Nottingham University Hospitals NHS
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# COMMISSIONING AND IMPLEMENTATION OF MOBIUS

## A COMMERCIAL INDEPENDENT CALCULATION SYSTEM FOR IMRT

# Introduction

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**At NUH all VMAT and Tomotherapy patients require PSQA**

**Machine-on time:**

- **4hrs/week for Tomotherapy**
- **2hrs/week on a linac**

**Mobius was purchased to try and reduce PSQA that requires machine-on time**

# A few things about Mobius

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- **A two stage process**
  - Recalculation of the final plan with an independent algorithm
  - Mobius Fx compares the delivery of the plan against the expected from the planning system (N/A for Tomo)
- **Independent calculation algorithm (CCCS)**

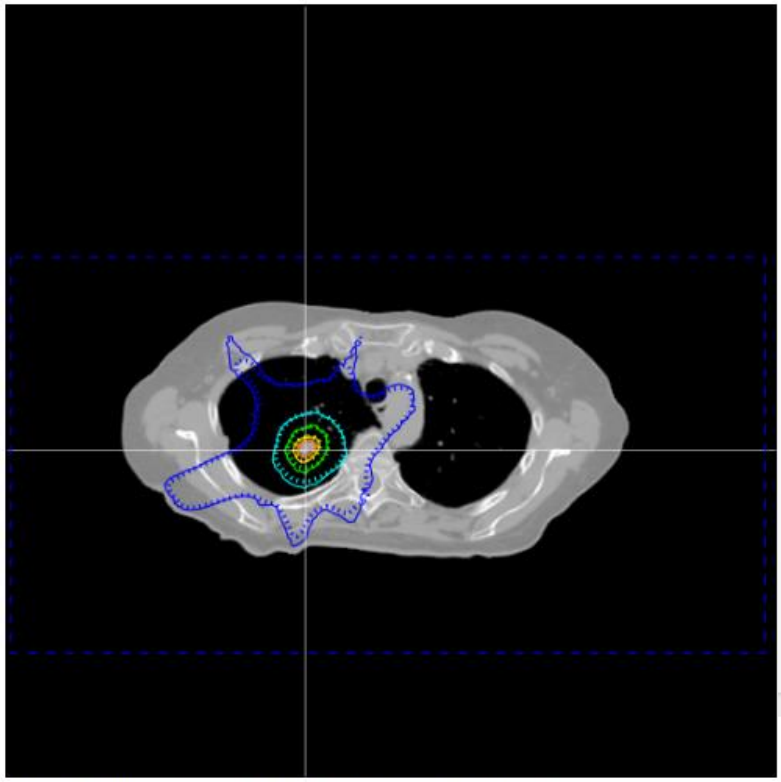
- **Compares DVH data, mean/max doses to OARs and carries out a gamma analysis**

## 3D Gamma ▲

| Passing Rate | Criteria | Reference Dose | Threshold Dose | TPS Voxels | MFX Voxels |
|---|---|---|---|---|---|
| 97.6% | 3% / 3 mm | 77.6 Gy (Max Dose) | 15.5 Gy | 2 mm | 3 mm |

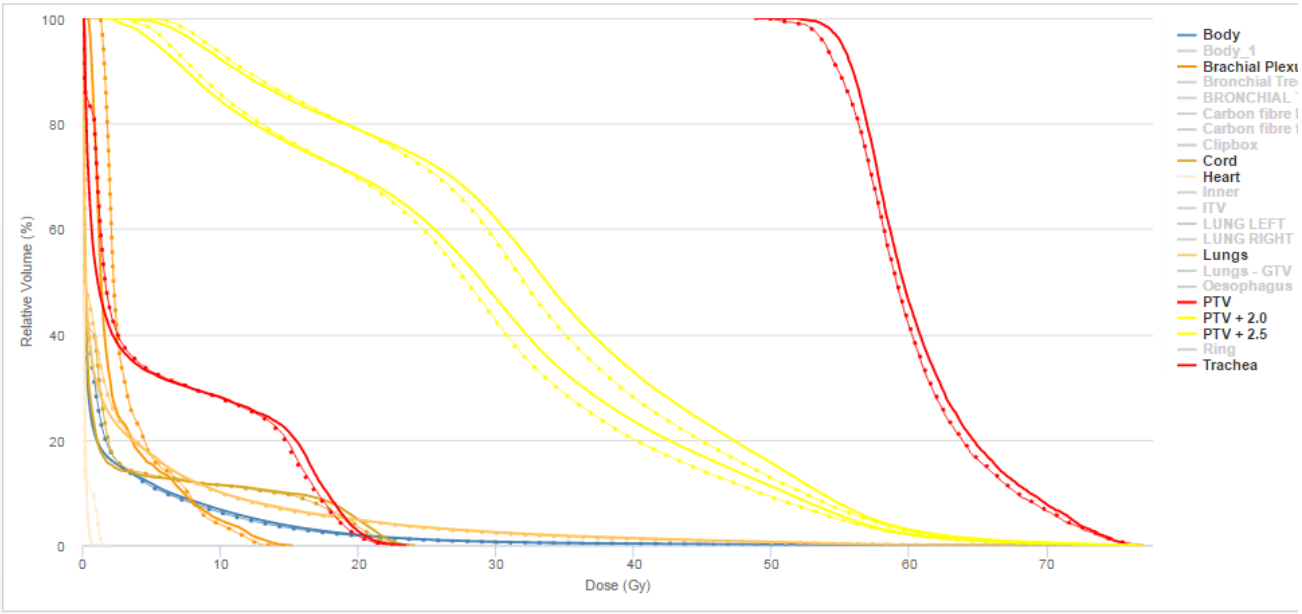
Transverse Gamma | Transverse Isodose | Coronal Gamma | Coronal Isodose | Sagittal Gamma | Sagittal Isodose

Transverse Plane at 0 cm from Max Dose



ROI "Body' used as external surface; density outside of "Body" set to zero.
TPS (Solid), Delivered (MobiusFX) (Dashed)

## DVH Graph ▲




Thick Solid: TPS; Dashed: Mobius3D;
Thin Solid: Delivered (MobiusFX)

Show structures: All None

## Target Coverage ▲

| | TPS Name | Mean Dose | | | | 95% Coverage | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TPS | M3D | Delivered | % Diff | TPS | M3D | Delivered | % Diff |
| ■ | PTV | 60.9 Gy | 60.2 Gy | 60.2 Gy | -0.9% | 55.1 Gy | 53.9 Gy | 53.9 Gy | -1.5% |

# Initial customisation

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- **Tomotherapy model is generic, only accounts for output**
  - Created a 2Gy plan on the cheese phantom for all jaw sizes
  - Initial results showed a distinct difference between the planned (Tomo) and calculated (Mobius) DVHs of ~4%
  - The license file was adjusted and the agreement was excellent.

- **For VMAT:**
  - PDDs, Off-axis ratios and Output factors were adjusted
  - Dynamic Leaf Gap adjustments to minimise differences between Monaco and Masterplan

# Tomotherapy Results

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- H&N, anal canal& nodes, prostate&nodes, bladder& nodes, craniospinal brain boost; results were compared with Delta4
- Gamma pass rate agreed with CheckTomo but not so much with Delta4
- Tolerances were set for each jaw size, results were reviewed 3 months later
- Air cavities and  pitch selection (threading) can cause failures

# 6MV VMAT Methods/Results

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- **Gamma agreement for static fields was better than 99% between 2x2 and 15x15 $cm^2$**
- **Single sided H&N and Brain plans were used to assess agreement**
- **Tolerances were set for gamma pass rate (3%/3mm) and dose difference at 95% in the PTVs using Mean±1.96 S.D.**

| Monaco 6MV | Mean | Lower Limit | Upper limit |
|---|---|---|---|
| Gamma pass rate | 98.9 | 96.6 | - |
| Dose Diff at 95% coverage | -0.88 | -3.23 | 1.48 |

# 10MV VMAT Methods/Results

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- Gamma agreement for static fields (2x2-15x15 $cm^2$) was better than 93% and 95% for OMP and Monaco respectively.
- Clinical plans for prostate& nodes, gynae and anal canal & nodes were calculated for Monaco, and prostate plans only for OMP.

| | Mean | Lower Limit | Upper limit |
|---|---|---|---|
| OMP 10MV | 91.7 | 86.9 | - |
| Monaco 10MV | 93.9 | 90.4 | - |

- Gamma pass rate

| | Mean | Lower Limit | Upper limit |
|---|---|---|---|
| OMP 10MV | -0.35 | -3.16 | 2.46 |
| Monaco 10MV | -0.04 | -1.81 | 1.72 |

- 95% coverage dose difference

# Mobius Fx Results

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- Detected errors≥1° in gantry angle
- Detected differences in MU delivered ≥1MU
- Different jaw position ≥10 mm (only this was tested)
- Detected errors≥1° in collimator angle
- Detected different energy
- Occasional issues with rms values for MLC, possibly due to sampling times

# Conclusion

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- **Mobius used clinically withTomotherapy for more than 1 year**
  1. V 1.6 has been implemented smoothly, slight adjustment to tolerances
- **It has been implemented clinically for VMAT in the last three months**
- **Machine-on time has been reduced significantly for PSQA**
- **View for the future to commission FFF model for use with:**
  1. SABR: 1 hr of machine-on time per week
  2. SRS: 1 hr of machine-on time per PTV per patient.