Hippocampal Contouring: A Contouring Atlas for RTOG 0933

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MRI-CT Fusion

• MRI:
  – Three-dimensional spoiled gradient (3D-SPGR) axial MRI scan of the head with standard axial and coronal FLAIR, axial T2-weighted and gadolinium contrast-enhanced T1-weighted sequence acquisitions.
  – **1.25mm slice thickness is preferred** to contour the hippocampus accurately. Slice thickness of 1.5mm or less is permitted.
  – Obtain in supine position; immobilization devices used for CT simulation and daily radiation treatments not necessary.

• CT Simulation:
  – Non-contrast treatment-planning CT scan of the entire head region.
  – **1.25-1.5mm slice thickness is preferred** for accurate hippocampal sparing planning. Slice thickness of 2.5mm or less is permitted.
  – Immobilize patient in supine position using an immobilization device such as an Aquaplast mask over the head. Treat patients in the immobilization device.

• MRI-CT Fusion:
  – Fuse the 3D-SPGR MRI and the treatment-planning CT.
General Principles

• Please note that we are not contouring the entire hippocampus, but focusing mostly on the subgranular zone (SGZ)

• Contour the hippocampus on T1-weighted MRI axial sequences.

• Given the preponderance of gray matter in the hippocampus, focus contouring on the T1-hypointense signal medial to the temporal horn.
Red: Hippocampus

Begin contouring at the most caudal (inferior) extent of the crescentic-shaped floor of the temporal horn of the lateral ventricle and contour the hypointense grey matter located medial to the CSF hypointensity, not the white, bright white matter.
Red: Hippocampus

Continue contouring in a cephalad (superior) direction, medial to the temporal horn of the lateral ventricle and contour the hypointense grey matter, not the white, bright white matter.

Continue contouring in a cephalad (superior) direction. Avoid contouring the fimbriae, the T1-hyperintense structures located superomedial to the hippocampus.

Continue contouring in a cephalad (superior) direction, medial to the temporal horn of the lateral ventricle and contour the hypointense grey matter, not the white, bright white matter. Note that the contours are progressively moving in a supero-posterior direction, keeping in line with the curved banana shaped structure of the hippocampus. Avoid the fimbriae and also avoid the grey matter (amygdala and uncus) located anterior to the tip of the temporal horn of the ventricles.
Red: Hippocampus

As contouring proceeds postero-cranially, the anterior boundary of the hippocampus is defined by the anterior edge of the temporal horn, to distinguish the hippocampus from the T1-hypointense gray matter of the amygdala, lying anterior and superior to the hippocampus. The medial boundary of the hippocampus is defined by the “boomerang-shaped” uncus.
Red: Hippocampus

Continue contouring in a cephalad (superior) direction, medial to the temporal horn of the lateral ventricle and contour only the hypointense grey matter, not the white, bright white matter. Continue to avoid the fimbriae and also avoid the grey matter (amygdala and uncus) located anterior to the tip of the temporal horn of the ventricles.

The emergence of the uncal recess of the temporal horn defines the anterior boundary of the hippocampus. This may not be seen on all axial image sets due to its limited size. The medial boundary of the hippocampus becomes defined by the medial edge of the uncal recess.
Red: Hippocampus

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Red: Hippocampus

Postero-cranially, the medial boundary of the hippocampus is defined by the lateral edge of the quadrageminal cistern which is the CSF containing space lateral to the pons.

Red: Hippocampus

Continue contouring in a cephalad (superior) direction; note that at this level, the temporal horn of the lateral ventricle may no longer be visible on every slice, but the quadrigeminal cistern serves as a medial reference landmark. Contour only the hypointense grey matter, not the bright white matter.

Red: Hippocampus

The hippocampus remains medial to the temporal horn of the lateral ventricle throughout its extent, and so on slices where you can visualize it, use it as a consistent reference. The quadrigeminal cistern remains a good medial landmark.

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Red: Hippocampus

The postero-cranial extent of the hippocampal tail is located just antero-medially to the atrium of the lateral ventricle.

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Red: Hippocampus

Even in its cephalad (superior) extent, the hippocampal tail remains lateral to the lateral edge of the quadrageminal cistern.

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Terminate hippocampal contours at the point where the T1-hypointense structure no longer borders the atrium of the lateral ventricle. At this point, the crux of the fornix emerges anteriorly and the splenium of the corpus callosum can be visualized posteriorly.

Red: Hippocampus
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The grey signal from the hippocampus is no longer visible. Do not contour any further.

Generate the hippocampal avoidance zone using a 5mm volumetric expansion on the hippocampus.
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The hippocampus has three anatomic subdivisions: the head, body, and tail; note that the head is inferior or caudad, the body is superoposterior and the tail is most cephalad (superior) and posterior, and an overall “banana” shape emerges on sagittal images, located in the plane of the lateral ventricle.
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On sagittal sections, confirm delineation of the hippocampus separate from neighboring structures, such as the amygdala.
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Red: Hippocampus    Green: Hippocampal Avoidance Zone

On coronal sections, confirm delineation of the hippocampus separate from neighboring structures, such as the parahippocampal gyrus, which has different signal intensity.

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On sagittal and coronal sections, confirm separation between the hippocampal tail and the crus of the fornix. Note the location of the hippocampii medial to the ventricles on the coronal images.
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