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Dose Objectives for Head and Neck IMRT Treatment Planning

Recommendation Report

A project developed by the Head and Neck Community of Practice of the Radiation Treatment Program of Cancer Care Ontario
for circulation to Regional Cancer Programs.

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INTRODUCTION

Scope

This recommendation report is intended for head and neck radiation therapy treatment, utilizing intensity modulated radiation therapy. As written, this report is applicable to 2 Gy per fraction treatments, with target coverage goals for a prescription of 70 Gy in 35 fractions to the high dose target volume, with intermediate dose and low dose disease target volumes receiving 63 Gy and 56 Gy, respectively, in 35 fractions.

Intended Users

These recommendations are for radiation oncologists, physicists, dosimetrists and therapists specializing in the management of head and neck cancer for the purpose of IMRT treatment planning. This document is not intended to be used as an educational or training tool.

METHODS

Development of Recommendations

This report was developed by a Working Group, which was established by the Cancer Care Ontario (CCO) Head and Neck Community of Practice (CoP). Current clinical practice, clinical trial protocols and other peer-reviewed literature were considered during the development process. The acceptability criteria for target coverage and dose limits for normal tissues at risk described in this report are based on criteria in place at the Princess Margaret Cancer Centre and recommended by the working group.

The final recommendations were formulated as follows:

1. Based on consensus from current practice in the province (please see Appendix A)
2. In the absence of consensus (few centres reporting a guideline for a specific structure or dose criteria and/or a large range in reported dose), clinical trials and other values reported in the literature [1-20] were also considered by the working group.

RESULTS

Recommended Dose Objectives

This section contains recommended dose objectives for a radiation treatment plan. These recommendations may not be rigidly applicable in all clinical scenarios.

A. Target Coverage

- The recommendations of Table 1, are to be met, unless coverage must be compromised due to dose limits imposed by a high priority dose limiting structure or other clinical considerations
- Assumption is that the PTV contours being evaluated for coverage have been restricted from the skin surface

Table 1. Recommendations for Plan Evaluation of Target Coverage.

Region of Interest	Dosimetric Parameter	Recommended Dose Coverage (Gy)
Targets		
(R|L)[H](node level)PTV70*	Minimum D95%	70
	Maximum D20%	77
	Minimum D99%	66.5
	Maximum Dose	80.5
	Maximum Mean Dose	73.5
(R|L)[H](node level)PTV63*	Minimum D95%	63
	Minimum D99%	59.8
(R|L)[H](node level)PTV56*	Minimum D95%	56
	Minimum D99%	53.2

*See Contouring Nomenclature Recommendation Report

B. Normal Tissues

- Recommended dose limits for the structures included in Table 2 may need to be exceeded to achieve the recommended values for acceptable target coverage, depending upon the clinical context. The clinical context is always an evaluation by a head and neck radiation oncology expert and this may require discussion and acceptance by the patient.
- Achievement of the recommended dose limits does not necessarily represent an acceptable plan
- The goal of the treatment plan should be to reduce doses below recommended limits when possible, depending upon patient and tumour geometry and the clinical context
- Planning risk volumes (PRV) are not included in Table 2. These regions of interest can be a mechanism for optimization, however, definition is centre-specific, and as they do not represent an anatomical structure, there have been no attempts to define criteria for these volumes.

Table 2. Recommendations for Normal Tissue Dose Objectives

Region of Interest	Dosimetric Parameter	Recommended Dose Limit (Gy)
Spinal Cord	Maximum Dose	48
Spinal Cord	Maximum D0.1cc	45
Brainstem	Maximum Dose	54
Brainstem	Maximum D0.1cc	50
Optic Chiasm	Maximum Dose	50
Right or Left Optic Nerve	Maximum Dose	50
Oral Cavity	Maximum Mean Dose	40
Brain	Maximum Dose	60
Brachial Plexus	Maximum Dose	63
Right or Left Parotid	Maximum Mean Dose	26
Right or Left Parotid	Maximum D50%	30
Combined Parotids	Maximum D20cc	20
Pharyngeal Constrictors	Maximum Mean Dose	50
Mandible	Maximum D0.1cc	70
Mandible within the PTV	Maximum D0.1cc	75
Larynx	Maximum D67%	50
Larynx	Maximum Mean Dose	45
Esophagus	Maximum Mean Dose	45
Lips	Maximum Dose	30
Orbit	Maximum Dose	45
Lens	Maximum Dose	5
Lacrimal Glands	Maximum Dose	30
Anterior Chamber	Maximum Dose	25
Acoustic Structures (Nerve, Cochlea, Inner or Middle Ear)	Maximum Dose	45

DISCUSSION AND CONCLUSIONS

IMRT planning is by definition a complex process of weighing of parameters to achieve an acceptable treatment plan for each patient. As such it may be necessary to exceed tolerance doses for the normal tissues in Table 2 to ensure appropriate coverage of the disease. However, exceeding these constraints will increase the risk of early and late side effects. This may be clinically necessary and should be carefully considered.

This document presents a set of acceptability criteria for target coverage and dose limits for normal tissues at risk. The list of acceptability criteria are based on consensus of practice amongst the nine

cancer centres in the province that provided their criteria to the working group (Appendix A). When consensus was not achieved amongst the group further guidance was sought from the literature [1-20]. Readers are also encouraged to refer to the literature for further guidance when considering deviating from the recommendations that are presented in this report.

It is CCO's intention to disseminate this report to the Regional Cancer Programs and advisory committees within the province and to make the document available to Ontario healthcare providers on the CCO website (www.cancercare.on.ca).This report will be reviewed on a regular basis to determine whether the information is still accurate and relevant to current practice and revised accordingly.

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DISCLAIMER

- This recommendation report was developed by a working group of the Head and Neck Community of Practice of the Radiation Treatment Program of Cancer Care Ontario. The working group was comprised of head and neck radiation treatment professionals belonging to the disciplines of radiation oncology, medical physics, and radiation therapy. The material presented in this recommendation report illustrates the consensus reached among members of the Head and Neck Community of Practice and may not reflect current practice at all Ontario cancer centres. All approaches to treatment are subject to clinical judgment and actual practice patterns may not follow the material outlined in this report.
- This recommendation report may not reflect all the available scientific research and is not intended as an exhaustive report. CCO and Head and Neck Community of Practice members assume no responsibility for omissions or incomplete analysis resulting from this recommendation report. It is possible that other relevant scientific findings may have been reported since completion of this recommendation report. This recommendation report may be superseded by an updated publication on the same topic.
- This recommendation report is not a clinical guideline or practice standard, and was *not* developed in collaboration with CCO's Program in Evidence-Based Care (PEBC). Evidence-based guidelines for head and neck cancer are available through the PEBC.
- This recommendation report is intended to be used for informational purposes only, by radiation treatment professionals. It is not intended to constitute or be a substitute for medical advice and should not be relied upon in any such regard. Any person seeking to apply this recommendation report is expected to use independent medical judgment in the context of individual clinical circumstances or seek out the supervision of a qualified clinician. CCO and Head and Neck Community of Practice members make no representation or guarantee of any kind whatsoever regarding the content, use, or application of this recommendation report and disclaim any responsibility for its application or use in any way.

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APPENDIX A

Summary of Current State of Assessment for Head and Neck Dose Objectives

Members of the CoP were asked to provide the dosimetric parameters currently used in their clinic to assess plan acceptability for head and neck IMRT treatment planning, for both target coverage as well as limits for organs at risk (OAR). Ten provincial cancer centres are represented in the CoP, and nine centres provided documentation. The tenth centre had no guidelines for head and neck IMRT specifically, referring to the literature for OAR dose limits. One centre provided guidelines for OAR only. Several centres (5) have used the HN.6 [18] protocol as a reference or starting point.

Tables 1 and 2 contain the results of the current state of assessment survey for the province, for target coverage and normal tissue dose limits respectively. Included are the dosimetric parameters, the range of values currently used in practice, as well as the number of centres that reported using that parameter for their institutional practice. Guidelines for one centre did indicate the possibility to increase slightly the dose limits for some structures in exceptional cases. Those limits are not included in the table. This summary does not account for any differences in contouring practice for any of the structures listed, and does not specify the nature of the planning target volume (PTV) that is used for evaluation purposes (i.e. retraction of the contour from the patient's external contour). Inter-centre variability in contouring guidelines have not been accounted for in this report.

Table A1. Current planning objectives for target coverage for head and neck IMRT planning in the province for radical treatment of 70 Gy in 35 fractions. The planning target volume (PTV) is indicated by the dose level in Gy which was prescribed.

Region of Interest	Dosimetric Parameter	Dose Range Reported	# of Centres Reporting on this Criterion	References
Targets				
PTV70	Minimum D95%	66.6-70Gy	6/8	[18]
	Maximum D20%	73.5-77 Gy	6/8	[18]
	Minimum D99%	65.1-66.5 Gy	7/8	[18]
	Maximum Dose	77-80.5 Gy	7/8	[18]
	Mean Dose	72.1-73.5 Gy	6/8	[18]
PTV63	Minimum D95%	59.85-63 Gy	4/8	[18]
	Minimum D99%	58.6 Gy	4/8	[18]
	Maximum Dose	73.5-77 Gy	5/8	[18]
PTV56	Minimum D95%	53.2-56 Gy	6/8	[18]
	Minimum D99%	53.2 Gy	6/8	[18]
	Maximum Dose	77 Gy	5/8	[18]
CTV56	Minimum D98%	56 Gy	3/8	

Table A2. Current planning objectives for normal structures for head and neck IMRT planning in the province. (PRV – Planning Risk Volume)

Region of Interest	Dosimetric Parameter	Dose Range Reported	# of Centres Reporting on this Criterion	References for ROI
Normal Tissues				
Oral Cavity	Mean Dose	40 Gy	2/9	[9, 15, 17]
Brain	Maximum Dose	60-70 Gy	4/9	[9, 15, 18]
Right or Left Parotid	Mean Dose	26 Gy	9/9	[3, 4, 8, 9, 13, 15, 18]
Right or Left Parotid	Maximum D50%	30 Gy	9/9	1, 2, 4-6][3]
Combined Parotids	Maximum D20cc	20 Gy	3/9	[3, 4, 8, 9, 13, 15, 18]
Spinal Cord	Maximum Dose	45-49 Gy	8/9	[7, 8, 13, 17, 18]
Spinal Cord	Maximum D0.1cc	45	7/9	[4, 7, 8, 13, 17, 18]
Spinal Cord PRV	Maximum D0.1cc	52	8/9	[9, 17, 18]
Brainstem	Maximum Dose	54	8/9	[4, 8, 18]
Brainstem	Maximum D0.1cc	50	6/9	[18]
Brainstem PRV	Maximum D0.1cc	60	7/9	[18]
Mandible	Maximum D0.1cc	70-75 Gy	8/9	[4, 8, 9, 15, 18]
Mandible within the PTV	Maximum D0.1cc	70-75 Gy	4/9	[18]
Larynx	Maximum D67%	50-52	5/9	[4, 5, 8, 9, 13-18]
Larynx	Mean Dose	45 Gy	5/9	[4, 5, 8, 9, 13-18]
Larynx	Max Dose (0.1cc)	50-52	2/9	[4, 5, 8, 9, 13-18]
Esophagus	Maximum D0.1cc	50 Gy	1/9	[9, 20]
Esophagus	Mean Dose	45 Gy	1/9	[9, 20]
Postcricoid Esophagus	Maximum D67%	50 Gy	1/9	[9, 20]
Postcricoid Esophagus	Mean Dose	45 Gy	1/9	[9, 20]
Brachial Plexus	Maximum Dose	60-66 Gy	5/9	[13, 15, 17, 18]
Lips	Maximum Dose	18-30 Gy	3/9	
Optic Chiasm	Maximum Dose	45-54 Gy	6/9	[8, 10, 18]
Optic Chiasm PRV	Maximum Dose	56 Gy	1/9	
Right or Left Optic Nerve	Maximum Dose	45-50 Gy	6/9	[8, 10, 18]
Optic Nerve PRV	Maximum Dose	54 Gy	1/9	
Orbit	Maximum Dose	45 Gy	5/9	[8, 10, 15, 18]
Lens	Maximum Dose	5-25 Gy	4/9	[15]
Lacrimal Glands	Maximum Dose	25 Gy	1/9	[6, 11, 12, 19]
Anterior Chamber	Maximum Dose	25 Gy	1/9	

Acoustic Nerve	Maximum Dose	25-45 Gy	2/9	[1]
Inner Ear/cochlea	Maximum Dose	40-45 Gy	3/9	[1, 8, 15]
Middle Ear	Maximum Dose	45 Gy	2/9	[1, 8]
Unspecified Tissue	Maximum D5%	70 Gy	1/9	[9, 13, 15, 18]
Unspecified Tissue	Maximum D1%	77 Gy (1 Centre: Maximum Dose of 73.5 Gy)	6/9	[9, 13, 15, 18]
Midline	Mean Dose	40-50 Gy	2/9	[18]
Midline	Maximum Dose	60 Gy	3/9	[18]