Whole Brain Rt with sparing Hippocampus

This technique was developed to spare the hippocampus and improved cognitive outcomes. The gold is to improve quality of life for patient need to have a whole brain radiation without affecting their survival. Location of brain lesions may be a limitation for this technique.

Patient ==must== be plan on ==TB,== for the use of the 6DOF table at time of the IGRT. Ideal, on ==TB a==, to have a better plan with the micro-MLCs, but, if no choice, TB with larger MLCs can be used.

Rapid Review to be done prior to start planning, even if palliative. If care path not done this way, ask Coordo booking to do the modification.

Dosimetry is to be done with a Template, created under a Clinical protocol template, call Brain HA-WBRT. This template was created by using a Varian template developed by their planning expert.

Rapid Arc to be used with 6MV.

1) At time of CT, Structure template to be insert is: ==Brain-HA==. Small structures, including Hippo, Hippo Rt and Lt, are to be changed to a high resolution. ** <u>Make sure to use our template Structures if patient is not on Protocol</u>.**
2) At time of CT, Brain have to be outlined following the definition. Attention, since Brain will become the CTV, and no PTV will be added, it's important to do the correction on all the slice, if contour is done by Limbus.

Contouring OARs:

- **Brain** is defining as the whole-brain parenchyma to the foramen magnum. (to include all foramen)
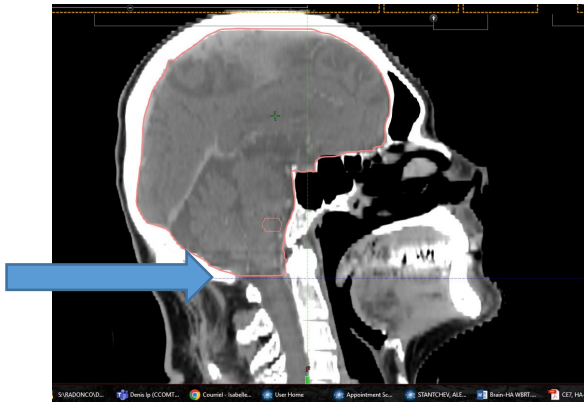
- **Eyes Lt and Rt**: Entire Globe. (No PRV)
- **Inner Ear Lt and Rt**. (No PRV) Include Inner and Middle ear like ENT cases.
- **Lens Lt and Rt**.
- **Lens PRV for Lt and Rt**: +3mm
- **Optic Chiasm**: using MRI fusion to help to define. (No PRV)
- **Optic Nerve Lt and Rt**. No PRV
- **Spinal Cord**: define as the canal, starting just at the top of the odontoid, for 3 cm below the last slice of Brain. (No PRV)

Contouring Target and Hippo:

- **CTV_30**: Is equal to brain. If the RO did not copy the brain to CTV_30, It can be done by the dosimetrists. If the brain need some adjustment, and the RO already copied Brain over the CTV_30, you will have to copy the brain with the adjustment over the CTV_30. ==****It's important that the Brain is done properly, since the PTV_30 doesn't include a margin for the Brain.
- **GTV**: If visible metastases, only the one within 5 mm of the Hippocampi are to be outlined. It's a High Resolution structure. If the RO outlined also some outside this area, you will have to copy them to another structures, not use for the optimization or the DVH analysis. (Ref_GTV) Note, we can have more than one metastases, but to be all contoured on the same GTV.
- **GTV+5mm**: Only to be used for the GTV within the 5 mm of the Hippocampi. It's a High resolution structure.
- **Hippo Lt and Rt**: High resolution structures. Contours to be done following guidelines of [RTOG 0933 Atlas](). (Done by the RO.)
- **Hippocampi**: It's the sum of Lt and Rt Hippo. If not done by the RO, it can be done by the dosimetrist, only if the Hippo Lt and Rt are done and approved by the RO.
- **Hippocampi_05**: It's a 5mm margin from the hippocampi, in the 3D direction. If not done by the RO, it can be done by the dosimetrist only if the Hippo Lt and Rt are done and approved by the RO.
- **PTV_30**: Is define as the CTV_30 + the (GTV+5mm). ==The PTV_30 excludes the hippocampi_05.== Make sure the PTV_30 ==is including the GTV+5mm.== No set-up margin is added.

Contouring Optimization structures:

- **optPTV_30**: It's define as PTV_30 excluding the Hippocampi_05 with an additional margin of 3mm.
- **optHippo Lt or Rt**: If we have a GTV+5mm outlined, you will have to create an optHippo on the same side of the GTV. It's define as the Hippo, Lt or Rt, minus the GTV+5mm with an additional margin of 4mm.
- **optHippo**: Will be used only if you have GTV+5mm on both side. It's define as the Hippocampi minus GTV+5mm with an additional margin of 4mm.
- **NonPTV**: Body minus PTV_30.
- **optNonPTV**: From PTV_30, create a 3cm margin. Crop parts extending outside body. Then, crop part extending inside PTV_30.
- **Hippo_Limits**: It's a helper structure, to be used for the placement of the fields. This structure is indicating the most superior slice of the Hippocampi_05 and the most inferior slice of the Hippocampi_05. When you fine the superior limit of the hippocampi_05, create a structure including the entire PTV_30 at this level. You will do the same for the inferior limit of the Hippocampi_05. Then, crop part going outside the PTV_30. (see picture)
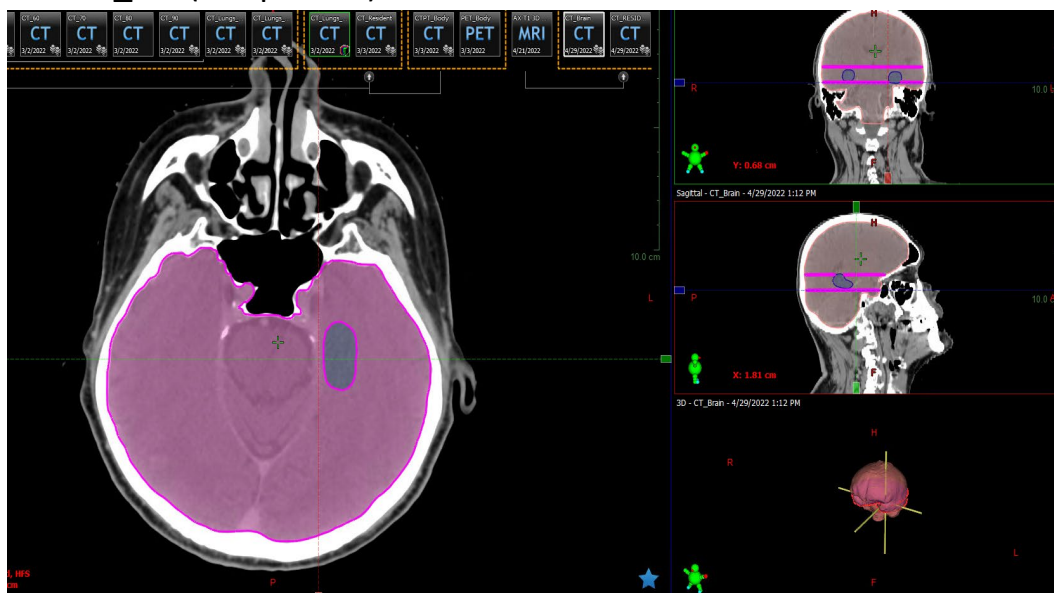
Planning:

- Insert the clinical protocol "Brain HA-WBRT". Note, we have a template ready for GTV on Rt Side. "BrainHA-WBRT_RtGTV"
- Create the plan from the clinical protocol (P1 WBRT-HA) Note you have to create the reference DPV before creating the plan. Plan must be on TB and energy used is 6X.
- Usual prescription dose is 30Gy/10, and clinical protocol was developed for this prescription.
- Before adjusting the fields, center the iso to PTV_30.
- The first arc is covering the PTV_30 up to the inferior limits of the Hippo_Limits.
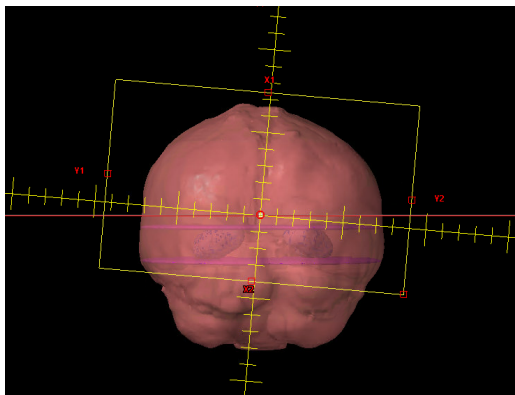
- The second arc is covering the PTV_30 up to the superior limits of the Hippo_Limits
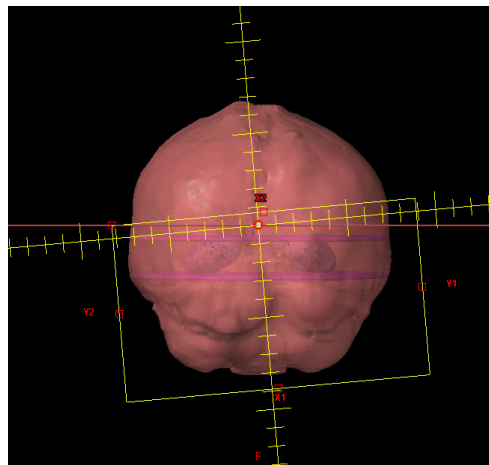
- The third arc is the oppose arc of the first arc, like a standard RA plan. X jaws are inverted, and Y jaws are the same.

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]
1.Lt Lat kV	STATIC-I	TrueBeam_a - 6X		0.000	Varian IEC	90.0	0.0	0.0	None	10.0	+5.0	+5.0	20.0	+10.0	+10.0
l.Ant CBCT	STATIC-I	TrueBeam_a - 6X		0.000	Varian IEC	0.0	0.0	0.0	None	10.0	+5.0	+5.0	20.0	+10.0	+10.0
1.Ant kV1	STATIC-I	TrueBeam_a - 6X		0.000	Varian IEC	0.0	0.0	0.0	None	10.0	+5.0	+5.0	20.0	+10.0	+10.0
.1 RA CCW	ARC-I	TrueBeam_a - 6X		1.114	Varian IEC	179.9 CCW 180.1	265.0	0.0	None	11.4	+7.4	+4.0	18.4	+9.4	+9.0
1.2 RA CW	ARC-I	TrueBeam_a - 6X		1.235	Varian IEC	180.1 CW 179.9	95.0	0.0	None	9.6	+8.9	+0.7	17.1	+8.9	+8.2
.3 RA CCW	ARC-I	TrueBeam_a - 6X		1.102	Varian IEC	179.9 CCW 180.1	95.0	0.0	None	11.4	+4.0	+7.4	18.4	+9.4	+9.0

- Since it's a plan from a clinical protocol template, optimization objectives are done for a standard case, without GTVs within the 5mm of the Hippocampi. Opt Hippo are not used.

NTO: Priority: 150

Distance: 0.5

Start Dose: 95%

End Dose: 60%

Fall Off: 0.1

Normalization: 100% of PD cover 95% of the PTV_30

Optimization template values for a standard case without GTVs.

☑ Use Normal Tissue Objective   Priority: 150   Define NTO Settings...

☑ **BODY**	**Volume [cc]:**	**3881**	**Points:**	**129383**	**Resolution [mm]:**	**3.00**
☑ Brainstem	Volume [cc]:	34	Points:	2633	Resolution [mm]:	2.26
Upper	Volume [%]:	0.0	Dose [Gy]:	30.5	Priority:	150
☑ CTV_30	Volume [cc]:	1320	Points:	44015	Resolution [mm]:	3.00
☑ Eye_L	Volume [cc]:	8	Points:	2179	Resolution [mm]:	1.48
Upper	Volume [%]:	70.0	Dose [Gy]:	10.0	Priority:	115
Upper		20.0		16.0		115
☑ Eye_R	Volume [cc]:	7	Points:	2160	Resolution [mm]:	1.42
Upper	Volume [%]:	70.0	Dose [Gy]:	10.0	Priority:	115
Upper		20.0		16.0		115
☑ Hippo_limits	Volume [cc]:	52	Points:	2000	Resolution [mm]:	2.86
☑ Hippocampi	Volume [cc]:	4	Points:	2131	Resolution [mm]:	1.18
Upper	Volume [%]:	0.0	Dose [Gy]:	13.5	Priority:	100
Upper		1.0		12.5		100
Upper		93.0		8.5		180
☑ Hippocampi_05	Volume [cc]:	29	Points:	2156	Resolution [mm]:	2.30
Upper	Volume [%]:	60.0	Dose [Gy]:	14.0	Priority:	100
Upper		20.0		18.0		100
☑ InnerEar_Lt	Volume [cc]:	1	Points:	1196	Resolution [mm]:	1.00
☑ InnerEar_Rt	Volume [cc]:	1	Points:	943	Resolution [mm]:	1.00
☑ Lens_L	Volume [cc]:	0	Points:	175	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	5.0	Priority:	110
☑ Lens_L_PRV	Volume [cc]:	1	Points:	1217	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	8.0	Priority:	110
☑ Lens_R	Volume [cc]:	0	Points:	185	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	5.0	Priority:	110
☑ Lens_R_PRV	Volume [cc]:	1	Points:	1292	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	10.0	Priority:	110
☑ NonPTV	Volume [cc]:	2592	Points:	86401	Resolution [mm]:	3.00
Upper	Volume [%]:	0.0	Dose [Gy]:	30.0	Priority:	100
☑ OpticChiasm	Volume [cc]:	1	Points:	702	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	30.0	Priority:	140
☑ OpticNerve_L	Volume [cc]:	1	Points:	732	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	28.8	Priority:	140
☑ OpticNerve_R	Volume [cc]:	1	Points:	637	Resolution [mm]:	1.00
Upper	Volume [%]:	0.0	Dose [Gy]:	28.8	Priority:	140
☑ optNonPTV	Volume [cc]:	1477	Points:	49226	Resolution [mm]:	3.00
Upper	Volume [%]:	0.0	Dose [Gy]:	30.0	Priority:	125
☑ optPTV_30	Volume [cc]:	1263	Points:	42085	Resolution [mm]:	3.00
Upper	Volume [%]:	0.0	Dose [Gy]:	32.3	Priority:	175
Upper		0.0		30.0		0
Upper		20.0		31.5		100
Lower	Volume [%]:	99.5	Dose [Gy]:	30.5	Priority:	185
Lower		99.7		30.2		200
Lower		100.0		28.7		175
☑ PTV_30	Volume [cc]:	1290	Points:	43008	Resolution [mm]:	3.00
☑ Spinalcord	Volume [cc]:	17	Points:	4665	Resolution [mm]:	1.49
Upper	Volume [%]:	0.0	Dose [Gy]:	29.0	Priority:	120

Optimization template values for a standard case with GTV(s)

- If GTVs are present in the both side, within the 5 mm of the hippocampi, use **optHippo.**
- If GTVs are present on the Rt side, within the 5 mm of the hippocampi, use **optHippo_R, and Hippo_L.**
- If GTVs are present on the Lt side, within the 5 mm of the hippocampi, **use optHippo_L, and Hippo_R**
- **GTV+5mm** will need to be used for the coverage of the GTV within the 5mm of the hippocampi.
- All the others values will be the same. Nothing to modify.

- *optHippo* or *optHippo_L/R*
  - Upper Volume 93% at Dose 10Gy (100)
  - Upper Volume 0% at Dose 20Gy (100)

- *Hippo_R/L*
  - Upper Volume 93% at Dose 8.3Gy (100)
  - Upper Volume 0% at Dose 14Gy (100)
  - We aim to meet the same constraints of the Hippocampi, to the Hippo not affect by the GTV within the 5mm of the Hippocampi.

- *GTV+5mm*
  - Lower Volume 100% at Dose 28.5Gy (125)
  - Upper Volume 0% at Dose 30Gy (100) (Facultative)

Dose constraints:

- Maximum dose constraints *do not apply to Hippocampus when we have a GTV* in the 5mm from the Hippocampi, but we should make efforts to limit dose in the Ipsi_Hippo.
- See Template Evaluation for dose constraints.
- It's possible you passed the Hippocampi, but in the script, you failed one side of the Hippo. In this situation, enter the value of the Hippocampi to the Hippo not passing. (Lt or Rt), and re-optimized.