

Scottish Medical Physics and Clinical Engineering Training Scheme (SMPCETS) Open Day

Radiotherapy

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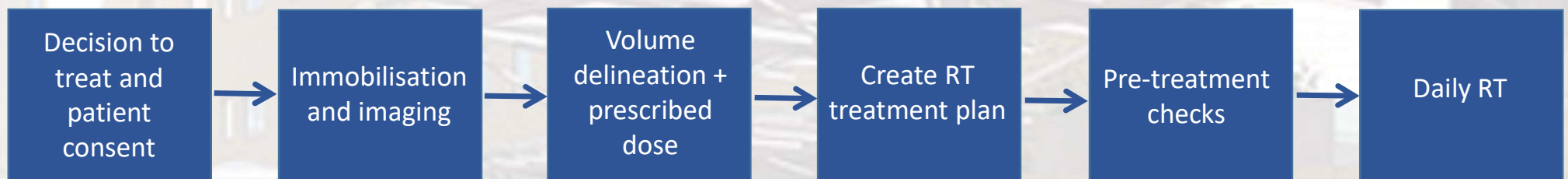


The Beatson West of Scotland Cancer Centre

- The Beatson is one of the largest cancer centres in the UK/Europe and serves around 60% of the Scottish population.
 - 2.5 million people across the West of Scotland working with five health boards.
 - Around 6,500 patients attend the radiotherapy department here in Glasgow each year, as part of their treatment for cancer.
 - A leader in many areas of cancer research and treatment.
- The Beatson is home to eleven linear accelerators (linacs), three CT scanners, two PET-CT scanners, diagnostic MRI scanner.
 - Treatment planning MRI scanner
 - Satellite centre in Lanarkshire, two linear accelerators and one CT scanner.

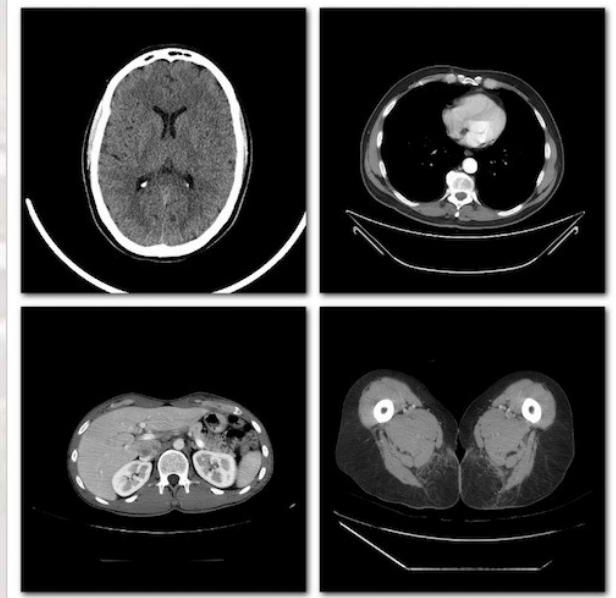
Radiotherapy - Introduction

- Radiotherapy uses high-energy, targeted radiation to treat cancer. It works by depositing energy which destroys cancer cells in the area, damaging the DNA. This stops the cancer cells from growing and dividing.
- There are two ways of delivering radiotherapy:
 - External beam radiotherapy is delivered from outside the body by a linear accelerator machine.
 - Internal radiotherapy, known as brachytherapy or radioisotope therapy, is where a radioactive material is placed inside the body (usually cavities).



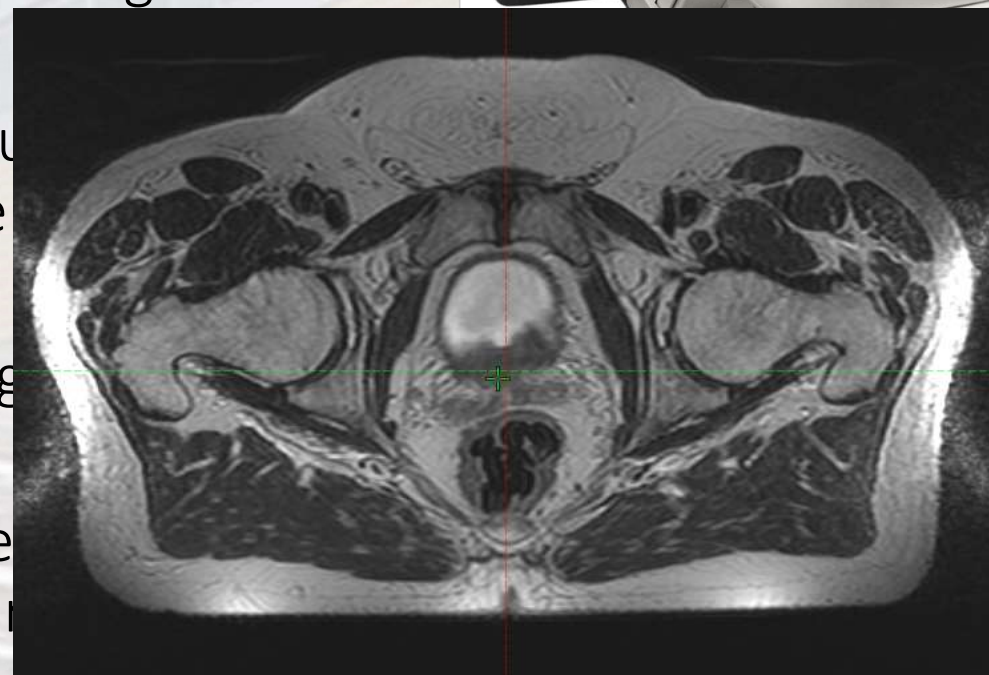
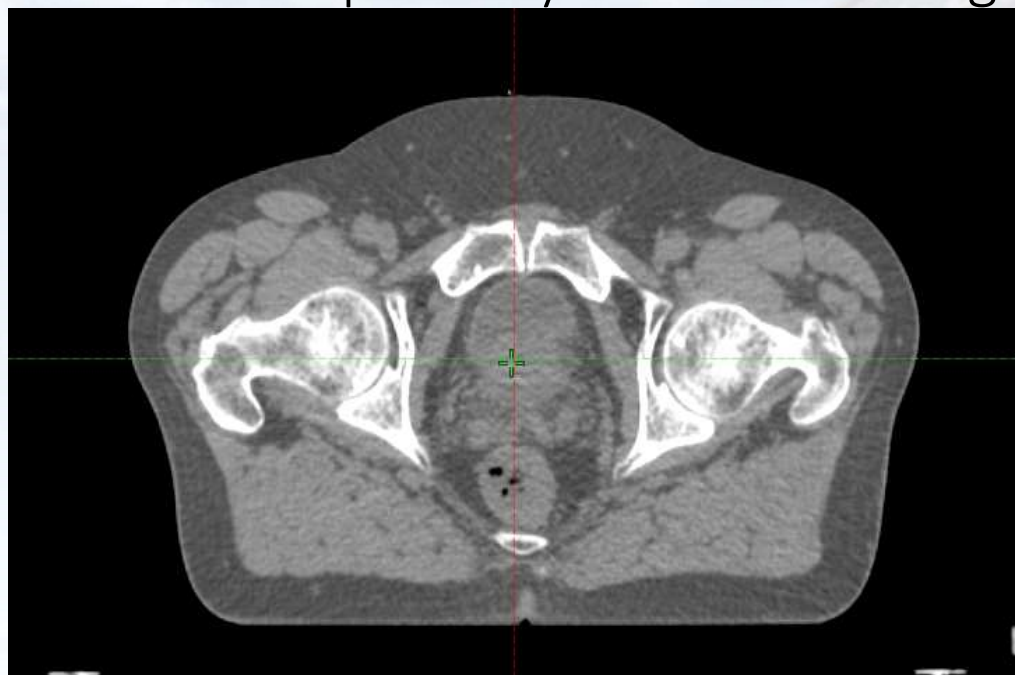
Radiotherapy Imaging

- Patients pathway starts with imaging using a CT or MRI scanner.
- These images will then be used for outlining the target volumes, and planning the patients radiotherapy treatment plan.
- The CT images are obtained by radiographers within the department.
- The role of the clinical scientist in the imaging process is QA on the CT scanners and on-board imaging on the linacs.



Radiotherapy Imaging

- Patients pathway starts with imaging using



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Radiotherapy Planning

- Radiotherapy planning uses sophisticated software to prepare customised treatment plans for each patient, to be delivered using a linear accelerator. Each treatment plan is designed to ensure that the tumour can receive as large a radiation dose as possible, whilst minimising the dose received by healthy tissue and sensitive surrounding organs.
- As a clinical scientist you will work as part of the physics planning team carrying out routine daily clinical work, as well as having the opportunity to be involved in many research and developmental projects within the department.

Radiotherapy Planning

File Edit View Insert Planning Tools Window

Selection Contouring Image Registration External Beam Planning Brachytherapy Planning Brachytherapy 2D Entry Plan Evaluation

NECK1_1 - Retired - Transversal - CT_1

NECK1_1 - Retired - BEV - SAD 100 cm - 1 - 1/178 - 181.00 [deg] - CT_1

NECK1_1 - Retired - Frontal - CT_1

NECK1_1 - Retired - Sagittal - CT_1

Isodoses [%]

- ✓ 125.0
- ✓ 115.0
- ✓ 110.0
- ✓ 105.0
- ✓ 100.0
- ✓ 95.0
- ✓ 90.0
- 80.0
- ✓ 70.0
- ✓ 60.0
- ✓ 50.0
- ✓ 40.0

Transport in medium
Dose to water

3D Dose MAX: 109.7 %
3D MAX for All PTV: 109.7 %
3D MIN for All PTV: 65.9 %
3D MFAN for All PTV: 93.9 %

Transport in medium
Dose to water

Transport in medium
Dose to water

Transport in medium
Dose to water

Fields

Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	Calculated SSD [cm]	MU	Ref. D [cGy]	
I	1	ARC-I	TRJ_18 - 6X	VMAT	1.449	Varian IEC	181.0 CW	179.0	30.0	0.0	None	14.6	+7.6	+7.1	18.3	+10.0	+8.3	0.00	0.00	0.00	95.0	314	
I	2	ARC-I	TRJ_18 - 6X	VMAT	1.520	Varian IEC	179.0 CCW	181.0	330.0	0.0	None	15.0	+5.9	+9.1	18.3	+10.0	+8.3	0.00	0.00	0.00	95.0	329	
I	ISO_IMAGE_1	STATIC-I	TRJ_18 - 6X		0.000	Varian IEC		0.0	0.0	0.0	None	16.0	+8.0	+8.0	17.5	+10.0	+7.5	0.00	0.00	0.00	91.2		
I	ISO_IMAGE_2	STATIC-I	TRJ_18 - 6X		0.000	Varian IEC		270.0	0.0	0.0	None	18.0	+8.0	+10.0	17.5	+10.0	+7.5	0.00	0.00	0.00	94.2		

Plan Information

ID/Type	coll	svr (%)	Dose [cGy]	Active Dose [cGy]	Priority	qf
PTV1	Upper	0.0	0.0	6800	7137	110
	Lower	6.9	3.0	6700	6782	110
	Lower	225.0	98.0	6500	6022	200
PTVLR	Upper	19.0	100.0	6300	6786	200
	Upper	1.9	1.6	6300	6145	110
	Upper	5.6	3.0	6300	5965	110
L.Orbit	Upper	99.0	99.0	6400	6020	66
	Lower	103.0	99.0	6300	6110	110
	Lower	167.6	100.0	6300	4903	120
L.Lens	Upper	0.0	0.0	650	171	100
	Lower	0.4	0.4	6000	220	160
L.ONerve	Upper	<0.1	1.0	6000	220	160
	L.Orbit	7.6				
	Upper	<0.1	1.0	6300	216	100
Larynx	Upper	21.6	90.0	4000	6118	45
	Upper	0.0	0.0	6900	7112	100
	Lower	45.1	0.0			45

3D Dose MAX: 7137 cGy
3D MIN for All PTV: 65.9 cGy
3D MFAN for All PTV: 93.9 cGy

Plan Objectives

Normal Tissue Objective: 100% Manual

MU Objective: None

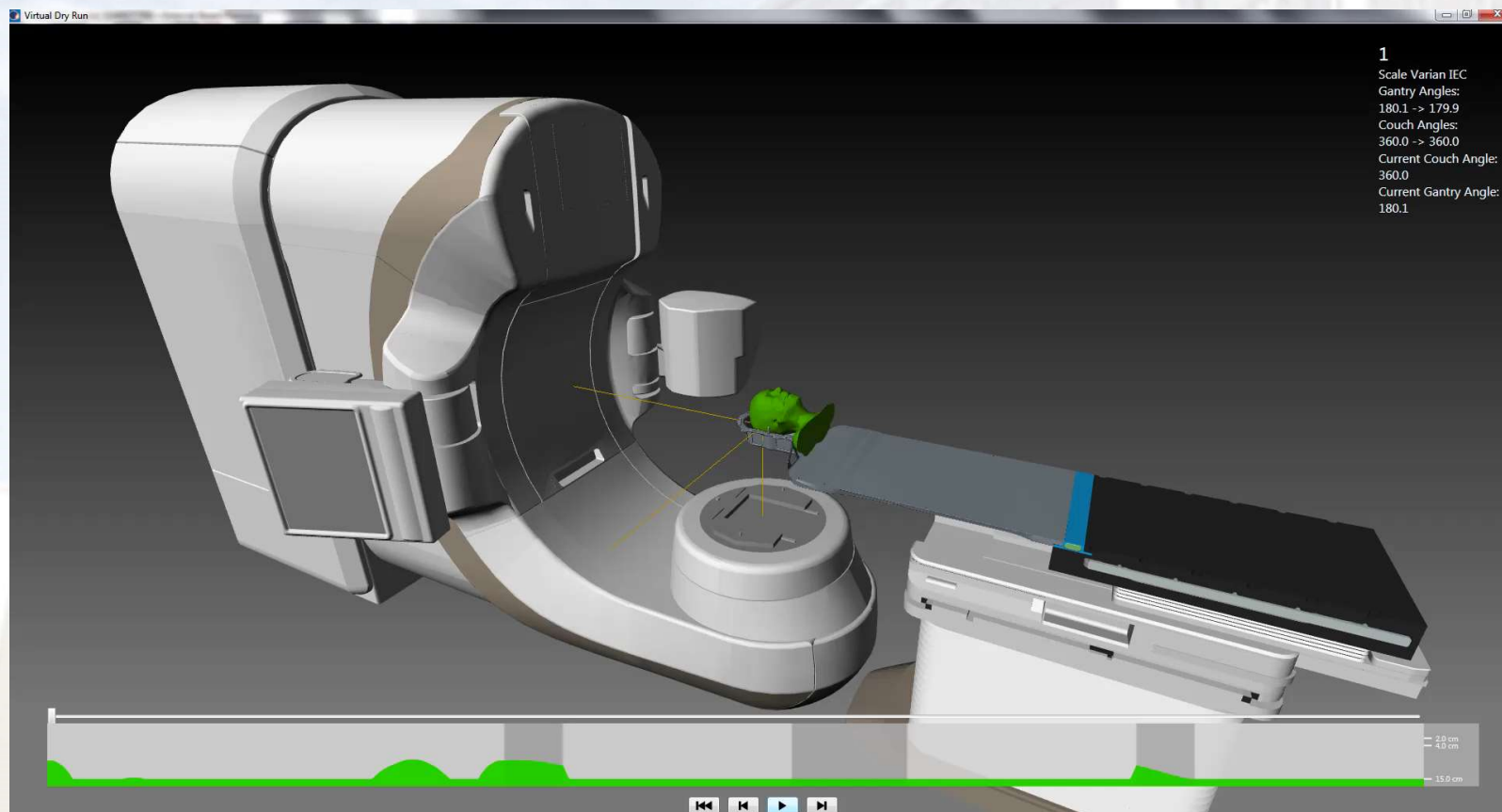
System Dose Plan: None

Settings: Normal (2.0 min)

Automatic Optimization Mode: User UMAT Optimization

Automatic Intermediate Dose: Intermediate Dose

Radiotherapy Treatment



Radiotherapy Dosimetry

- The radiation engineering team here at the Beatson prepare the linear accelerators for daily use prior to treatment commencing. Along with dosimetry physicists, they undertake a detailed programme of quality assurance, safety and radiation calibration tests on weekly, monthly and annual basis.
- As a clinical scientist, you are responsible for ensuring that the equipment is calibrated precisely and used safely.
 - Involved in the installation and commissioning of new machines.
 - Involved with equipment faults and repairs.
 - Active member of the QA programme.
 - Project work and development.



Radiotherapy Clinical Trials

- Can be used to:
 - Identify the optimum treatment dose that gives greatest tumour control and minimal side effects
 - Inform clinical practice
- Research – continuing to try to improve radiotherapy treatments and reduce side effects.
- *For example; Laura – 10 week project/Treatment Planning; dose escalation for H&N cancers; paper accepted in Radiation Oncology Jan22; Clinical Trial in the offing*

As a trainee Clinical Scientist in Radiotherapy

- You will have to gain competencies in four main subject areas:
 - Dosimetry
 - Treatment Planning
 - Brachytherapy
 - Computing and IT
 - Service Development & Research
 - Work within a multi-disciplinary team.
 - You will have the opportunity to shadow Medical Physics staff.
 - Be involved in routine work, research projects and development.