MRIcron

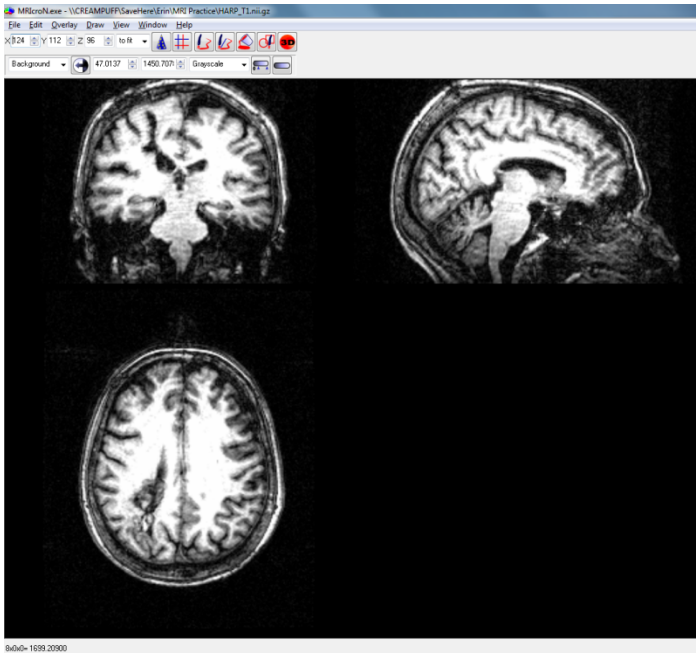
S.O.P.

General Tips:

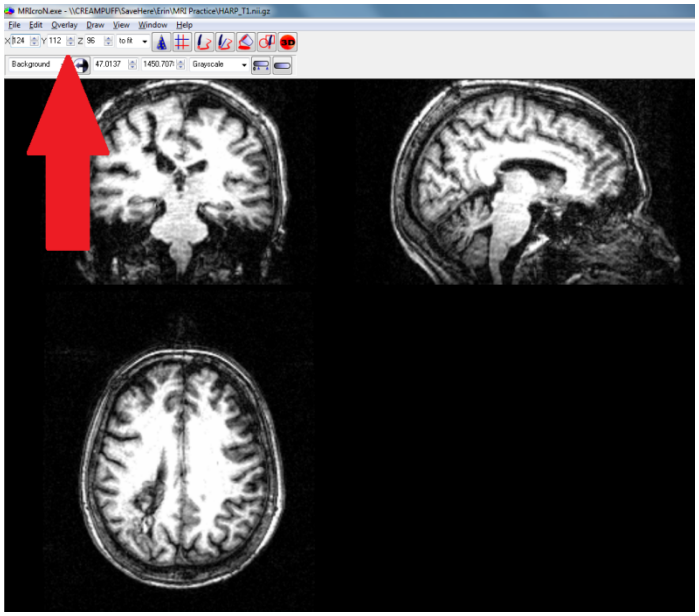
- **3D tool is best for subcortical and/or contained lesions and large cortical lesions should be traced by hand**
- **Brains should be flagged if they contain multiple strokes, strokes on both sides, TIAs, etc.**

A.) Getting Started

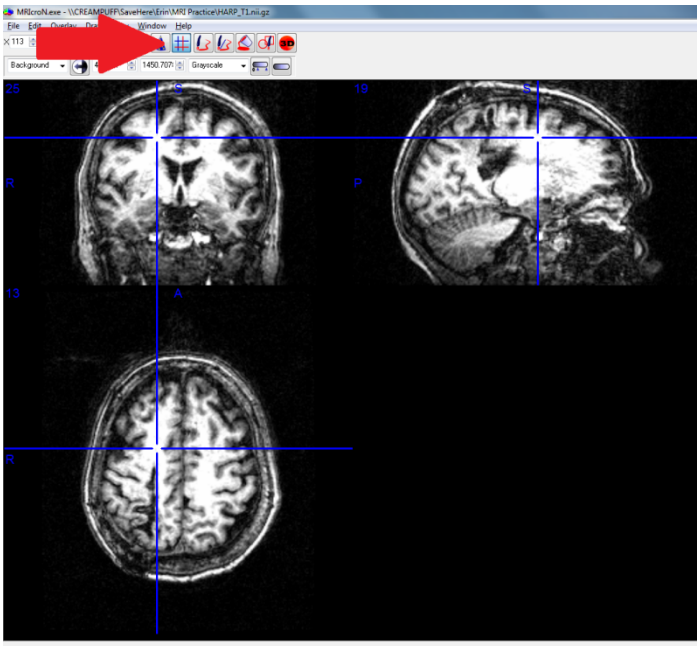
1. Open MRIcron and open the subject's T1 image. The program should display the coronal, sagittal, and axial view. (If not go to the "View" menu, and under the "Display" section, select "Multiple."



2. The left-click button on the mouse can be used to scroll through the slices of the image or specific slices may be chosen using the X, Y, and Z coordinates in the top left hand corner. (The zoom of the image can be adjusted by the drop-down menu next to the Z coordinate box. It should say "to fit" as a default setting)



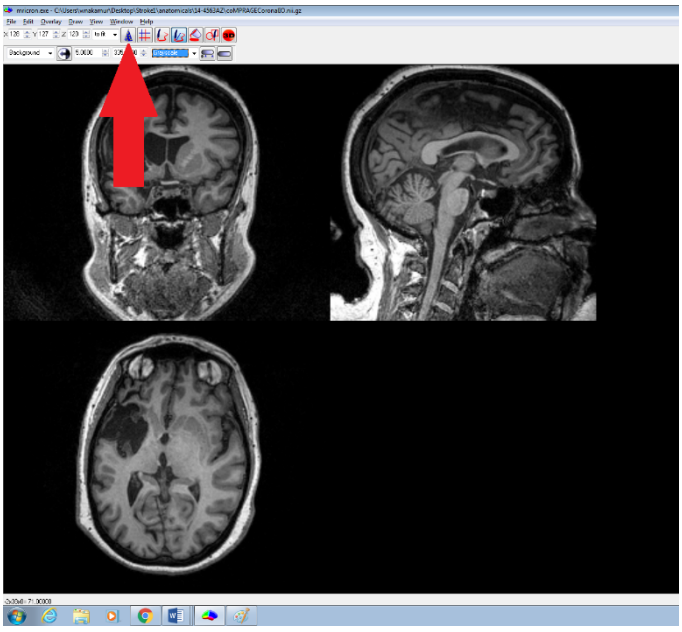
3. To the right of the X,Y,Z boxes: the cross-hair tool (indicated by a small grid of red and blue lines) can be used to determine the current location in all three views.



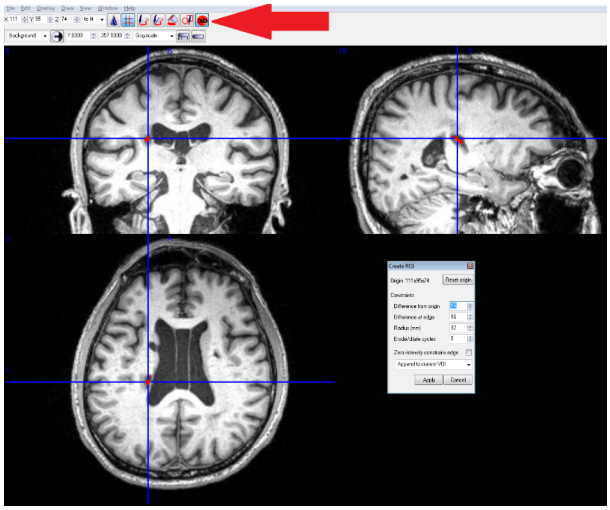
B.) Toolbox

1. Hide VOI and Overlays:

   As you fill in the lesion, you may want to check that everything you marked is a part of the lesion. To do this click on and hold the blue triangle tool or press and hold F11.

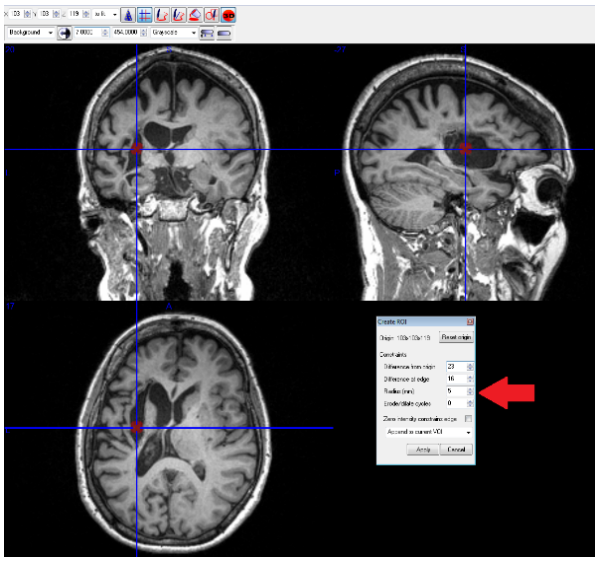


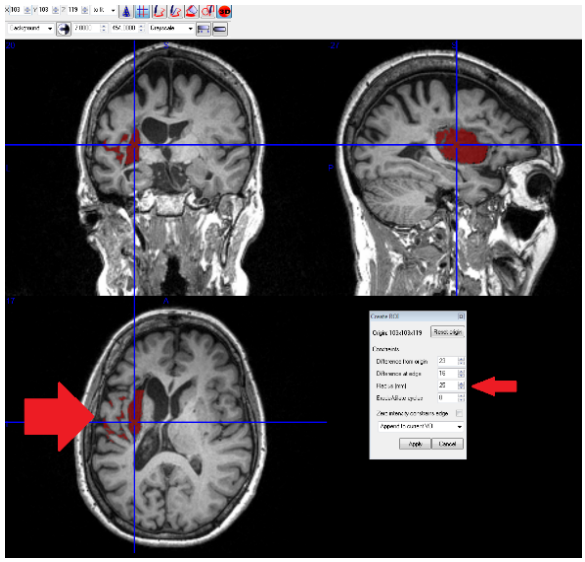
2. 3D Tool:



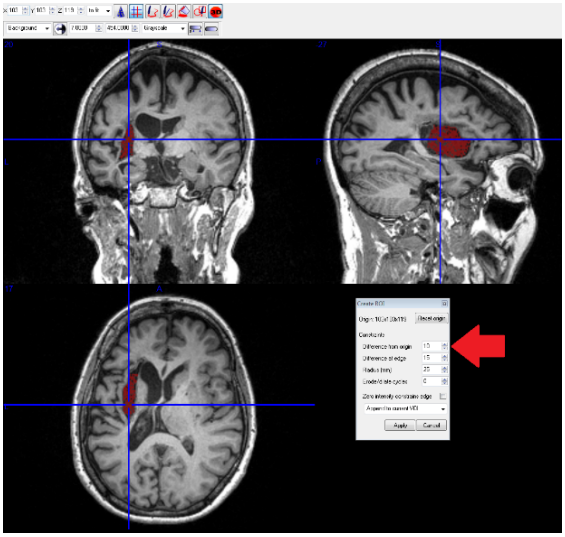
The 3D tool fills in regions in a 3D space originating at the blue crosshairs. The tool will fill in voxels similar to the one at the point of origin within the selected radius and at the sensitivity specified by the difference from origin and difference at edge tools. This should be your main tool for filling in affected regions.

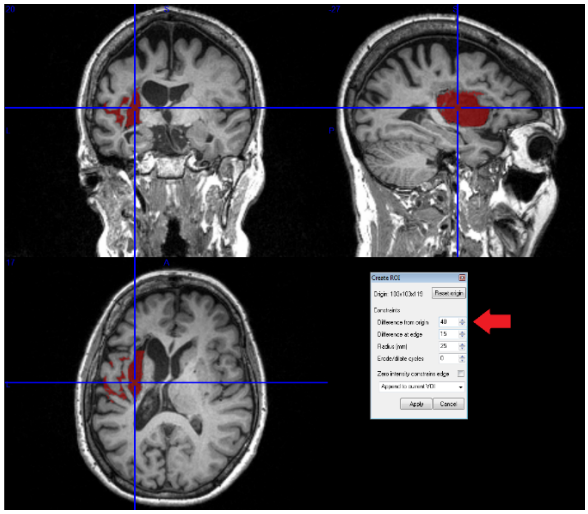
Place the crosshairs in the center of the affected region and expand the **radius** as far as necessary to encompass the affected region. The picture below on the left shows a radius value of 5, while the picture on the right has the radius expanded to 25. Notice how the picture on the right has begun to fill in unwanted areas, but hasn't filled up the lesion in the axial view. In cases like these, more than one use of the 3D tool may be required. As a general rule, you should aim to make this the highest value possible within the lesion.



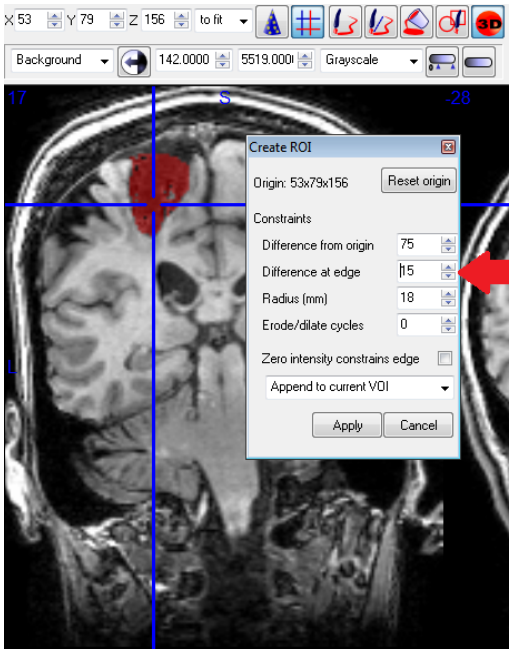


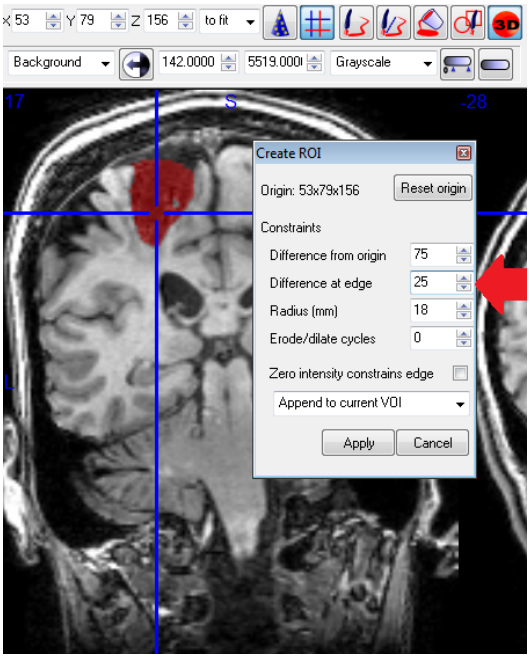
Another way to avoid filling in unwanted areas is to decrease the **difference at the origin**. However, decreasing this value may also create holes in the correctly marked area. Increasing this value will fill in more of the area within the given radius as shown below. The picture on the right has a difference from the origin of 10, while the picture on the left has a difference from the origin of 40. As a general rule, going past 75 is usually unnecessary; in cases where this doesn't work, consider moving your point of origin to a darker voxel as this tool works based on the voxel at its origin or using another tool, such as the one described below.





The difference from origin tool may not always work well to fill in the edges of the lesion since its focus is more at the center. To make up for this, you can use the **difference at edge** tool to fill in the gaps as it focuses its power more at the edges. In the picture below, notice how there is still a number of unfilled voxels within the radius despite the high value for difference from origin. A change from 15 to 25 in difference at edge fixes this. In general, this tool should be used last and is used least often. Increasing the value for this tool beyond 50 is usually unnecessary; past this point, consider using a different point of origin or drawing in the edges manually.

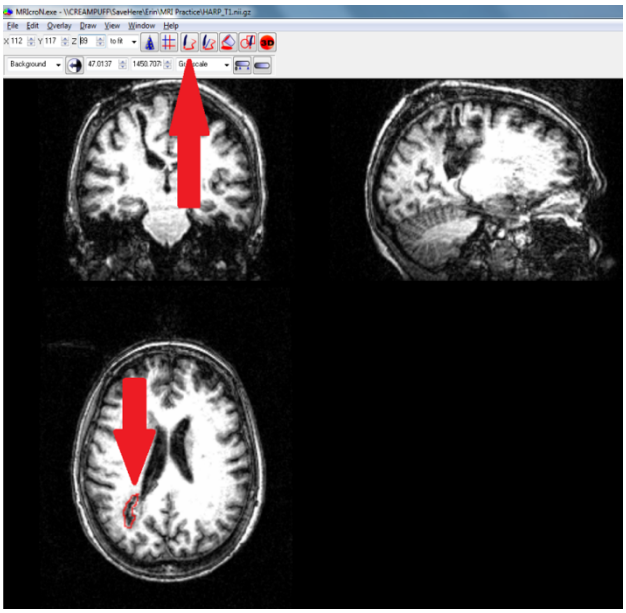




This tool does not work well at the edges of lesions, especially if they expand into naturally occurring empty spaces such as the ventricles, sulci, and subdural space. It also may miss affected voxels or fill in unaffected voxels. In these cases, using the pen tool is necessary to manually draw in the edges, fill in the gaps, or erase mistakes.

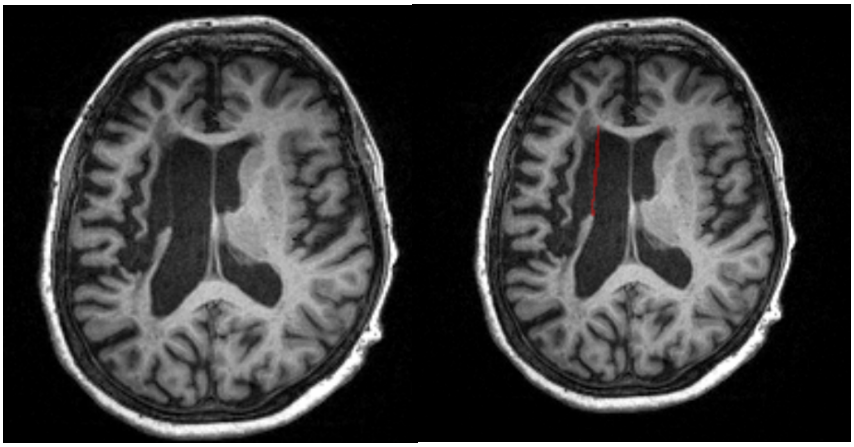
3. Pen Tool:

The pen tool can be used to draw over affected regions or correct mistakes made by the 3D tool. Holding **Shift** while drawing will allow to use the pen tool to erase. Holding down **Ctrl** will make the pen or eraser thicker, allowing you to draw over larger regions and fill in voxels missed by the 3D tool more easily.

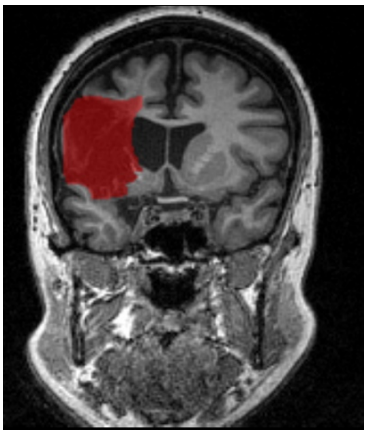


Notes on Drawing Missing Edge Areas

When drawing lesions that reach into naturally empty spaces and don't have clear edges, draw a straight line between the last visible regions as shown below.

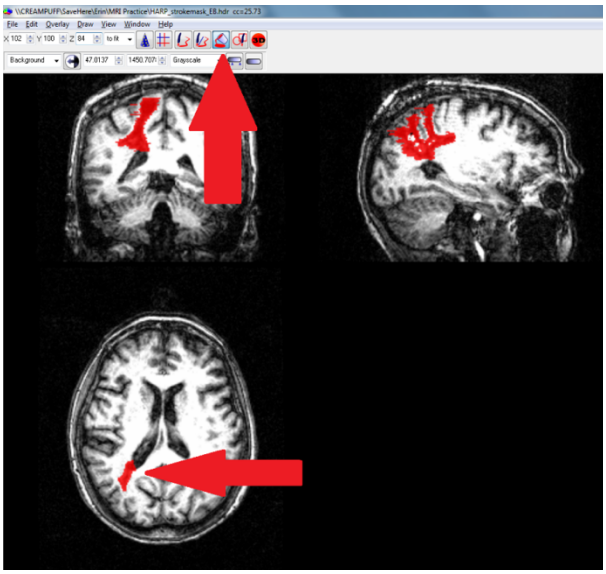


However, when drawing lesions that take up the edges of the brain, approximate where the brain tissue should be by drawing the lesion to make it symmetrical to the other side of the brain.



4. Paint Bucket Tool:

When the outline is finished and completely closed, fill in the center with the paint-bucket tool. Check to make sure that the drawing looks smooth in the other two views as more slices are drawn in and adjust as necessary.

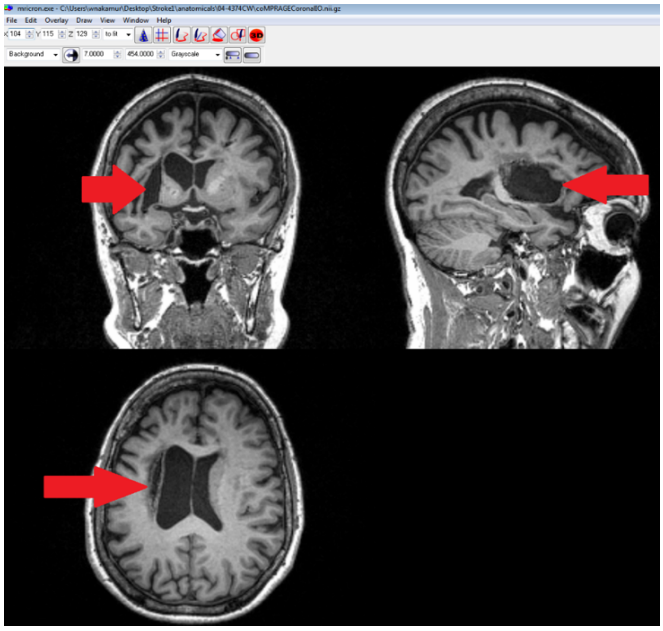


5. Undoing Mistakes:

If at any point mistakes are made, using the command Ctrl+Z will undo the previous command. However, this can only be used to undo the most recent command. Thus, it is especially important to immediately fix any large mistakes, which most often occur when the paint-bucket tool is used on an area that isn't fully enclosed.

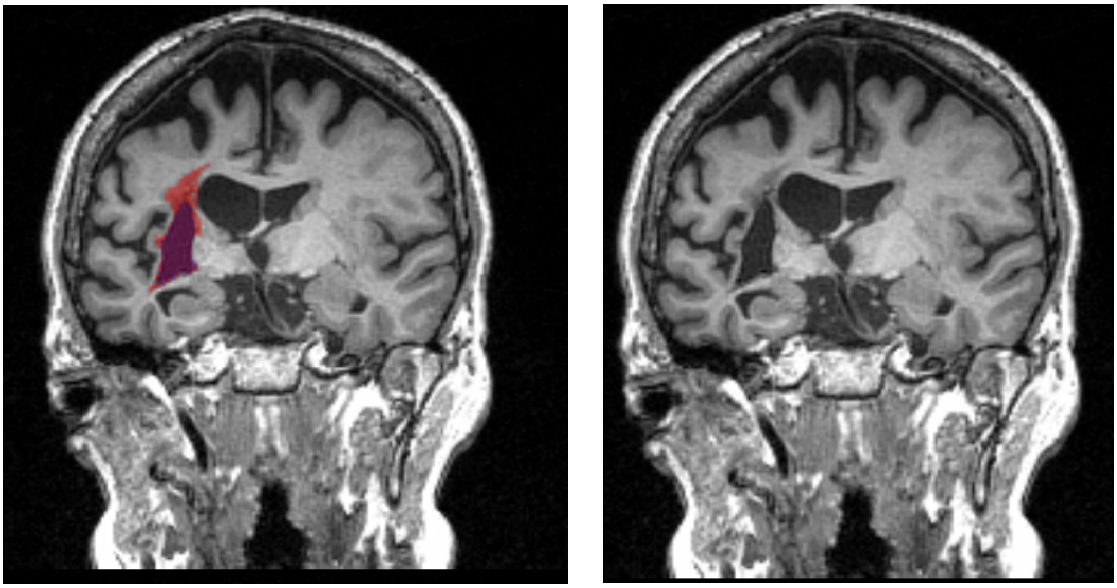
C.) Finding Lesions

Scroll through the slices and look for black or grey areas that do not appear bilaterally. When scrolling through the slices, make sure that other tools are not selected as they will take precedence over scrolling. To de-select tools, simply click them again or press F9.



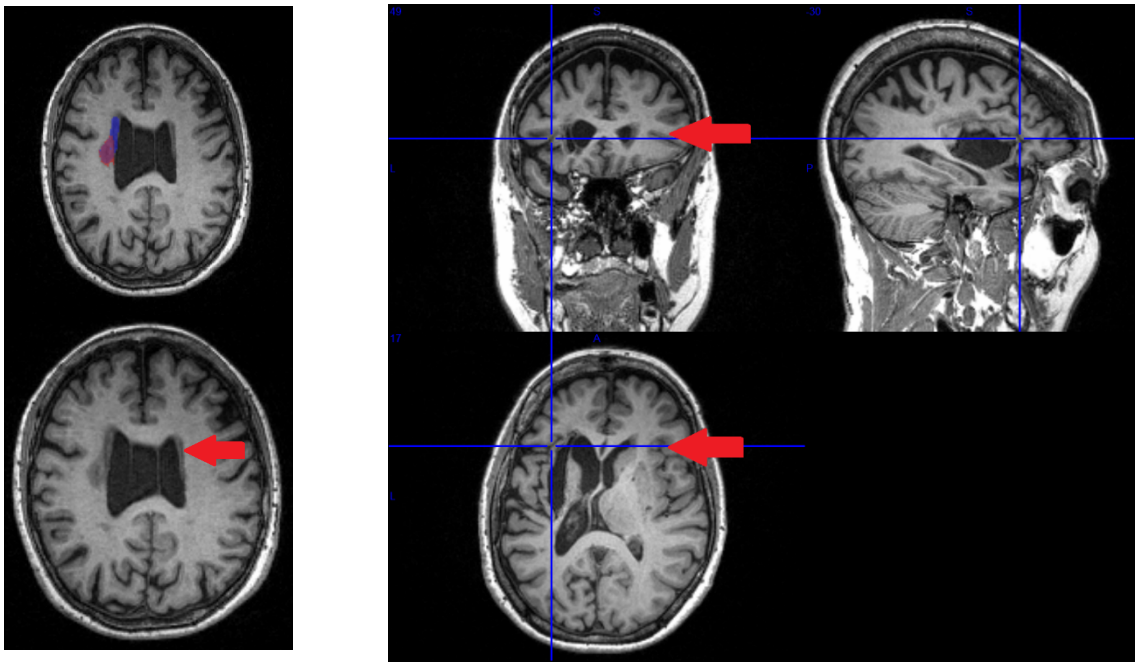
Once you find an area, begin to fill it in and look for connected areas that are also darkened as lesions are usually connected. Remember that a lesion can be black, which indicates the tissue is completely gone, or gray when it should

be white, which indicates that the tissue partially gone. In the pictures below, the person drawing in blue has left out the gray parts of the lesion, the totality of which is indicated in red.



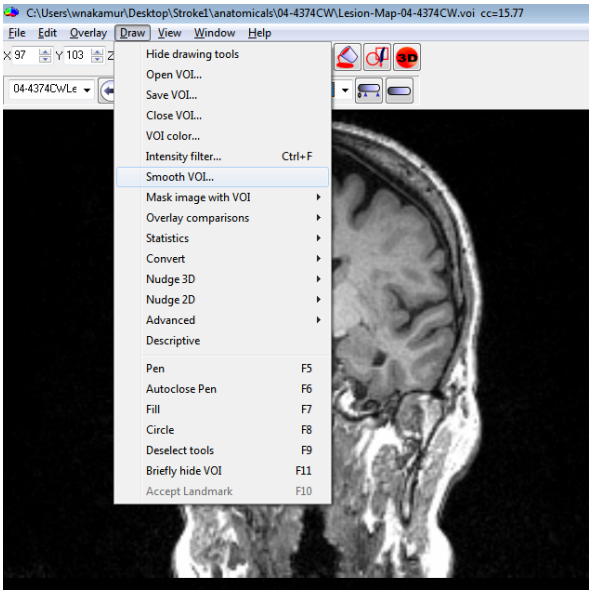
However, don't be fooled into following a lesion into black or gray parts that are normal and have analogous regions on the other side. For example: the region marked in blue below is incorrectly marked because there is an analogous region on the other side indicated by the red arrow.

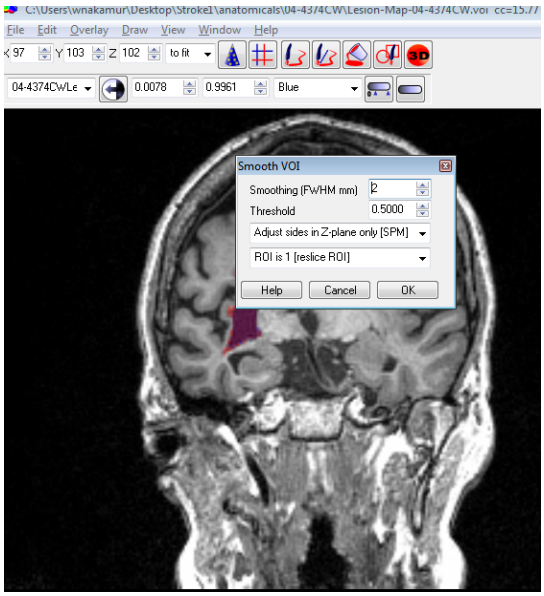
When looking for lesions, it is usually better to look at the coronal and axial views as they show what the brain is like on the opposite side and can help you differentiate between what is and isn't part of a lesion. For example, the region indicated by the crosshairs appears to be a part of the lesion if you look at the sagittal view, looking at the other views reveals that it is part of the normal structure of the brain. Additionally, as indicated by the red arrows, there is an analogous structure on the other side of the brain.



D.) Smoothing the VOI

To smooth the VOI, click the Draw dropdown menu and select Smooth VOI. Change the Smoothing setting to 2 FWHM mm and click OK. This should take a few seconds to finish.





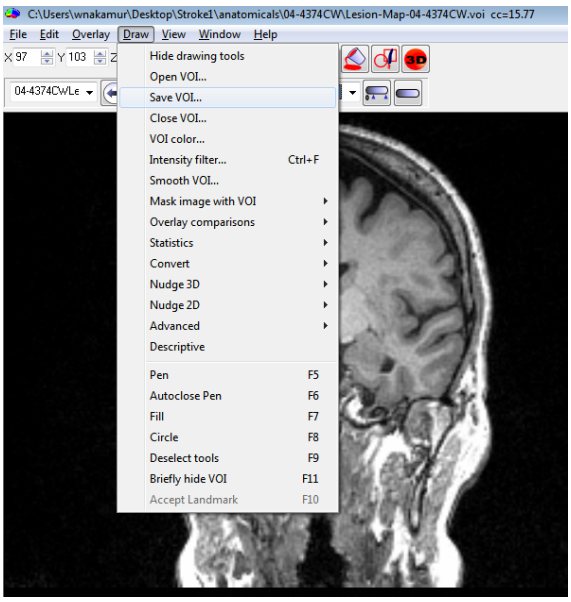
E.) Saving the VOI

To save your drawing, click the Draw dropdown menu and select Save VOI… and save the file.

F.) Converting to Nifti

To convert the file to a Nifti format, using the Draw dropdown menu and then selecting Convert.

E.



F.