Supplementary Information

S1 Additional Manually Delineated AuxROI Required for PPN

1. Overview

The following details the additional anatomically related BowelBagRegion volume which was manually delineated for all patients prior to automated plan generation.

2. AuxROI Purpose

Bowel is delineated as standard for all patients treated at our centre. During the course of treatment bowel may move within the abdominal cavity and fall outside regions spared by the IMRT/VMAT optimiser. Our clinical practice is therefore to delineate an AuxROI which corresponds to the abdominal cavity, and reduce dose to this region during the optimisation. This ensures that dose is minimised across the whole abdominal cavity and therefore plans are more robust to bowel movement during treatment. BowelBagRegion is delineated manually and does not need to be accurately defined to fulfil its purpose.

3. AuxROI Delineation

Abdominal cavity and tissue anterior to the cavity delineated. Inferior boundary defined as two slices superior to PTV60 and superior boundary defined as at least two slices superior to PTV44. Delineated volume retracted from skin surface and all PTVs to create final ROI (Fig. S1).

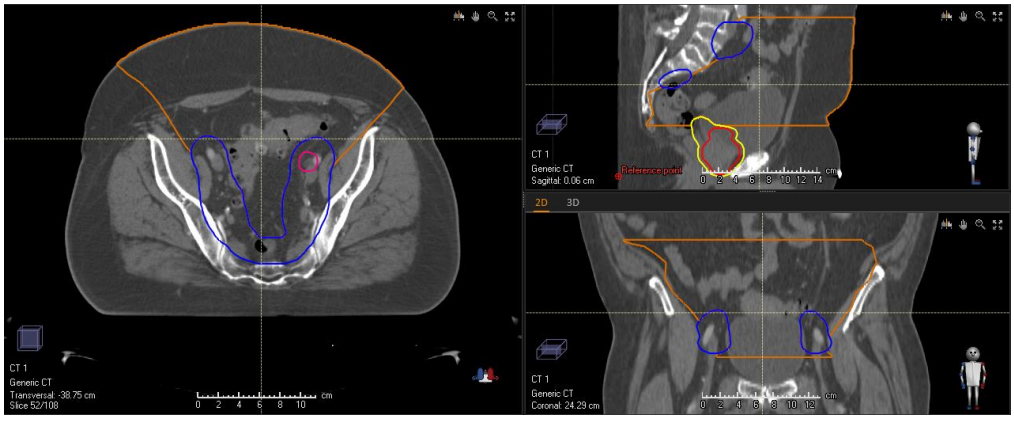

Fig. S1.~~1~~ Example BowelBagRegion AuxROI (Brown) required for PPN automated planning. PTV60 (red), PTV50 (pink), PTV48 (yellow) and PTV44 (blue) ROIs are also shown.

S2 Local Clinical Planning Goals for PSV and PPN

Table S2
Local Clinical Planning Goals for PSV and PPN

Priority 1: Primary OAR Objectives

ROI Name	Dose Parameter	Actionable*
Bowel	D0.1 cm^3	≤52.7 Gy

Priority 2: Target and Max Dose Objectives

ROI Name	Dose Parameter	Actionable*
All PTVs	D99%	≥95% of PTV prescription
Patient Outline	D1.8 cm^3	≤107% of Prescribed Dose

Priority 3: Secondary OAR Objectives

ROI Name	Dose Parameter	Optimal	Actionable*
Rectum	V24.3 Gy	≤80%	-
Rectum	V32.4 Gy	≤65%	-
Rectum	V40.5 Gy	≤50%	≤60%
Rectum	V48.6 Gy	≤35%	≤50%
Rectum	V52.7 Gy	≤30%	≤30%
Rectum	V56.8 Gy	≤15%	≤15%
Rectum	V60.8 Gy	≤3%	≤5%
Bladder	V40.5 Gy	≤50%	-
Bladder	V48.6 Gy	≤25%	-
Bladder	V52.7 Gy	-	≤50%
Bladder	V56.8 Gy	≤5%	≤35%
Bowel	V36.5 Gy	≤78 cc	≤158 cc
Bowel	V40.5 Gy	≤17 cc	≤110 cc
Bowel	V44.6 Gy	≤14 cc	≤28 cc
Bowel	V48.6 Gy	≤0.5 cc	≤6 cc
Bowel	V52.7 Gy	≤0.0 cc	≤0.0 cc

*Deviations from actionable planning goals are permissible if approved by the treating oncologist.

S3 Planning goals for the PPN AutoPlan Protocol

Table S3

Planning goals for the PPN AutoPlan protocol

Priority 1: Primary OAR Goals

ROI Name	Dose Parameter	Target (Gy)
Bowel_1mm	Dmax	51.0

Priority 1: Primary Conformality Goals

ROI Name	Dose Parameter	Target (Gy)	Distance (cm)
PTV48	Dmax	43.2	1.5
PTV44	Dmax	37.4	1.5

Priority 2: Target Goals

ROI Name	Dose Parameter	Target ($\%_{Presc,PTV}$)
PTV60	Dmin	96.5
PTV60	Dmax	102.5
PTV60	D50% max	99.5
PTV50	Dmin	96.5
PTV50	Dmax	102.5
PTV48	Dmin	96.8
PTV48	Dmax	105.0
PTV44	Dmin	96.8
PTV44	Dmax	102.7

Priority 3: Trade-off Goals (Standard)

ROI Name	Dose Parameter	Target (Gy or $\%_{Vol}$)	Group
Rectum	V23.4Gy (%)	0.0	12
Rectum	V31.5Gy (%)	0.0	12
Rectum	V39.6Gy (%)	0.0	1
Rectum	V47.7Gy (%)	0.0	1
Rectum	V51.8Gy (%)	0.0	1
Rectum	V55.9Gy (%)	0.0	1
Rectum	Dmax (Gy)	58.8	1
Rectum	Dmean (Gy)	5.0	2
Bladder	V24.0Gy (%)	0.0	3
Bladder	V31.8Gy (%)	0.0	3
Bladder	V39.6Gy (%)	0.0	3
Bladder	V47.7Gy (%)	0.0	3
Bladder	V51.8Gy (%)	0.0	3
Bladder	Dmax (Gy)	55.9	3
Bowel	V36.0Gy (%)	0.0	6
Bowel	V40.9Gy (%)	0.0	6
Bowel	V43.8Gy (%)	0.0	6
Bowel	Dmax (Gy)	48.6	6
BowelBagRegion	V19.8Gy (%)	0.0	11
BowelBagRegion	V28.8Gy (%)	0.0	11
BowelBagRegion	V36.0Gy (%)	0.0	8
BowelBagRegion	V40.9Gy (%)	0.0	8
BowelBagRegion	V43.8Gy (%)	0.0	8
BowelBagRegion	V48.6Gy (%)	0.0	8

Priority 3: Trade-off Goals (Dose Fall Off)

ROI Name	Fall Off Type	High Dose Level (Gy)	Low Dose Level (Gy)	Dose Gradient ($\%_{Presc}$ cm^{-1})	Group
PTV48	Normal Tissue Falloff	54.0	36.5	50.0	4
PTV48	Intra PTV Falloff	54.0	52.8	50.0	5
PTV48	Normal Tissue Falloff (Inf)	54.0	31.2	50.0	13
PTV44	Normal Tissue Falloff	54.0	33.4	50.0	9
PTV44	Normal Tissue Falloff	54.0	39.6	50.0	14
PTV44	Intra PTV Falloff	54.0	44.9	50.0	15

Abbreviations: $\%_{Presc,\ PTV}$ = % of individual PTV prescription dose; $\%_{Presc}$ = % of overall treatment prescription; $\%_{Vol}$ = % volume of ROI.

Notes: Bowel_1mm ROI generated automatically by EdgeVcc through isotropic expansion of Bowel ROI by 1mm. Priority 3 target = 0.0 by default, but can be specified if desired. The target is dynamically adjusted during optimisation and therefore initial values have negligible impact plan quality, but may decrease planning time if correctly defined.

S~~3~~4 Post Calibration Nominal Weights for PPN AutoPlan Protocol

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Table S~~3~~4

Nominal weights (w_n) for the calibrated PPN AutoPlan protocol planning goals

Priority	Type/Group	w_n*
Priority 1	Primary OAR Goals	1000
	Primary Conformality Goals**	1000
Priority 2	Target Goals	250
Priority 3	Group 1	1.23
	Group 2	4.65
	Group 3	0.500
	Group 4	70.0
	Group 5	1.73
	Group 6	6.30
	Group 7	7.78
	Group 8	24.00
	Group 9***	365
	Group 10	0.800
	Group 11	24.0
	Group 12	5.00
	Group 13	1.26
	Group 14***	31.9
	Group 15	4.27

* Rounded to 3 significant figures

**Nominal weight manually increased during PPN calibration to match Primary OAR nominal weight

***For PTV44 normal tissue fall off goals, the final dynamically adjusted weight was observed to be orders of magnitude smaller than the initial weights (w_i) loaded into the optimiser. This discrepancy was reduced by setting the constant F_N to 0.01. Details of F_N are provided by wheeler *et al* [1]

S45 Supplementary Information References

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[1] Wheeler PA, Chu M, Holmes R, Smyth M, Maggs R, Spezi E, et al. Utilisation of Pareto navigation techniques to calibrate a fully automated radiotherapy treatment planning solution. Phys Imag Radiat Oncol 2019;10:41–8. doi:10.1016/j.phro.2019.04.005.