.53106.9e
11. Gapany M. Defining Risk Levels in Locally Advanced Head and Neck Cancers: A Comparative Analysis of Concurrent Postoperative Radiation Plus Chemotherapy Trials of the EORTC (#22931) and RTOG (#9501). Yearb Otolaryngol Neck Surg. 2006;2006:260-261. doi:10.1016/s1041-892x(08)70224-5.