Section: Radiation Oncology

Original Research Article

PROSPECTIVE COMPARATIVE ANALYSIS OF DYSPHAGIA IN STANDARD IMRT (SIMRT) VERSUS DYSPHAGIA/ASPIRATION-RELATED STRUCTURES-SPARING IMRT (DIMRT) IN HEAD AND NECK CANCER

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ABSTRACT

Background: Dysphagia is a common, disabling complication of chemoradiotherapy for head and neck squamous cell carcinoma (HNSCC). Intensity-modulated radiotherapy (IMRT) planned to spare the dysphagia/aspiration-related structures (DARS) may reduce this morbidity. This study compared swallowing function between standard IMRT (sIMRT) and DARS-sparing IMRT (dIMRT).

Materials and Methods: This prospective, open-label study enrolled 52 histopathologically confirmed HNSCC patients receiving chemoradiotherapy, allocated 1:1 to dIMRT or sIMRT. Dysphagia was assessed subjectively (RTOG criteria; EORTC QLQ-C30/QLQ-CX35) and objectively (modified barium swallow with the Penetration-Aspiration Scale) at baseline, 1, and 3 months, and correlated with mean dose to swallowing structures.

Results: Mean age was 52.87 ± 10.08 years; 63.46% were male, and oropharynx was the commonest site (55.77%). dIMRT achieved significantly lower doses to the pharyngeal constrictors, larynx, and esophagus than sIMRT, with comparable coverage ($p > 0.05$). At 3 months, normal swallowing was seen in 72.3% of dIMRT versus 25.09% of sIMRT patients (penetration 78.26% sIMRT vs 21.72% dIMRT; $p = 0.001$); no aspiration occurred. dIMRT showed significantly better global health, functional, and swallowing/social QoL scores at 3 months (all $p < 0.05$), with lower grade IV toxicity and grade II dysphagia ($p < 0.001$). Dysphagia correlated strongly with superior constrictor dose ($p = 0.001$). Fifteen patients, mostly in the sIMRT arm, needed temporary nasogastric feeding.

Conclusion: DARS-sparing IMRT reduced dose to swallowing structures without compromising target coverage, and was associated with significantly less dysphagia and better swallowing-related quality of life than standard IMRT, supporting DARS-sparing contouring in IMRT planning for head and neck cancer.

Keywords: Head and neck cancer; dysphagia; deglutition disorders; intensity-modulated radiotherapy; DARS-sparing IMRT; quality of life.

INTRODUCTION

Head and neck squamous cell carcinoma (HNSCC) is a common and heterogeneous malignancy arising from the mucosal squamous epithelium of the oral cavity, oropharynx, paranasal sinuses, nasal cavity, nasopharynx, larynx, and hypopharynx.[1] It is the seventh most common cancer worldwide, with more than 660,000 new cases and 325,000 deaths reported annually.[2,3] Although HNSCC typically affects patients over 60 years of age, its incidence among younger adults has risen over the past five decades; oral cancers account for roughly 0.4–3.6% of cancers diagnosed under age 40 and 6.7% under age 45.[4] Chemoradiotherapy is the mainstay of treatment for oropharyngeal, nasopharyngeal, hypopharyngeal, and laryngeal cancers but carries a substantial risk of acute and late dysphagia. Acute mucosal injury, inflammation, pain, and swelling generally resolve within three months, but chronic hypoxia, oxidative stress, and fibrosis can produce persistent or delayed swallowing dysfunction, sometimes appearing years after treatment; lymphedema and neural injury may further contribute.[5] Dysphagia after definitive radiotherapy for head and neck cancer has a substantial negative impact on quality of life.[6]

Radiotherapy is central to the management of oral cavity and pharyngeal cancers, particularly where locally advanced disease limits surgical options. Intensity-modulated radiotherapy (IMRT) allows conformal targeting of tumor while sparing adjacent normal tissue, which is especially valuable in the functionally critical structures of the oral cavity and pharynx.[7] By delivering precise doses to tumor while limiting exposure of the uninvolved mucosa and swallowing structures, IMRT may reduce late dysphagia and aspiration; retrospective comparisons of IMRT with older techniques suggest that improved conformity can lower the rate and severity of post-chemoradiotherapy dysphagia, provided dose to the structures responsible for these complications is adequately minimized.

This study examined the relationship between radiation dose to the critical swallowing structures, the pharyngeal constrictors, glottic-supraglottic larynx, and esophagus and swallowing dysfunction and aspiration before and three months after chemoradiotherapy, and aimed to correlate structure dose with severity of dysphagia. Evidence on dysphagia/aspiration-related structures (DARS)-sparing radiotherapy remains limited, motivating this comparison with standard IMRT.

Objectives

Primary objective

1. To assess and compare dysphagia by subjective (RTOG toxicity criteria
2. EORTC QLQ-C30 and QLQ-CX35) and objective (modified barium swallow) methods between standard IMRT and DARS-sparing IMRT.

Secondary Objectives

1. To correlate dysphagia (RTOG toxicity criteria) with prescribed dose
2. To assess clinical and radiological response rates using RECIST criteria.

MATERIALS AND METHODS

Study design, setting, and participants

This prospective, double-arm, open-label study enrolled 52 histopathologically confirmed patients with squamous cell carcinoma of the head and neck receiving chemoradiotherapy at the Department of Radiation Oncology, Apollo Health City, Jubilee Hills, Hyderabad, between November 2014 and December 2015.

Inclusion criteria

1) Histopathologically confirmed squamous cell carcinoma of the nasopharynx, oropharynx, hypopharynx, or larynx
2) Undergoing definitive chemoradiotherapy
3) Stage I–IVB disease (AJCC 7th edition)
4) ECOG performance status 0–2
5) Age 18–65 years
6) Either sex

Exclusion criteria

1) Loco-regional recurrence during swallowing assessment; Stage IVC disease
2) Distant metastases (bone, visceral, or distant nodal)
3) Prior neoadjuvant chemotherapy (e.g., cisplatin, paclitaxel, carboplatin, or 5-FU)
4) Prior head and neck radiotherapy
5) Refusal of consent
6) Dysphagia from other causes (e.g., head injury, cranial nerve compression)
7) Significant comorbidities (e.g., stroke, coronary heart disease).

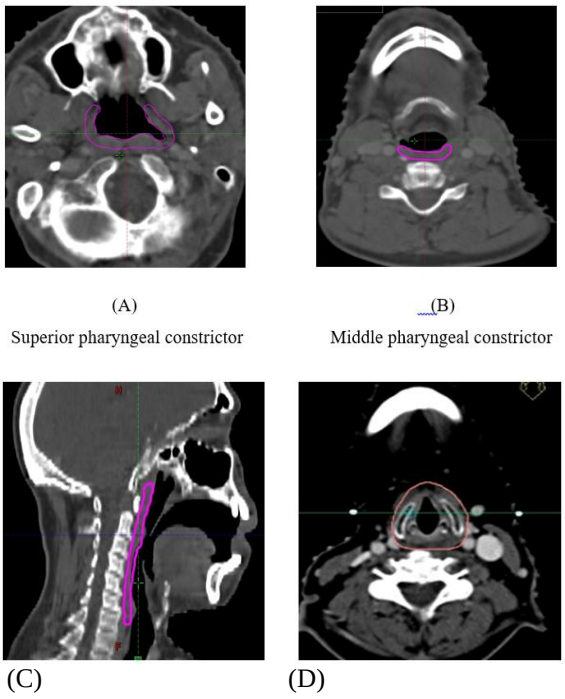
Sample size, allocation, and data collection

Following approval from the Institutional Ethics Committee, eligible patients were enrolled after informed consent. Sample size was calculated from the study of ***Eisbruch et al***.[8] assuming 95% confidence, 80% power, and expected success proportions of 20% in the study group and 10% in the control group, yielding 26 patients per arm (52 total). Eligible patients were counselled and alternately assigned to Arm A (dIMRT) or Arm B (sIMRT); this was an open-label design in which both participants and investigators were aware of the allocated arm. A study proforma recorded participant details and treatment allocation for each patient.

Radiation planning

Patients were positioned supine and immobilized from head to shoulders with a thermoplastic mask and appropriate headrest. Contrast-enhanced planning CT or PET-CT with 3 mm slices was acquired from vertex to carina. Targets and organs at risk were contoured on the treatment planning system per RTOG guidelines; in the dIMRT arm,

DARS were additionally contoured and dose-constrained without compromising target coverage (Figure 1).



Sagittal (topographic) view
Glottic-supraglottic larynx (GSL).
Figure 1: CT-based contouring of dysphagia/aspiration-related structures

(A) Superior pharyngeal constrictor
(B) middle pharyngeal constrictor
(C) sagittal (topographic) view
(D) glottic-supraglottic larynx (GSL).

Planning used the Eclipse treatment planning system (version 8.3). DARS were constrained to a mean dose of 50 Gy in the dIMRT arm. For simultaneous integrated boost IMRT, gross disease (PTV66) received 66 Gy, high-risk subclinical disease (PTV60) received 60 Gy, and lower-risk subclinical disease (PTV54) received 54 Gy, all in 30 fractions. Standard IMRT delivered 70 Gy to gross disease and 50–54 Gy to subclinical disease over 33–35 fractions, once daily, 5 fractions/week, over 7 weeks, following ICRU 83 guidelines and institutional protocol, on a Novalis Tx linear accelerator. Concurrent weekly cisplatin (40 mg/m^2) was deferred for serum creatinine > 2 mg/dl, absolute neutrophil count < 1000/mm^3, or platelet count < 100,000/mm^3.

Pre-treatment and post-treatment evaluation

Baseline evaluation included history (symptom duration, pain, dysphagia, neck swelling, weight loss, dietary habits, comorbidities, family and personal history, and tobacco/alcohol/betel-nut use), general and systemic examination, local examination with attention to oral and dental hygiene, complete hemogram, renal and liver function tests, biopsy of the primary tumor and/or FNAC of metastatic nodes, dental evaluation and prophylaxis, chest X-ray, and CT of the neck (skull base to clavicle).

Post-treatment evaluations at 1 and 3 months assessed subjective outcomes with the EORTC QLQ-C30 and QLQ-CX35 questionnaires and objective swallowing function with video fluoroscopic modified barium swallow (MBS). Patients were imaged in lateral and antero-posterior planes in sitting/standing position; oral, pharyngeal, and esophageal swallowing phases were analyzed for abnormalities in timing, aspiration, penetration, laryngeal sensation, and residue. Dysphagia was graded with the Penetration-Aspiration Scale (PAS): scores 1–2 were classified as normal and scores ≥3 as penetration; aspiration was scored ≥6. Patients were staged by the AJCC 7th-edition TNM system. Follow-up included clinical and radiological response assessment by RECIST criteria, with documentation of primary tumor and nodal response, toxicities (e.g., xerostomia, laryngitis), and nutritional status. Routine follow-up continued 3-monthly; longer-term follow-up was outside the scope of this analysis.

Statistical Analysis

Data were entered into an electronic spreadsheet and analyzed in IBM SPSS version 20.0 with biostatistical support. Descriptive statistics summarized demographic, tumor, and treatment characteristics. Each symptom score was modeled by linear regression over time (pretreatment to last follow-up). Categorical MBS/PAS outcomes were compared using the chi-square test; EORTC QLQ-C30/CX35 scores were compared using the Mann-Whitney U test (non-parametric); RT dose and dosimetric parameters were compared using appropriate parametric tests. A two-sided p-value < 0.05 was considered statistically significant.

RESULTS

Baseline characteristics

Among the 52 enrolled patients, mean age was 52.87 ± 10.08 years (median 52.5, range 28–70). Most patients were aged 50–60 years (34.62%), followed by 40–50 years (30.77%) and 60–70 years (23.08%); smaller proportions were younger than 30 years (3.85%) or aged 30–40 years (7.69%). Males comprised 63.46% of the cohort and females 36.54%. Oropharynx was the commonest primary site (55.77%), followed by hypopharynx (25.00%) and larynx (19.23%); by subsite, the base of tongue was most frequent (30.77%), followed by tonsil, pyriform sinus, soft palate, post-cricoid, supraglottis, and glottis. Most patients presented with Stage III disease (44.23%), followed by Stage II (34.62%) and Stage IV (21.15%); no patients had Stage I disease. ECOG performance status was 1 in 32.69% of patients (17/52) and 2 in 67.31% (35/52). [Table 1]

Table 1: Baseline demographic and clinical characteristics (N = 52)

Characteristic	n	%
Age ≤ 30 years	2	3.85
Age 30–40 years	4	7.69
Age 40–50 years	16	30.77
Age 50–60 years	18	34.62
Age 60–70 years	12	23.08
Male	33	63.46
Female	19	36.54
Primary site – Oropharynx	29	55.77
Primary site – Hypopharynx	13	25.00
Primary site – Larynx	10	19.23
Subsite – Base of tongue	16	30.77
Subsite – Tonsil	7	13.46
Subsite – Pyriform sinus	7	13.46
Subsite – Soft palate	6	11.54
Subsite – Post-cricoid	6	11.54
Subsite – Supraglottis	5	9.62
Subsite – Glottis	5	9.62
Stage II	18	34.62
Stage III	23	44.23
Stage IV	11	21.15
ECOG performance status 1	17	32.69
ECOG performance status 2	35	67.31

Note: the earlier draft of this manuscript transposed the ECOG figures (reporting ECOG 1 = 67.31% and ECOG 2 = 32.69%); the values above follow the source thesis data (ECOG 1 = 17 patients/32.69%, ECOG 2 = 35 patients/67.31%).

Treatment and dosimetric parameters

Both techniques achieved comparable target coverage. Mean RT dose was identical between arms (65.154 Gy in each, p = 0.999). PTV-primary Dmax (dIMRT 68.962 Gy vs. sIMRT 68.600 Gy, p = 0.773), D98% (68.436 vs. 68.937 Gy, p = 0.998), and D2% (72.567 vs. 73.243 Gy, p = 0.934) did not differ significantly, nor did nodal PTV Dmax (66.896 vs. 66.062 Gy, p = 0.537), D98% (63.213 vs. 64.987 Gy, p = 0.276), or D2% (68.234 vs. 67.764 Gy, p = 0.082). Number of chemotherapy cycles was marginally higher with dIMRT (4.692 vs. 4.423, p = 0.052). [Table 2]

Table 2: Treatment-related dosimetric parameters by arm

Parameter	dIMRT (n=26) Mean ± SD	sIMRT (n=26) Mean ± SD	p-value
Radiation dose (Gy)	65.154 ± 4.164	65.154 ± 4.164	0.999
PTV primary Dmax (Gy)	68.962 ± 4.458	68.600 ± 4.533	0.773
PTV primary D98% (Gy)	68.436 ± 4.786	68.937 ± 5.251	0.998
PTV primary D2% (Gy)	72.567 ± 4.851	73.243 ± 4.170	0.934
PTV node Dmax (Gy)	66.896 ± 5.303	66.062 ± 4.338	0.537
PTV node D98% (Gy)	63.213 ± 7.439	64.987 ± 6.036	0.276
PTV node D2% (Gy)	68.234 ± 4.828	67.764 ± 3.871	0.082
No. of chemotherapy cycles	4.692 ± 0.618	4.423 ± 0.643	0.052

Note: the radiation dose row previously reported the standard error (0.817) in place of the standard deviation; the corrected SD (4.164) is shown above and is consistent with the underlying source data and with every other row of this table.

Swallowing outcomes (Modified Barium Swallow / PAS)

At baseline, all patients had normal swallowing (100% both arms; p = 0.302). At 1 month, 76.9% of dIMRT patients remained normal versus 34.6% of sIMRT patients, with penetration in 23.07% versus 65.3% respectively (p = 0.002). At 3 months, 72.3% of dIMRT patients (16/23 evaluable) were normal versus 25.09% of sIMRT patients (5/23 evaluable), with penetration in 21.72% versus 78.26% (p = 0.001); no aspiration was recorded in either arm at any time point. [Table 3]

Table 3: Modified Barium Swallow (MBS)/Penetration-Aspiration Scale (PAS) outcomes by arm

Timepoint/category	dIMRT n (%)	sIMRT n (%)	p
Baseline – Normal	26 (100)	26 (100)	0.302
Baseline – Penetration	0 (0)	0 (0)	–
1 month – Normal	20 (76.9)	9 (34.6)	0.002*
1 month – Penetration	6 (23.07)	17 (65.3)	–
3 months – Normal (n=23/arm)	16 (72.3)	5 (21.72)	0.001*
3 months – Penetration (n=23/arm)	7 (25.09)	18 (78.26)	–

*Statistically significant (p < 0.05). Six patients per arm (n = 12) did not repeat MBS at 3 months per the source thesis narrative; the tabulated denominators (23/arm) do not fully reconcile with that stated attrition (which implies 20/arm). This should be verified against the raw dataset before submission.

Quality of life (EORTC QLQ-C30 and QLQ-CX35)

On QLQ-C30, global health status and role functioning favored dIMRT at baseline (p = 0.039 and p = 0.003), reflecting baseline imbalance between arms. By 3 months, dIMRT showed significantly better global health status (p = 0.024), physical functioning (p = 0.025), role functioning (p = 0.013), and emotional functioning (p = 0.002); social functioning favored dIMRT at 1 month (p = 0.027). No significant between-arm differences were seen in cognitive functioning, fatigue, or pain at any time point. On QLQ-CX35, dIMRT showed significantly better swallowing (p < 0.001) and social functioning (p = 0.005) at 3 months, and better sensory symptoms (p = 0.007 at baseline, p = 0.006 at 1 month) and social eating (p = 0.023 at 1 month); trouble with social contact did not differ significantly at any timepoint. The domains reaching statistical significance at 3 months are summarized in Figure 2; full baseline, 1-month, and 3-month scores for all QLQ-C30 and QLQ-CX35 domains are available from the authors on request.

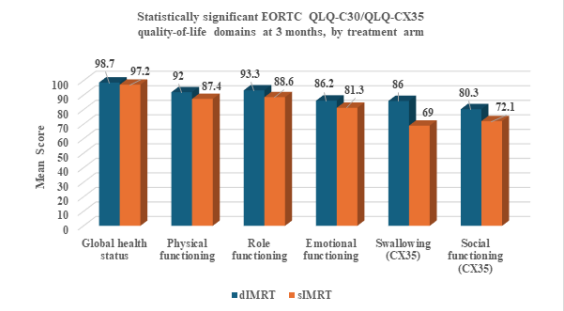


Figure 2: Statistically significant EORTC QLQ-C30/QLQ-CX35 quality-of-life domains at 3 months, by arm

Toxicity

RTOG pharyngeal and esophageal toxicity scores were comparable at baseline (0.23 dIMRT vs. 0.27 sIMRT, p = 0.751) and rose in both arms during treatment, with sIMRT significantly higher by week 6 (3.73 vs. 2.92, p < 0.001) and at 1 month (2.73 vs. 2.08, p < 0.001) and 3 months post-treatment (2.46 vs. 1.85, p < 0.001). [Table 4]

Table 4: RTOG pharyngeal and esophageal toxicity score by arm over time

Timepoint	dIMRT Mean ± SD	sIMRT Mean ± SD	p-value
Baseline	0.23 ± 0.43	0.27 ± 0.45	0.751
Week 1	0.43 ± 0.50	0.69 ± 0.47	0.392
Week 2	1.23 ± 0.51	1.50 ± 0.76	0.199
Week 3	1.73 ± 0.45	1.96 ± 0.55	0.134
Week 6	2.92 ± 0.39	3.73 ± 0.53	<0.001*
Post-treatment, 1 month	2.08 ± 0.39	2.73 ± 0.45	<0.001*
Post-treatment, 3 months	1.85 ± 0.37	2.46 ± 0.51	<0.001*

Statistically significant (p < 0.05). Weeks 4–5 data were not separately reported in the source data.

Dose to swallowing structures and correlation with dysphagia

Mean dose to the pharyngeal constrictors was significantly lower with dIMRT than sIMRT for all three primary sites: larynx (43.12 vs. 57.00 Gy, p = 0.001), hypopharynx (47.34 vs. 58.25 Gy, p < 0.001), and oropharynx (47.91 vs. 54.31 Gy, p < 0.001). Mean laryngeal dose in oropharyngeal cancer was also significantly lower with dIMRT (42.83 vs. 48.81 Gy, p < 0.05). Mean esophageal dose was significantly lower with dIMRT for hypopharyngeal cancer (37.33 vs. 53.29 Gy, p = 0.018) but did not differ significantly for laryngeal (30.72 vs. 48.00 Gy, p = 0.136) or oropharyngeal cancer (30.00 vs. 36.00 Gy, p = 0.137) (Table 5, Figure 3). Dysphagia severity correlated strongly with pharyngeal constrictor dose, most markedly the superior constrictor (p = 0.001). All 52 patients achieved a complete response by 3 months on clinical and radiological (RECIST) assessment.

Table 5: Mean radiation dose to dysphagia/aspiration-related structures (DARS) by primary site and arm

Structure / primary site	dIMRT Mean ± SD (Gy)	sIMRT Mean ± SD (Gy)	p-value
Pharyngeal constrictor – Ca larynx	43.12 ± 6.446	57.00 ± 1.414	0.001*
Pharyngeal constrictor – Ca hypopharynx	47.34 ± 2.996	58.25 ± 2.712	<0.001*
Pharyngeal constrictor – Ca oropharynx	47.91 ± 2.170	54.31 ± 2.774	<0.001*
Larynx – Ca oropharynx	42.83 ± 4.821	48.81 ± 5.120	<0.05*
Esophagus – Ca larynx	30.72 ± 9.56	48.00 ± 8.49	0.136
Esophagus – Ca hypopharynx	37.33 ± 5.03	53.29 ± 3.25	0.018*
Esophagus – Ca oropharynx	30.00 ± 8.31	36.00 ± 11.25	0.137

Statistically significant (p < 0.05).

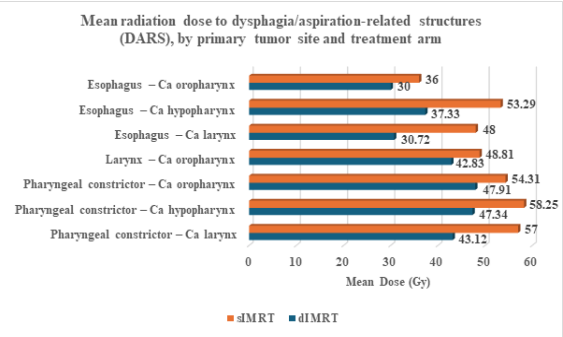


Figure 3: Mean dose to dysphagia/aspiration-related structures by primary tumor site and arm

Fifteen patients required nasogastric tube insertion during treatment, predominantly in the sIMRT arm and mostly in the 3rd or 4th week; tubes were removed 2–4 weeks post-treatment. Patient flow through enrollment, allocation, and follow-up is summarized in Figure 4.

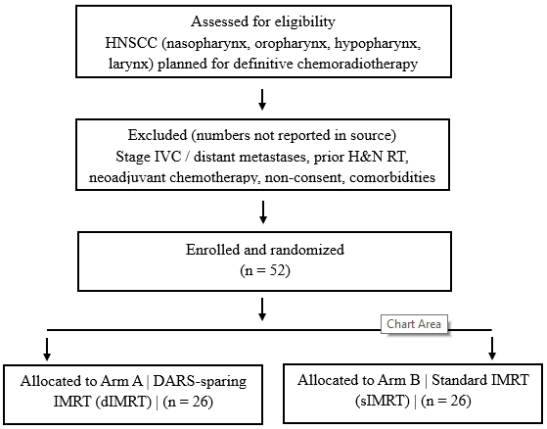
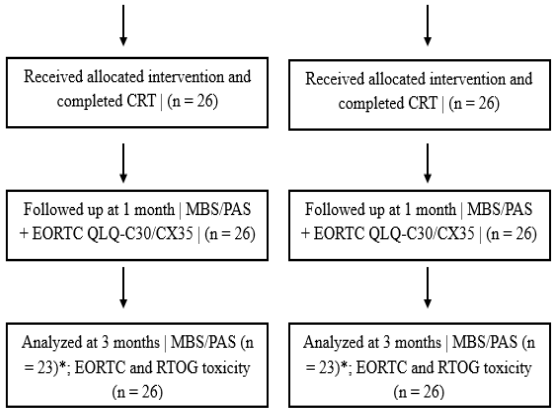


Figure 4: Patients flow through enrollment, allocation, treatment, and follow-up



*3-month MBS/PAS totals as tabulated in the source data (23/arm; 46/52 overall). The source narrative states 6 patients/arm did not repeat MBS at 3 months (20/arm); this discrepancy between narrative and tabulated n is unresolved in the source documents and should be verified against the raw dataset before submission

DISCUSSION

Loco-regionally advanced head and neck cancers were historically managed with surgery, with or without adjuvant radiotherapy, or with radiotherapy alone; only a minority of patients with advanced loco-regional disease could undergo adequate surgical resection, and survival and organ-preservation outcomes were poor. Radiotherapy alone is also often insufficient for intermediate- or advanced-stage disease. Over the past decade, concurrent chemoradiation has markedly improved survival and organ preservation, but at the cost of significant toxicity, including mucositis, xerostomia, and dysphagia. The present study examined dysphagia following head and neck radiotherapy, focusing on penetration and aspiration during the pharyngeal phase of swallowing. Eisbruch et al. (2002),[9] assessed swallowing dysfunction and aspiration after chemoradiotherapy using modified barium swallow, finding a significant rise in aspiration post-therapy (65% early, 62% late) versus pre-therapy (14%, p = 0.0002), with six cases of pneumonia. By contrast, no aspiration occurred in either arm of the present study, though dysphagia (penetration) was significantly worse with sIMRT (78.2%) than dIMRT (25.09%) and improved significantly in the dIMRT arm by 3 months, supporting the benefit of dose optimization to swallowing structures despite the relatively short (0–3-month) follow-up.

Eisbruch et al. (2004),[8] showed that dysphagia-optimized IMRT significantly reduced dose to DARS compared with standard 3D radiotherapy and standard IMRT, lowering the volume of pharyngeal constrictor receiving >50 Gy (V50) by 10% with standard IMRT and a further 10% with dysphagia-optimized IMRT (p < 0.001), with laryngeal V50 reduced by 11% (p = 0.002); no aspiration occurred in patients with mean pharyngeal constrictor dose <60 Gy. The present study reinforces these findings: constraining mean DARS dose to <50 Gy in the dIMRT arm significantly reduced dysphagia (7% vs. 18% with standard IMRT, as reported in the source thesis) and no aspiration occurred, particularly with sparing of the superior pharyngeal constrictor (p = 0.001). Eisbruch et al. (2007),[10] demonstrated a strong correlation between dose to the pharyngeal constrictors and glottic-supraglottic larynx and dysphagia severity, with aspiration occurring in patients receiving mean pharyngeal constrictor doses >60 Gy but not <50 Gy, and reduced laryngeal elevation with higher doses. The present study similarly found that maintaining mean DARS dose <50 Gy in dIMRT significantly reduced dysphagia relative to sIMRT (>50 Gy): at 1 month, penetration occurred in 17 sIMRT patients versus 6 dIMRT patients (p < 0.001), and at 3 months dysphagia was significantly lower with dIMRT (25.09%) than sIMRT (78.2%). Mean doses to DARS structures in the present dIMRT arm were

pharyngeal constrictors 47.34 Gy, glottic-supraglottic larynx 42 Gy, esophagus 37 Gy, which were comparable to those reported by Eisbruch et al,[10] (49, 47, and 41 Gy, respectively) and significantly lower than in the sIMRT arm. Post-treatment dysphagia, characterized by food pooling and aspiration risk, was significantly reduced with dIMRT. By 4 weeks post-treatment, most patients showed food pooling at the base of tongue, valleculae, and pyriform sinus requiring additional swallowing maneuvers, improving by 10 weeks. These findings emphasize the value of optimizing dose to DARS structures. Eisbruch and colleagues also assessed dysphagia subjectively using HNQOL and UWQOL questionnaires, reporting significantly worse dysphagia scores at 3 months versus baseline ($p < 0.001$); the present study similarly found no significant between-arm difference in overall QoL at baseline, but by 3 months dIMRT showed significant improvement in global QoL ($p = 0.04$), physical functioning ($p < 0.025$), role functioning ($p = 0.013$), and emotional functioning ($p = 0.002$), with non-significant improvements in global health, cognitive and social functioning, fatigue, nausea/vomiting, and pain in both arms.

Using QLQ-CX35 scales, the present study found significant improvement in swallowing function ($p < 0.001$) and speech problems ($p = 0.005$) at 1 and 3 months post-treatment with dIMRT relative to sIMRT, with non-significant trends in pain, social eating, social contact, and sexuality. These findings are consistent with Nguyen et al,[11] who reported significant declines in QoL domains including swallowing, speech, and pain in patients with dysphagia after head and neck cancer treatment. The present study further found significantly lower grade IV toxicity during weeks 4–6 and less grade II dysphagia at 1 and 3 months with dIMRT.

Prophylactic nasogastric tube insertion was not performed in this study, given the continued debate over its role during head and neck radiotherapy. While nutritional support can reduce weight loss and severe mucositis, as shown by Rabinovitch et al.[12] (RTOG 90-03), it may also be associated with worse 5-year loco-regional control and long-term swallowing dysfunction from muscle atrophy and pharyngeal fibrosis related to disuse. In this study, 15 patients required nasogastric feeding, mainly during the 3rd or 4th week, while being encouraged to continue oral intake; swallowing exercises were not initiated before treatment, but nearly all patients were referred to a speech and swallowing pathologist for rehabilitation after treatment, and most tubes were removed 3–4 weeks post-treatment.

Prophylactic swallowing exercises have been shown to improve swallowing function at 3 and 6 months post-chemoradiotherapy (Kotz et al,[13]) and pretreatment swallowing education and exercises have been shown to enhance dysphagia-specific QoL (Kullberg et al.). Swallowing exercises were not advised before or during treatment in the present cohort; incorporating such techniques, especially in centers without access to conformal radiotherapy, could further improve QoL and swallowing outcomes. Agarwal et al,[14] assessed swallowing dysfunction with modified barium swallow before and after chemoradiotherapy, finding pooling in 23% of patients pre-treatment, rising to 48% at 2 months post-treatment, with aspiration in 23%; acute mucositis worsened early dysphagia and late pharyngeal toxicity impaired swallowing through 6 and 12 months. Similarly, the present study observed increased swallowing dysfunction (penetration) at 1 month post-treatment, 23.0% (6/26) in dIMRT versus 65.3% (17/26) in sIMRT, with significant improvement in dIMRT by 10–12 weeks.

This study demonstrates that swallowing dysfunction is a significant source of morbidity after chemoradiation for head and neck cancer. Its limitations include the relatively small sample and short follow-up (0–3 months); the internal inconsistencies identified in the 3-month MBS/PAS denominators and in the reported swallowing p-value at 1 month (Table 4 of the source manuscript) could not be resolved from the available source documents and should be checked against the raw dataset before submission. Larger studies with longer follow-up are warranted to confirm these findings.

CONCLUSION

Dysphagia is a common and serious complication of radiotherapy for head and neck cancer, often associated with silent aspiration and risk of aspiration pneumonia. Its severity correlates significantly with radiation dose to the swallowing structures, particularly the superior pharyngeal constrictor ($p = 0.001$). Compared with standard IMRT, DARS-sparing IMRT significantly reduced dysphagia incidence (7% vs. 18%, as reported in the source thesis) without compromising target coverage, underscoring the value of dose optimization to critical swallowing structures in improving outcomes for patients undergoing chemoradiotherapy for head and neck cancer.

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Author Contributions

Dr Basavaraj H - Conceptualization, surgical procedures, data collection, manuscript drafting, and final approval.

Dr VinayakChavan - Data collection, manuscript drafting, data analysis

Dr Savitha A K- Data collection, manuscript drafting

Dr M G Giriyappagoudar - Data collection, manuscript drafting, data analysis

Conflicts of Interest

The authors declare that they have no competing interests. There are no financial or personal relationships with other people or organizations that could inappropriately influence or be perceived to influence this work.

Ethical Approval

The study was conducted in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Approval was obtained from the Institutional Ethics Committee of Apollo Health City, Jubilee Hills, Hyderabad. Written informed consent was obtained from all individual participants included in the study.

Informed Consent

Written informed consent was obtained from all patients for radiation treatment and use of anonymized clinical photographs for academic and publication purposes.

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