Custom-Fitting Surgical Template Workflow

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Workflow design insipired by: **RSM** Institute for Reconstructive Sciences in Medicine
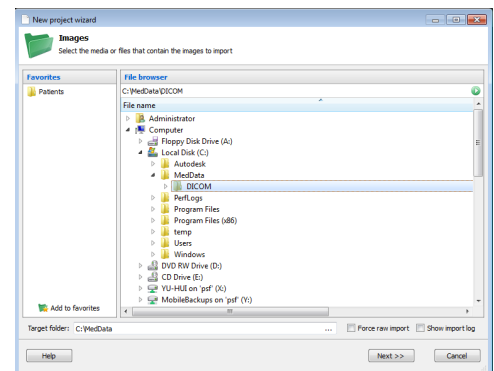
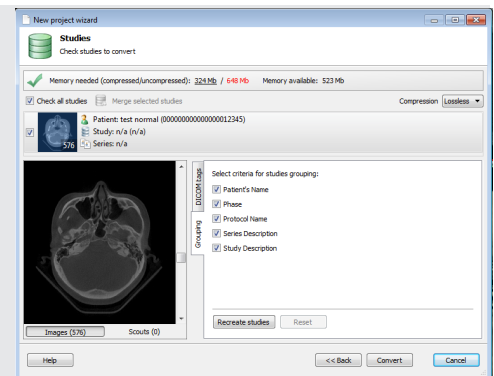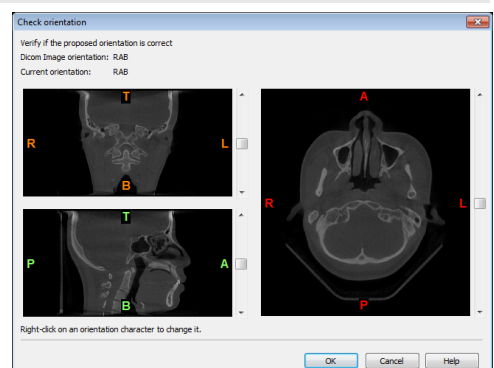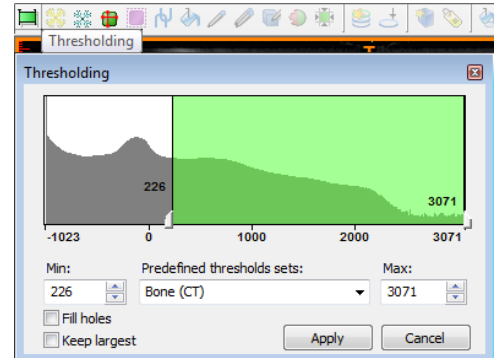|		
1	Open the **Mimics** icon on your desktop.	
2	Select the **New project wizard** from the main toolbar.	
3	Locate the appropriate **DICOM** folder and click **Next**.	
4	Mimics will automatically create a Mimics project since it reads the DICOM tags directly from the DICOM images. Click **Convert** to proceed.	
5	Verify the orientation in the orientation window. Click **OK** to open the project.	

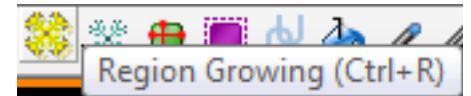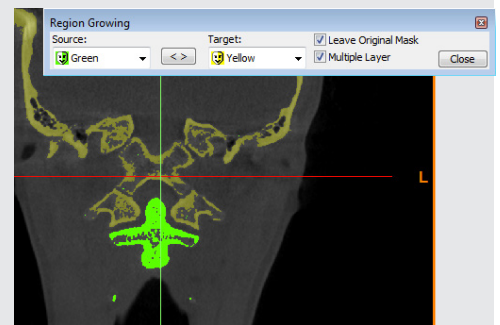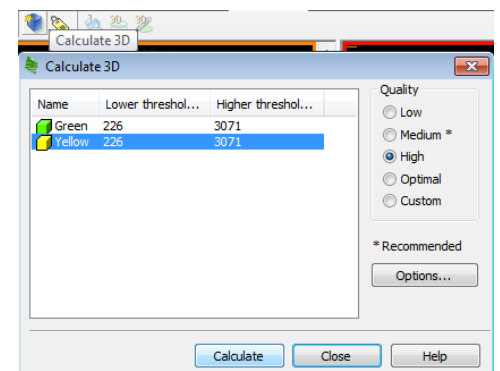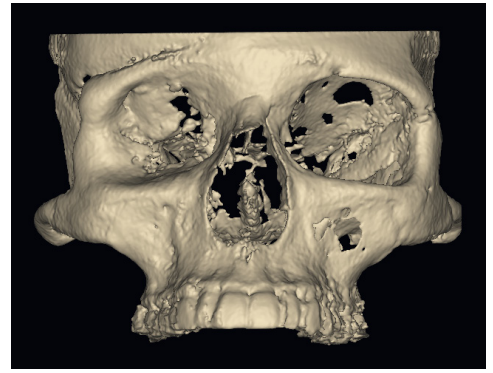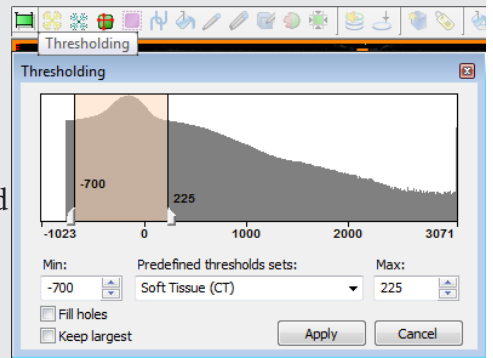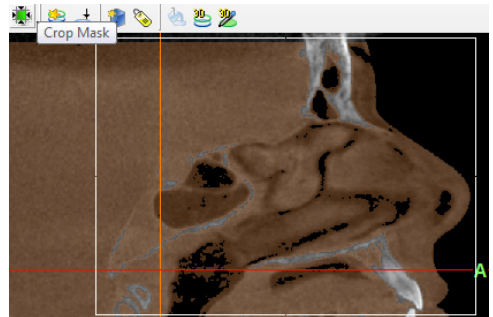| 6	Select the **Thresholding** function and choose **Bone (CT)** from the predefined threshold sets. Drag the sliders to adjust as necessary to select the bone and click **Apply**.	
7	Select the **Crop Mask** function to include only the area of interest within the defined threshold and click **OK**.	
8	Select the **Region Growing** function to separate the skull from the floating voxels.	
9	Click on the bone. All connected voxels will be added to a new mask. Click on the new mask to name it "bone".	
10	Click **Calculate 3D** to create a **3D Object** from the mask. Select **Optimal** or **High** quality for best representation and click **Calculate**.	

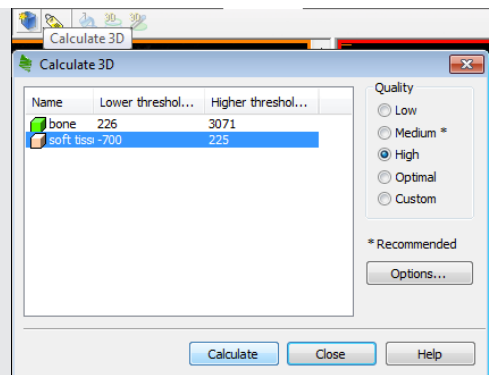| 11 | The 3D model will appear in the 3D View window. | |

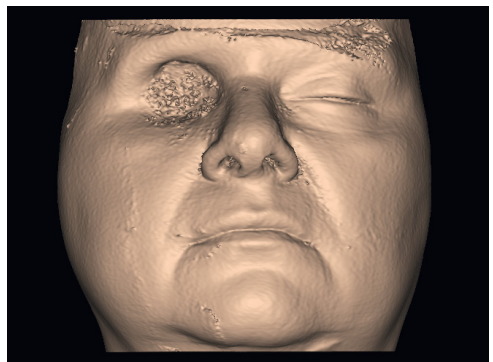| 12 | Select the **Thresholding** function and choose **Soft Tissue (CT)** from the predefined threshold sets.
Drag the sliders to adjust as necessary to select the soft tissue and click **Apply**. Name the new mask "soft tissue". | |

| 13 | Select the **Crop Mask** function to include only the area of interest within the defined threshold and click **OK**. | |

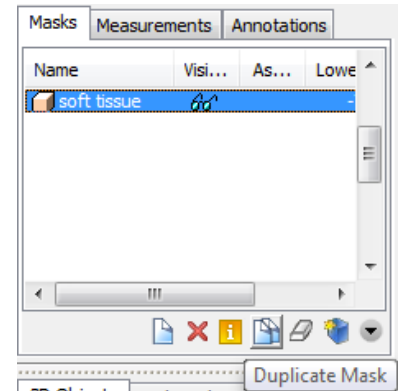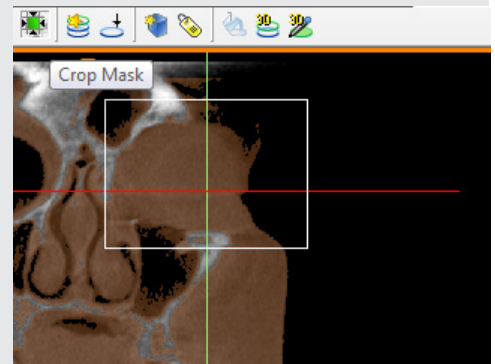| 14 | Click **Calculate 3D** to create a **3D Object** from the mask. Select **Optimal** or **High** quality for best representation and click **Calculate**. | |

| 15 | The 3D model will appear in the 3D View window. | |

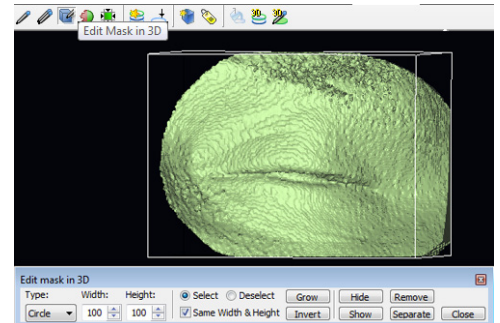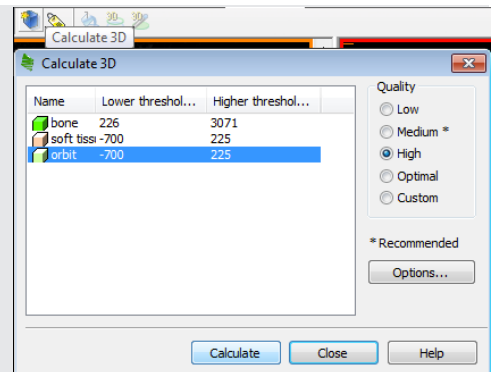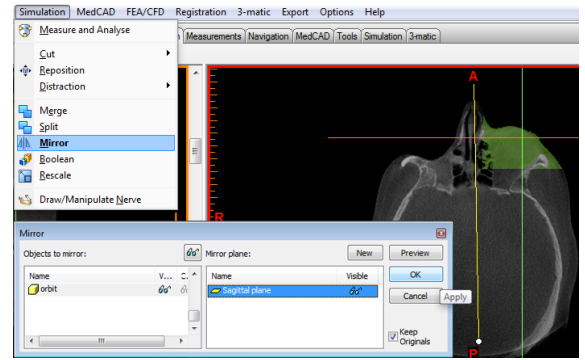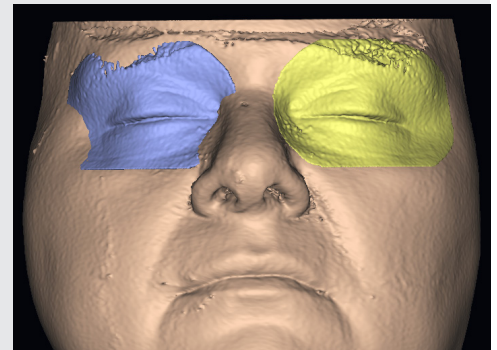| 16	Select the "soft tissue" mask and click the **Duplicate Mask** function. Name the new mask "orbit".	
17	Select the **Crop Mask** function to include only the unaffected orbit of the soft tissue and click **OK**.	
18	Select the **Edit Mask in 3D** function to include only the area of interest of the unaffected orbit and click **Close**.	
19	Click **Calculate 3D** to create a **3D Object** from the mask. Select **Optimal** or **High** quality for best representation and click **Calculate**.	
20	The 3D model will appear in the 3D View window.	

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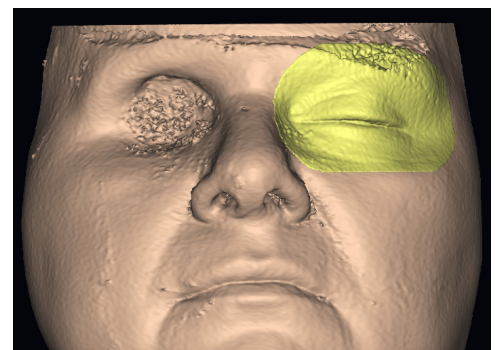
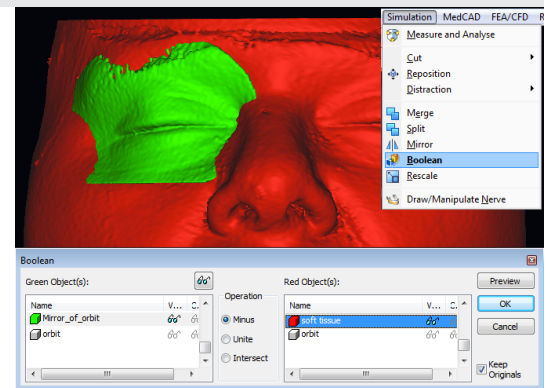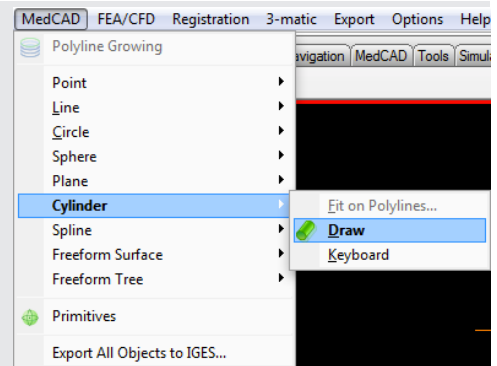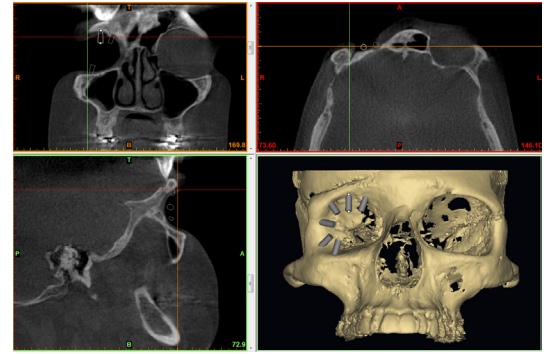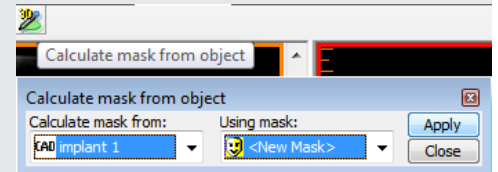| 21	Select **Simulation** > **Mirror**. Choose the mask "orbit". Adjust the "Sagittal plane" as necessary. Click **Preview** then **OK** if satisfied.	
22	The mirrored 3D model will appear in the 3D View window.	
23	Select **Simulation** > **Boolean**. Choose the 3D object "mirror of orbit" minus the 3D object "soft tissue" and click **OK** to fit the unaffected orbit to the treatment site.	
24	Select **MedCAD** > **Cylinder** > **Draw** to create cylinders to represent the implants.	
25	Select the cylinder and click on **Properties** to modify the radius and length to be representative of the implants. Click **OK**.	
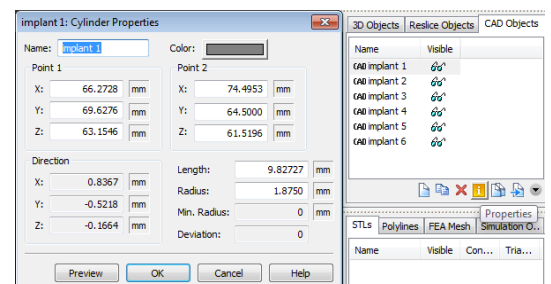
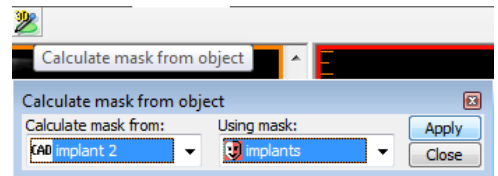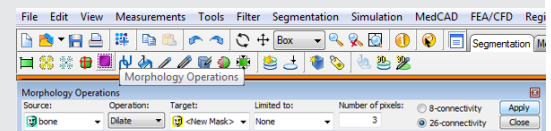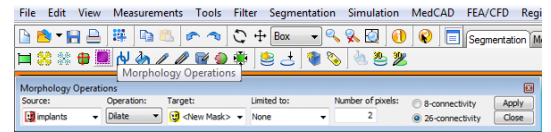|		
26	Evaluate bone thickness and quality for implant placement in all 4 views (coronal, axial, sagittal and 3D) and adjust implant position and angulation as necessary.	
27	Select **Calculate mask from object**. Choose "implant 1" to be calculated into a new mask and click **Apply**. Name the new mask "implants".	
28	Select **Calculate mask from object**. Choose "implant 2" to be calculated into the "implants" mask and click **Apply**. Repeat remaining implants.	
29	Select **Morphology Operations**. Choose "bone" as source, **Dilate** as operation, and enter 3 for number of pixels. Click **Apply**. Name the new mask "dilate 3".	
30	Select **Morphology Operations**. Choose "bone" as source, **Dilate** as operation, and enter 5 for number of pixels. Click **Apply**. Name the new mask "dilate 5".	
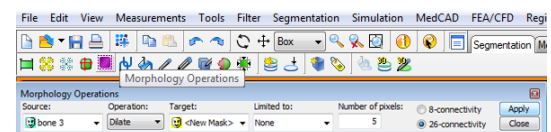
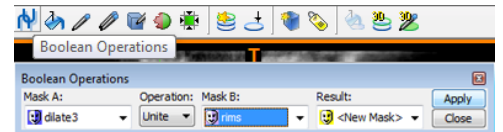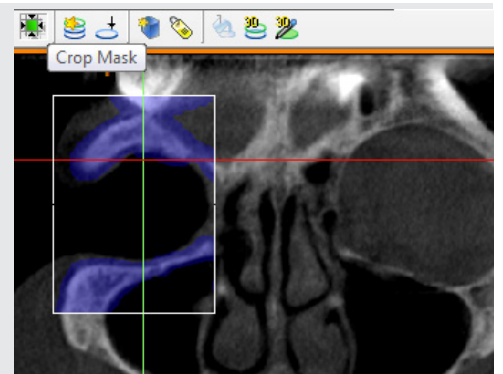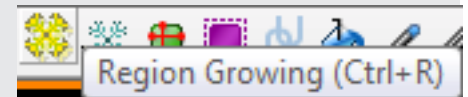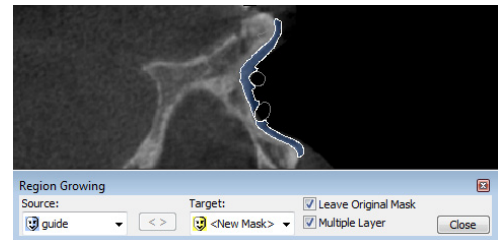| 31	Select **Morphology Operations**. Choose "implants" as source, **Dilate** as operation, and enter 2 for number of pixels. Click **Apply**. Name the new mask "implantDilate 2".	
32	Select **Boolean Operations**. Choose "dilate 5" intersect "implantsDilate2". Name the new mask "rims".	
33	Select **Boolean Operations**. Choose "dilate 3" unite "rims". Name the new mask "dilate3+rims".	
34	Select the **Crop Mask** function to include only the area of interest of the affected orbit and click **OK**.	
35	Select **Boolean Operations**. Choose "dilate3+rims" minus "implants". Name the new mask "dilate3+rims-implants".	
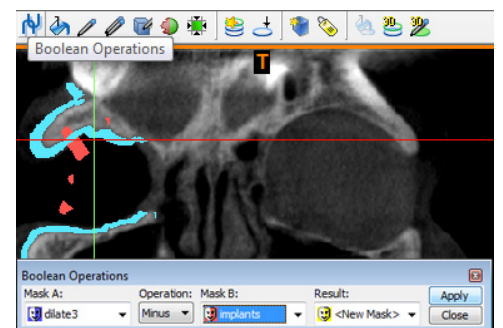
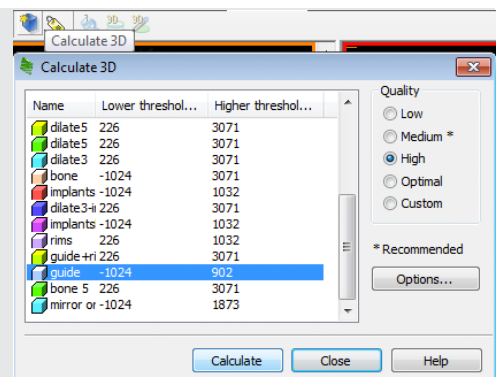| 36 | Select **Boolean Operations**. Choose "dilate3+rims-implants" minus "bones". Name the new mask "guide". | |

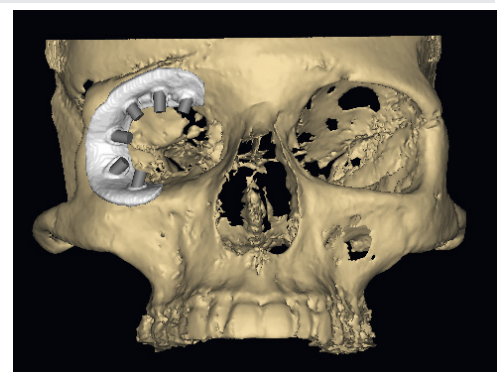| 37 | Select the **Region Growing** function to separate the guide from disconnected floating voxels. | |

| 38 | Click on the guide. All connected voxels will be added to a new mask. Click on the new mask to name it "guide". | |

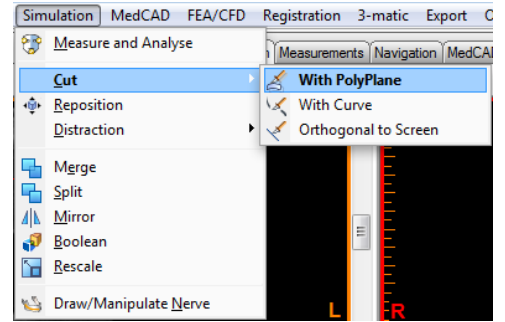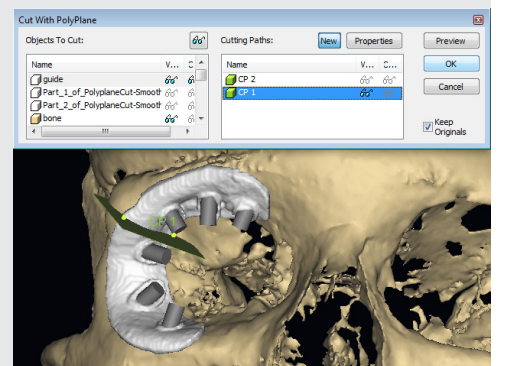| 39 | Click **Calculate 3D** to create a **3D Object** from the mask. Select **Optimal** or **High** quality for best representation and click **Calculate**. | |

| 40 | The 3D model will appear in the 3D View window. | |

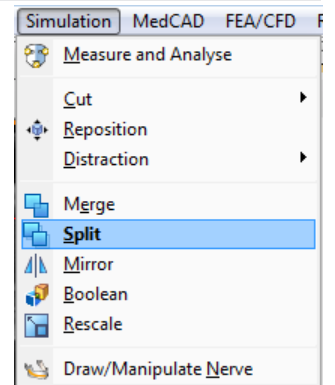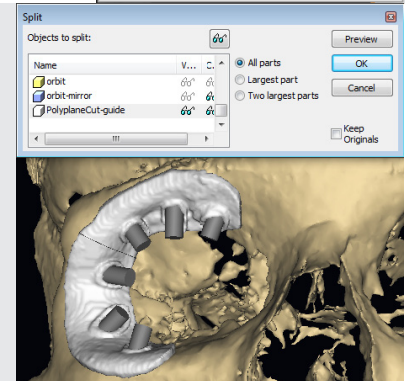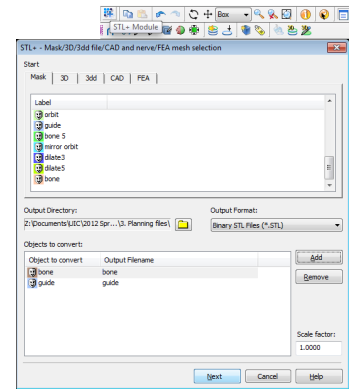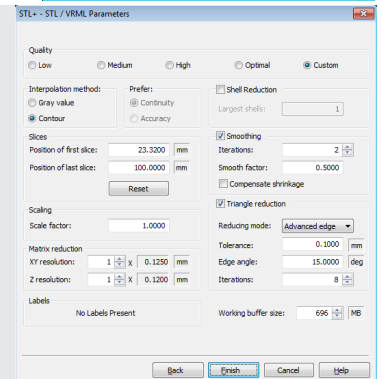| 41	To make a two-piece guide design, select **Simulation** > **Cut** > **With PolyPlane**.	
42	Choose the object "guide". Click **New** to create a new cutting path and adjust "CP1" as necessary. Have **Keep Originals** checked to keep the 1-piece guide design. Click **Preview** then **OK** if satisfied.	
43	To split the "PolyplaneCut-guide", select **Simulation** > **Split**.	
44	Choose the object "PolyplaneCut-guide" to split. Check **All parts**. Click **Preview** then **OK** if satisfied.	
45	"Part_1_of_PolyplaneCute-guide" and "Part_2_of_Polyplane-Cut-guide" will appear in the list of 3D Objects.	
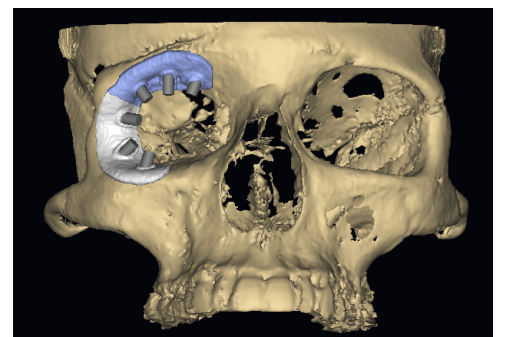
| 46 | Select the **STL+Module** function, select the "bone" and "guide" masks, choose the appropriate **Output Directory** and **Binary STL File** as the Output Format. Click **Add** to place the file in the conversion window. Rename the file as necessary. Click **Next.** | |

| 47 | Adjust quality as needed for appropriate file size and click **Finish** to export the STL file of the "bone" and "guide". | |

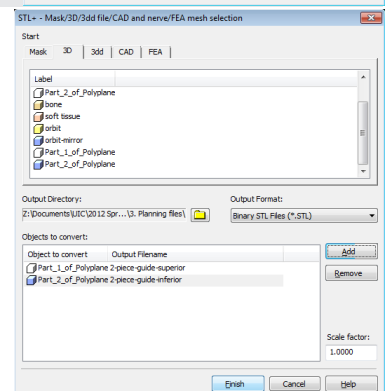| 48 | Select the **STL+Module** function, select the "Part_1_of_Poly-planeCute-guide" and "Part_2_of_PolyplaneCute-guide" 3D objects, choose the appropriate **Output Directory** and **Binary STL File** as the Output Format. Click **Add** to place the file in the conversion window. Rename the file as necessary. Click **Finish.** | |

| 49 | Congratulations! The STL files of the surgical templates and reference skull model are now ready to be rapid prototyped. | |