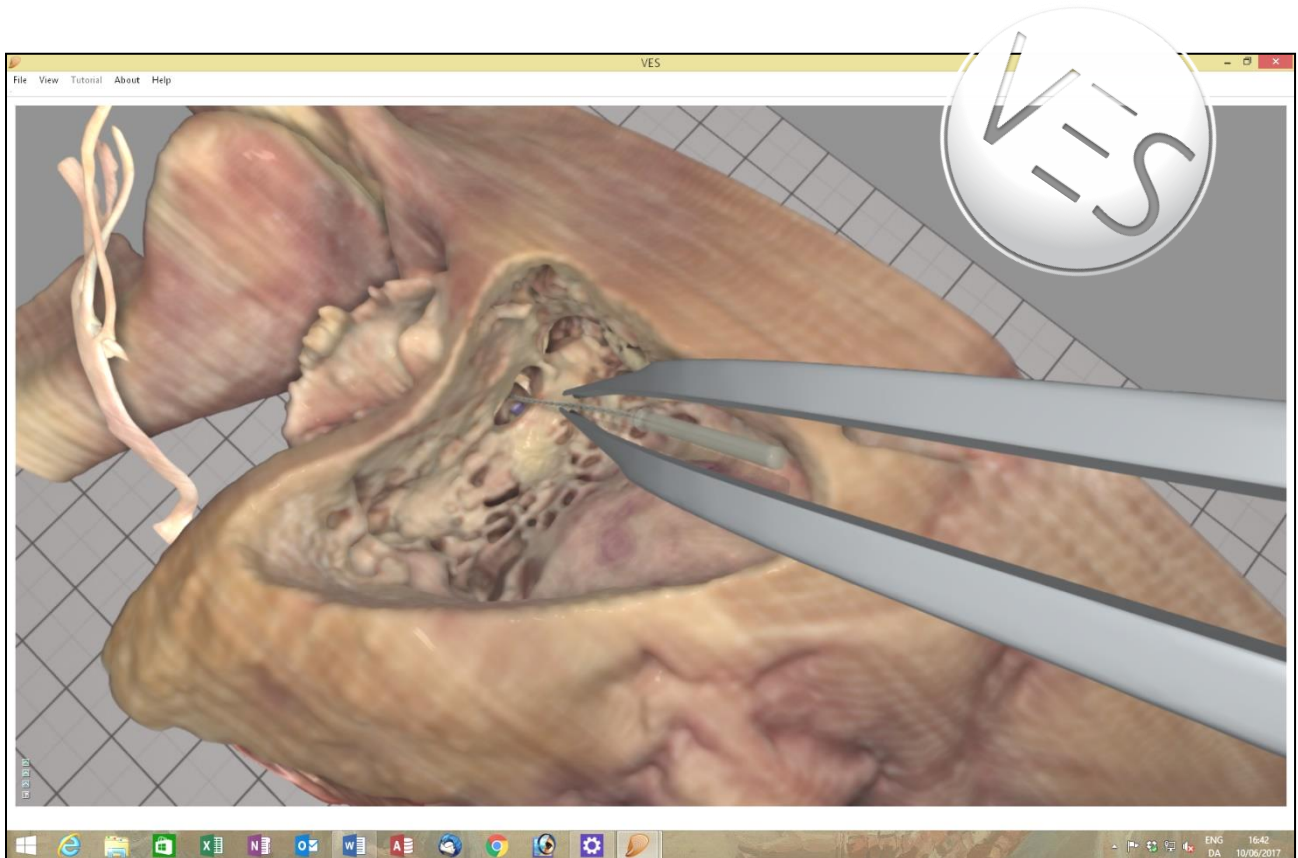


# The Visible Ear Simulator Dissection Manual.



Stereoscopic Tutorialized Version 3.1, August 2017



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<http://ves.alexandra.dk/>



## Preface

This step by step manual was designed for use with the VES freeware, Visible Ear Simulator 3.0 (<http://ves.alexandra.dk/>) developed by Peter Trier Mikkelsen, The Alexandra Institute A/S, Aarhus, Denmark; Steven Arild Wuyts Andersen, Copenhagen Academy for Medical Education and Simulation and Mads Sølvsten Sørensen, ENT department, Rigshospitalet, University of Copenhagen, Denmark.

The first section **Installation** provides information on hardware requirements, computer configuration and software installation.

Next the **Check out your tools** section shows how to set up and operate the virtual tools for drilling and control of visual settings.

The **Get to know your bone** section demonstrates several anatomical reference points for navigation.

Finally, in the **Drill your bone from A-Z** paragraph you are guided through a complete anatomical resection of the mastoid step by step.

The mastoidectomy procedures are 'temporal bone course' routines, which aim to demonstrate the surgical landmarks and boundaries. They remove more bone than the average surgical mastoidectomy, but the fundamental approach is similar. The integrated CI tutorial presents a more realistic surgical procedure with facial recess access to the round window niche. A labyrinthectomy tutorial was recently added.

In each step of **Drill your bone from A-Z** you may click the video tag and view the corresponding surgical animation at: [\(VES-3D\)](#). Check the stereo intro at: [\(VES-Tutor\)](#)

Some of the 2-D images are presented in stereoscopic 3-D as well. Stereo images appear fuzzy in plain sight – they must be viewed through red/blue anaglyph 3D glasses, which are easily obtained online at eg. <http://www.rainbowsymphony.com/freestuff.html>



A **tutorial** is integrated in the VES application to provide intuitive visual guidance while you are drilling. We will extend the manual and the tutor library to cover other temporal bones and procedures. The **sensor** function can evaluate your drilling automatically and the evaluations may be saved to monitor your progress.

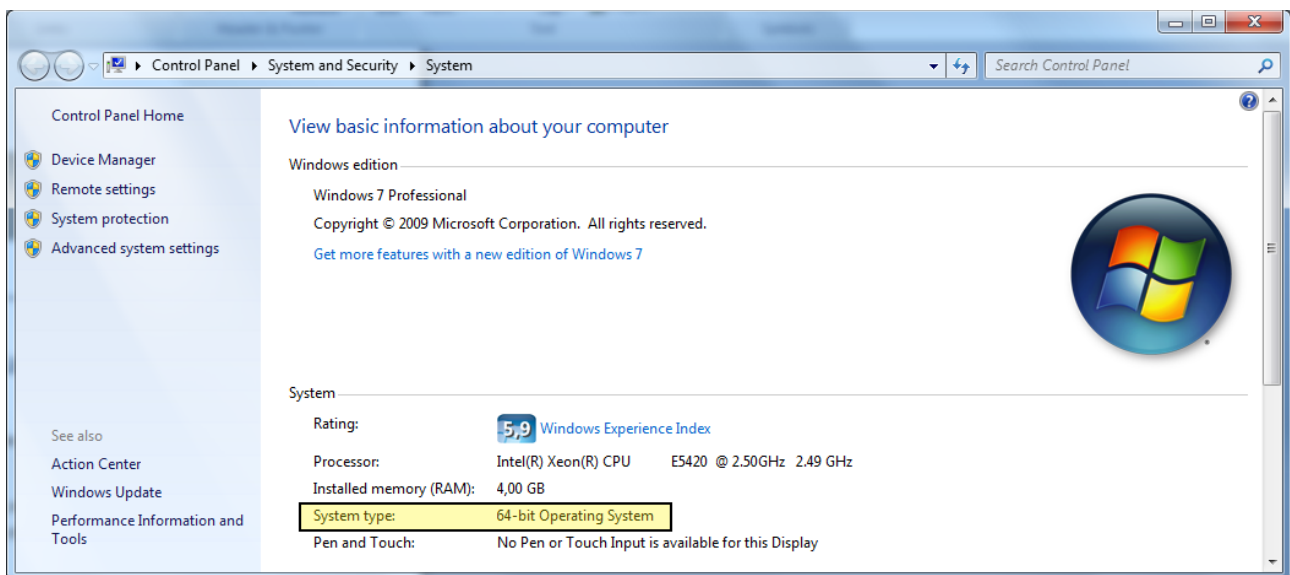
Check the VES homepage/blog <http://ves.alexandra.dk/> for updates and remember to leave your email to receive future reminders on updates. Your comments and suggestions for future improvements are all appreciated at the blog.

The VES is an academic freeware project supported by the Oticon Foundation, Oticon Medical and MED-EL. You need to buy your own PC and haptic device but the software is free!

## Installation

First it is important to know if your computer meets certain requirements to be able to run the simulator. You need a Windows PC and an Nvidia GeForce GTX graphics card. A Phantom Omni® (now Geomagic Touch®) haptic device is needed for drilling but you may install and view the VES even without a haptic device connected. NB! The old Phantom device requires a FireWire IEEE-1394 port but the current version of the Geomagic Touch device connects to your PC via the USB port.

If you have the necessary computer hardware make sure your Windows installation is a 64-bit version. To check out the type (32-bit or 64-bit) of your Operating System, press the "Windows" button and the "Break" button on your keyboard simultaneously. This will display the Windows system information.



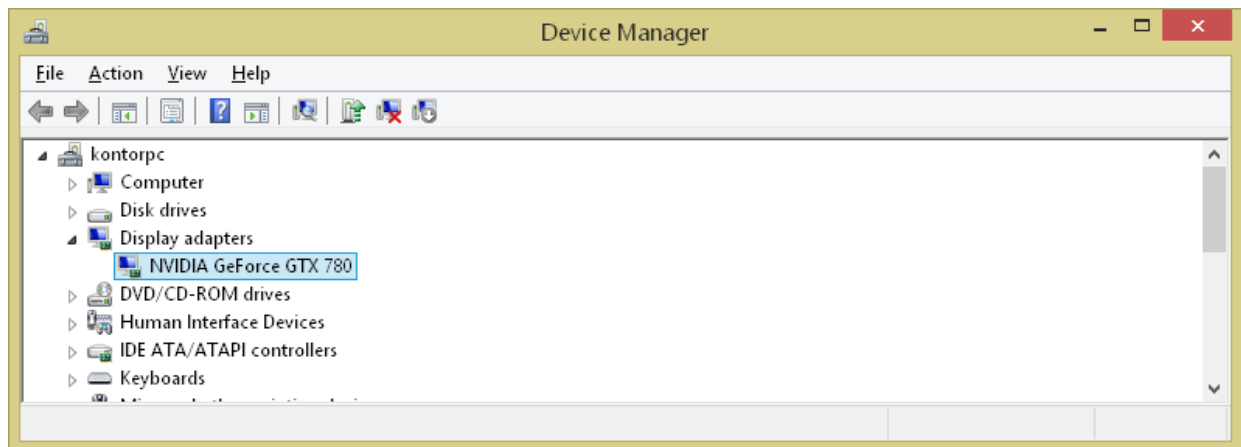
In this case the highlighted text shows that there is a 64bit Windows 7 installed.

The simulator currently supports the Operating Systems Windows XP, Windows Vista, and Windows 7-10. Before you run the VES3: Go to "PC Settings", select "Update and recovery" and then download and install any updates as suggested by Windows Update.

The current simulator version supports only Nvidia GeForce GTX graphics cards. We recommend Nvidia GeForce GTX 1070 or better. However, the simulator will also run on older cards.

To check what kind of graphics card you have, press "Windows + Break", open the "Device Manager" and click on "Display adaptors" as highlighted in the image below. This will display the type of graphics card you have, and it must have an "NVIDIA" in the description.

In the image below, the graphics card is an "NVIDIA Geforce GTX 780" which is a few years old but still fine.

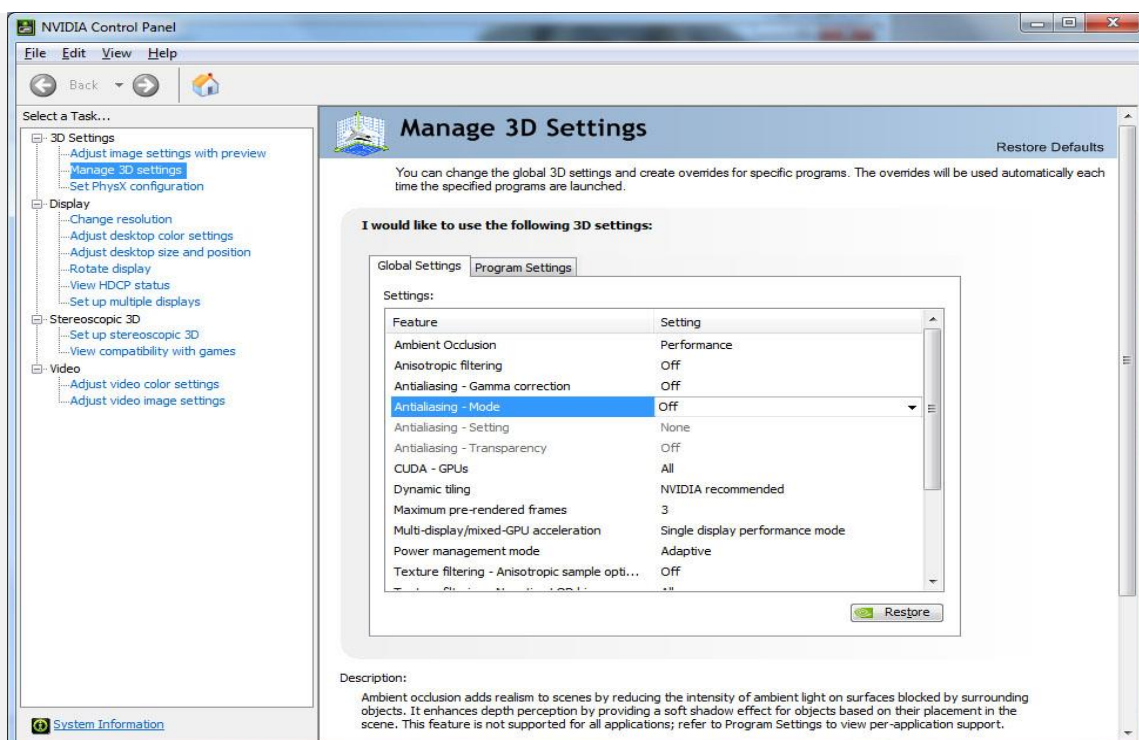


The reason for these relatively high requirements is that visualization is based on a voxel rendering technique, which is very hardware-demanding to provide the high visual quality, which we suggest is important in the training process.

It is crucial to have a high resolution and frame rate on the PC screen. This increases the image fidelity during navigation and it also improves the haptic response.

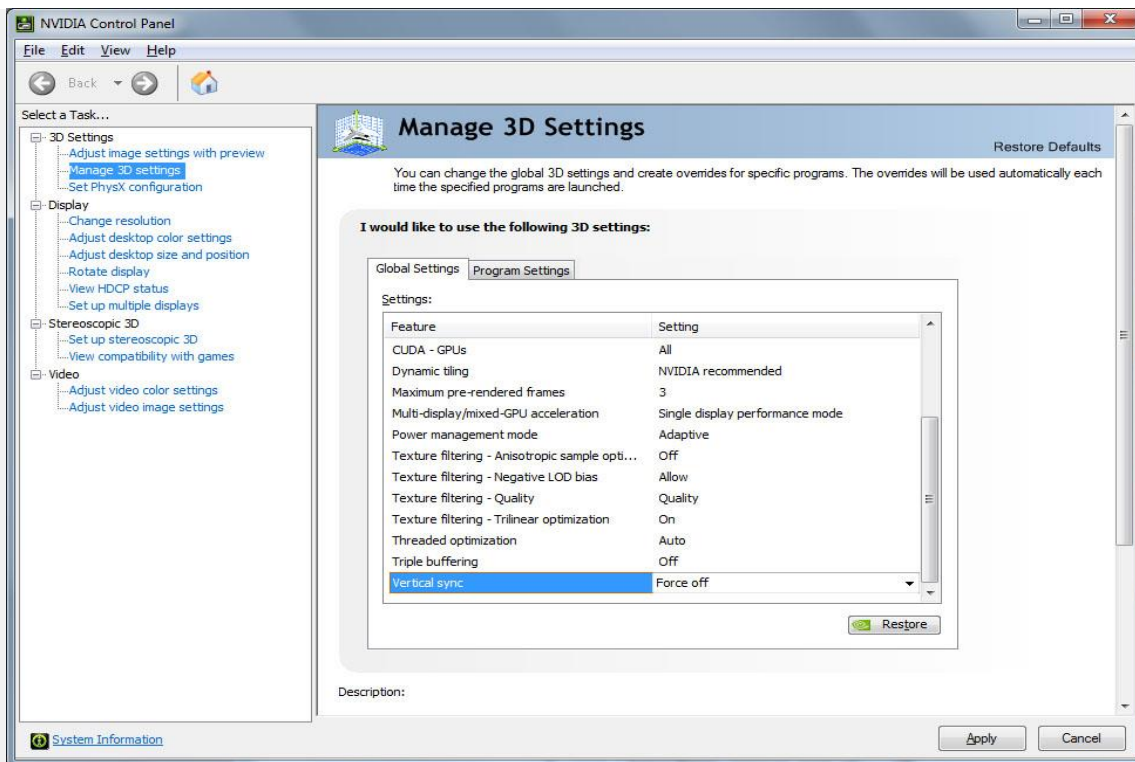
Go to the NVIDIA GeForce homepage <http://www.geforce.com/drivers> to update your graphics driver:

When the latest driver issue for your card has been installed, optimize your Nvidia graphics settings: Open the Nvidia control panel by right clicking a blank space on the Windows desktop, then select the “Nvidia Control Panel” option and make the selections as indicated in the screenshots below.



Turn Antialiasing mode off.





Turn off vertical sync, to enable high frame rates.

You need a [Phantom Omni/ Geomagic Touch haptic device](#) to move the virtual drill in 3-D and to experience a force feedback simulation of the vibrations and bony contact and resistance during drilling. Visit <http://geomagic.com/en/how-to-buy/find-a-distributor> to find a reseller.



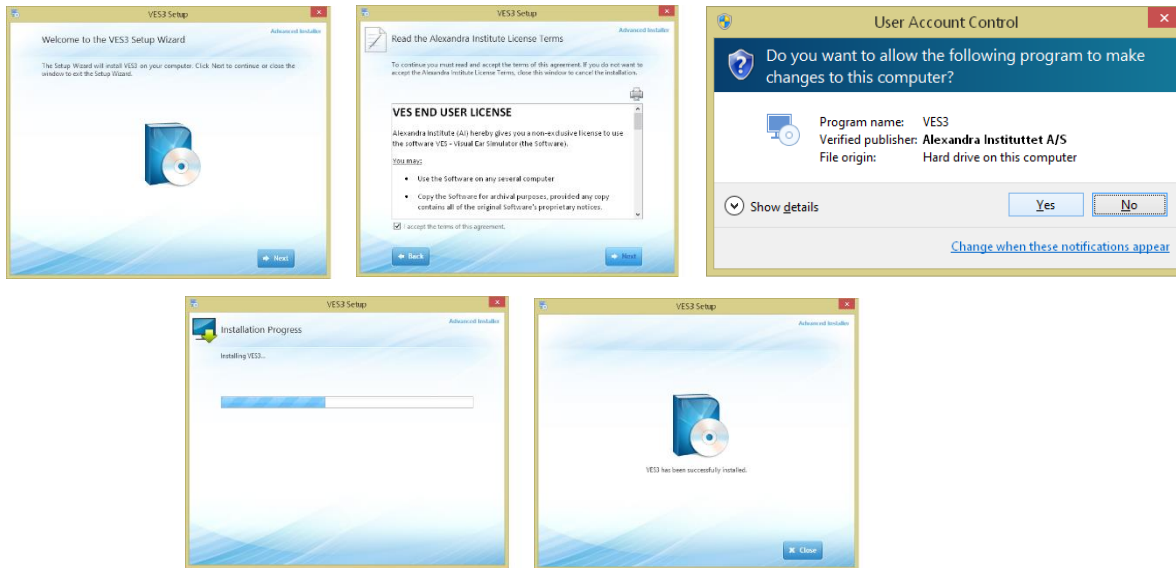
Notice, if you do not own a Phantom Omni device, you can still install and preview the simulator and drill with your PC mouse. The drilling experience will be lousy, but all the other features are still available.

For the older Phantom Omni device, you need an IEEE-1394 Fire Wire port (6 pins, or 4 pins on laptops) for connecting to the PC. New product versions come with a USB interface. Before you connect the Phantom, be sure to install the Phantom device drivers that come with your device. Shortcuts for the Geomagic Touch Setup utility and for the Geomagic Touch Diagnostic (calibration) utility will appear on your desktop.



For Visible Ear Simulator software installation visit the VES download page at <http://ves.alexandra.dk/>

After downloading the VES3 zipped folder, unzip it by right clicking the downloaded file and select the “Extract Here” option. Go to the “Setup Files” folder, double click the “VesSetup.exe” file and follow the instructions.



The installation procedure should install both the sound driver (oalinst.exe) and the Microsoft Visual C++ redistributable 2013 (vc\_redist\_x64.exe) automatically. If not, open the Prerequisites directory in the installation folder and double click the vc\_redist\_x64.exe and oalinst.exe file to install this prerequisite manually.

Now the VES shortcuts will appear on your computer desktop.



Before you start the simulator, it is recommended to calibrate your Phantom Omni/Geomagic Touch. This ensures that your PC can recognize the haptic device and that the drilling tools will be properly aligned in the virtual workspace.

To connect the haptic device, run the “Geomagic Touch Setup” program. To calibrate forces, alignment and refresh ratio run the “Geomagic Touch Diagnostic” program.

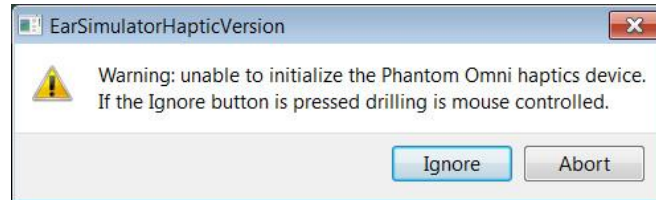


This calibration is normally only necessary the first time you run the simulator after a computer restart. However, should you at any time experience trouble with the haptic functions of the simulator, save your action, close the VES3 and re-calibrate.

With the Phantom Omni calibrated, then double click the VES icon and start the simulator.



If no Phantom Omni device is installed when the VES is starting up a message will appear on the display:



Click “Ignore” and use the PC mouse to control the drill. This option is intended to provide a first impression of what the simulator offers before you go ahead and purchase the (relatively costly) Phantom Omni device.

If the simulator fails to start, please first make sure the sound system is installed as mentioned earlier by running the “oalinst.exe”. Next check for system updates at Windows Update and make sure you have the latest graphic drivers from: <http://www.geforce.com/drivers>

If the action is slow or erratic remember to turn your user access control off. *(Please note: Any background CPU activity such as Skype, automatic maintenance programs, a wireless LAN or FRAPS type video streamers may exhaust your CPU capacity and slow down the haptic update frame rate. This may slow down performance and interfere with real-time interaction and haptic “smoothness”.*

*Turn off such resident programs if you experience this type of problem.*

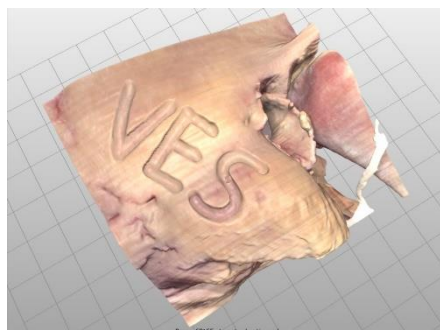
If nothing works you are welcome to send us an email where you can attach the simulator log file, which will be in your:

“C:\Program Files\Alexandra Institute\VES3\Veslog.txt”

Please include some information about your computer and the nature of the error.

Send this to [peter.trier@alexandra.dk](mailto:peter.trier@alexandra.dk) and we will try to help you out. Other issues might already be described on the VES3 blog.

We encourage you to report bugs and to enter comments on our blog, where you can share your Visible Ear Simulator work and experience with other users and even contribute new tutorials.

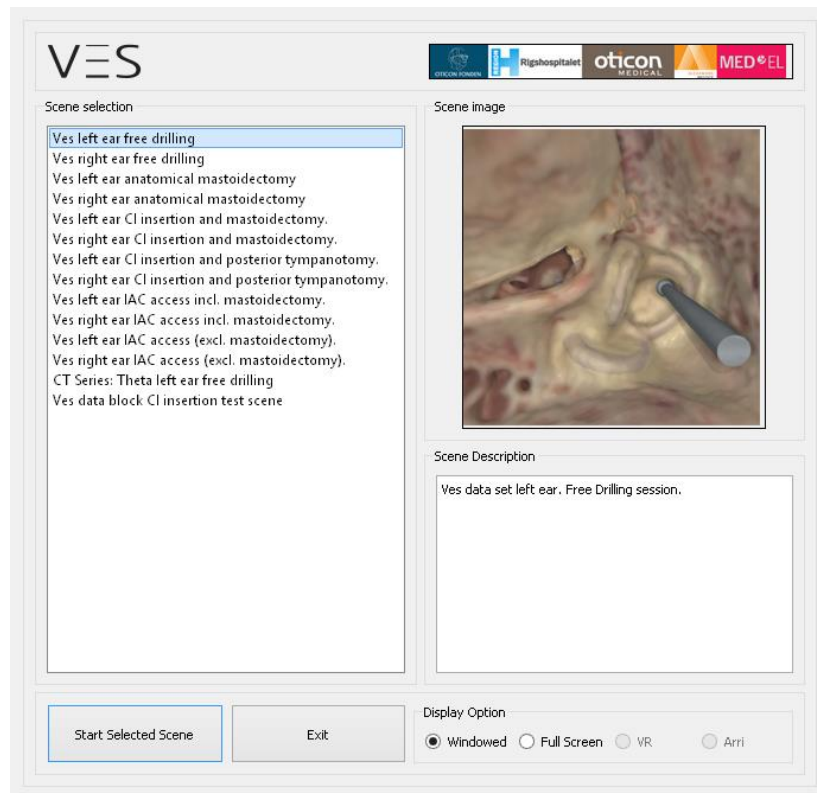


## Check out your tools.

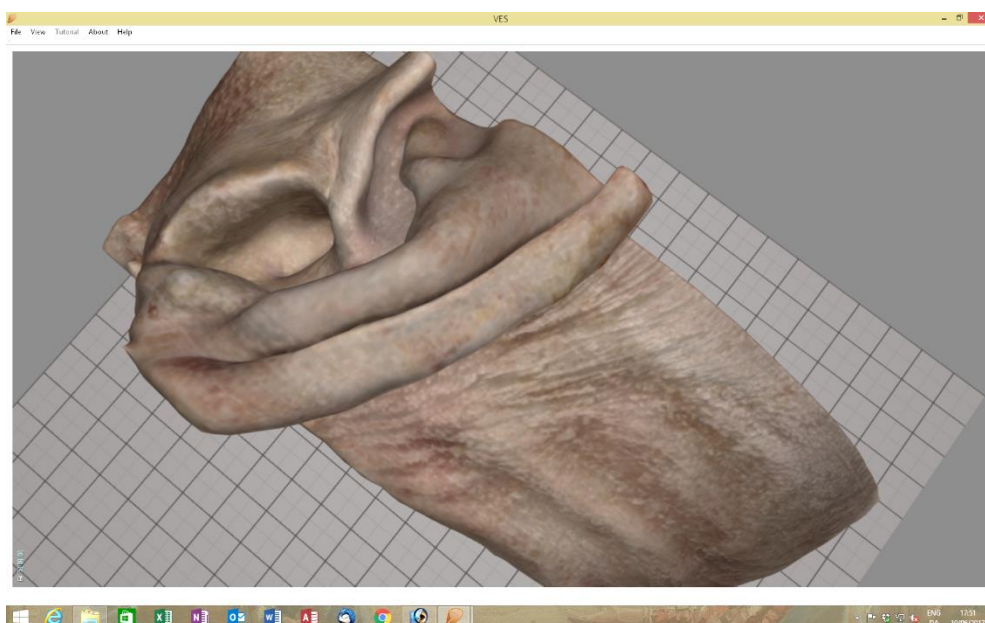
Click the VES icon and start the simulator.



From the scene selection screen select “VES left ear free drilling” and press “Start Selected Scene”.



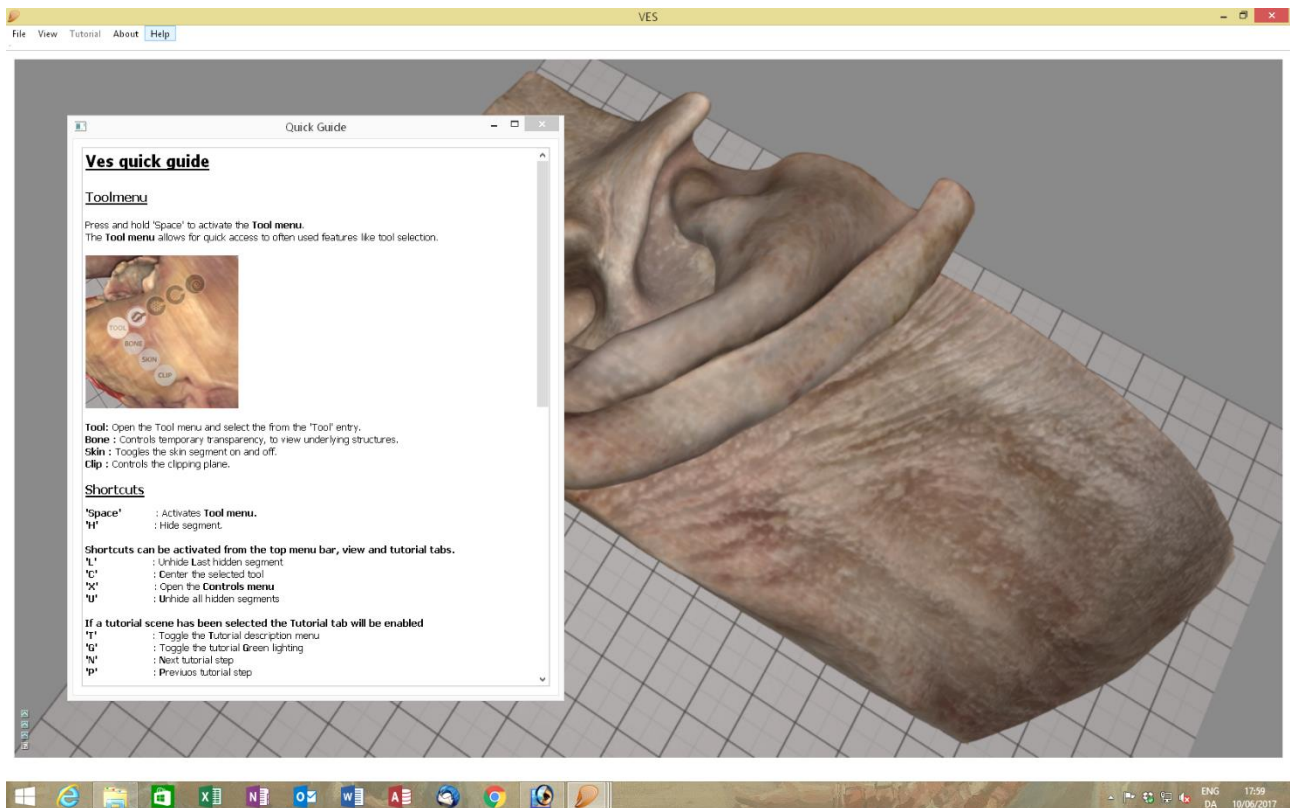
A temporal bone appears in your workspace



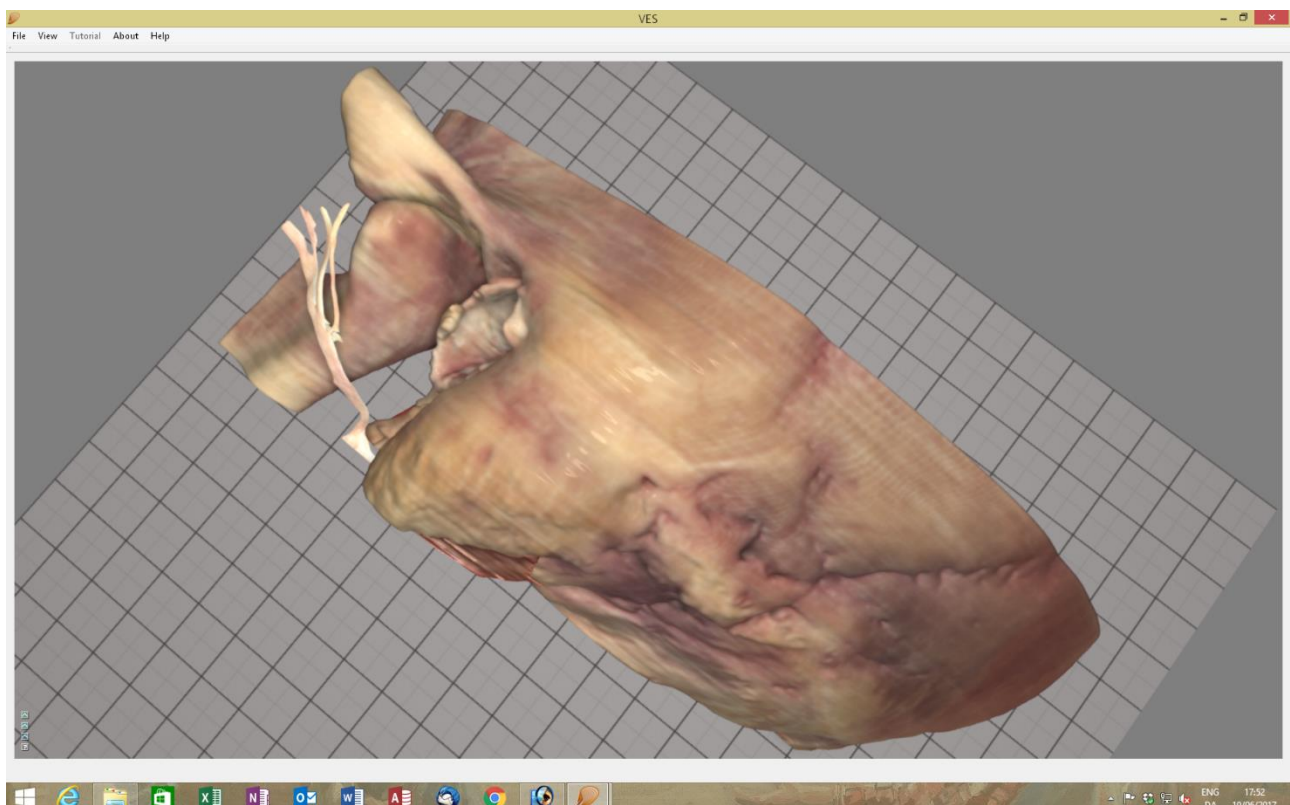
If you select “Help” from the menu bar on top or press “F1” the VES quick guide appears.



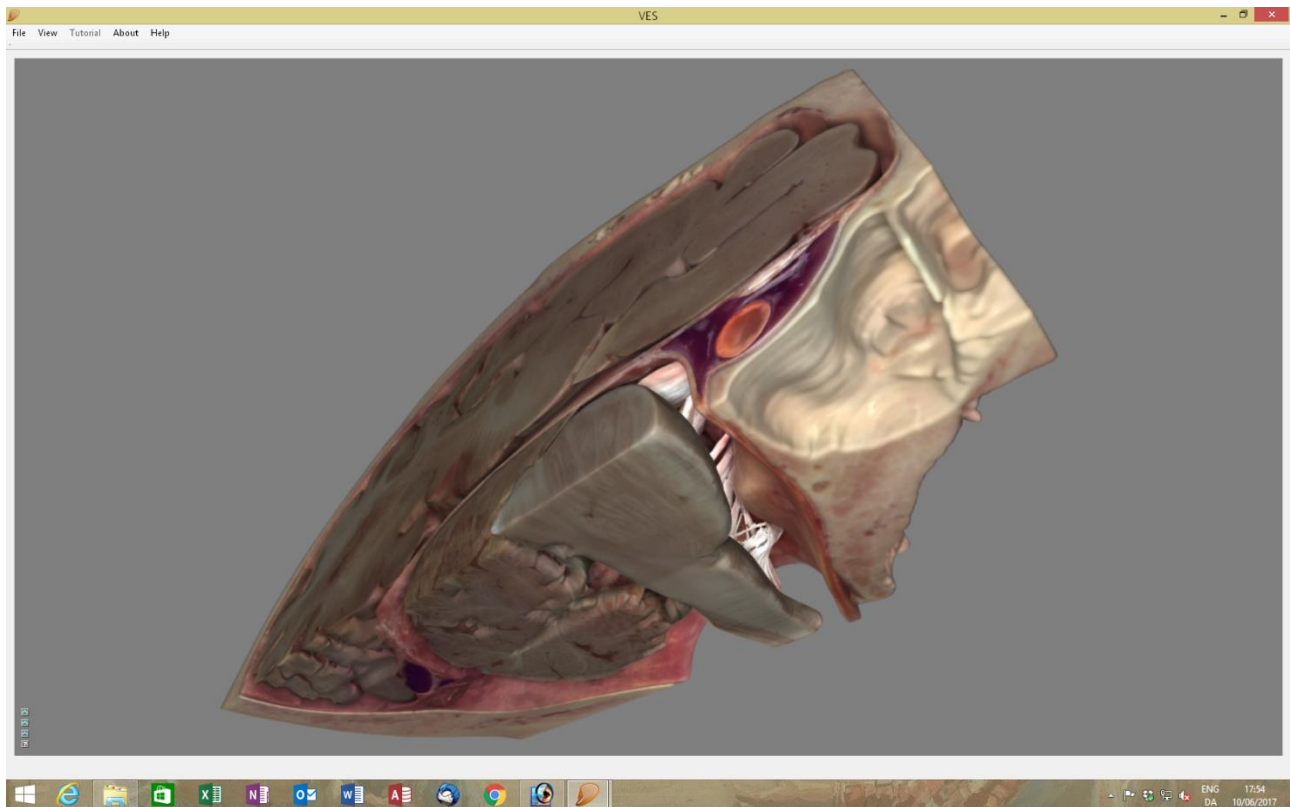
You can click it and drag it around in the workspace, re-size it and keep it on top while working with the simulator or close it at the “X” in the corner. The quick guide shows the most common keyboard commands and shortcuts.



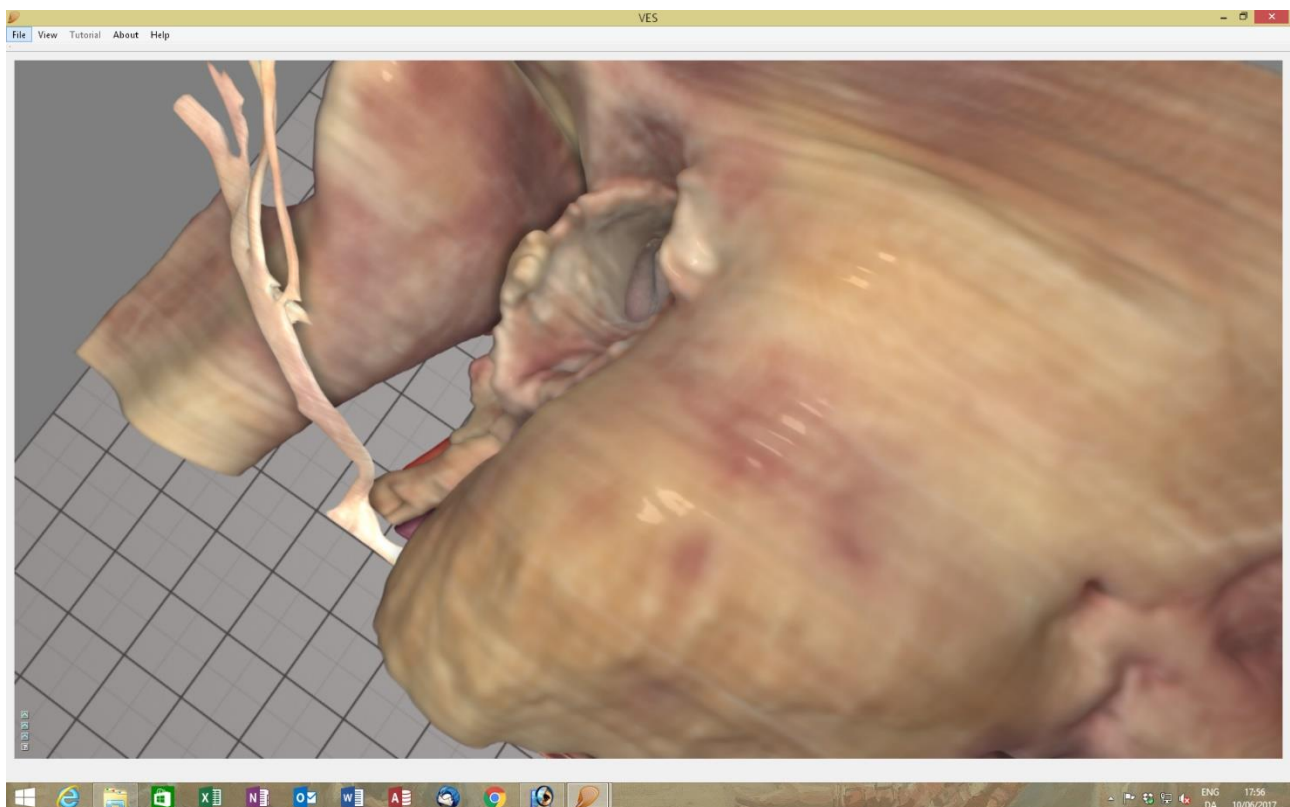
Double right click on the skin to hide it. You can press “L” to unhide it again, “U” to unhide all.



Left click and drag to rotate the model. Left double click any spot to select this as a new pivot point for the rotation.



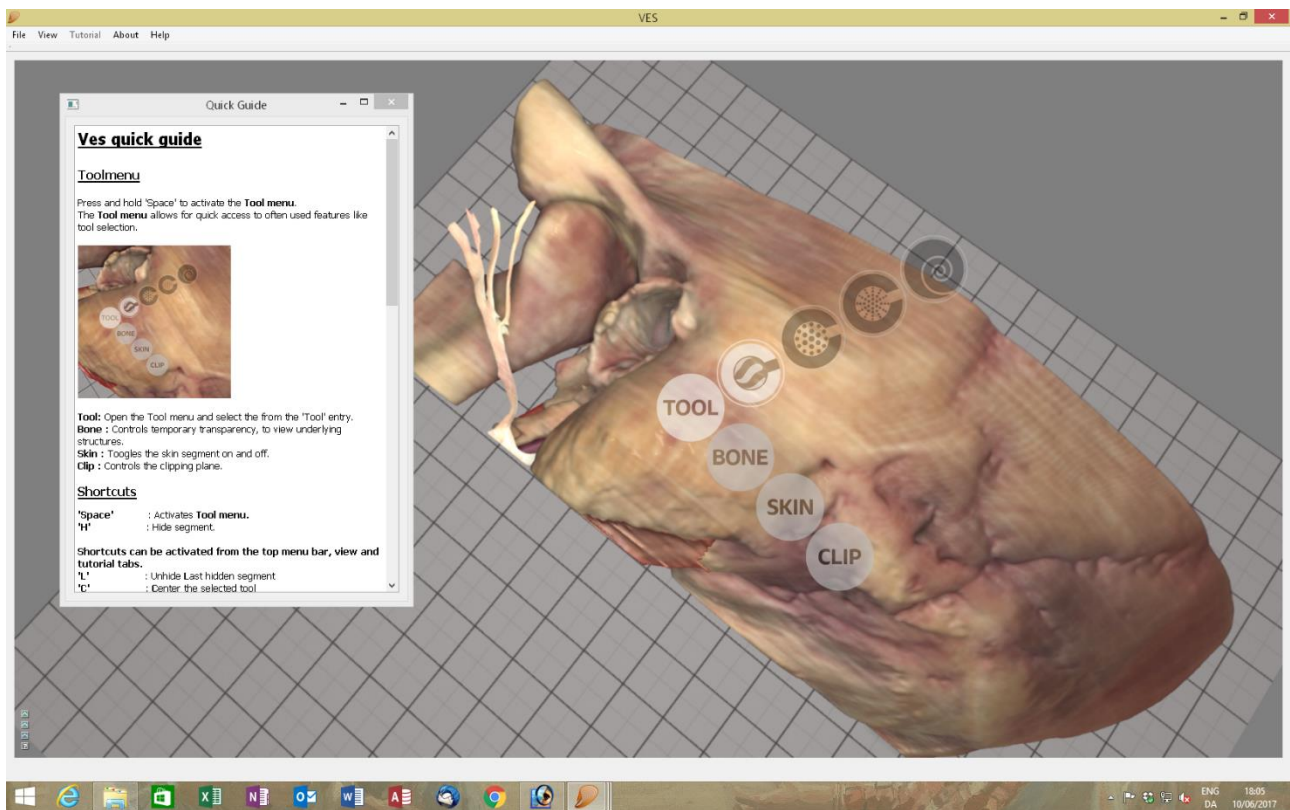
Right click and drag to pan (slide) the model.  
Use the mouse wheel to zoom in or out.



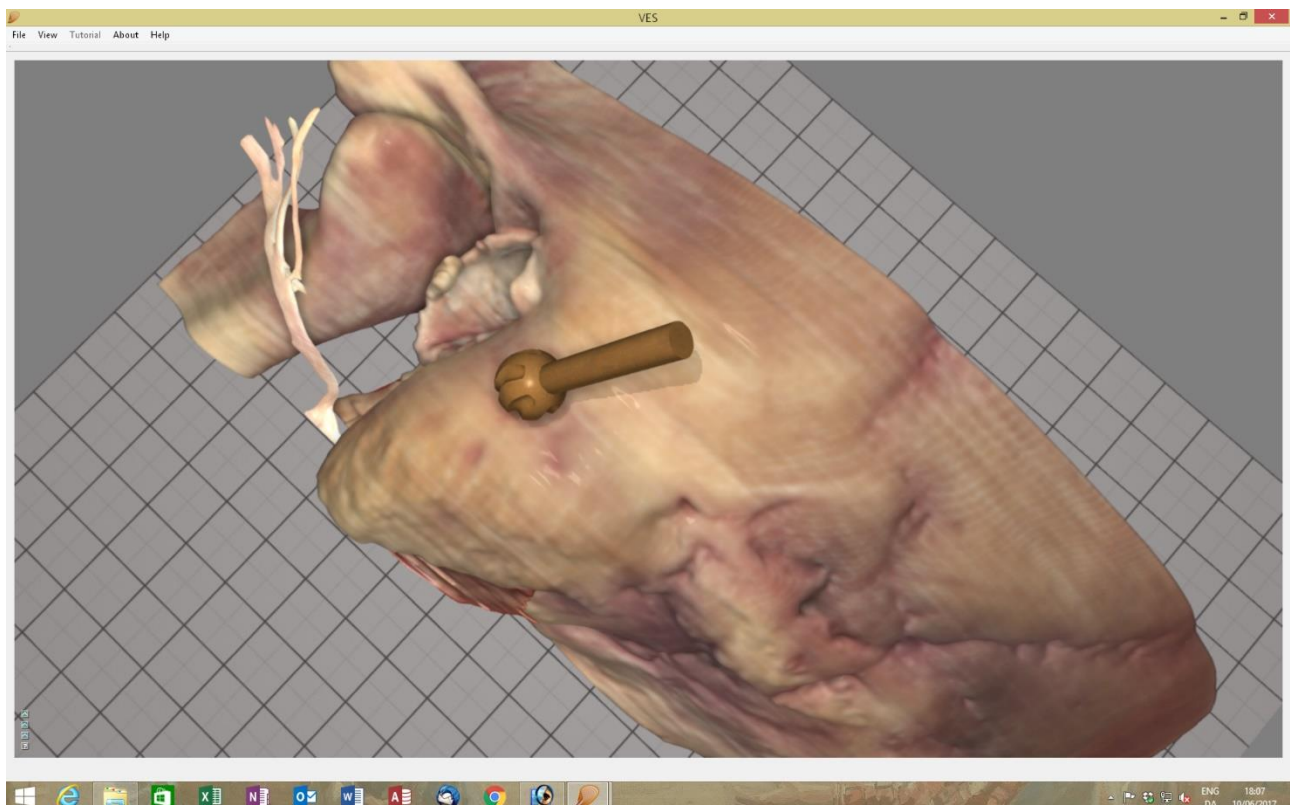
Press and hold the “Space bar” to select a sharp drill, coarse diamond or fine diamond drill or forceps. Bone transparency, clipping plane and skin toggle can also be reached here.



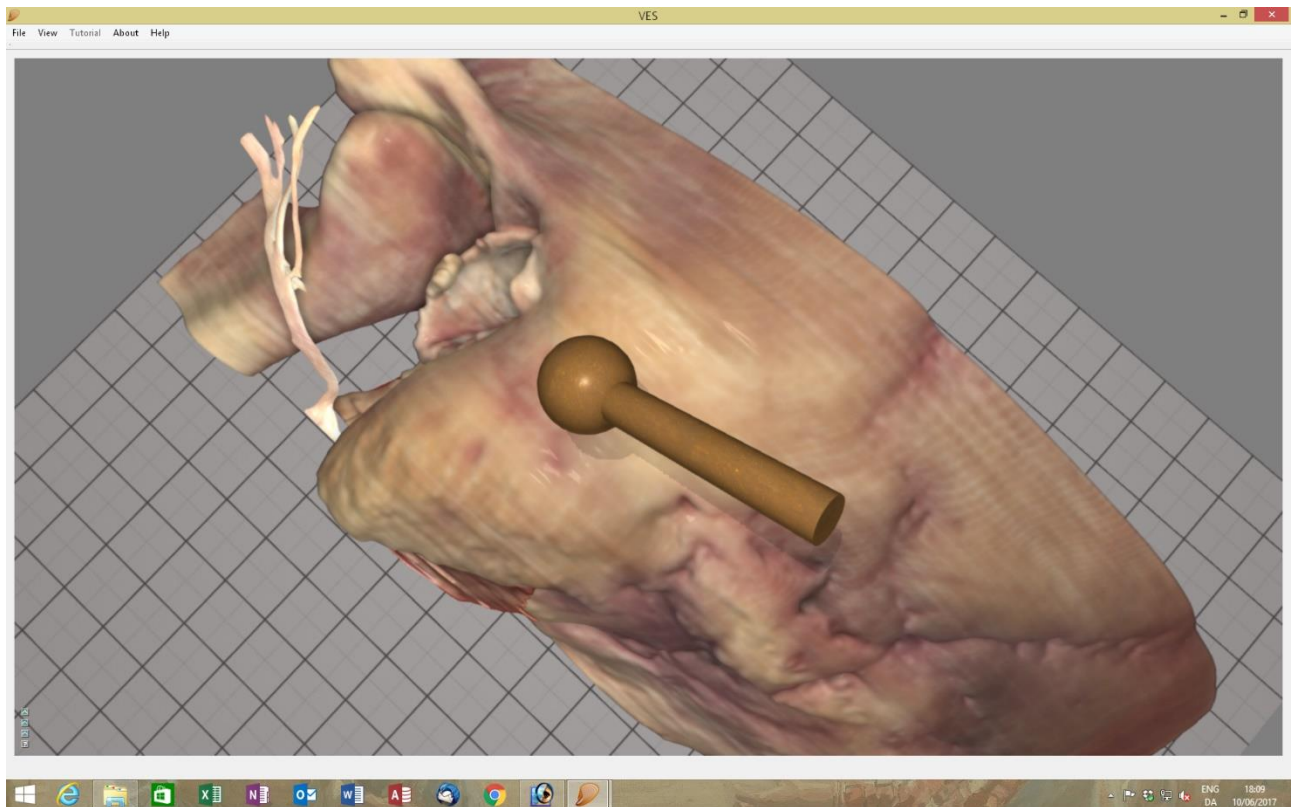
Make you selection with the mouse arrow and execute it by releasing the “Space bar”



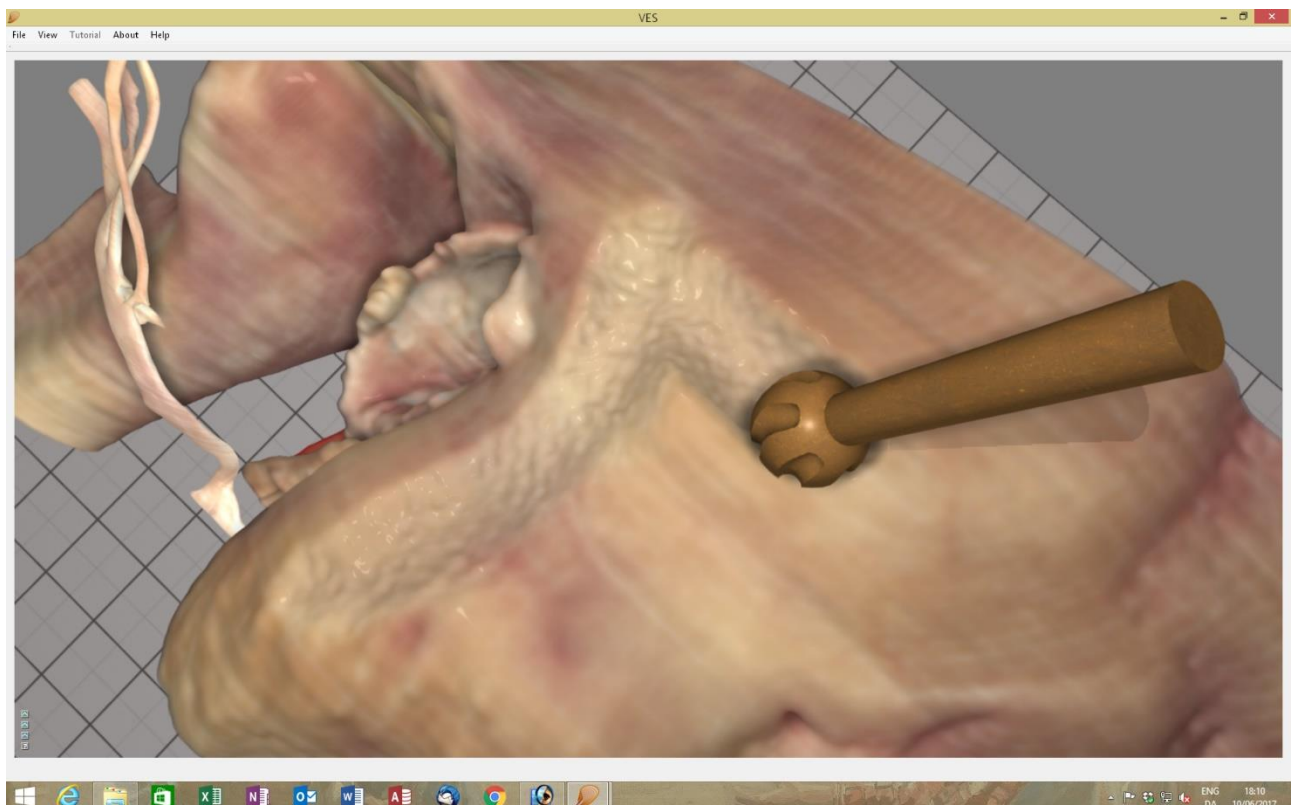
Select a sharp drill and watch it settle on the bone surface. Grab the stylus of the haptic device, move the drill around and feel the bony surface of the model and the weight of the hand piece.



Hold the stylus like a pencil and press and hold the front button with your index finger to start the drill rotation and feel the vibration.

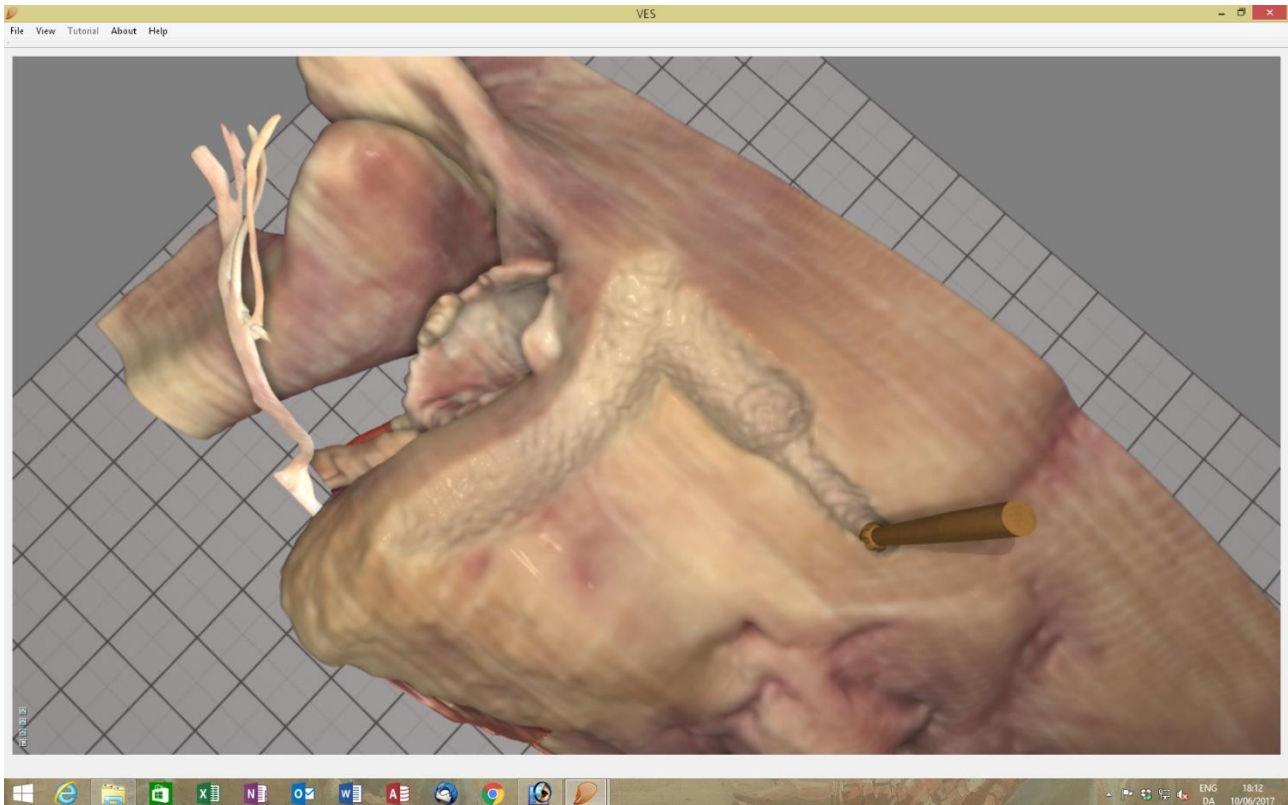


Put the drill to the bone gently and move it along the surface to drill.





The default drill size is 5-mm. Use the up arrow or down arrow to change the size from 7-mm to 6-5-4-3-2-1-½-mm. The drill size is shown in the upper right corner.



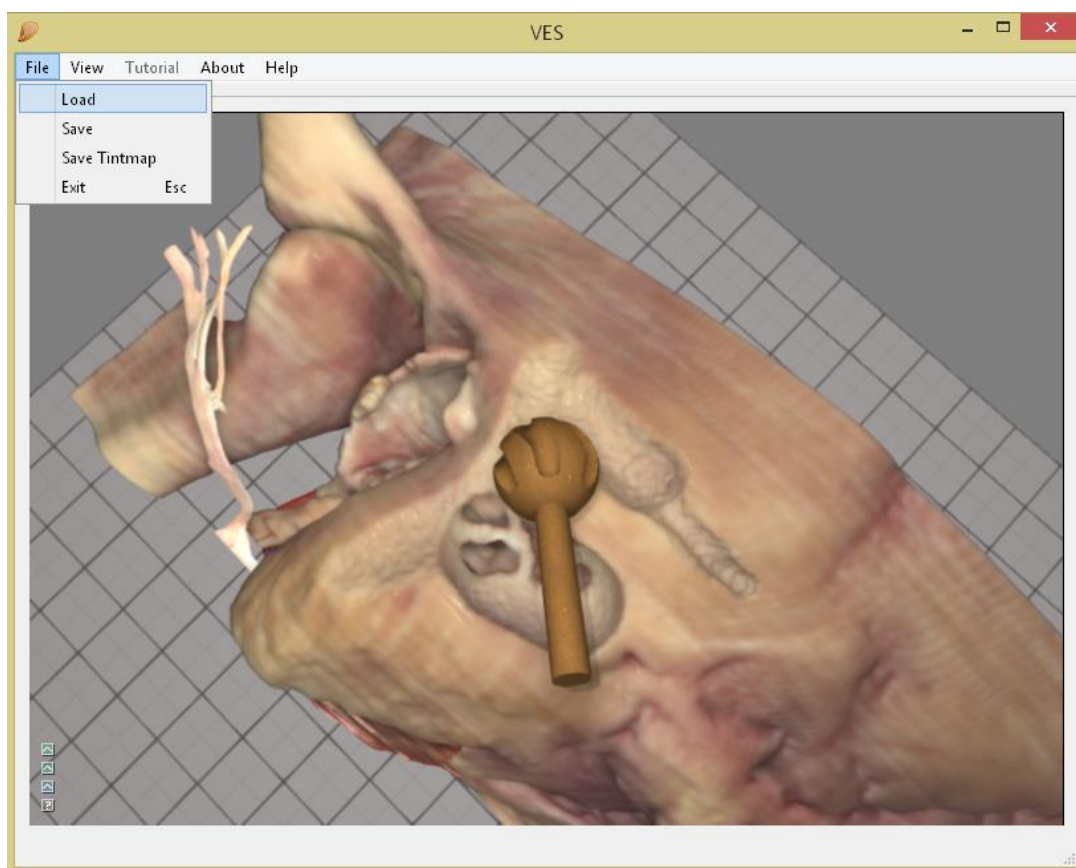
The model can be rotated, panned and zoomed using the haptic device: Press and hold the front button to rotate, press and hold the back button to pan, press and hold the back and front buttons simultaneously to zoom, rotate and pan in one combined movement.

If sometimes the haptic stylus comes out of range when you drill you may easily calibrate your working position by placing the drill as close as possible to where you want to drill and then press and hold the back button. Feel the pen device disconnect from the virtual drill, move the pen to a comfortable position inside the working range of the device, release the back button and feel the pen re-engaging the drill.

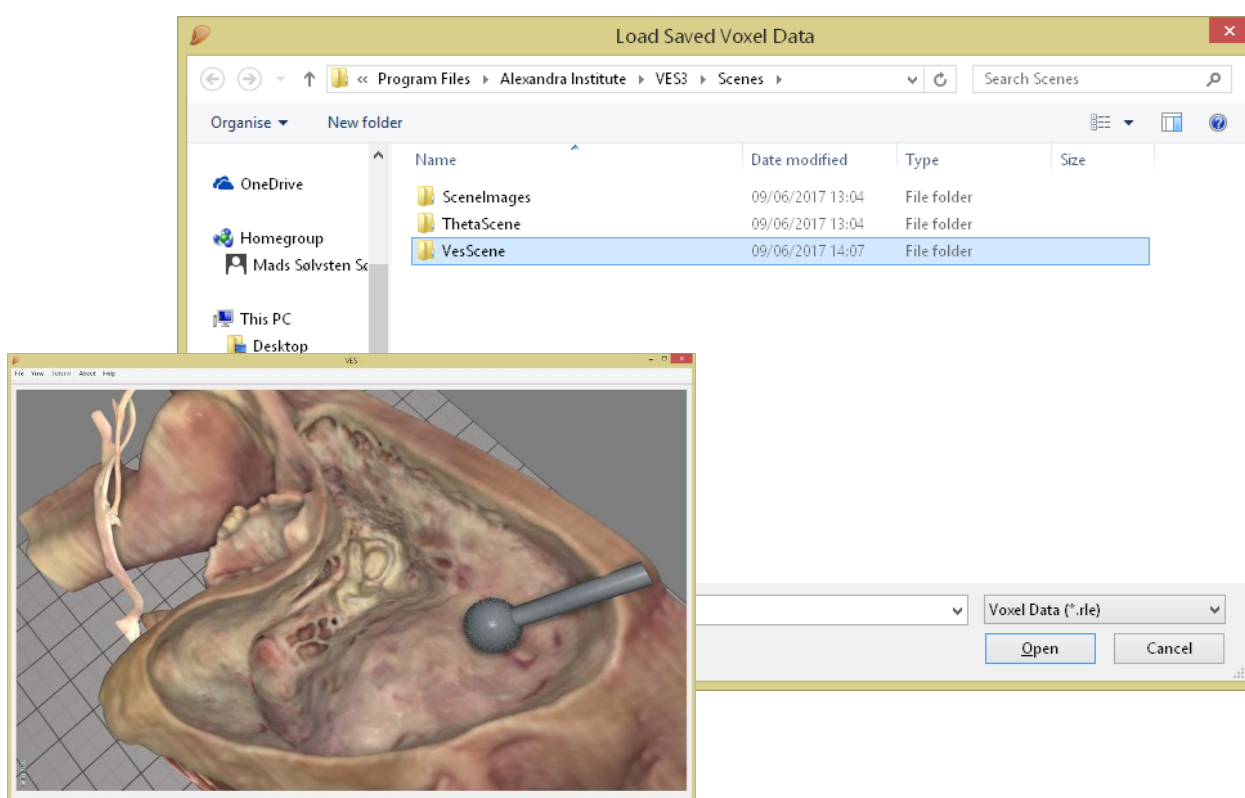
To align the stylus pen of the haptic device and the shaft of the virtual drill press and hold keyboard "Left Ctrl" and stylus' back button simultaneously and turn the stylus until it is parallel to the drill shaft, then release the buttons.

If sometimes you cannot find the drill you just selected on the screen, press "c" to centre the virtual drill in the workspace.

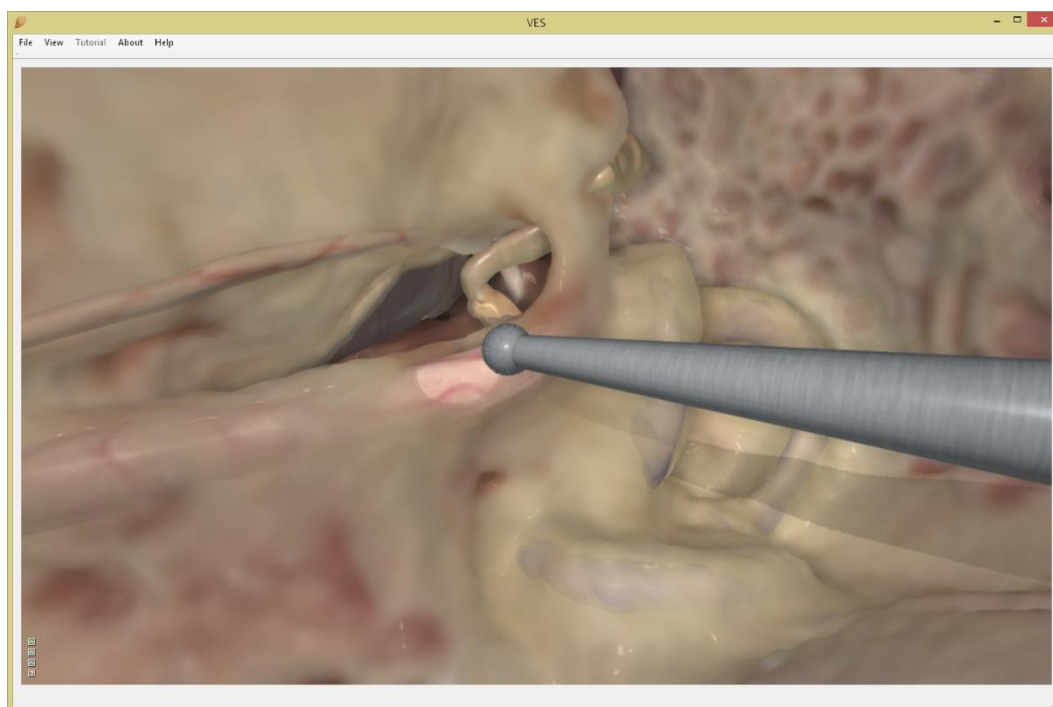
To load a previously saved exercise/scene use “File/Load”  
Use the same menu to save (“File/Save”) your work when needed.



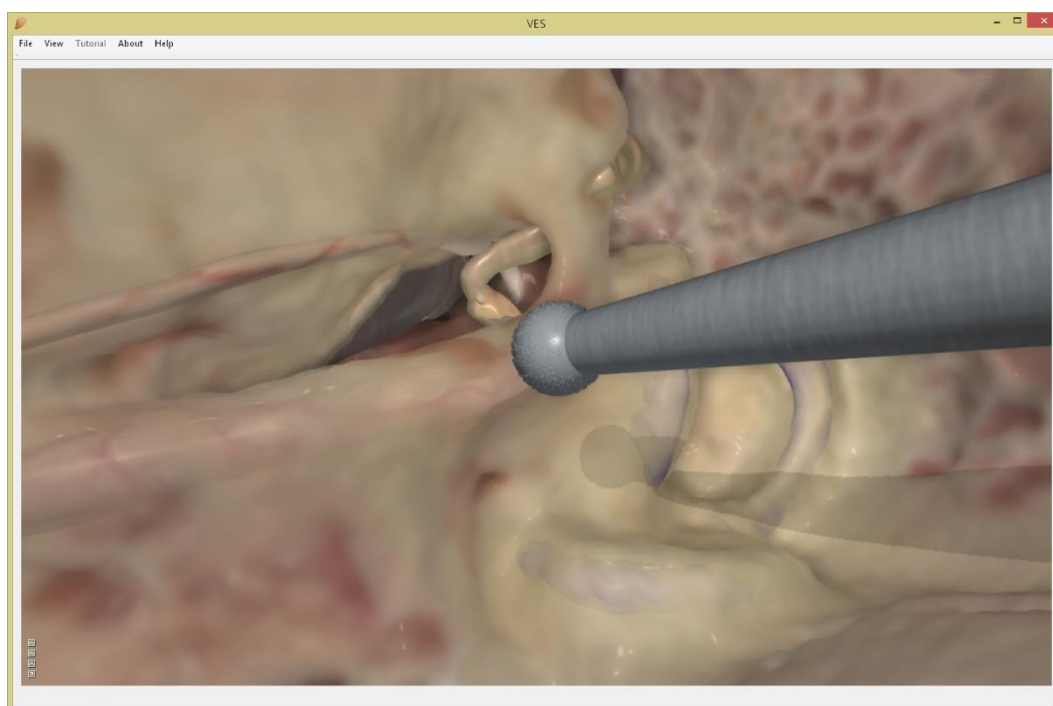
Select the scene you need for the exercise at hand.



If you make a mistake ...



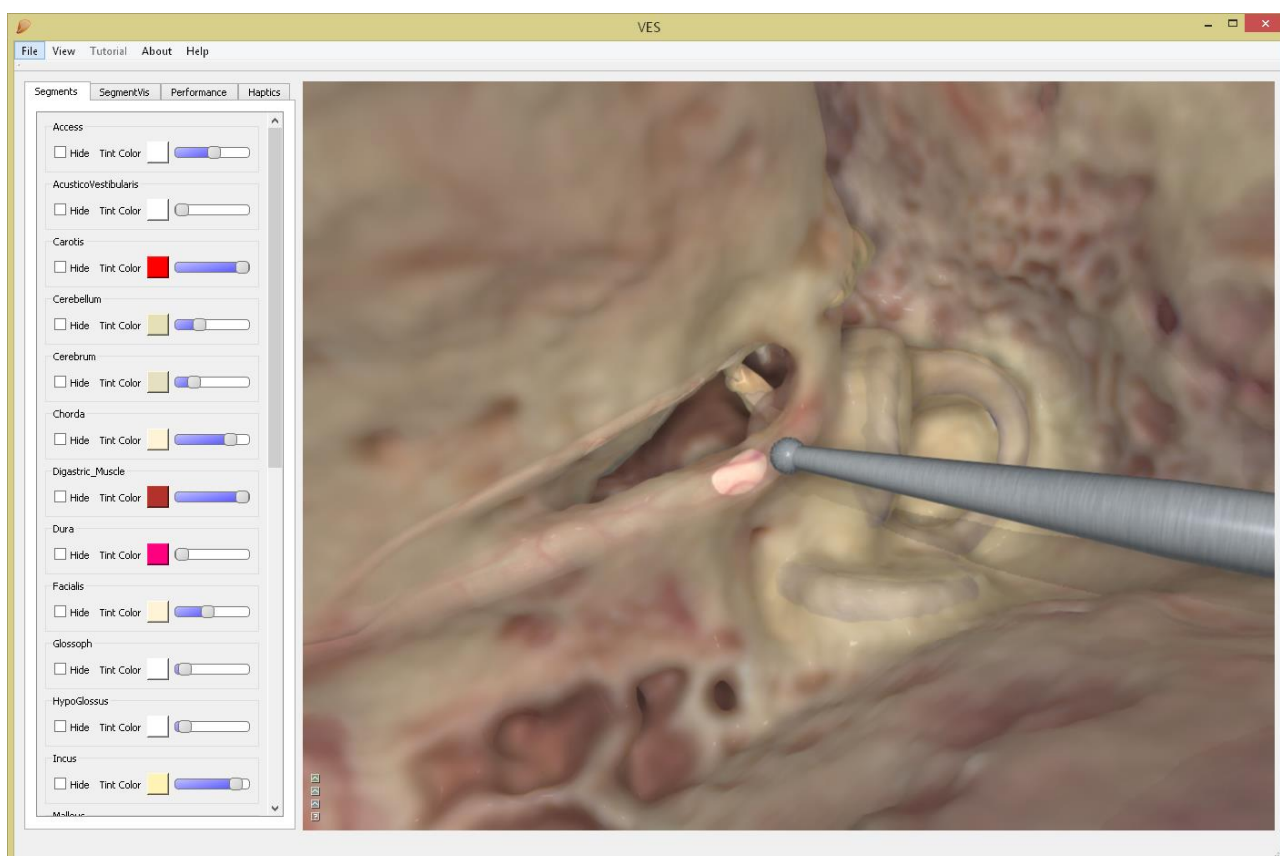
... press “z” to undo and roll back your action one second, or more by pressing “z” repeatedly.



This is not a “cheat” function intended for covering up poor surgery. However, it will allow you to learn how to go closer to the limit because you may easily explore the consequences of further drilling without having to start all over with a fresh session each time you went too far and learned a new lesson.

Press “x” to access the graphic and haptic calibration menu.

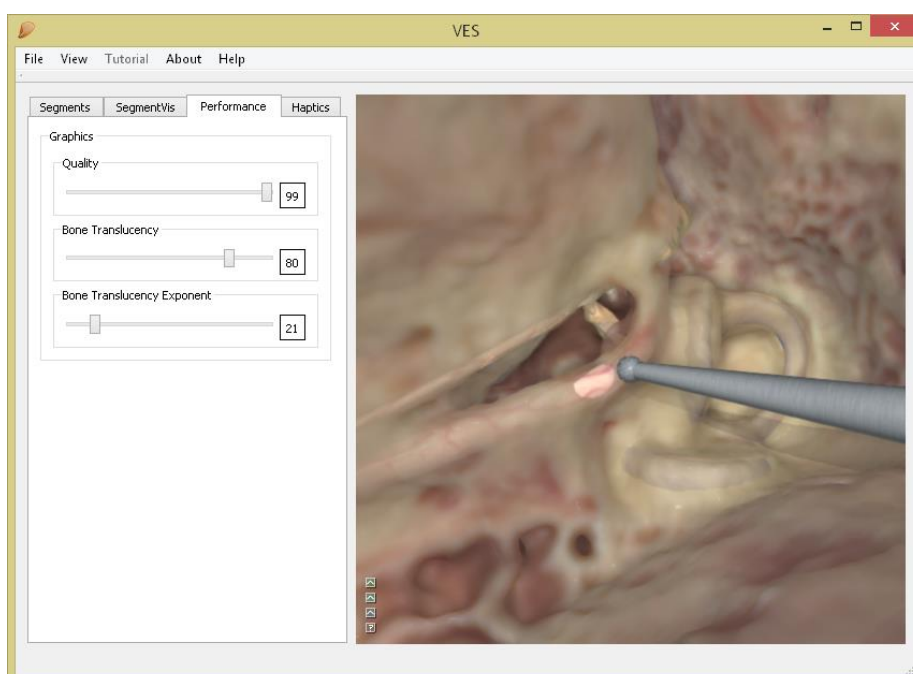
In “Segments” you may hide/unhide any segment (structure) or tint it with a colour and intensity of your preference.



In “Performance” you can trim the overall graphic performance to match the power of your graphics card.

“Bone Translucency” calibrates the transparency through the entire model.

“Bone Translucency Exponent” increases transparency only in the most superficial bone.





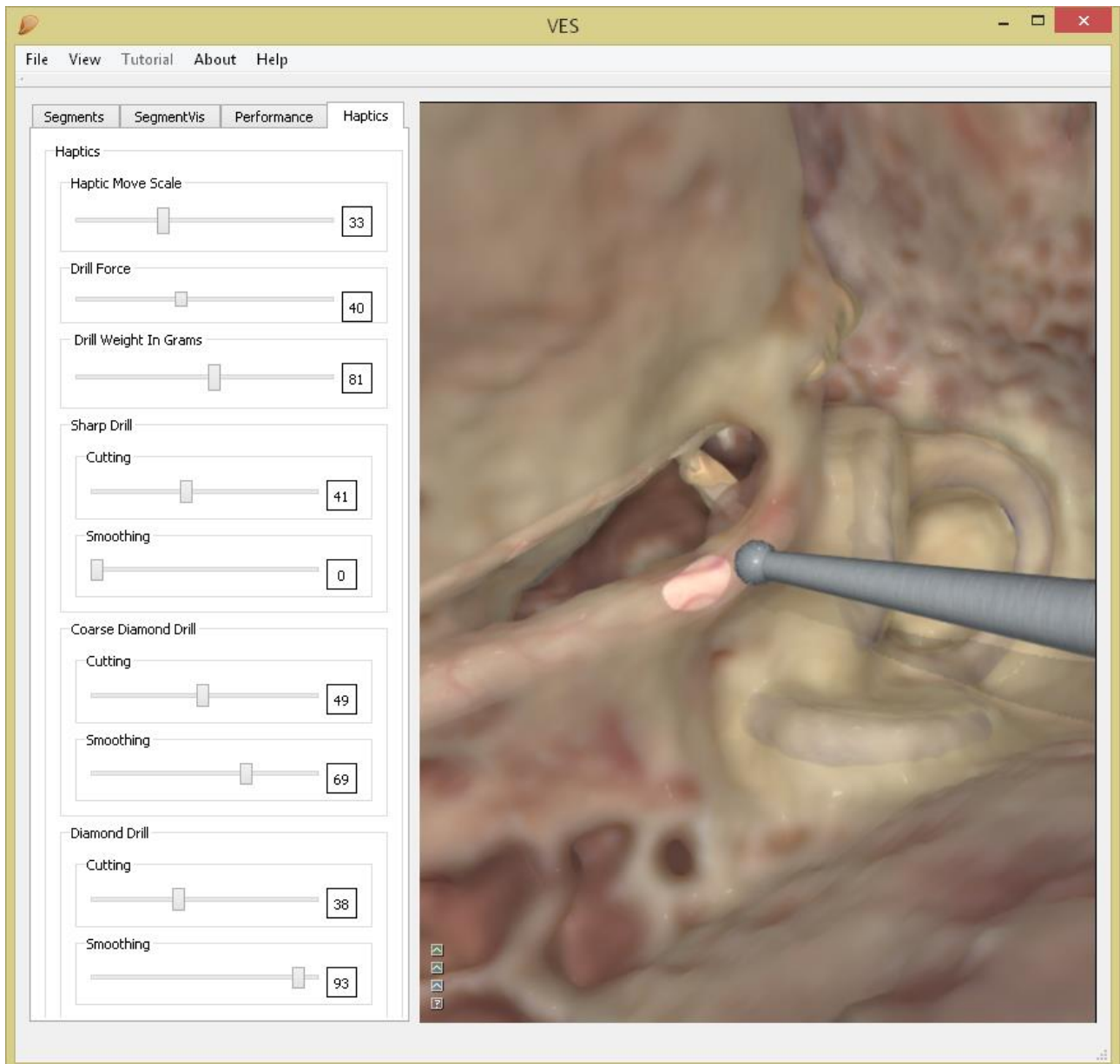
In “Haptics” you can calibrate the translation function from hand movement to drill movement at “Haptic Move Scale”.

“Drill Force” determines the degree of haptic feedback during drilling – too little feels dull, too much makes your drill jumpy and hard to control.

Too much “Drill Weight” will make you tired.

For any of the 3 drill types, cutting- and smoothing effect can be tuned.

The haptic calibration is depending on the type and speed of your PCs CPU – no setting is right for every PC, so this is a calibration you will most likely have to go through.

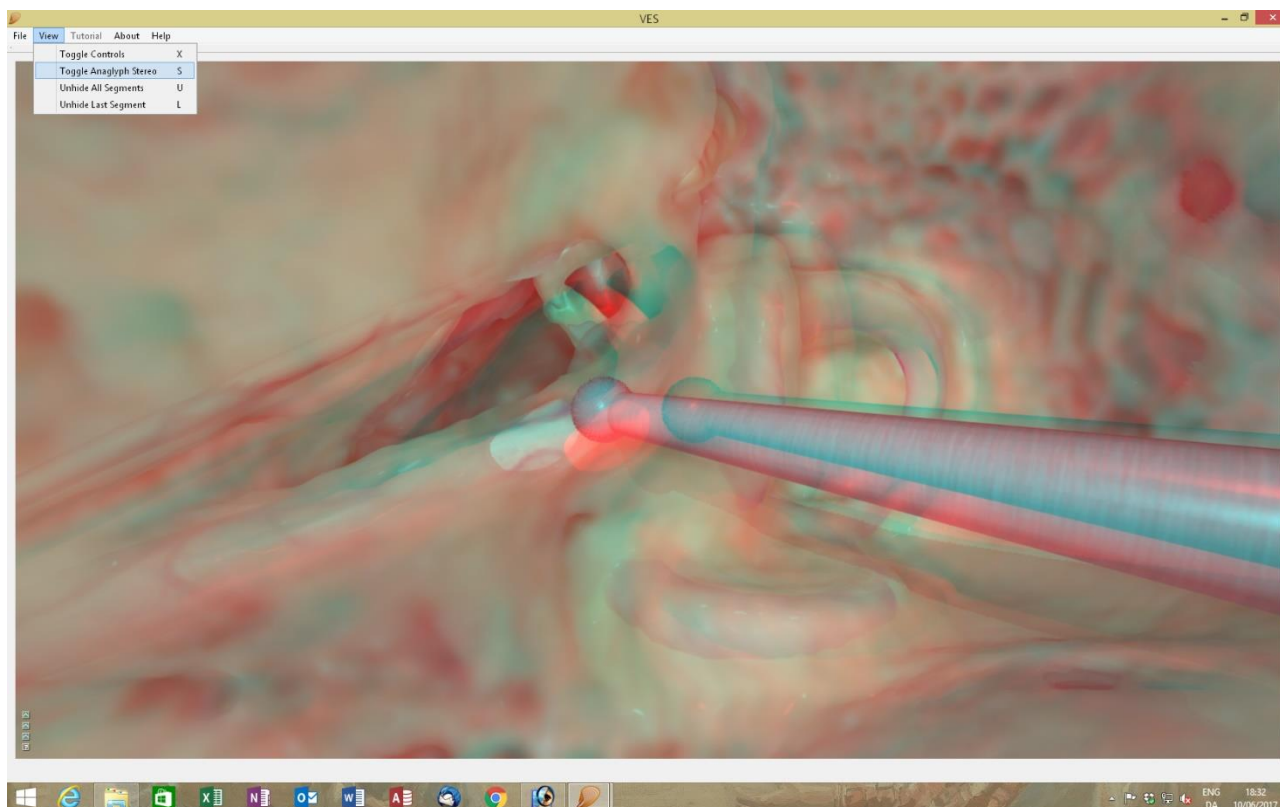


You may want to drill in 2D, but if a stereoscopic view is needed press “View/ Toggle Anaglyph Stereo” or keyboard “S” and put on a pair of red/blue anaglyph glasses. Without such glasses, you will only see a double red/blue image on the screen.

The image below will appear in stereo whether on the pc screen or in colour print.

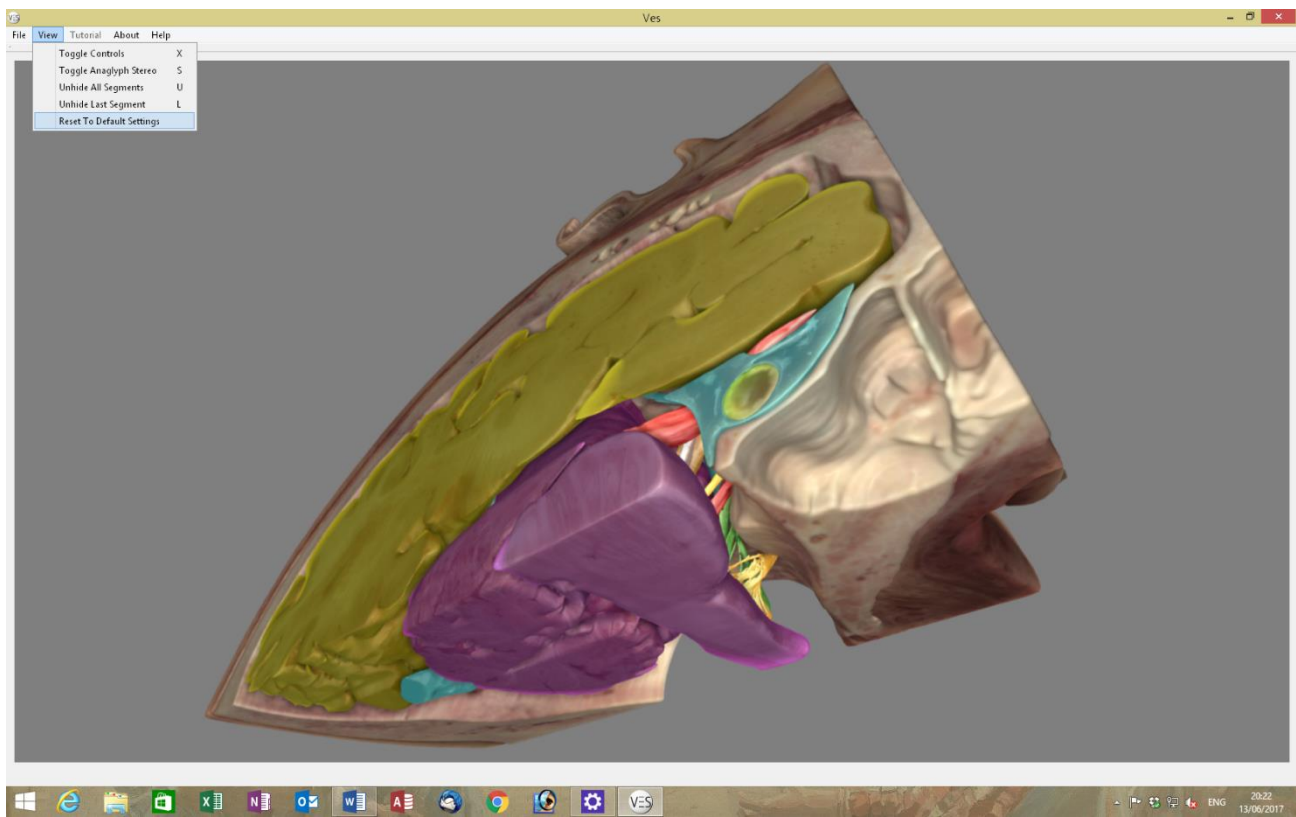
Some colour information is lost, but this stereo mode is opensource code, which helps to keep the VES3 simulator free.

Whenever you wish to return to 2D press “S” or “View/ Toggle Anaglyph Stereo” again.



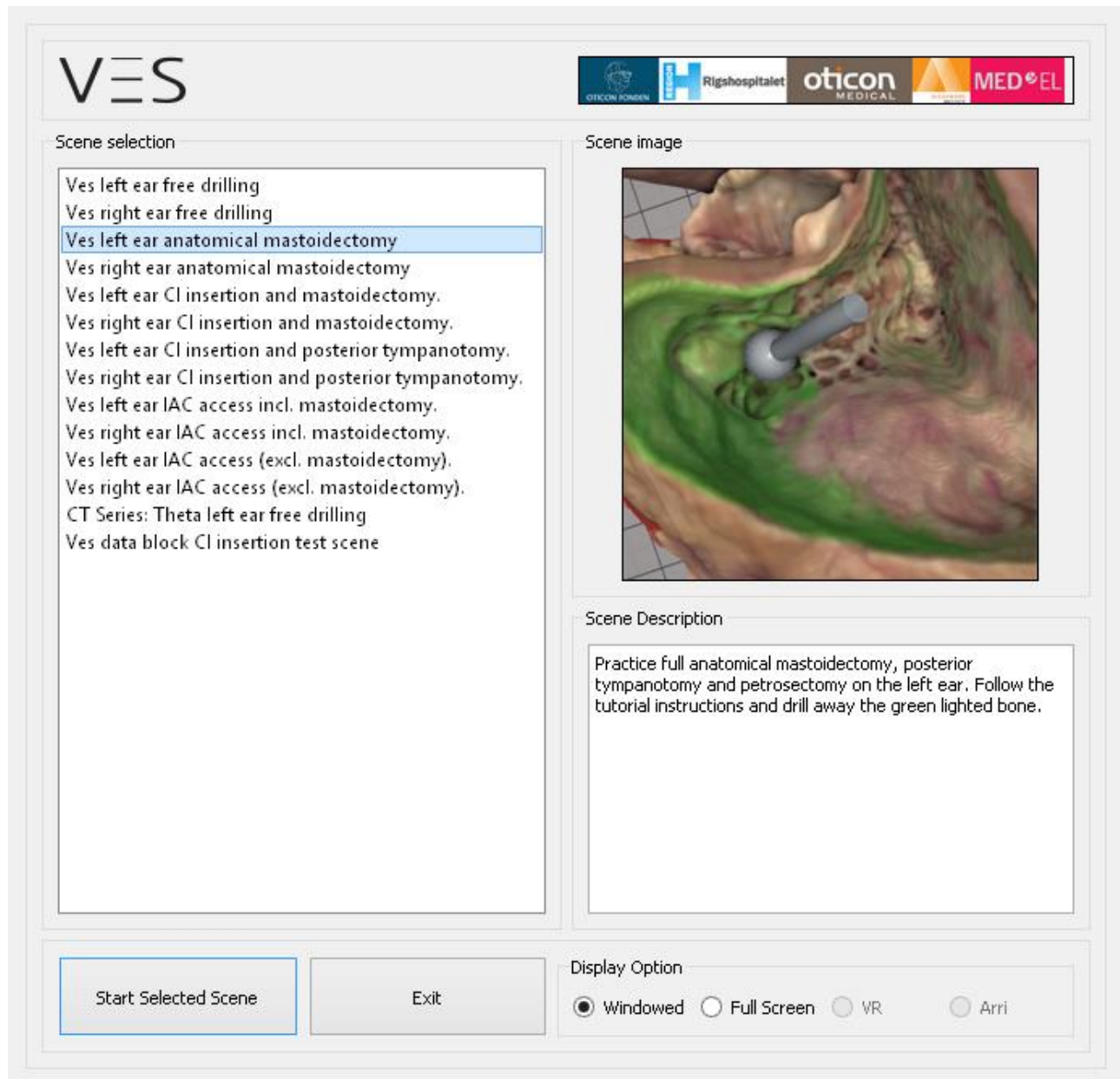
Stereo output for a polarizing screen, Oculus Rift VR or the Arriscope® digital surgical microscope as optional in VES2 will become available for VES3 soon (as it is for VES2).

If you played around with every calibration of graphics and haptics and got lost in the process use the “View/Reset to Default Settings” to return to a realistic set up.



Press “File/Exit” to return to the scene selection screen.

Drill a complete anatomical mastoidectomy assisted by the integrated tutor function by selecting “VES left ear mastoidectomy tutorial” and pressing “Start Selected Scene”

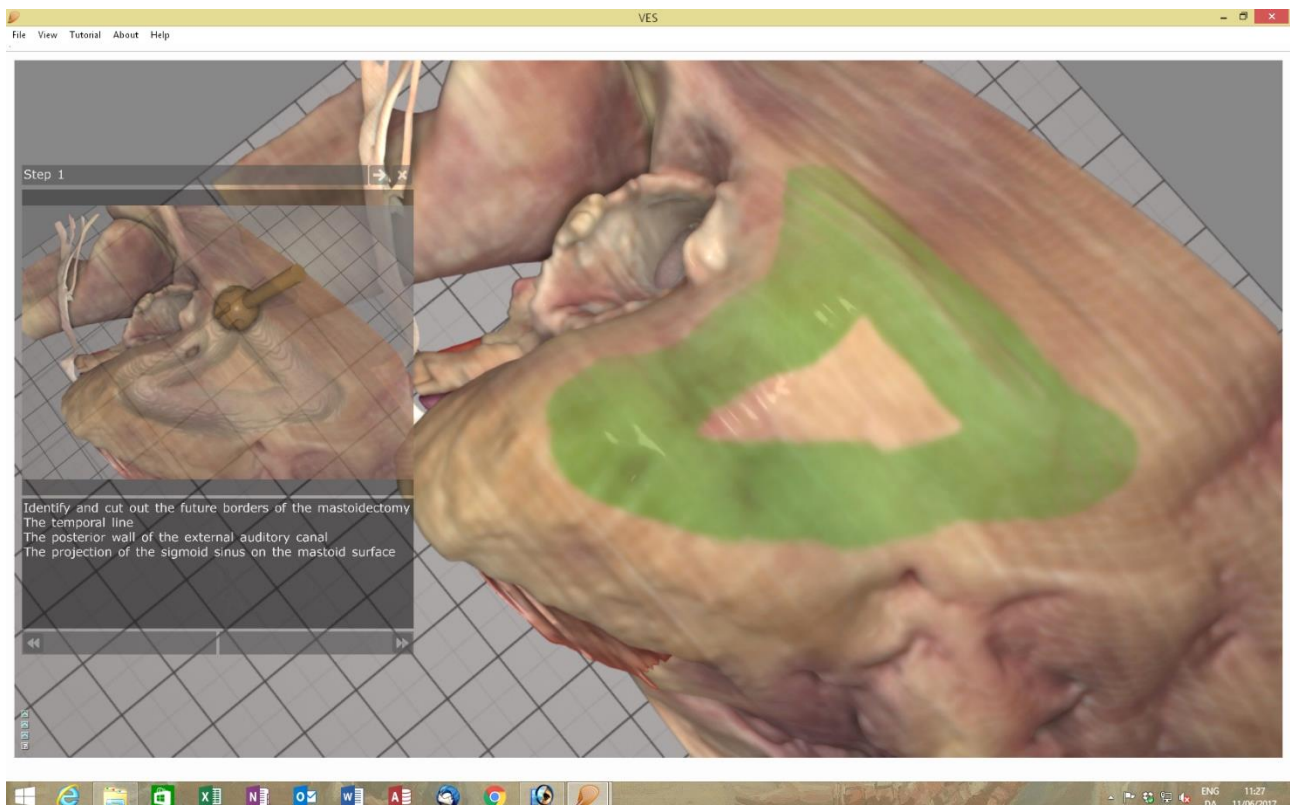




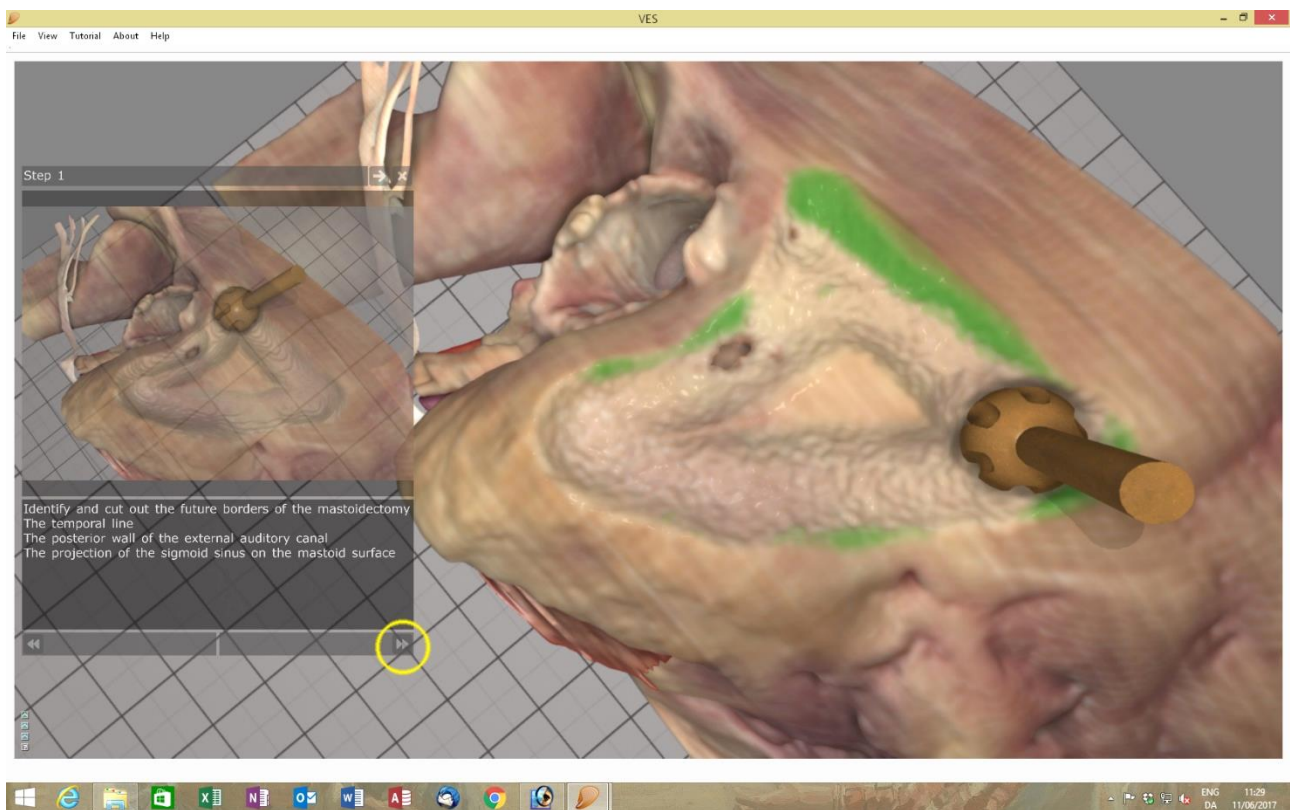
The VES3 presents a new bone with an overlay of stepwise instructions, which can be pushed aside by clicking the arrow. You can toggle the instruction On/Off with “t”.



The volume of bone that you are prompted to remove is greenlighted in the voxel model, so all you really need to do for a start is to remove the green bone.



When the green bone is gone, go to the next step by clicking the arrows (bottom left)



Complete the next step and so on...

