BrainLAB's *iPlan* 4.5.4 vs. *Elements* 2.0 Multiple Brain Mets SRS: A plan quality comparison study

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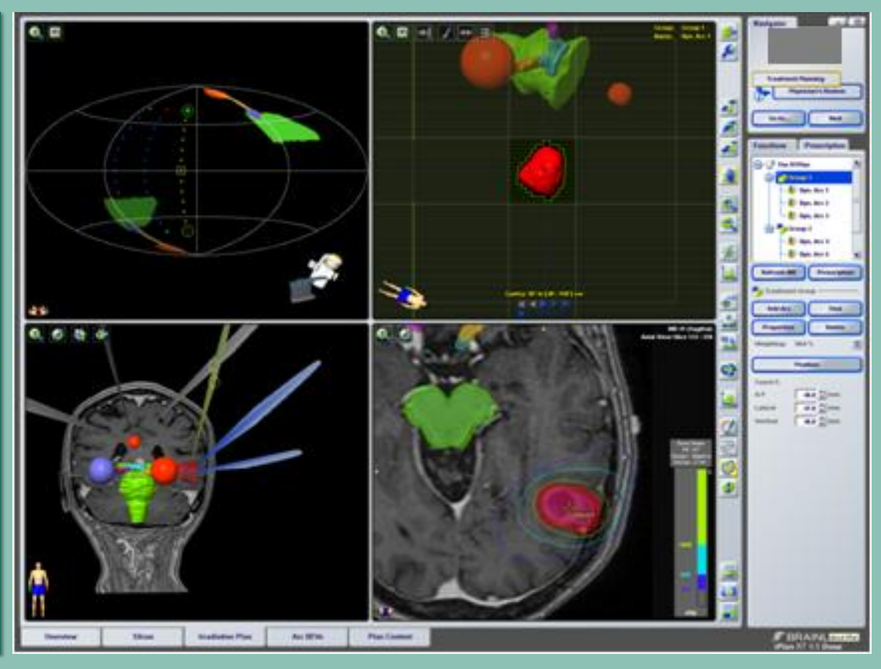
Introduction

- Stereotactic radiosurgery (SRS) is a valuable treatment option in the management of patients with brain metastases (mets)
- At the Edinburgh Cancer Centre (ECC), SRS treatments are planned using BrainLAB *iPlan* and delivered via Varian Novalis or SRS TrueBeam linear accelerators with frameless SRS thermoplastic masks, EXAC TRAC and 6D couch
- A trial version of BrainLAB *Elements* was evaluated. This version enabled prescribing to isodoses, in line with current practice at ECC
- A retrospective planning comparison study was conducted in *Elements* for multi-met patients previously planned on iPlan version 4.5.4

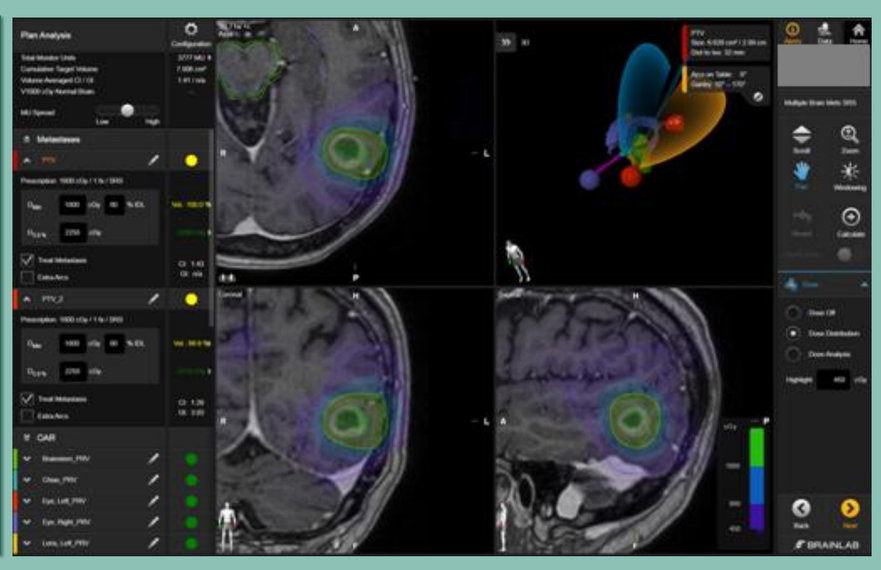
ECCSRS planning of multi-mets

- **Defining volumes:**
  - GTV = lesion seen on MRI and CT
  - CTV = 1-2mm (as MRI is 2 weeks prior to CT)
  - PTV = 1mm (for set up, larger if CT only)
  - OARs = brainstem, chiasm, optic structures (PRV = OAR + 1 mm)
- **Prescription depends on PTV volume:**
  - < 7cc = 2100 cGy to 80 %, 1 fraction
  - 7-13 cc = 1800 cGy to 80 %, 1 fraction
  - > 13 cc = 1500 cGy to 80 %, 1 fraction, or,
  - > 13 cc (or posterior fossa) = 2100–2700 cGy to 90 %, 3 fractions
- **Planning:**
  - For multi-mets, plans are generated using **one isocentre per met**
  - **3-4 dynamic conformal arcs** (DCA) per met
  - Plan quality metrics: conformity index (CI), homogeneity, volume of normal tissue receiving 12 or 24 Gy (V12/24) for 1 or 3 fractions, respectively

iPlan 4.5.4

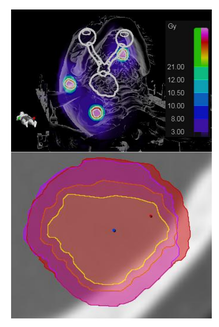


Elements 2.0



SRS plan optimisation in *iPlan*

- All SRS plans are forward planned and iteratively optimised via:
  - MLC margins fitted to PTV
  - Number of arcs
  - Couch/gantry angles
  - Collimator angle
  - Arc lengths
  - MLC shaping
  - Isocentre positioning
  - oPTV sculpting



- Additionally, for multi-mets:
  - Overlapping entry/exit beams
  - Exit dose contributions to other PTVs
  - Mets in same hemisphere might be planned with shorter arcs
  - Mets in opposite hemisphere might be planned avoiding lateral beams
  - Low dose bridging effect
  - For patients returning for SRS to additional met(s) previously treated beam paths are also considered

Materials and methods

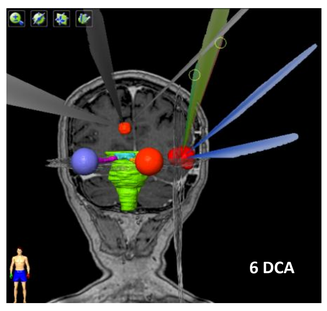
- Six previously treated patients were replanned in *Elements*: 3x2 mets, 3x3 mets
- Patients were included where prescription and fractionation were the same for each met
- Where the patient had more than one SRS treatment course, i.e. successive treatments, a plan sum was generated in *iPlan*
- Plans were generated in *Elements* from templates based on prescription, number of arcs, OAR constraints
- SRS plans were automatically generated using 4π optimisation for a **single isocentre**
- Where distance to isocentre was large, a further dual isocentre plan was created

Results

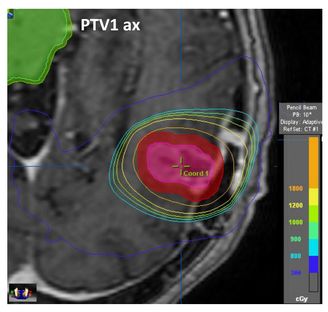
Patient	1		2		3		4		5			6	
Plan details	2 met, 18Gy/80%/1#		2 met, 21Gy/80%/1#		2 met, 21Gy/90%/3#		3 met, 21Gy/80%/1#		3 met, 21Gy/80%/1#			3 met, 24Gy/90%/3#	
TPS	iPlan	Elements	iPlan	Elements	iPlan	Elements	iPlan	Elements	iPlan	Elements	Elements	iPlan	Elements
# DCA	6	3	6	3	7	5	8 + 3	6	10	10	3 + 6	8 + 3	10
PTV1 cov. (%)	100	99.9	100	100	99.9	100	100	99.9	100	99.8	100	96.4	99.9
PTV2 cov. (%)	99.9	100	100	99.9	99.8	99.9	99.7	100.4	100	100.1	100	99.2	99.5
PTV3 cov. (%)	-	-	-	-	-	-	100	100	99.8	100	99.9	98.7	99.8
Total MU	6097	3859	6710	3864	5541	3864	10571	5772	11153	6916	8952	10380	7179
Mean CI	1.40	1.40	1.38	1.28	1.34	1.28	1.25	1.30	1.28	1.36	1.26	1.28	1.54
V 12/24 (cc)	16.1	20.5	9.34	10.8	3.4	5.1	26.5	32	19.9	21.2	18.9	13.5	15.6
BS max (cGy)	271	298	334	142	965	696	361	417	289	223	246	646	861

- The table above shows a comparison of plan quality measures; number of DCA, dose to PTVs, total monitor units (MU), mean CI, V12 or V24, and maximum dose to brainstem (BS) as principal OAR
- **Plan quality was comparable** between *iPlan* and *Elements* for all patients
- *Elements* produced similar PTV coverage to *iPlan*, but with lower total MU for 5 of 6 patients
- The use of a single isocentre meant fewer couch positions, and hence reduced treatment time
- However, for all cases *Elements* results in increased volume of normal brain receiving 12 or 24 Gy
- Effects on CI and dose to brainstem PRV were variable

iPlan 4.5.4



Patient 1



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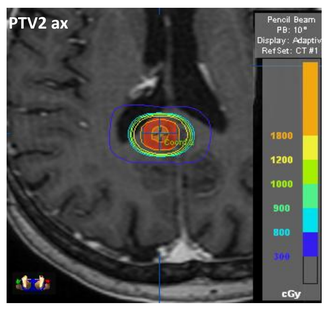
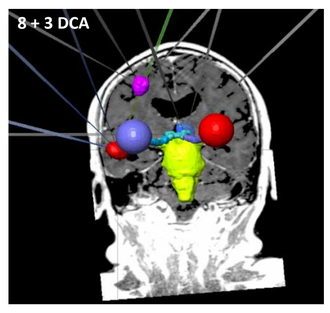
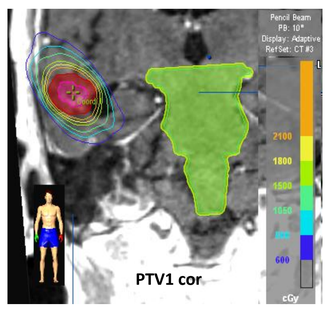


Patient 1

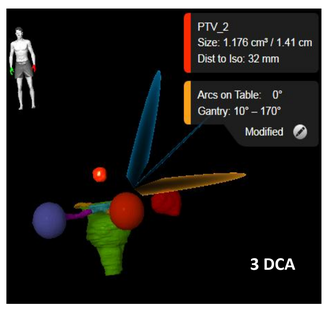


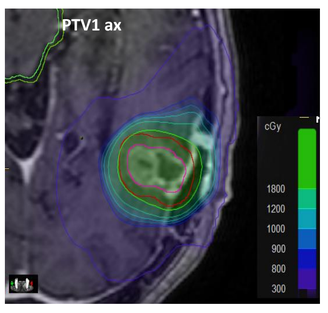
Patient 4

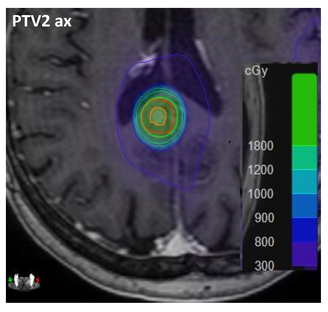


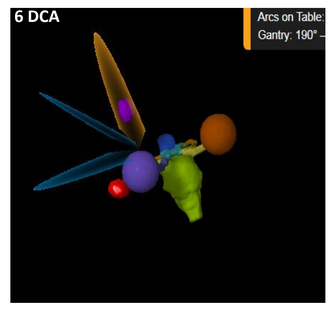
Patient 4

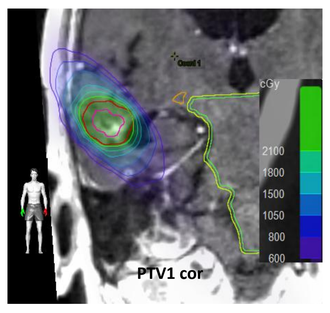
Elements 2.0











Conclusion/Discussion

- The major benefit of *Elements* with respect to *iPlan* is **significant reduction in planning time**, as well as the **reduction in overall treatment time**
- However, *Elements* offers less control over shaping of the dose distribution, and results in higher V12/24. The clinical significance of this must be weighed against the logistical benefit