

The Influencing Factors for Adaptive Radiotherapy (ART) in Head and Neck Cases: Single Center Experience

Jie See Yong, Hui Sin Ng, John Seng Hooi Low, Jennifer Siew Mooi Leong,
Ivan Yee Siang Shew, Hafizah Zaharah, Nik Aslan Abdullah
Cancer Centre, Sunway Medical Centre, Selangor, Malaysia.

Purpose/Objective

Intensity-modulated radiotherapy (IMRT) and volumetric-modulated arc therapy (VMAT) with daily-imaging guidance are frequently used as the standard in treating head and neck squamous cell carcinoma (HNSCC). However, anatomical changes that happen throughout the treatment course may cause significant impact to the efficacy of treatment, and at the same time may lead to serious toxicity as they cause increased dose to the organ at risk (OAR).

Hence, adaptive radiotherapy (ART) is needed in order to reduce the effect of the dosimetric change resulting from the anatomical variation during the course of radiotherapy. However, some studies displayed that not every patient benefits from ART. Rescanning the patient and replanning might be time-consuming and may cause considerable effects on departmental workload. Therefore, identifying the influencing factors are crucial.

This study aims to define the influencing factors for ART, predict an effective replan time frame, in order to maximize the clinical benefits of ART.

Materials/Methods

SUBJECT INCLUSIVE CRITERIAS

91 H&N cancer patients who underwent ART

From year 2021 to 2023

Tomohelical & VMAT treatment techniques

33 to 35 fractions with 2.00 to 2.12 Gy per fraction

VARIABLES

% difference between initial weight and weight during re-simulation

Neck separation at the level of C1, C3 and C4/5 vertebrae

% difference of planned and projected parotid glands mean dose

% difference of planned and projected spinal cord maximum dose

RE-SIMULATION FRACTION

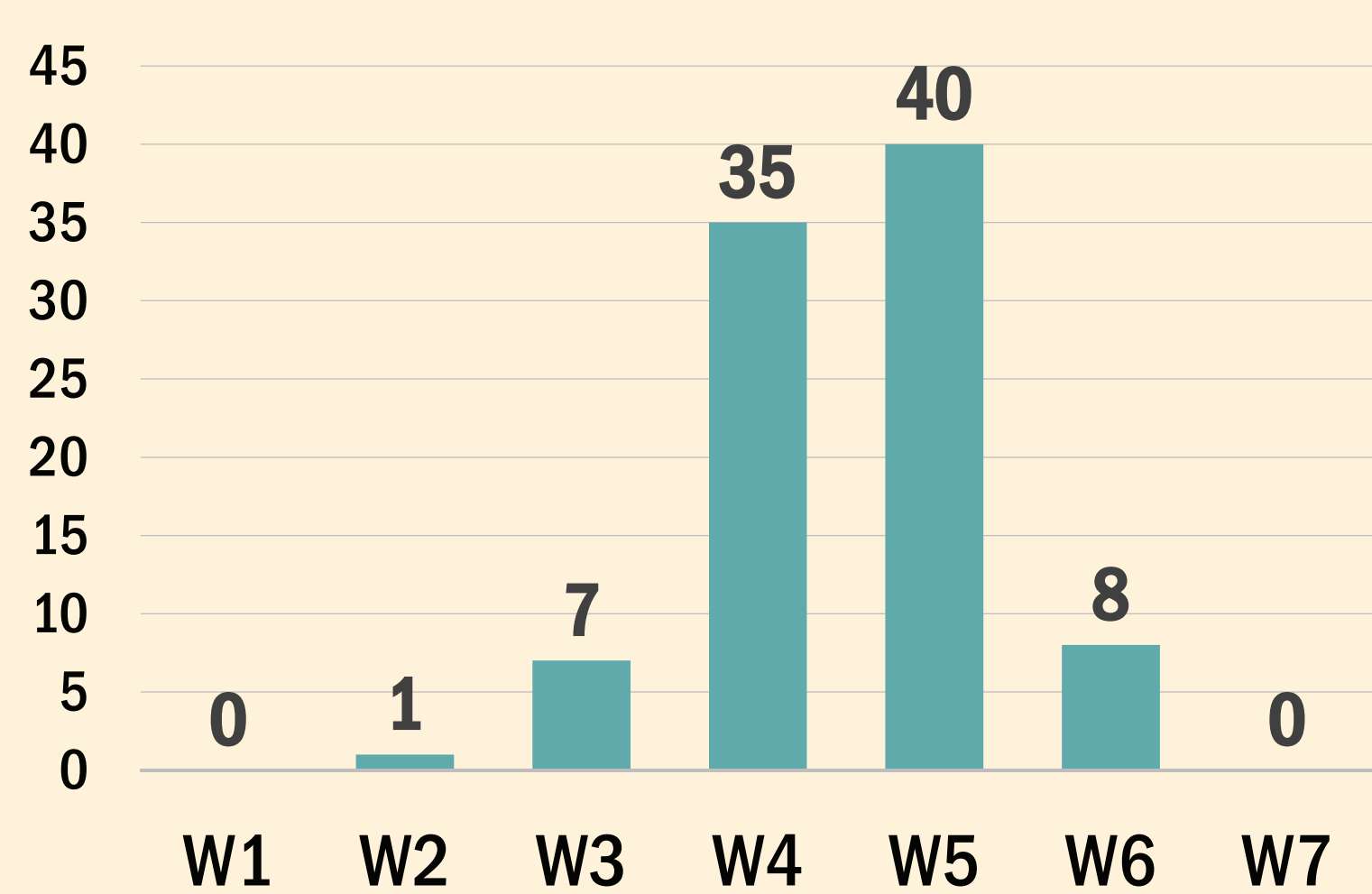


Figure 1: Most of our patients underwent re-simulation on the 4th and 5th week.

WEIGHT LOSS DURING RE-SIMULATION

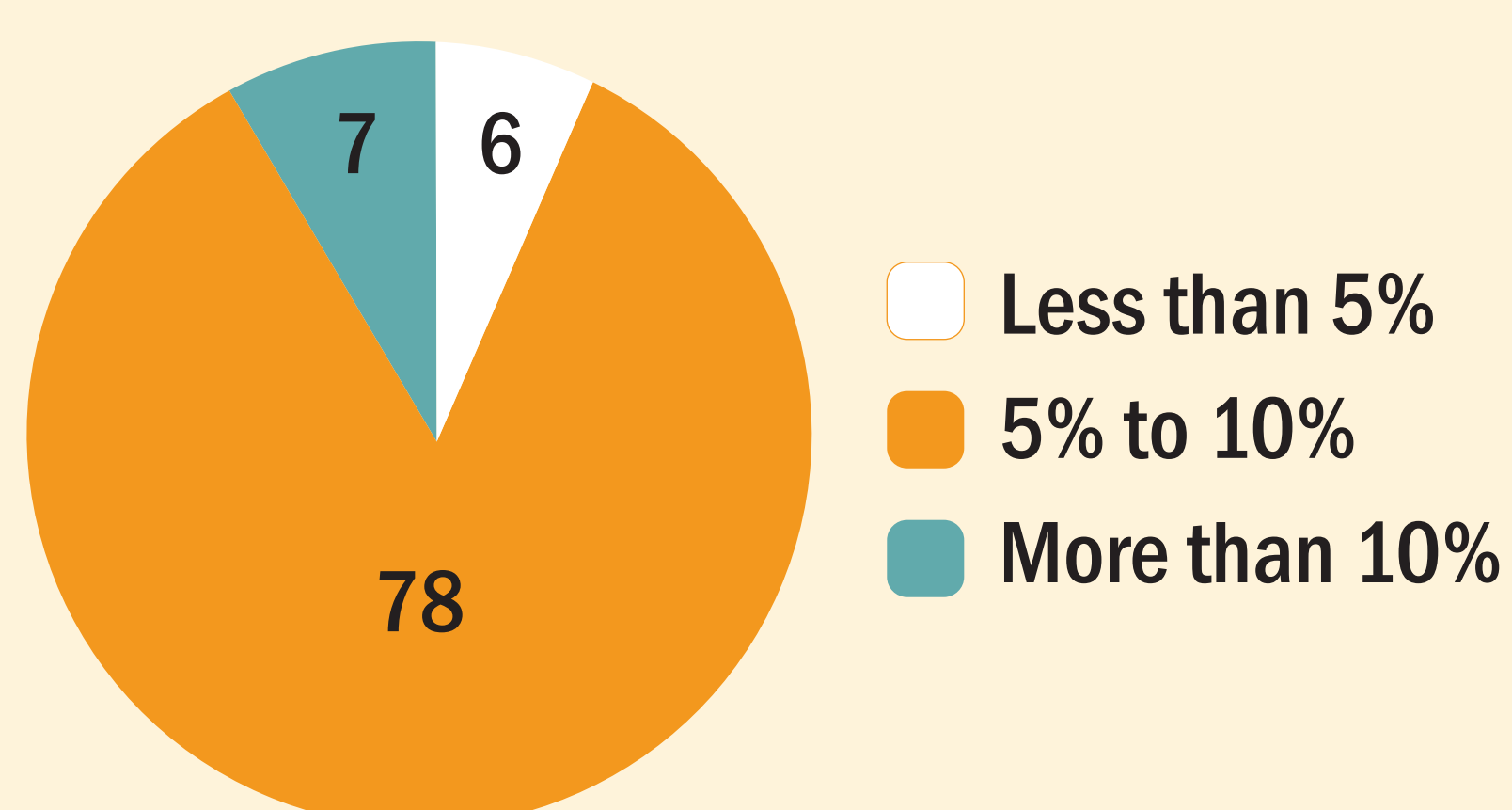


Figure 2: Most of our patients loss 5 - 10% of their initial weight during re-simulation, with the mean of 5.6kg.

Results

NECK SEPARATION

	Left Neck	Right Neck
At level of C1		
≤ 0.5cm	34 (38%)	31 (34%)
0.5cm - 1.0cm	44 (48%)	51 (56%)
≥ 1cm	13 (14%)	9 (10%)
At level of C3		
≤ 0.5cm	38 (42%)	37 (41%)
0.5cm - 1.0cm	46 (51%)	52 (57%)
≥ 1cm	7 (8%)	2 (2%)
At level of C4/5		
≤ 0.5cm	58 (64%)	61 (67%)
0.5cm - 1.0cm	29 (32%)	28 (31%)
≥ 1cm	4 (4%)	2 (2%)

	Left Neck			Right Neck		
Level	C1	C3	C4/5	C1	C3	C4/5
Mean (cm)	0.6	0.6	0.4	0.6	0.5	0.4

Figure 3 : The highest mean of neck separation between pre-treatment CT and daily imaging (MVCT/CBCT) prior re-simulation was 0.6cm.

SPINAL CORD DOSE VARIATION

Spinal Cord	Variation	No. of patients
Dose Reduction	Range from 0.36%-24.16%	16 (17.6%)
Dose Increment	Range from 0.06%-18.80%	75 (82.4%)

PAROTID DOSE VARIATION

Right Parotid	Variation	No. of patients
Dose Reduction	Range from 0.46%-6.81%	6 (6.6%)
Dose Increment	Range from 0.00%-19.68%	85 (93.4%)

Right Parotid	Variation	No. of patients
Dose Reduction	Range from 0.14%-22.26%	8 (8.8%)
Dose Increment	Range from 0.00%-30.72%	83 (91.2%)

Figure 4: Most of the patients experienced an increased projected spinal cord and parotid doses from their daily imaging before re-simulation. The projected doses were collected using ART Assist MIM software.

Conclusion

Weight loss and neck anatomical variation which can be detected by the radiation therapists would be the primary triggering factors for ART followed by the dosimetric change of parotid glands and spinal cord.

A good collaboration between the oncologists and allied-health professionals is imperative in detecting the needs of ART. Close monitoring on anatomical variation in H&N radiotherapy patients should be started on the 3rd week of treatment in order to track and trace the ideal time for re-simulation.

References

- Burton, A., Beveridge, S., Hardcastle, N., Lye, J., Sanagou, M. and Franich, R., 2022. Adoption of respiratory motion management in radiation therapy. *Physics and Imaging in Radiation Oncology*, 24, pp.21-29.
- Jean-Pierre Bissonnette; Kevin N. Franks; Thomas G. Purdie; Douglas J. Moseley; Jan-Jakob Sonke; David A. Jaffray; Laura A. Dawson; Andrea Bezjak (2009). Quantifying Interfraction and Intrafraction Tumor Motion in Lung Stereotactic Body Radiotherapy Using Respiration-Correlated Cone Beam Computed Tomography. ,75(3),688695. doi:10.1016/j.ijrobp.2008.11.066
- Meyers SM, Kisling K, Atwood TF, Ray X. A standardized workflow for respiratory-gated motion management decision-making. *J Appl Clin Med Phys*. 2022; 23:e13705. <https://doi.org/10.1002/acm2.13705>
- Molitoris, J.K., Diwanji, T., Snider III, J.W., Mossahebi, S., Samanta, S., Onyeuku, N., Mohindra, P., Choi, J.I. and Simone, C.B., 2019. Optimizing immobilization, margins, and imaging for lung stereotactic body radiation therapy. *Translational lung cancer research*, 8(1), p.24.
- Qi, Y., Li, J., Zhang, Y., Shao, Q., Liu, X., Li, F., Wang, J., Li, Z. and Wang, W., 2021. Effect of abdominal compression on target movement and extension of the external boundary of peripheral lung tumours treated with stereotactic radiotherapy based on four-dimensional computed tomography. *Radiation Oncology*, 16(1), pp.1-8.