A Guide to OsiriX
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Introduction:

OsiriX is an open source DICOM viewing software developed for Mac computers. It is an easy to use application, and easy to learn how to use as well. OsiriX is not limited to medical viewer formats such as CT or MR, it can also view images saved as jpg, tiff, mov, NIfTI, and much more. It can even save images in another format, making it easy to use desired or key images in presentations, publications, and for research. This guide is aimed at explaining some of the basic, and intermediate uses of OsiriX.

Starting off:

The first time the OsiriX application is run, there will be nothing in the Database. The window should look something like this:
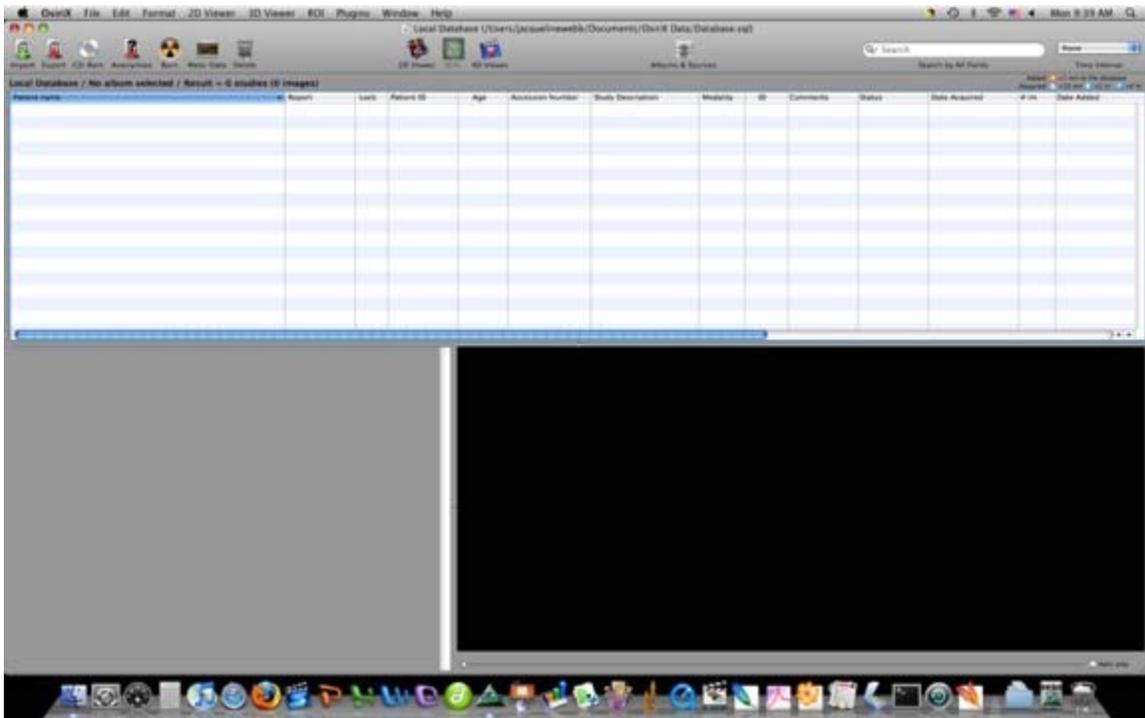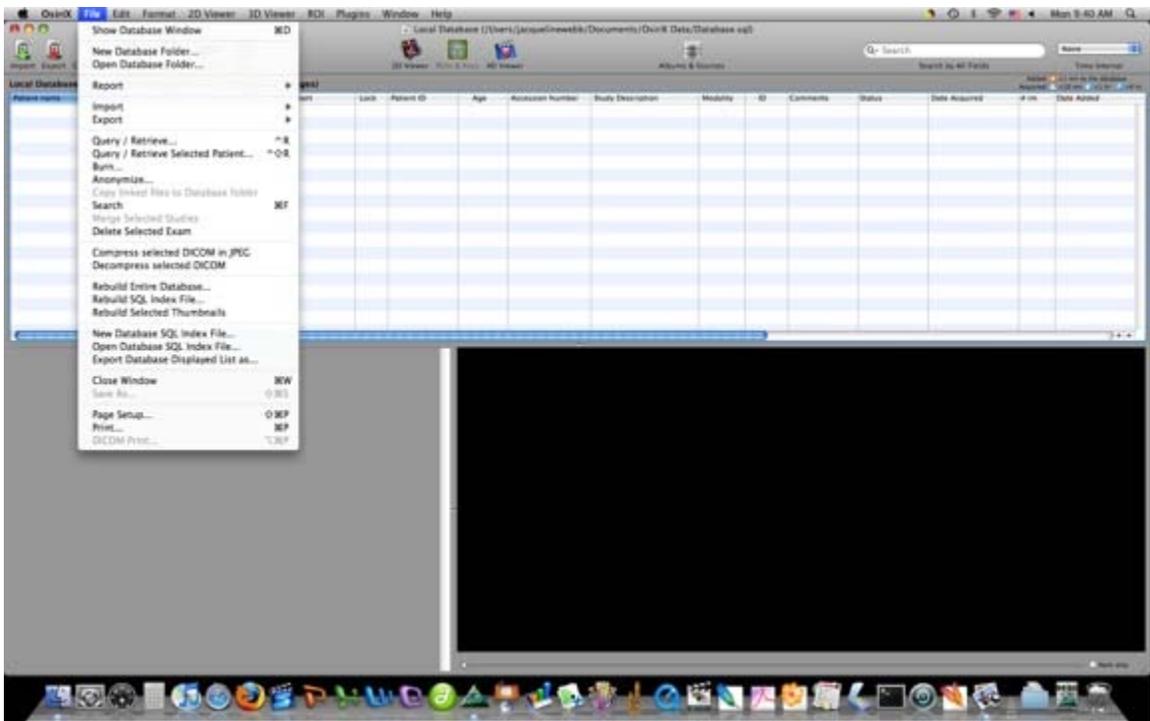

Figure 1.

The screen is visibly divided into five sections. The Apple Toolbar runs across the top of the screen all the time. The OsiriX Toolbar is located beneath the Apple Toolbar, and runs the length of the window. Underneath the OsiriX Toolbar is the Local Database. This contains a list of all the patients/specimens that have been imported into OsiriX. The bottom left of the screen displays all of the series of images for the selected patient. The bottom right of the screen displays the first image of the selected series of the selected patient. Since there are no images in the Local Database yet, nothing is showing up in the lower windows.

In the Apple Toolbar there are objects to click on. They are: OsiriX, File, Edit, Format, 2D Viewer, 3D Viewer, ROI, Plugins, Window, and Help. Clicking on them will grant access to most of the functions that OsiriX has to offer.

Figures 2-3.

There are two methods to adding images to the database, one is to click on 'Import' in the OsiriX Toolbar and select the file/images ready for importing, or click on 'File' from the Apple Toolbar then click 'Import' 'Import from file' and select the file/files ready for importing. Once images are imported, the patient and image series can be selected and viewed in the 2D viewer mode.
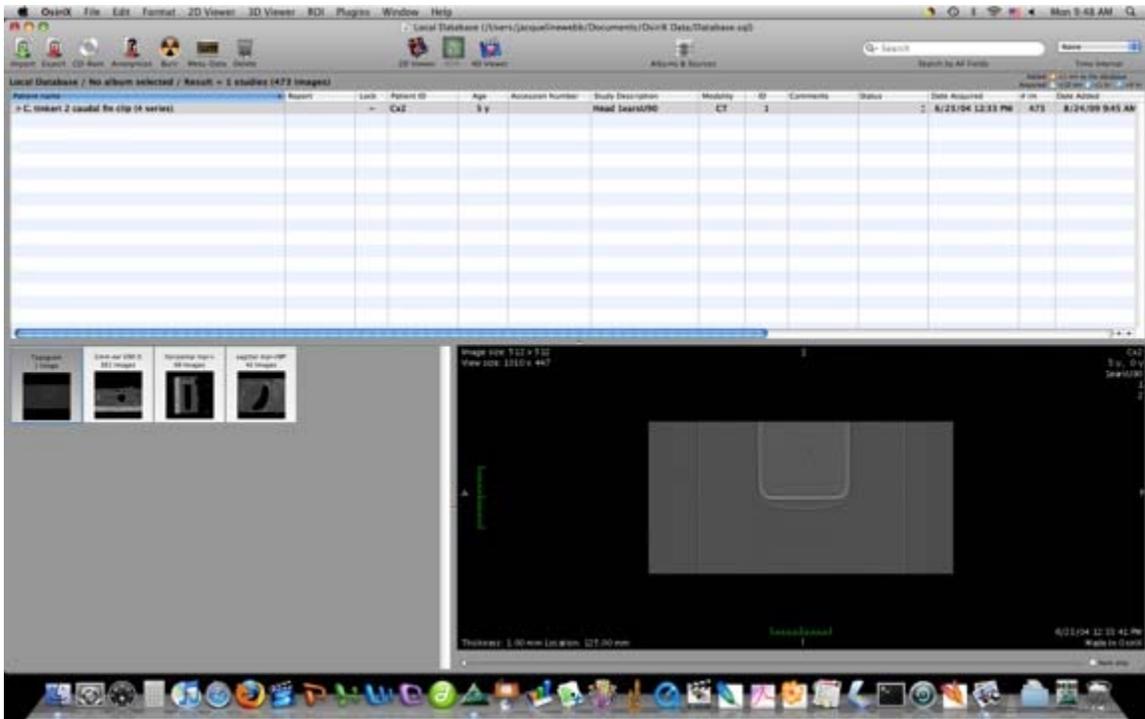
2D Viewer Mode:

Figure 4.

In 2D viewer mode, it is noticeable that the Apple toolbar stays the same, while the OsiriX Toolbar changes. There is now a bar with images that runs down the left side of the screen. This allows the user to change between series by left clicking the desired series, or open a new window (by right clicking the image) in tandem with the current series. The image screen provides an abundance of information about the image currently being viewed. In the center is the image itself. To the right of the image is a grayscale bar with numbers at the top, middle, and bottom. Each shade of color represents different levels of attenuation. Typically the lighter the color, the denser the material being viewed. The upper right corner of the screen contains information relative to the patient, such as patient ID, Age, Study Description, and ID#. The upper left corner of the screen contains information pertaining to the picture/image, such as image size, view size, Window Length, and Window Width. Window Length and Window Width affect the contrast of the image being viewed, and they also affect the numbers for the attenuation bar. The lower left corner of the screen contains information relating to the image series, such as % zoom, angle, image number out of total images, thickness of each image, and the location in the patient as a whole. The lower right corner contains the date and time of viewing.

As mentioned before, the OsiriX Toolbar has drastically changed from the database window to the 2D viewer window. There are many more items to customize the toolbar with, tools for fusing image, and tools for regions of interest. Here are a few zoomed in pictures of the toolbar along with descriptions of what each tool does.

4

Figure 5.

***Database** saves all changes done to the image series and returns the user to the Local
      Database window.

***Tile** aligns all windows on the screen evenly.

*The **Series** buttons changes the series being viewed, and the patient buttons changes the
      patient being viewed.

*The **Mouse Button Function** allows the user to assign different uses to the left and
      right mouse buttons. From left to right the functions are:

    Window Level Option: Allows the user to click and drag the mouse to change
        the window width and window length in Hounsfield Units (changes pixel
        values)

    Screen pane: Click and drag the mouse to change the x and y coordinates of the
        image (moves the image across the screen)

    Screen zoom: Click and drag the mouse up and down to zoom in and out on the
        image. The up and down arrow keys can be used to do this as well, and
        pressing shift opens up a large magnifying glass on the image.

    Rotate image: Click and drag mouse left and right to rotate the image
        counterclockwise and clockwise.

    Animate: Allows the user to change the z coordinate of the image. Click and
        drag the mouse left and right to browse through the image series. This can
        also be done using the left and right arrow keys on the keyboard.

    Right mouse button: While the dot is checked off, left clicking on any of the
        above icons will set its function to the right mouse button.

    Left mouse button: While the dot is checked off, left clicking on any of the
        above icons will set its function to the left mouse button.

    ROI tool: ROI stands for region of interest, and they have many uses, such as
        outlining objects, finding the length of an object, determining volume,
        area, diameter, radius, and finding the angle between surfaces. ROI tools
        can only be assigned to the left mouse button.

    *Length: Allows the user to draw a straight line. Tells the length from point A to
        point B

    *Angle: 3 clicks, first click sets 1st point, 2nd click sets vertex of angle, 3rd click
        places the last point. There is a line connecting points 1 and 2,
        and a line connecting points 2 and 3. This tool gives the angle
        between those two lines.

    *Rectangle: Click and drag to create a rectangle. A box will appear containing
        information (such as area) about the rectangle.

    *Oval: Click and drag to create an oval.

    *Text: Click to place a text box.

*Arrow: Click to place an arrow.

*Opened Polygon: Click on the image to place points to be used to create an open polygon. Can be used to find abstract lengths or outline certain structures. Used with the 2D-Curved MPR tool to flatted curves into a flat plane.

*Closed Polygon: Click on the image to place points to be used to create a closed polygon. After the third point is placed, a line will be drawn to connect the most recent point placed to the first point placed. This tool is useful for outlining and removing structures and finding the area and volume of structures.

*Pencil: Trace the image using a pencil like tool. The thickness of the lines drawn can be changed at the users discretion.

*Point: Places a point on the image. The point stores the x, y, and z coordinates. These points can be used to align images are crooked, serve as an anchoring point for PET fusion images, and keep track of certain features of the structure being viewed, such as skin, bone, muscle, and nerve fibers.

*Brush: Trace the image using a paintbrush like tool. The color and size can be chosen at the users discretion. This tool can be used as an alternative to the closed polygon ROI. Other uses of this tool include a Growing Area tool, 'opening' and 'closing' filters, and volumetric measurements.

*Axis:

*Dynamic Angle: Allows the user to compare the angle between two different line segments. This functions uses four points placed by the user. The first two points compose the first line, line A, and the second two point make up the second line, line B. A transparent line connects points 2 and 3. The angle that is found using this tool, is the angle that line B makes with Line A, if they were to intersect. The angle that is given is always the smallest angle between both lines, and therefore is always between 0 and 90 degrees.

*Repulsor: The user clicks the mouse to create a yellow sphere that can 'push' other ROI's around. This can be used to expand or shrink some ROI's without having to redo them, or select them. It can also be used to add more points in the closed and open polygon tools. The distance the mouse is from the nearest ROI affects the size of the sphere when the mouse button is clicked.

*Selector: The selector tool allows the user to click, drag the mouse, and select ROIs currently located on the image.
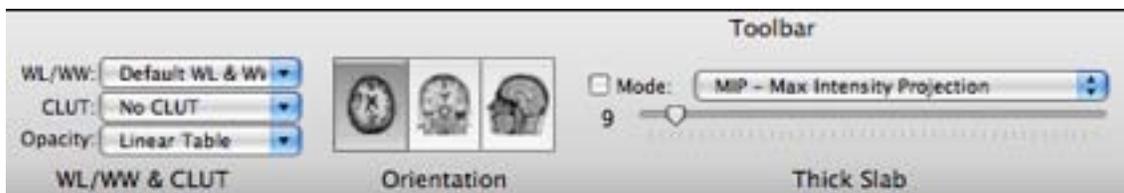

Figure 6.

*__WL/WW__ allows the user to change the window length and width to predetermined settings. There is also an option to set it manually, or save the current WL/WW settings. To remove a saved setting, hold down shift while selecting the preset. When setting the WL/WW, it is helpful to keep the following mathematical equation in mind, since it relates WL/WW to the Max, Mid, and Min attenuation values on the attenuation bar:

$$Mid = WL$$
$$Min = (WL * 2 - WW) * (1/2)$$
$$Max = WW + Min$$

*__CLUT__ stands for Color Look Up Table, and allows the user to choose from a handful of preset color schematics. Changing the CLUT changes the color scale of the attenuation bar. This allows users to view the images in color spectrums that satisfy their needs.
*__Orientation__ changes how the image series is 'sliced'. The different views are Transverse, Coronal, and Saggital.
*The __thick slab__ tool allows the user to view images X number of images in advance. If X were chosen to be the number 9, then the user will see from the current image to 9 images in the future.

Figure 7.

*__Convolution__ filters allow the user to blur or sharpen an image to their needs. These filters function similarly to the filters in most Photoshop tools. These filters include, but are not limited to: Lowpass, Highpass, Edge detection, Medium, Moving Average, Butterworth, Maximum, Minimum, and Laplacian filters.
*__Browse__ will play through all of the images sequential like a movie. Pressing space on the keyboard has the same effect. The rate bar determines the rate at which OsiriX browses through the images.
*__Sync__ will synchronize two similar series with each other.
*While the __propagate__ tool is active, all changes made to one image window will be applied to all other open image windows
*__Movie Export__ allows the user to save the series as a Quicktime movie, or .mov.
*__3D panel__ will open a window with the series constructed in 3D Maximum Intensity Projection mode.

The following image shows all of the tools that can be used in 2D viewer mode.
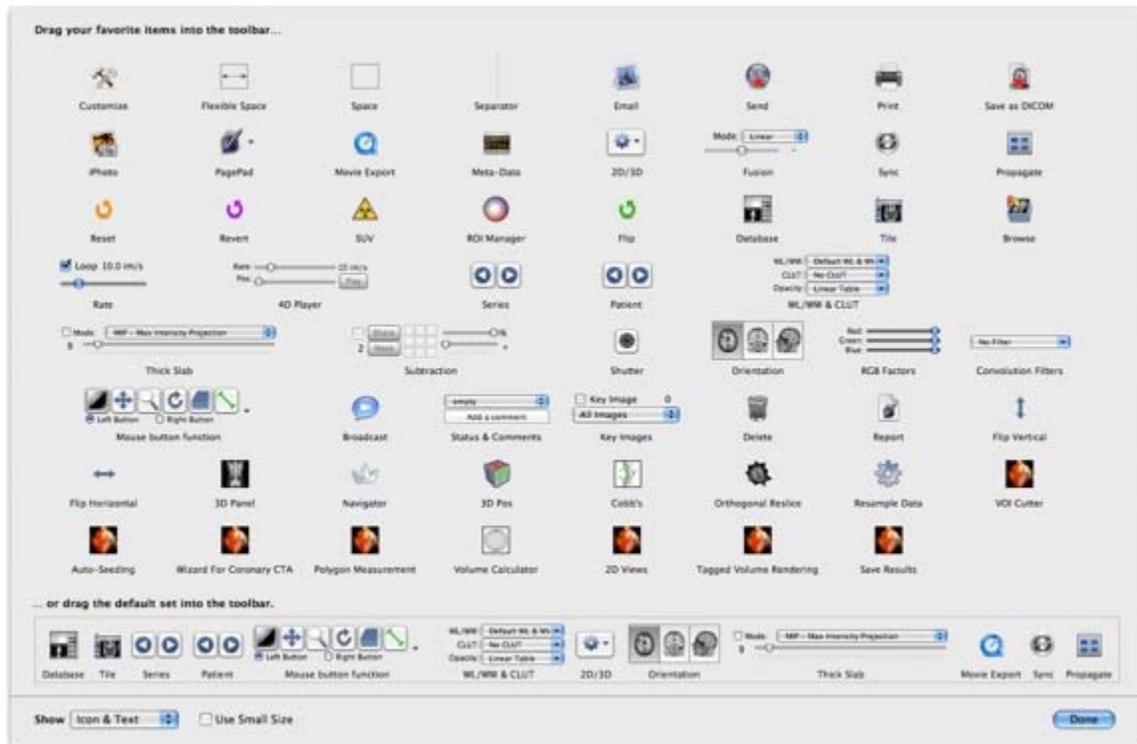
Figure 8.

The tools do not have to be in the OsiriX Toolbar to use them. The user can access them by left-clicking on '2D Viewer' on the Apple Toolbar and choose the tool he or she wishes to use. Two very useful tools that are located under '2D Viewer' are **Revert Series** and **Reset Image View**. Revert Series allows the user to undo every change made to the series. Reset Image View sets the image in the center of the screen with the preset size, angle, WW, and WL.

3D Viewer Mode:

3D Viewer Mode allows the user to use multiple methods to view and align images on multiple planes.

3D MPR mode:

The first option in this mode is 3D MPR. This opens up three windows, each one a different viewing plane of the series.
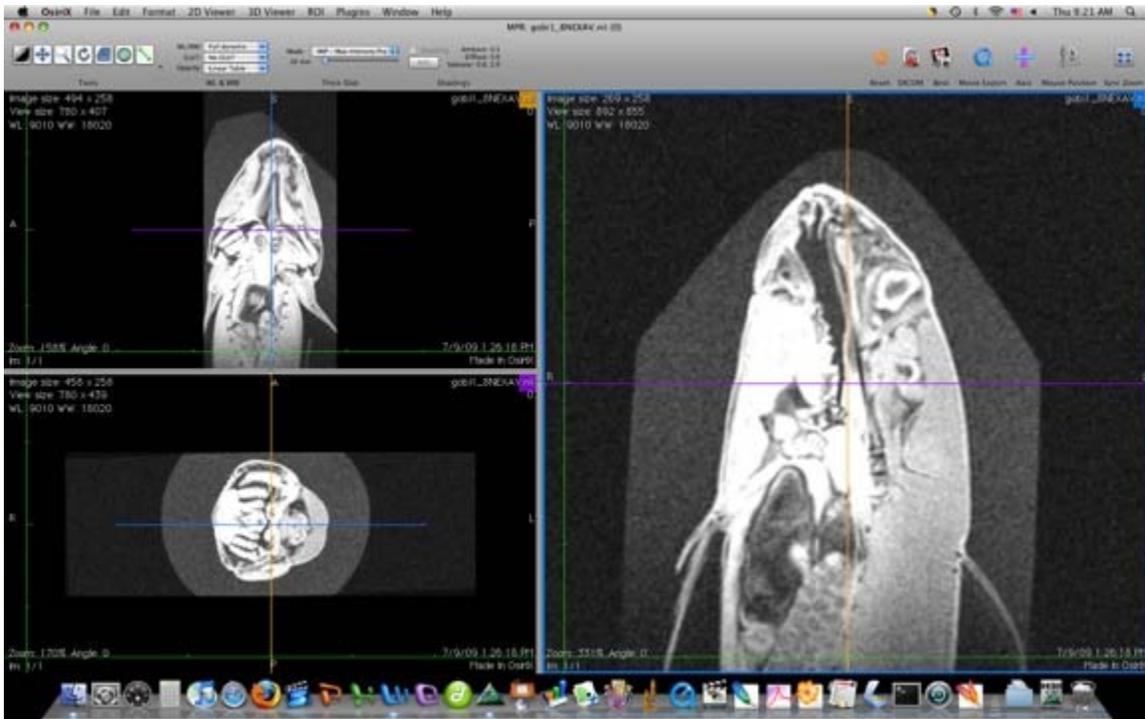
Figure 9.

In the middle of each image is a crosshair of two different colors. Rotating the crosshairs allows the user to change the perspective the images are being viewed in the 2D viewer mode. In the top right corner of each viewing frame is a different color (blue, orange, and purple). The colors play an important role when exporting the images as a new series with the corrected position changes.
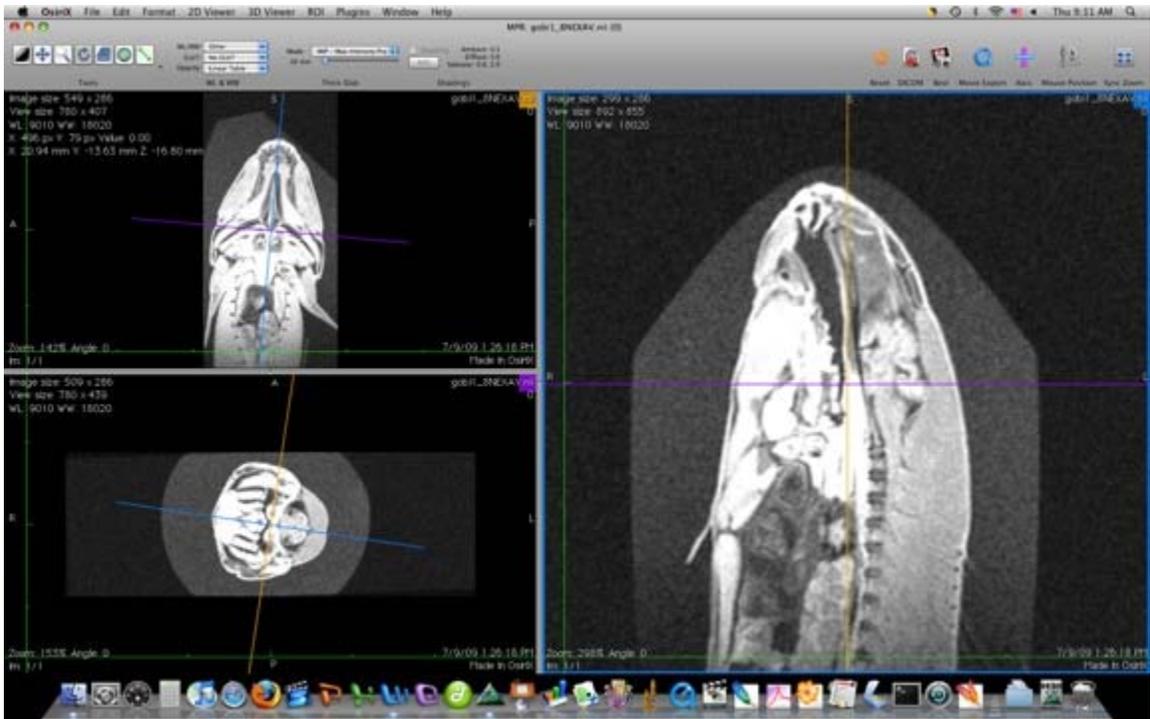
Figure 10.

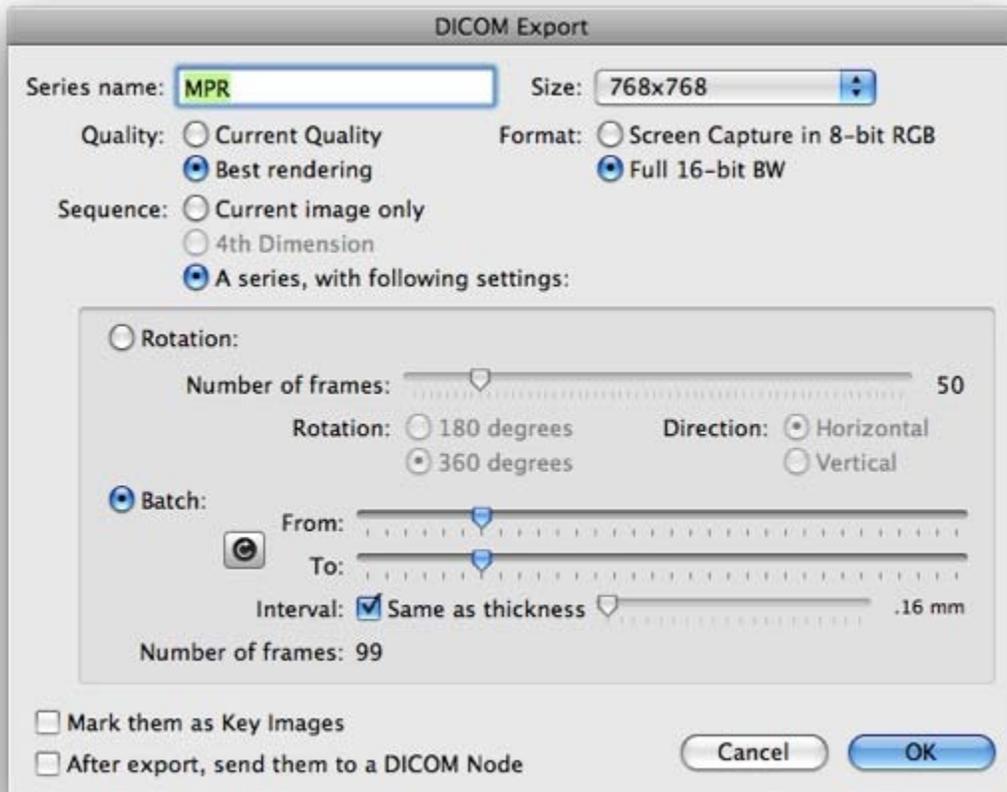While exporting the new series, a window will pop up looking similar to this.

Figure 11.

The user can choose the name, thickness of each slice, the number of slices, and image sizes. Since the blue image was highlighted when the export option was used, the slices were parallel to the 'blue' axis.
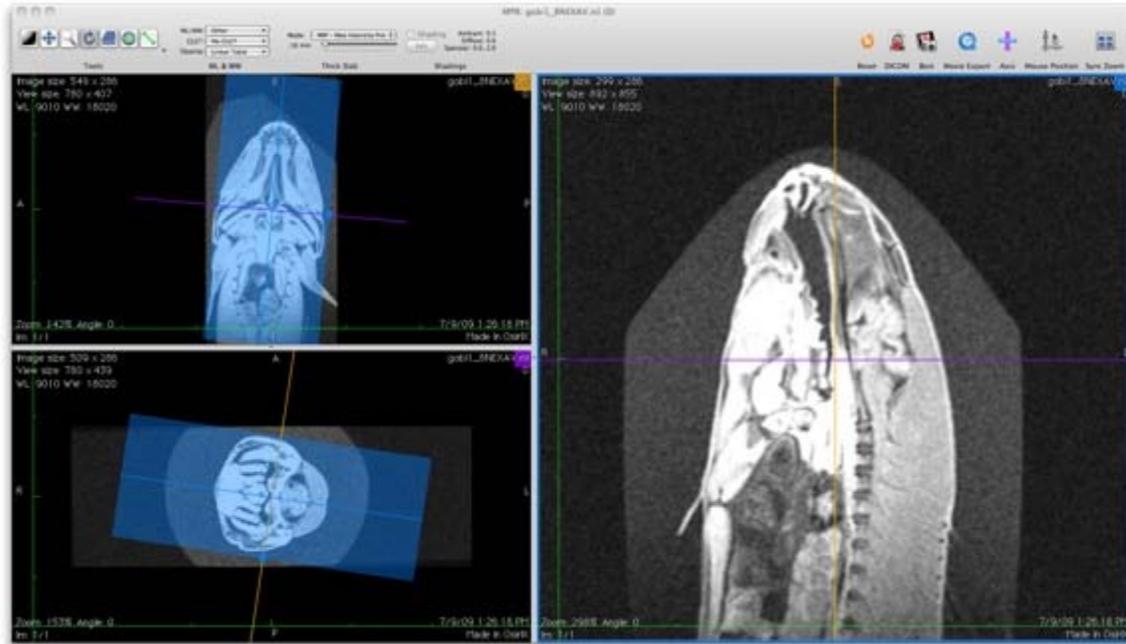
Figure 12.

After exporting, the images should show up in the local database, however all of the images will be separate and need to be merged together in a series. To do this, select all of the images to be included in the series, right click, and select 'Merge selected studies'. This will group them all into one study. Once they are all in the same study, the images can be merged into a series using the same method described above. Now the series is complete and ready to be viewed.

2D Curved-MPR mode:

The next option under 3D viewer is '2D Curved-MPR'. This tool is used to take curved or round objects, and flatten them for viewing on a 2D plane. In order to use this tool, at least one open polygon ROI must be present on the image.
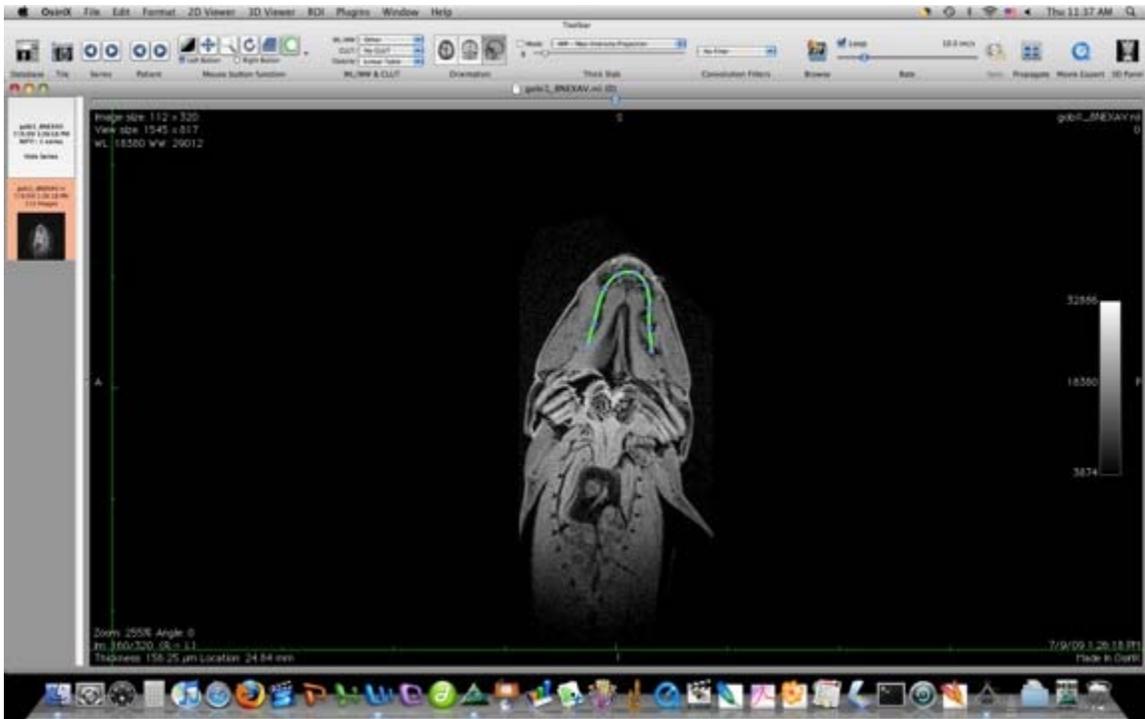
Figure 13.

The green line with the blue dots on it is an open polygon ROI. It was drawn along the mouth of a Goby. The 2D curved-MPR mode will flatten the line that was drawn to a 2D plane. The resulting view will be orthogonal to the line that was drawn (with respect to the x and y directions only, not z). Be aware that some distortion may occur.
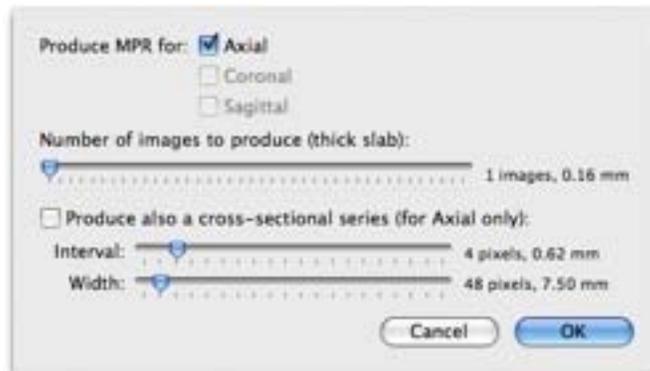

Figure 14.

Under the options for this tool, the user can decide how many images or mm thick the flattened images will be. The resulting image(s) look like this:
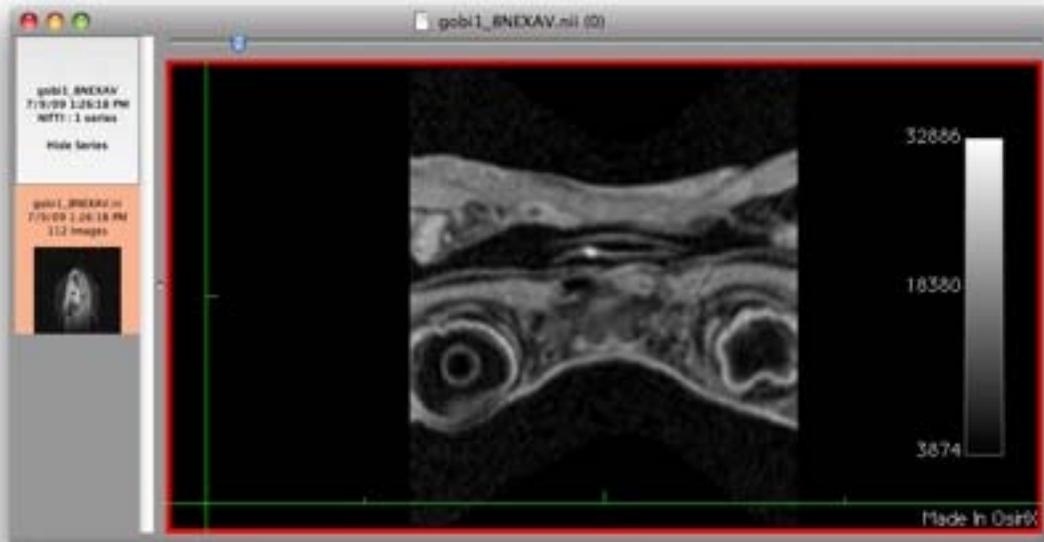
Figure 15.

Since the fish was ventral up, the eyes are on the bottom.

2D orthogonal MPR mode:
The next mode under 3D viewer is '2D orthogonal MPR' mode. This mode takes the transverse, coronal, and saggital views of the patient, and places them side-by-side one screen for easy viewing.
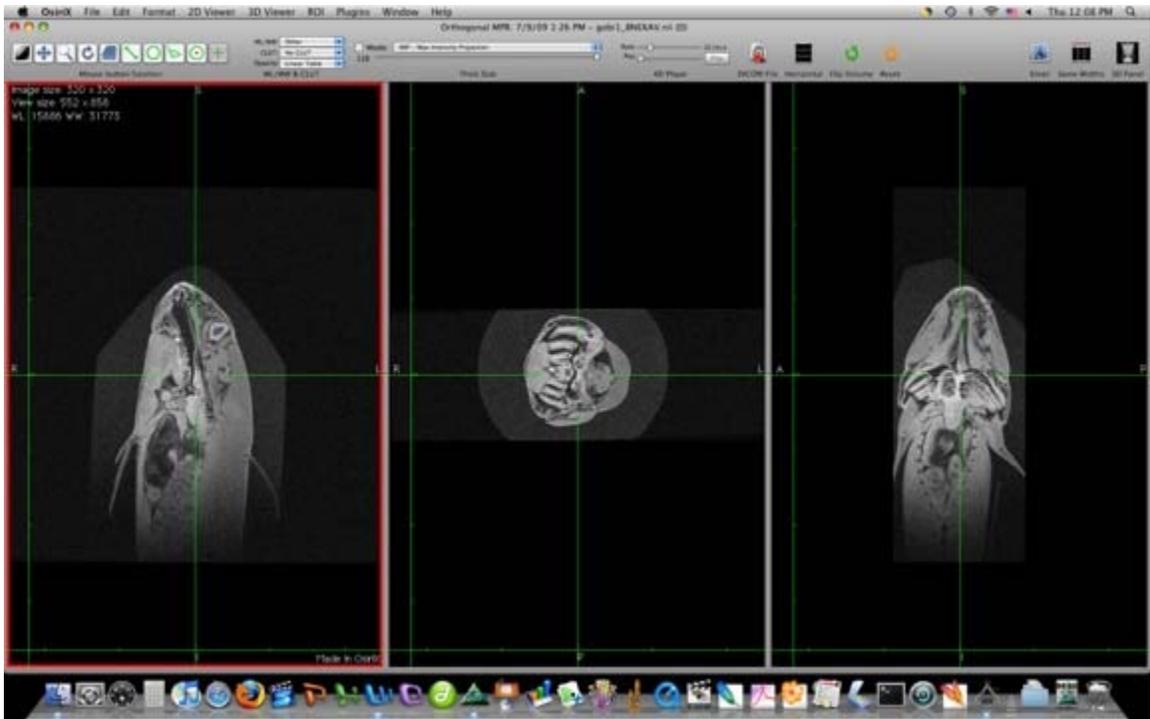
Figure 16.

Clicking on a location on one of the views focuses the other two views on that specific location.

Figure 17.

While in this mode, the space button adds/gets rid of the green crosshairs. The up and down arrow keys can be used to zoom in and out, while the left and right arrow keys browse through the selected view.

The next four modes in the 3D viewer require a lot of RAM, and therefore, only one of them should be viewed at a time.

3D MIP mode:
3D MIP (Maximum Intensity Projection) is the first fully 3D mode under the 3D viewer. In this mode, the higher the attenuation, the brighter it shines. Specific details are difficult to make out in this mode; however, the shapes are still easy to distinguish.
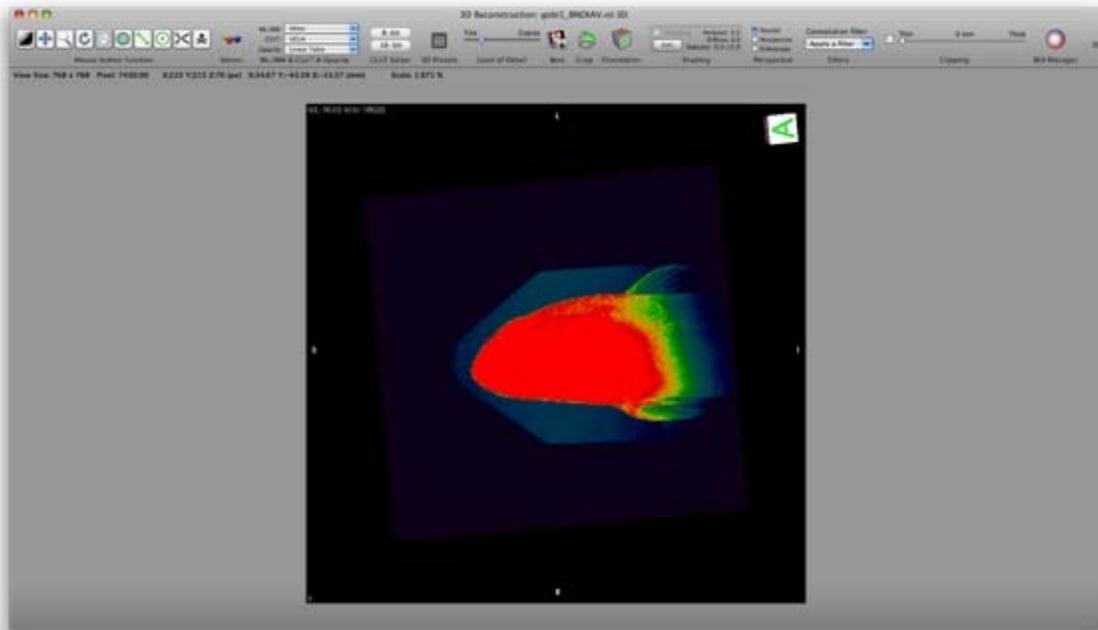

Figure 18.

The 3D object can be rotated, moved spatially, objects can be cut away, and the viewing angle can be adjusted. A few shortcuts for changing the function of the left mouse button are: holding down 'control' allows the image to be rotated, holding down 'apple' allows the image to be moved spatially, and holding down 'shift' allows the 3D image to be zoomed in on, and pressing space causes the image to rotate. There are two methods to cut away objects in 3D MIP mode. The first, and less frustrating of the two methods is the scissor tool.

Figure 19.

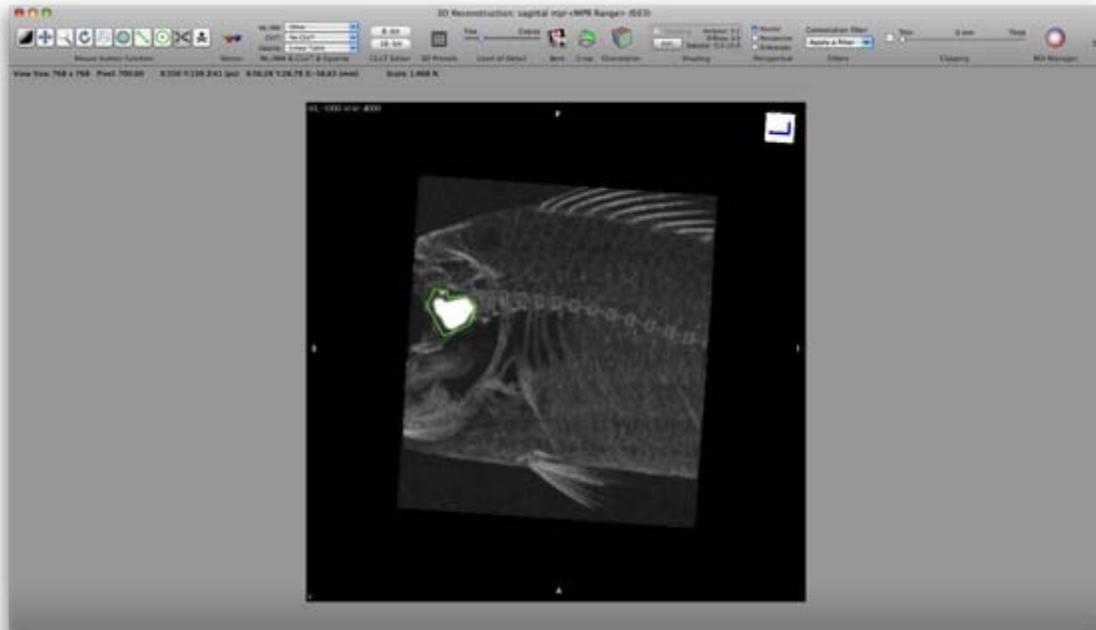This tool allows the user to outline a section to be deleted (by pressing 'delete') or saved from deletion (by pressing 'enter'). Pressing enter deletes all parts of the 3D image outside of the scissor selected area.
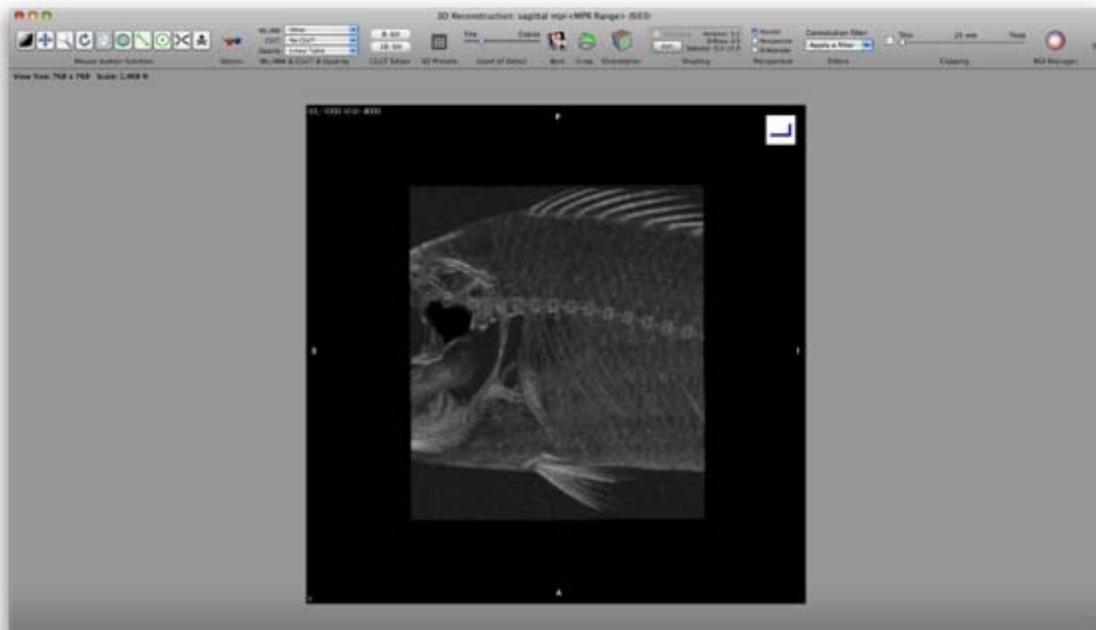

Figure 20.

The bone removal tool deletes everything in a specific range on the 3D image. The user can choose the range by holding down 'alt' while the bone removal tool is clicked. This

tool is frustrating since it not only deletes all parts of the image within the specified range, but it also deletes all parts of the image directly touching the parts being deleted. Both the scissor and bone removal tool affect the appearance of the 2D viewer mode images of that series as well. Parts that are cut away can be recovered by clicking 'undo' under edit, or 'revert series' under either 2D or 3D viewer. States of the 3D image can be saved by clicking 'save scissor editing' under 3D viewer.

On the north, south, east, and west faces of the 3D image screen, there are letters that change as the image rotates. These letters can be used to help determine the orientation of the 3D image. The letters include the following: S for Superior, I for Inferior, A for Anterior, P for Posterior, L for left, and R for Right. Clicking the orientation button can turn off the orientation markers. Another useful tool while in this mode is the image crop tool. The symbol for this tool is a cube with one of its faces green, and a pair of scissors resting on top of it. This creates a box around the image that can be expanded or shrunk in 6 directions to allow parts of the image to be hidden or revealed.
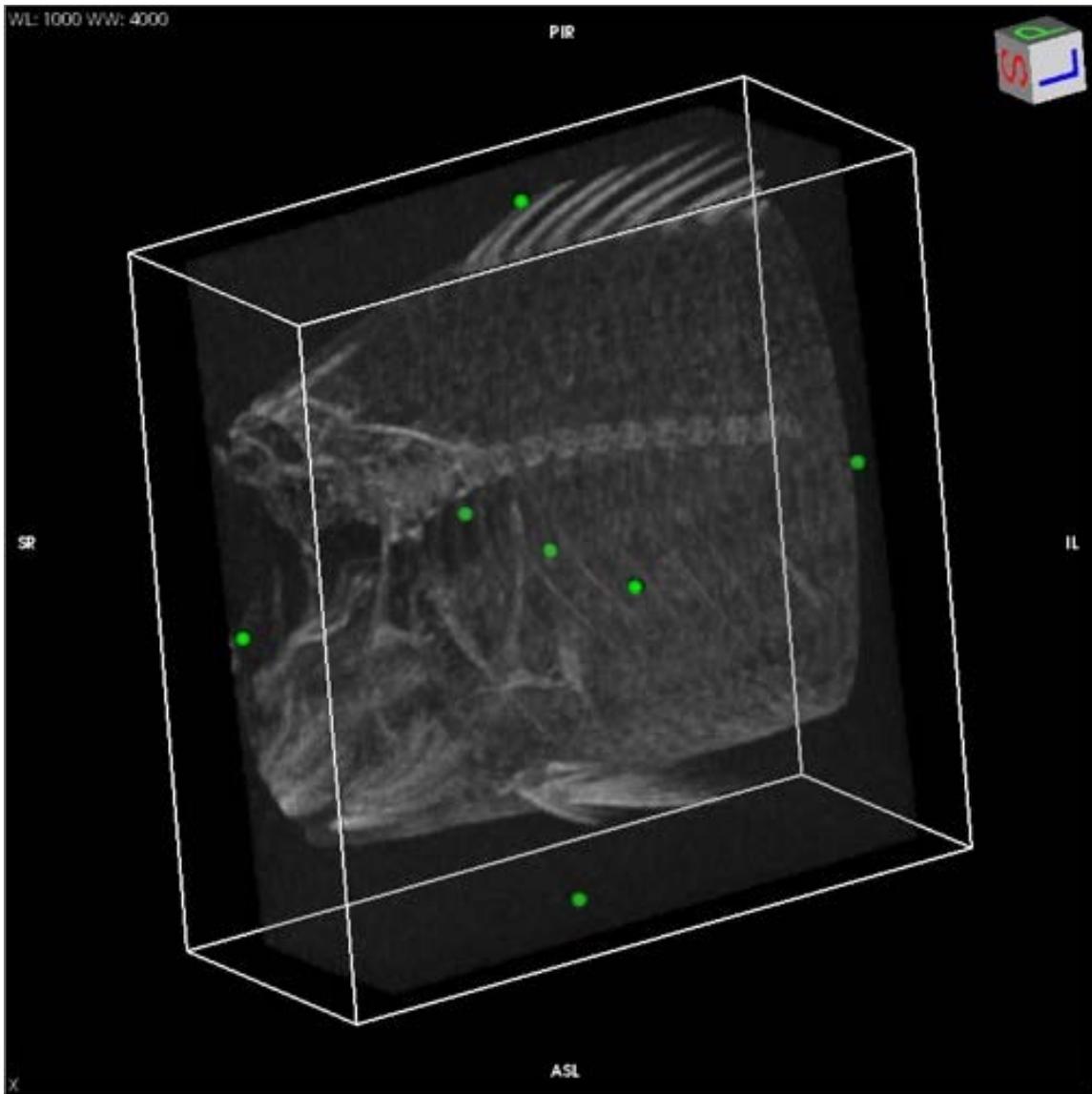
Figure 21.

Parts of the image that are removed by the crop tool can be recovered again by adjusting the cropping cube.
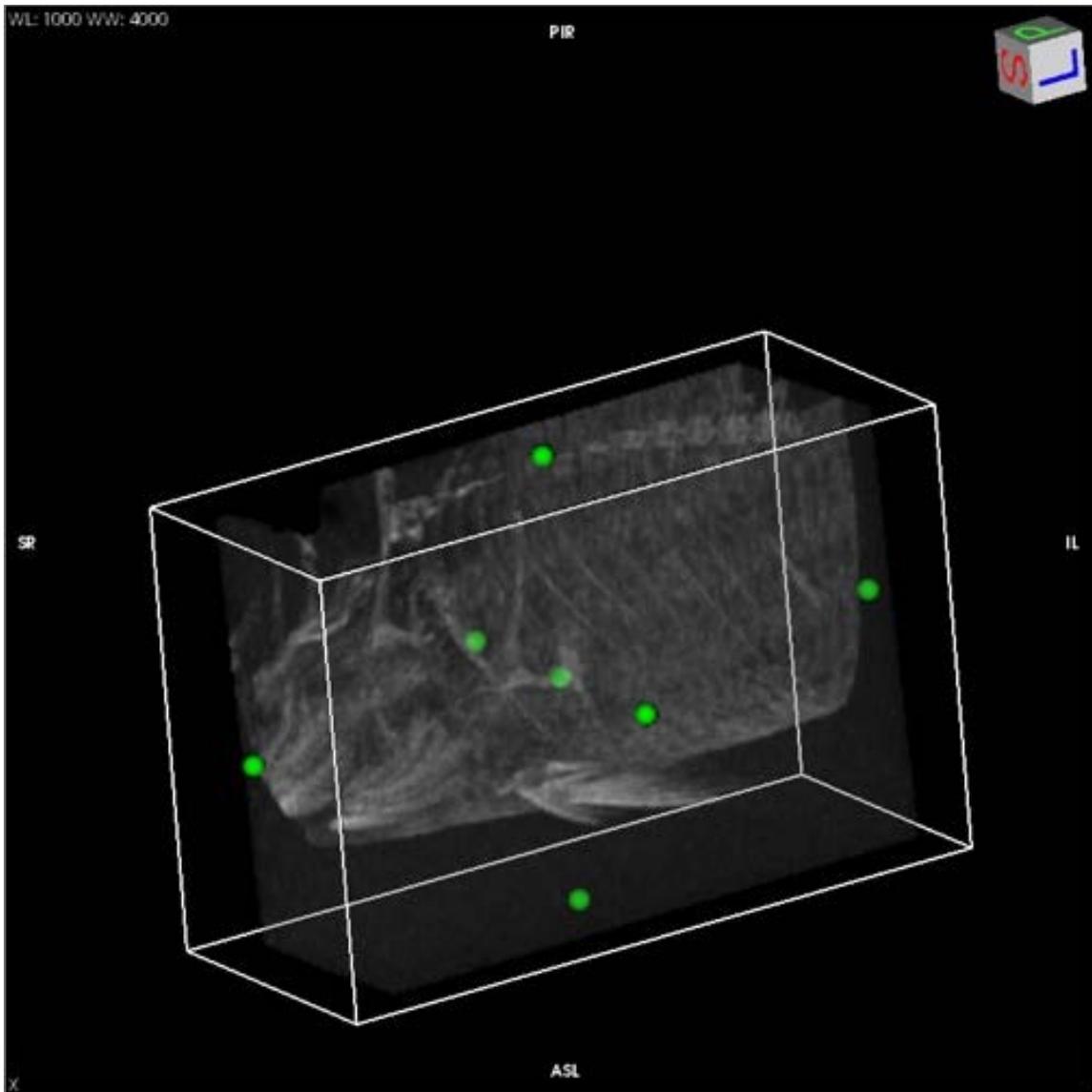
Figure 22.

      Once again, convolution filters can be applied to the image to sharpen or smoothen the view, however they can not be removed when applied in 3D mode. The Clipping tool is similar to the thick slab tool from the 2D viewer mode. What makes it different is that instead of determining how many images are visible in the series, the user is determining how thick (in mm) the visible part of the image is. The parts of the 3D image that do not fall in the thickness range are cut away until the tool is not in use.

      Two more tools that are particularly useful in 3D viewer mode are the Shading tools and ROI manager. These tools have more use in 3D Volume Rendering and 3D Surface Rendering, and will described in those sections.

3D Volume Rendering Tool:

      The 3D Volume Rendering Tool (VR for short) works exactly the same as the 3D MIP tool. Instead of projecting an intensity for specific volumes/attenuations, the VR

tool displays the image using solid colors to represent volumes. The only differences between the two tools are: 3D MIP is designed to view 3D objects using the 8-bit CLUT and 8-bit Editor. The shading tool is also disabled in this mode. 3D VR is designed to view 3D objects using the 16-bit CLUT and 16-bit Editor. The shading tool is enabled in this mode. Other than that, they function the same way. Two tools that have not been talked about are the Select 3D-Preset tool and the 16-bit CLUT Editor tool. Select 3D-Preset allows the user to select many preprogrammed 16-bit CLUT options. There are three categories in this tool: Basic, Bone CT, and Soft Tissue CT. Basic contains 4 presets that are within the same color/light spectrum. Bone CT contains 10 presets, which are good for viewing most bones and objects of high attenuation. A total of 9 presets can be viewable per page, and the page can be changed by clicking on the arrow button on the top right of the preset window.
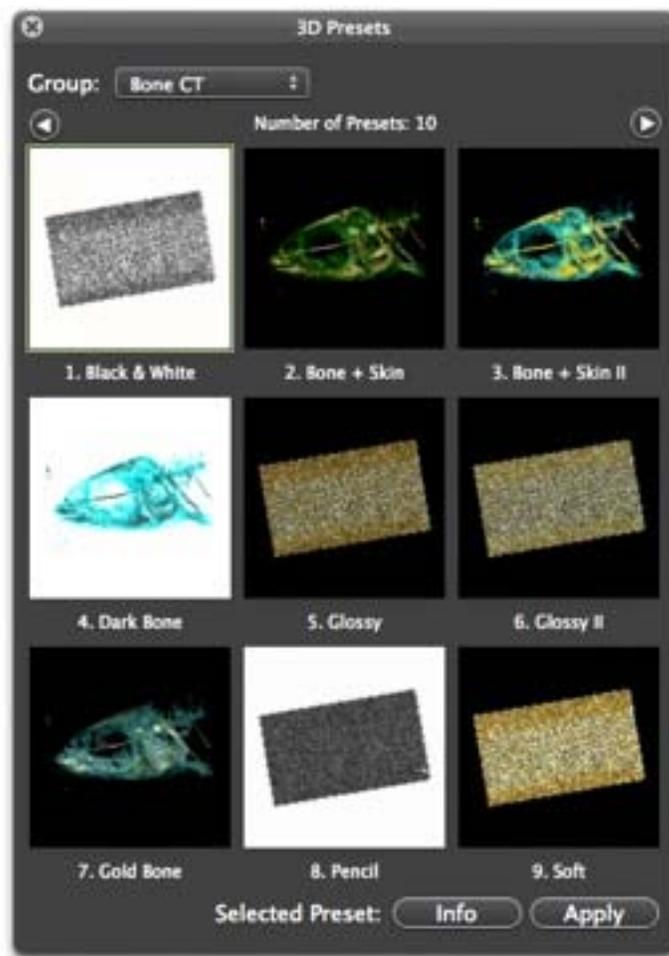

Figure 23.

The image that appears with the preset shows what the resulting view will look like. Soft Tissue CT has 15 presets that are selectable by the user. These presets are geared towards viewing airways, arterial and venous vessels, soft tissue, and skin. If the view obtained from one of the presets is unsatisfactory, then the 16-bit CLUT Editor tool can

be used to obtain a better, if not clearer view. This tool opens up a histogram at the bottom of the viewing window.

Figure 24.

The grey 'Mountains' refer to values of attenuation throughout the object currently being viewed. The colorful shape (black, red, yellow, and white one) represents a color reel. The closer the color to the bottom, the more transparent that color is, the closer the color to the top, the more opaque the color is. The range of colors between two color points increases with respect to the distance between the two points. Double left-clicking on the color curve between two points adds another color point. Double left-clicking on a point allows the user to change the color of the selected point. This allows the user to decide what color they want to use to represent a range of attenuation values to create realistic virtual representations.
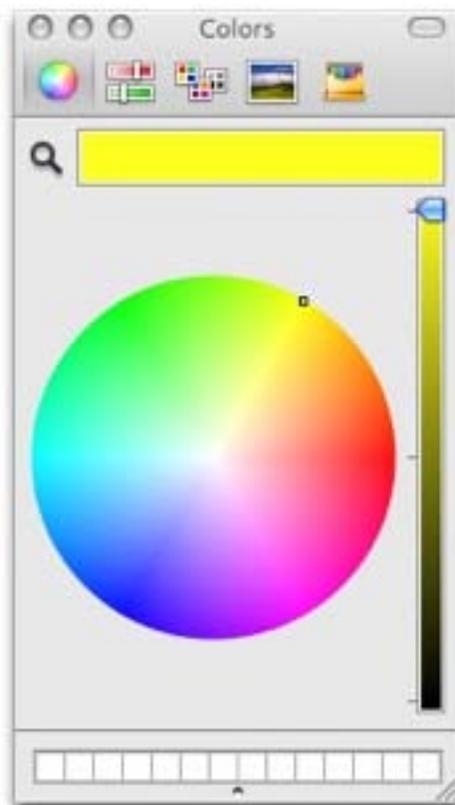

Figure 25.

There are 4 buttons on the left side of the 16-bit Editor window. The top most one is a circle with an 'x' in it. This button will exit the editor and bring the user back to the 3D

object. The two buttons beneath that one are a circle with a '+' and a circle with a '-' in it. The '+' circle will add a new color reel to the editor, and the '-' circle will delete the selected color reel. The settings from the 16-bit Editor can be saved by clicking the circle with a dot in the middle located at the bottom left corner of the 16-bit Editor table. To view saved 16-bit Editor settings, click on CLUT, and the saved settings will be under the title '16-bit CLUTs'.

Another way to change how an image appears in 3D VR mode is to change the shading settings. This tool can be found in the OsiriX Toolbar, along with most of the other 3D VR tools. In the shading box there is a check box, and edit box, and values for Ambience, Diffusion, and Specular. These values can be adjusted by clicking on the edit box. A new window will open with a '+' and '-' button in the to right corner. Clicking on '+' will add a new preset to the list of preset shadings, while clicking on '-' will delete the selected preset. The preset currently in use can be changed to another preset by clicking on the arrows next to the preset name. In order to edit the values for ambient, diffuse, specular coefficient, and specular power, the edit button must be clicked. Now the values can be changed to bring out desired effects in the image.
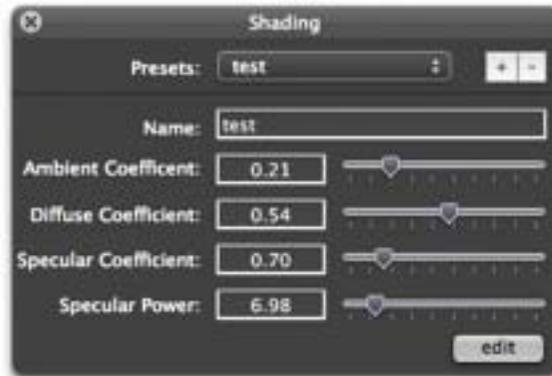

Figure 26.

Ambient Coefficient: This affects 'ambient' lighting on the 3D image. The closer the value is to 0, the glossier/darker the image will appear to be. This also affects the 16-bit color intensity. The ranges of values are from [0.00 – 1.00]

Diffuse Coefficient: This affects how much color 'radiates' out of the 3D image. If a light bulb were to be placed into the 3D structure, the diffuse coefficient would be a knob that dims or brightens that bulb. Another way to think of it is light diffusing through an object. The ranges of values are from [0.00 – 1.00] with 0.00 being no diffusion light, and 1.00 being the max.

Specular Coefficient: This affects the amount of outside light that is hitting the 3D object. This also affects how much light shines off of the 3D structure as well. One way to think of this is as an adjustable spotlight. The ranges of values are [0.00 – 4.00] with 0.00 being no outside light, and 4.00 being the max amount of outside light.

Specular Power: This affects how close the specular light is to the 3D object. The closer
it is to the 3D object, the brighter the reflective light. The further it is from the 3D
object, the less light reflects off of it. The ranges of values are [0.0 – 50.0] with
0.0 being the specular light is right in front of the 3D structure, and 50.0 being the
greatest distance the specular light can be from the 3D structure.

When used correctly, shading can add plenty of depth to a 3D image.

3D Surface Rendering:

3D Surface Rendering or 3D SR for short allows the user to create a 3D model
based on a specific attenuation value. In this mode the 3D structure is hallowed out, thus
leaving only the detected surfaces visible to the user.

Figure 27.
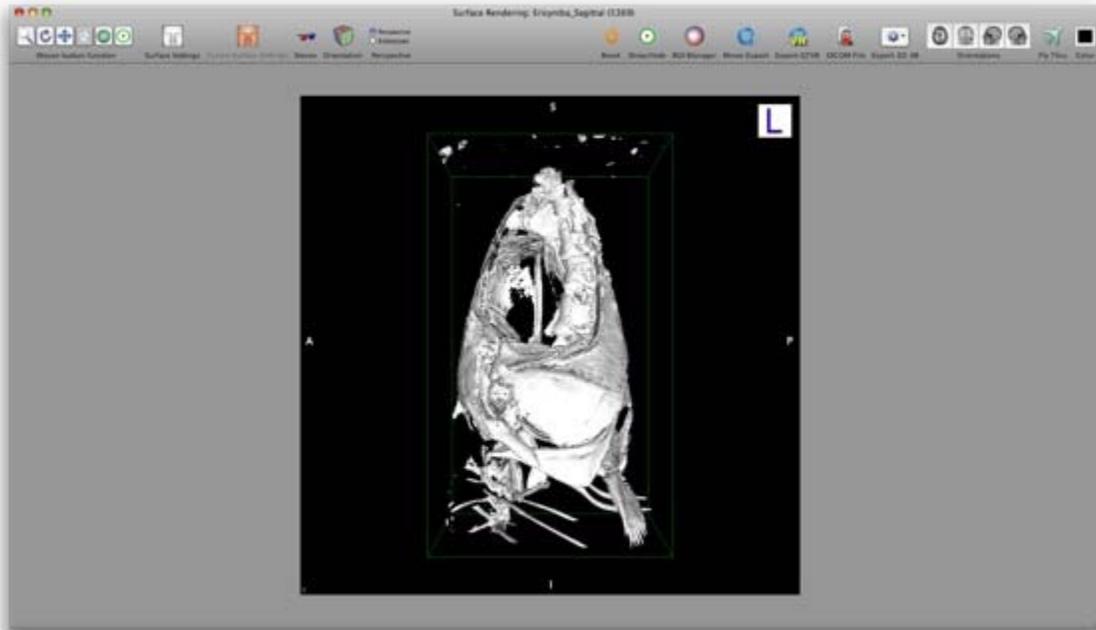
In this mode, the edges tend to be a little rough sometimes, and some details tend to be
blurred together. This mode does not use up as much RAM as the previous two, and thus
runs smoother. While in this mode, the user can choose a uniform color to represent the
range of attenuations being viewed. To change the viewing settings, click on 'Surface
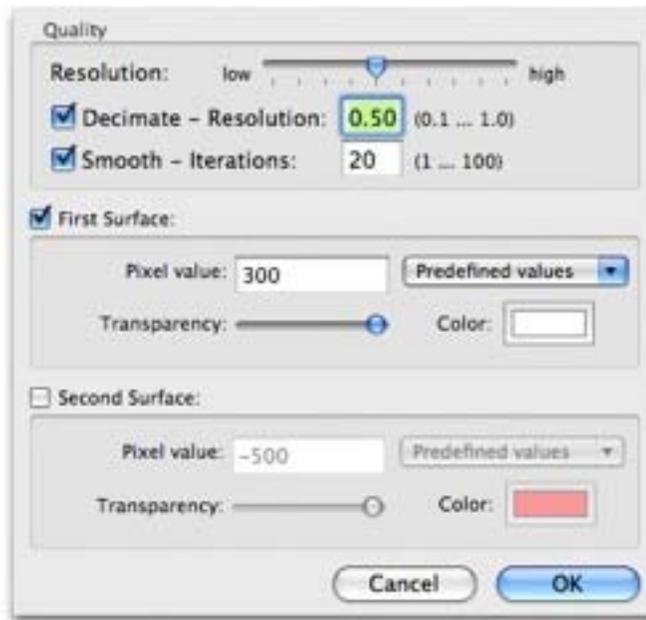Settings' and a small window will appear.

Figure 28.

At the top of this window, there is a bar for adjusting the resolution of the 3D image. Changing this option will make the surface details finer or smoother. The decimate option allows the user to 'fill in' the space between each image slice. The number range, from 0.10 to 1.00, determines the thickness of the filling. Smooth determines the appearance of the surface texture. The lower the value for the smooth option, the bumpier/coarser the image will be. The higher the value for the smooth option, the more rounded the image will be. At any given time, two surfaces can be represented while in SR viewing mode. To change the values for the displayed surface, simply set the pixel (attenuation) value to the desired number. For best results, try to keep the number within the WW and WL range. When all changes are complete, do not press the 'ok' button, instead, press the enter key on the keyboard to initiate the changes.

In the OsiriX Toolbar, there is a tool that looks like a pair of '3D' classes called 'Stereo'. While this setting is active, the 3D image is divided into positive and negative views (red and blue) allowing the user to the 3D image jump out of the screen while wearing 3D glasses. The 'Orientation' button has the same effects as it does in 3D MIP and 3D VR. 'Perspective' allows the user to view the 3D image in 'normal' perspective, or from an 'endoscopy' perspective. In the normal perspective, the zoom mouse button can only zoom into the image so far, and it is ideal to navigate using the 3Drotate image tool as well. While in 'endoscopy' mode, the zoom button has no limitations as to how far it can zoom in. It acts more like moving a camera forwards in this mode than a zoom button, thus making it more ideal to use the 'rotate camera' tool under the mouse button functions to navigate around the 3D image. If during use of any of the image navigation tools, the image becomes off center, the 'Reset' tool can be used to re-center the 3D image. The 'Show/Hide' tool will show or hide any point ROIs on the 3D image. If any volume or area detecting ROIs were created or generated in 2D viewing mode, they can be viewed in 3D VR and 3D SR by clicking on the 'ROI Manager' tool in the OsiriX Toolbar. Another window will open prompting the user to select which ROIs, if any, the

user wishes to view in tandem with the 3D image. This is exceptionally useful when viewing air-filled structures in any 3D mode. Clicking on the 'Color' tool in the OsiriX Toolbar, and selecting a new color from the color wheel can alter the color of the image background, allowing the user to change the contrast between the image and the background.

3D Fly Thru:

This tool is located in the OsiriX Toolbar of the 3D MIP, VR, SR, and Endoscopy modes. It allows the user to take pictures of the current state of the image, and at the end, create a dynamic movie of the 3D structure. At least 3 pictures must be taken using this tool to generate a movie. The '+' button on the bottom left of the Flu Thru window will add a picture, and the '-' button takes one away. On the top of the window there is button labeled 'Steps' and 'Movie'. Clicking on 'Movie' will bring the user to the Movie creation process.
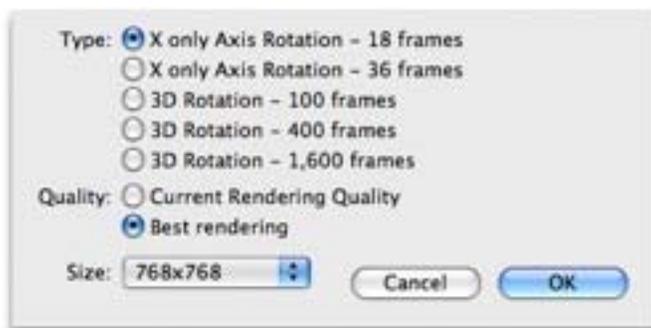

Figure 29.

In the movie creation process, the user can decide the total number of frames (images) the movie will be composed of. The more frames, the smoother the movie and the images. 600 frames will generate a movie 60 seconds in length at 10 images per second. Enabling 'loop' will make the image rotate to its starting position in the last few frames of the movie. 'Spline' will generate smoother transitions from image to image, especially if the images rotate or change angles rather quickly. When the desired preferences are selected, click on 'compute' to generate the movie. OsiriX will allow the user to view the movie, and if the user likes the movie enough, they can save the movie too.

The movies that the 3D Fly Thru creates are only movies and are not intractable with the user. A tool called QTVR allows the user to make an interactive Quick Time file where the user will be able to rotate the 3D structure for their own viewing pleasure. This can be useful for presentations or conferences where the audience can interact directly with the 3D model. When the QTVR tool is used, a small window pops up asking the user how many images the interactive model will contain.
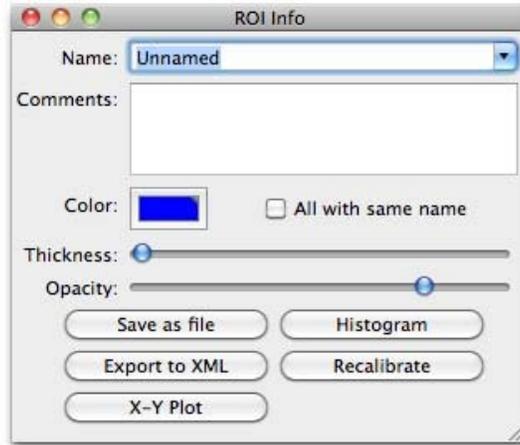
Figure 30.

Regions Of Interest (ROI):

Regions of interest, ROI for short, were briefly talked about in the 2D viewer section. It is through these that majority of the user interface comes from. There are applications to draw lines, make histograms, calculate area and volume, add arrows and notes, find angles, and place points. After placing an ROI, the user may 'double click' on said ROI to bring up a window.
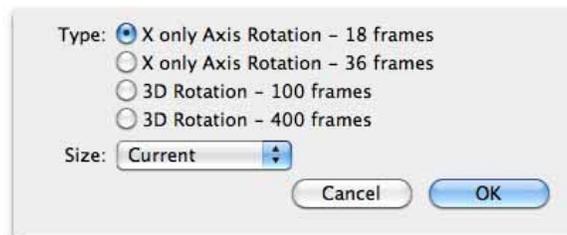

Figure 31.

From top to bottom are sections to change the ROIs name, add comments about the ROI, change the color of the ROI, and change the thickness and opacity of the ROI. Underneath this, there are five buttons, three of which are available to all ROIs. These include the *Save as File* button, the *Histogram* button, and the *Export to XML* button. The other two are only available for the Length ROI tool, and they are *Recalibrate*, which lets one recalibrate the length of the ROI in cm and the *X-Y Plot* button which opens up a window with length as the x-axis and attenuation as the y-axis.

ROIs have more functions that can be accessed through the ROI tab on the Apple Toolbar. Here is a list of all the ROI functions under this tab:

*Import ROI(s): Allows the user to import an previously saved ROI into the selected series.

*Save Selected ROI(s): This function allows the user to save one or more selected ROIs on the screen to a save file.

*Save all ROIs of this Series: This function allows the user to save all ROIs in the series to a save file.

*Delete all ROIs in this Series: As the name suggests, this will delete all ROIs in the series.

*Delete all ROIs with Same Name as Selected ROI: This allows the user to selectively delete ROIs in the series.

*Select all ROIs of the Series: Clicking on this will select all ROIs of the series.

*Deselect all ROIs of the Series: Clicking on this will deselect all ROIs of the series.

*ROI Manager: This will open a window that will allow the user to view the area and volume of all ROIs of the series.

*ROI Info: Clicking on this is the same as double-clicking on an ROI.

*ROI Rename: Clicking on this will allow the user to rename the selected ROI(s), all ROIs on the image, or all ROIs in the series.

*Set Default ROI Name: This will allow the user to set a default name for all newly created ROIs.

*Display info Only when ROI Selected: Clicking on this will remove ROI information from the screen (length, area, etc.) unless the ROI is selected.

*Display Name Only: Clicking on this only display the names of the ROIs.

*Increase Thickness: This will increase the thickness of the ROI.

*Decrease Thickness: This will decrease the thickness of the ROI.

*Increase Font Size: This will increase the ROI name and info font size.

*Decrease Font Size: This will decrease the ROI name and info font size.

*Histogram of Selected ROI: This will generate a histogram for the selected ROI.

*Create Layer from Selected ROI: This tool uses enclosed ROIs to create an ROI identical in shape to the selected ROI. This new ROI looks like the part of the image that was enclosed in the selected ROI.

*ROI Volume: This tool is used to compute the volume of a group of ROIs with the same name. If there are images between ROIs where there are no ROIs, the *Generate Missing ROIs* tool can be used to fill in the gaps. Similarly, there is a *Delete Generated ROIs* tool as well. This tool can also be used to delete all pixels within the selected ROIs, and restore the pixels within the selected ROIs to normal. If one clicks on the *Compute Volume* button, OsiriX will generate a 3D model for the volume contained within the ROIs.

*Propagate Selected ROI: This tool will allow the user to propagate a selected ROI through the entire series or to a specific image number.

*Propagate Selected ROI to Current Thick Slab: While in thick slab mode, the user can propagate an ROI through the thick slab with this tool.

*Group Selected ROIs: This tool enables the user to group a number of selected ROIs in the same image together. While grouped together, if one moves or is deleted, they all moved or deleted.

*Ungroup Selected ROIs: This tool will ungroup the selected ROIs.

*Lock Selected ROIs: Using this tool will lock all selected ROIs into place. A locked ROI can not be moved, changed, or deleted.

*Unlock Selected ROIs: This tool will unlock all selected ROI(s).

*Make Selected ROIs Unselectable: This tool will make all selected ROIs unable to be selected by the user.

       *Make all ROIs Selectable: This will allow the user to select all ROIs in the series.

       *Set Pixel Value to: This will open the *Set Pixel Value* tool window. Here, one can decide to change the pixel values from the old value to a new value. The user can decide whether it affects all pixels in the series, all ROIs with the same name as the selected ROI, or all ROIs of the series. The user can then choose if it will change the pixel values inside or outside of the ROIs. Lastly, the user can decide the range of pixels that they want to change (all above a selected value, all below a selected value, all between these two values, or all pixels inside or outside of the ROI) as well as the resulting pixel value.

       *Grow Region (2D / 3D Segmentation): This tool allows the user to create an ROI region based on certain pixel values. First, the user can decide whether it will be 2D (current image) or 3D (the whole series). There are four algorithms that the growing region is based of off. The first one is Threshold, where the user clicks on a particular point on the image with a pixel value of X. Then, the user decides the standard deviation of pixels to be included in the growing region +/- Y where Y is any number between 0 and 1000. The second algorithm is a Threshold based on upper and lower bounds. Here the user decides the upper and lower limits of the growing region, clicks on the region of interest of the image, and the growing region will color all pixels within the limits defined earlier. The third algorithm is a localized version of the Threshold upper and lower bounds algorithm. The only difference here is that the user decides the pixel radius area of effect. The last algorithm is called Confidence, which is based off of a numerical multiplier and the number of iterations the algorithm completes.

      After all the parameters are set, the user can change some of the settings under results to alter what the outcome of the growing region is. The first of which is *Preview Results when Clicking*. This creates a visual representation of what the growing region will look like if the User were to click Compute at that moment. The next option is *Directly Generate ROI when Clicking*. This is only available when doing a growing region on a 2D plane (current image only) and will create the ROI without having to press Compute. The next two options are *Merge with existing brush ROIs* and *Propagate Result in 4D*. Of the next two options, only one may be selected at a time. *Create ROI(s)in the Original Series* will generate the ROI(s) in the original series. *Generate a new Series With:* will create a new series where the user can select the pixel values inside and outside of the growing region. Lastly, the user can decide the name of the growing region ROI, and whether it will be based off of a brush ROI or a closed polygon ROI.

       *Brush ROIs: By using this tool, one will be able to alter the shapes of some brush ROIs. This can be done via brush dilation, erosion, opening, and closing.

PLUGINS: UNDER CONSTRUCTION
3D ENDOSCOPY: UNDER CONSTRUCTION

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