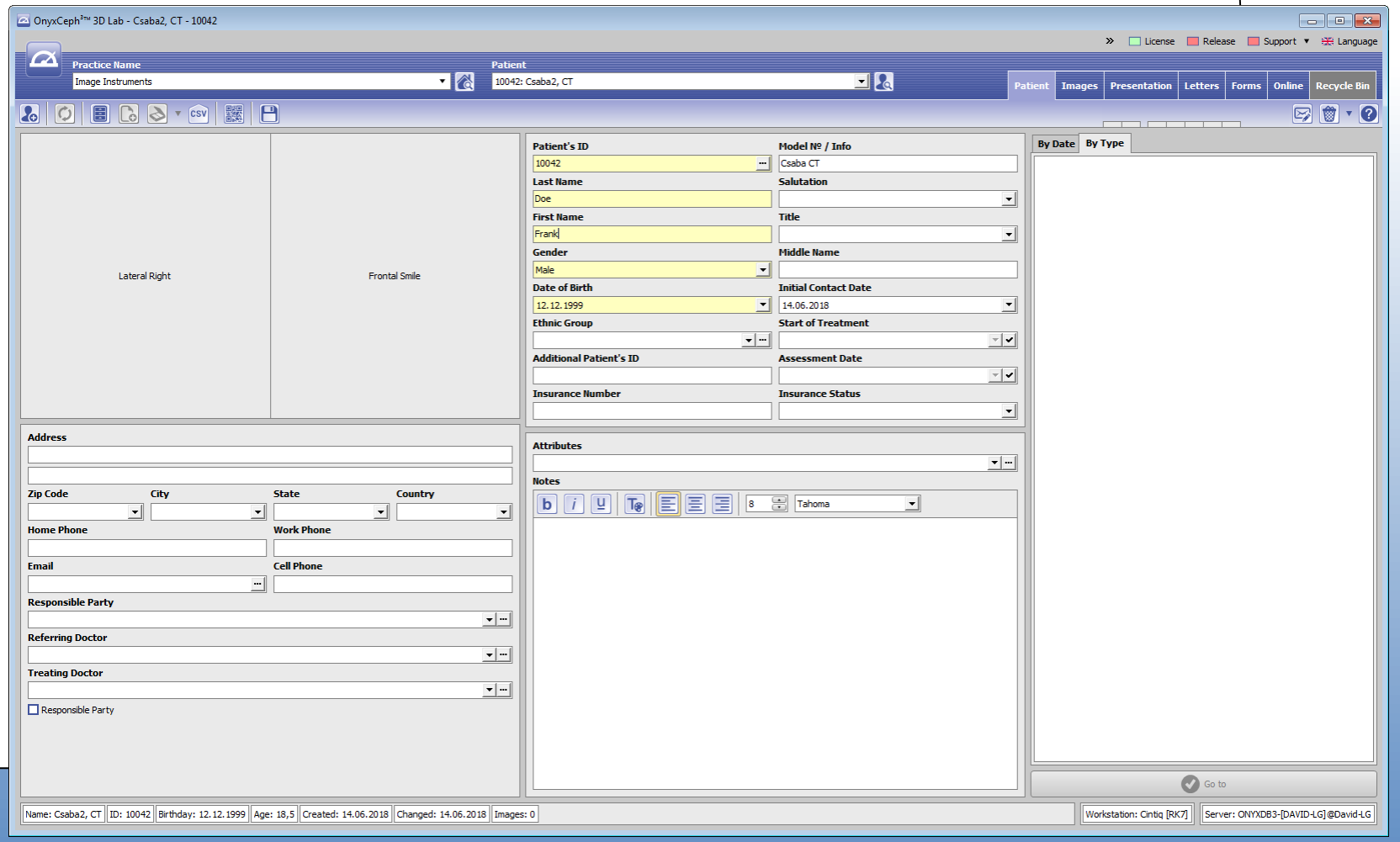
Treatment Simulation Sim 3D - PreProcessing

OnyxCeph³™ Imaging Software

Create / Select Patient Record

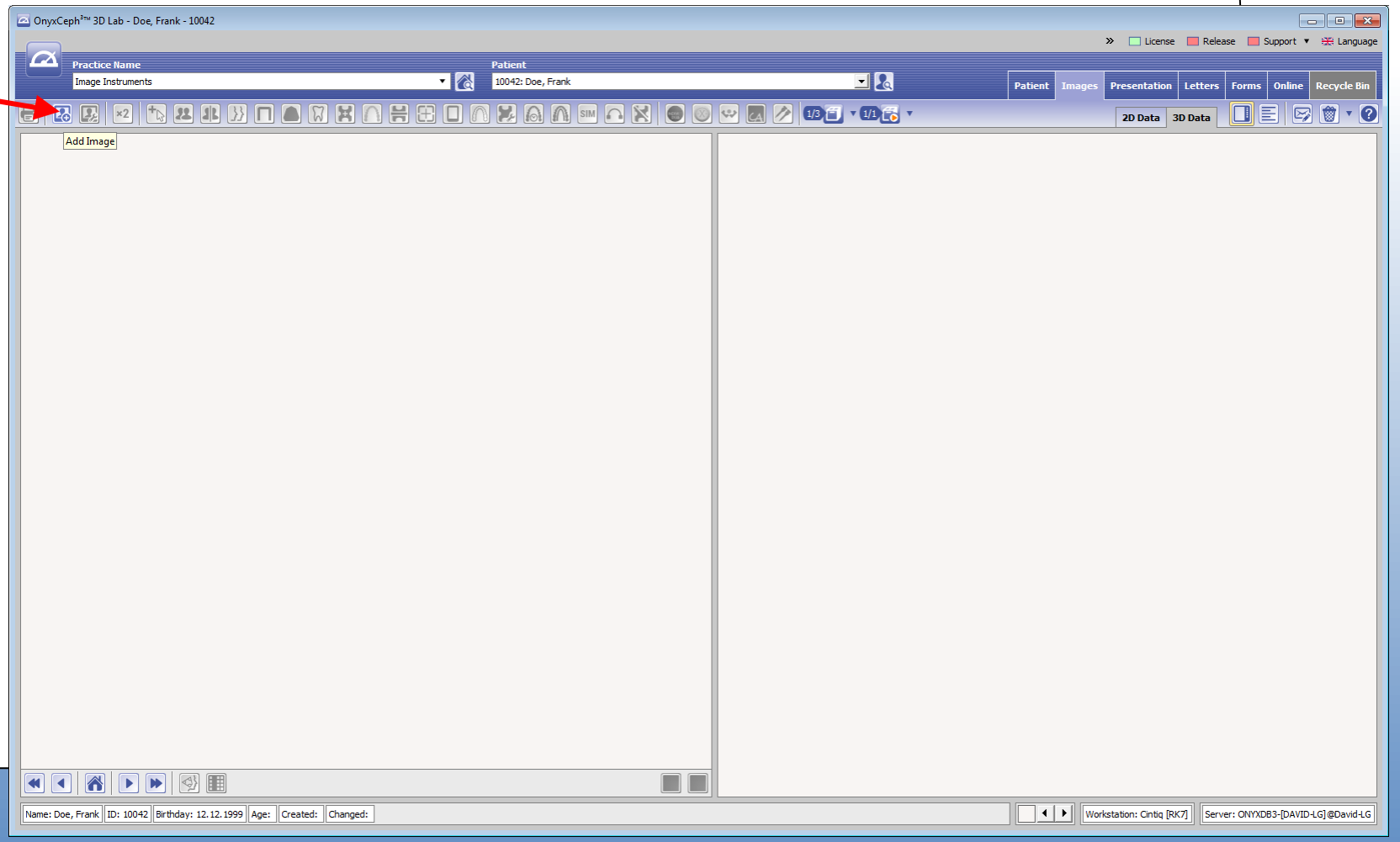
Create, take over or simply open the patient record the case is belonging to.



Add Image

Switch to tab |Images / 3D Data| and click Icon [Add Image].

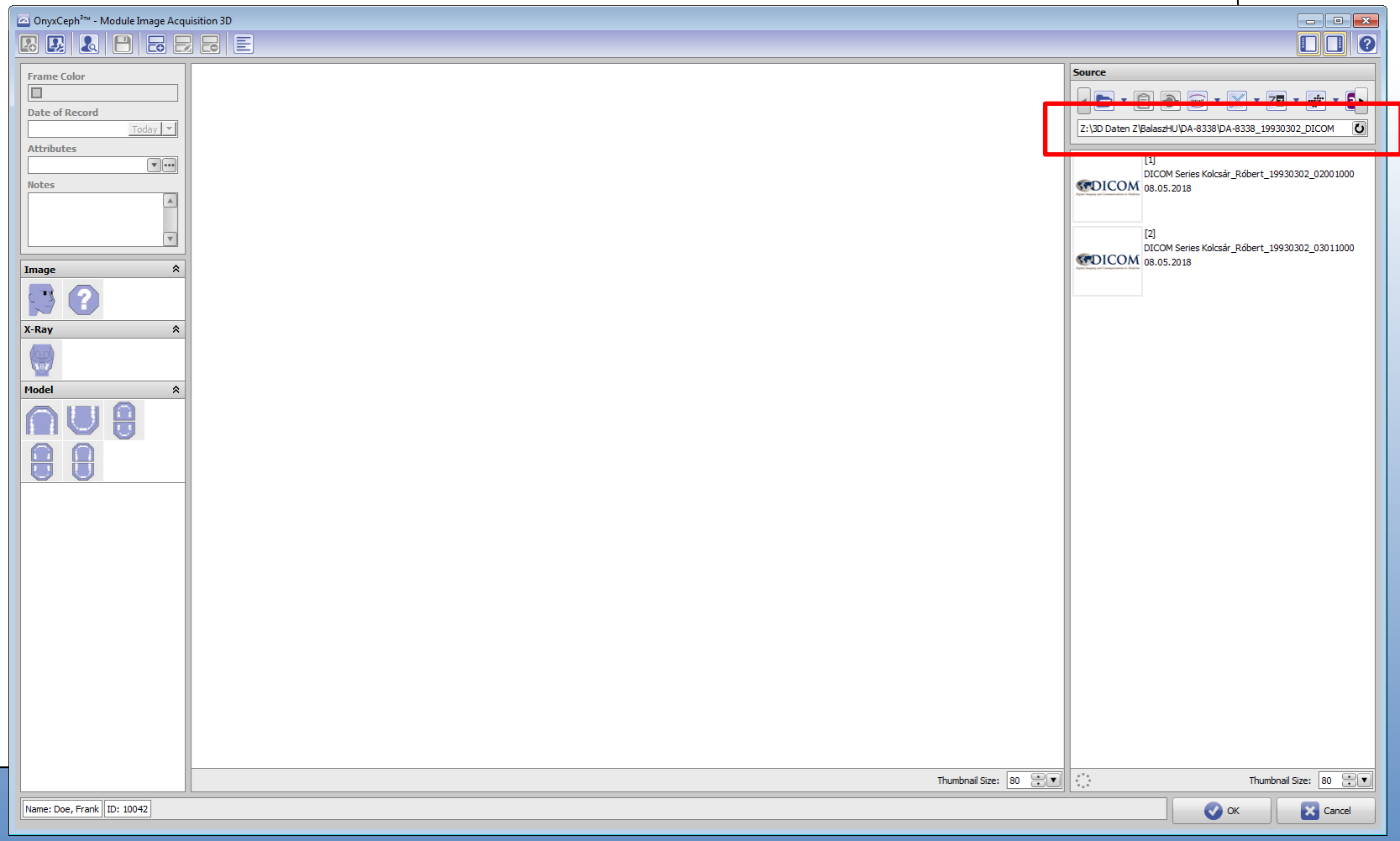
Alternatively, use [CTRL]+3 while on any tab.



Add Image (DICOM)

DICOM Import:
Select subfolder that contains the DICOM study.

Place holders for each contained study will be displayed in the image source panel on the right.



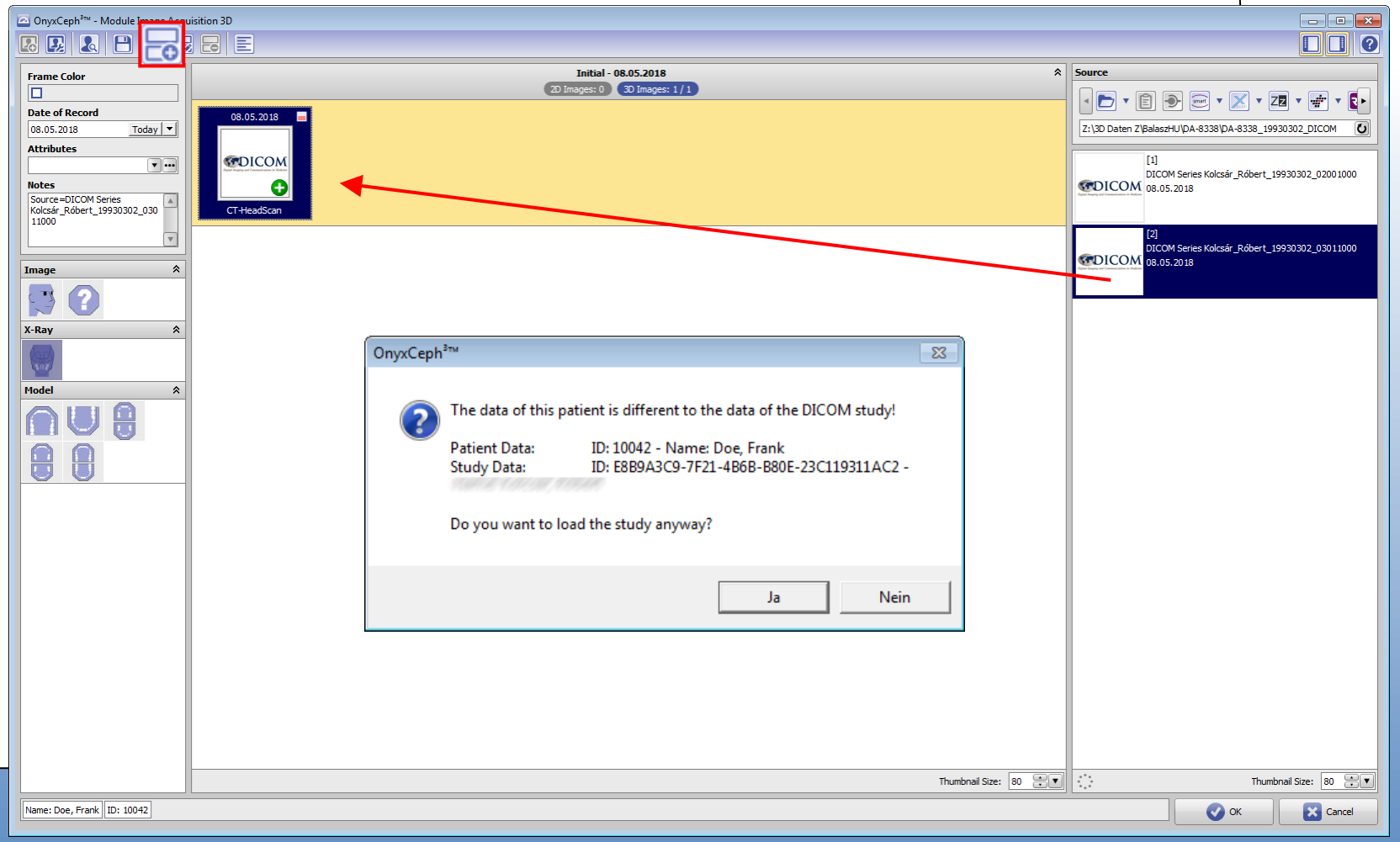
Add Image (DICOM)

Select the thumbnail of the study to be imported and drag&drop it to the appropriate record series.

If not available, create or define the record series on import or before.

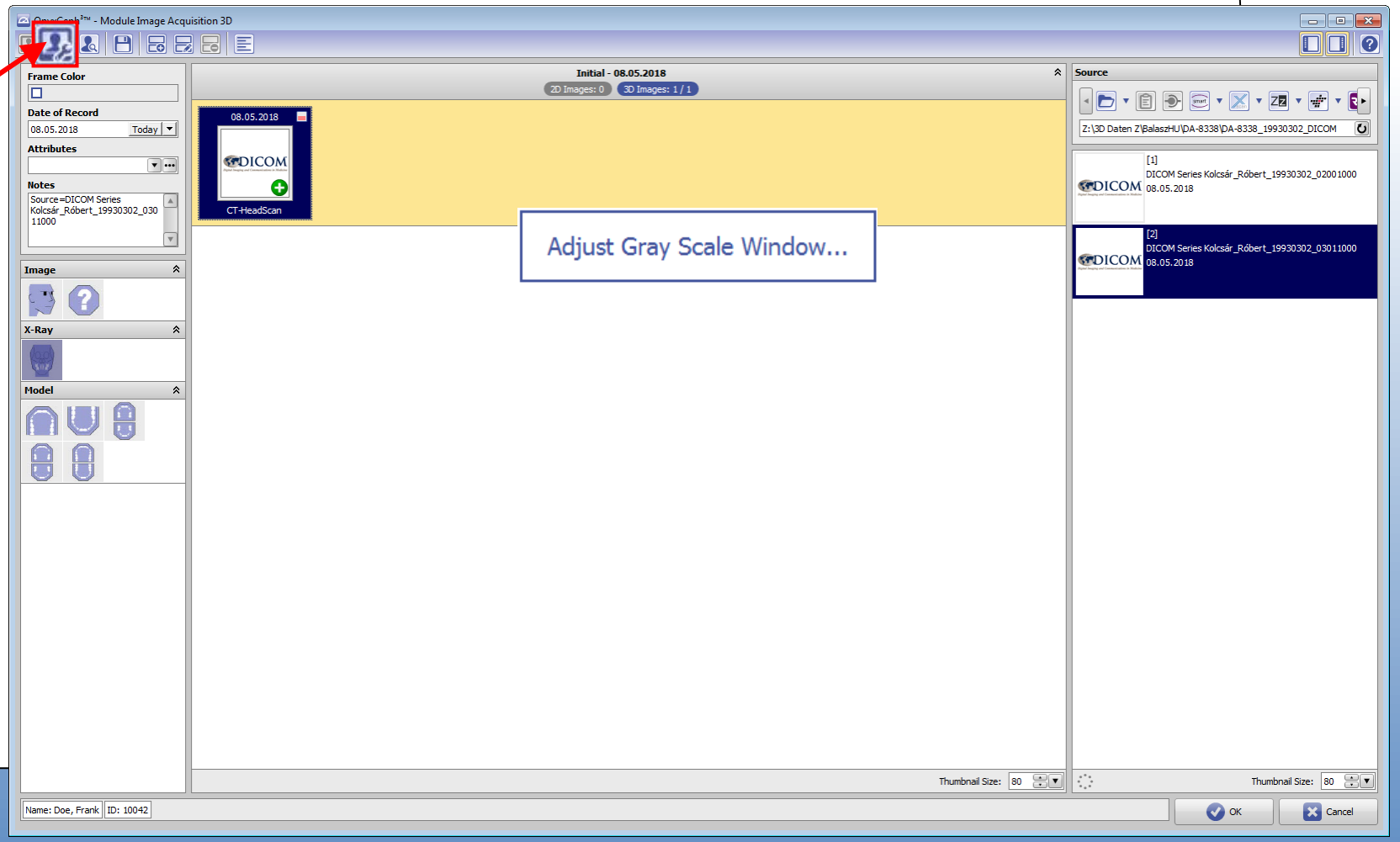
If patient data encoded in the study are different, a warning will be displayed.

Assign image type [HeadScan] by drag&drop image type icon to thumbnail or vice versa.



Add Image - Classification

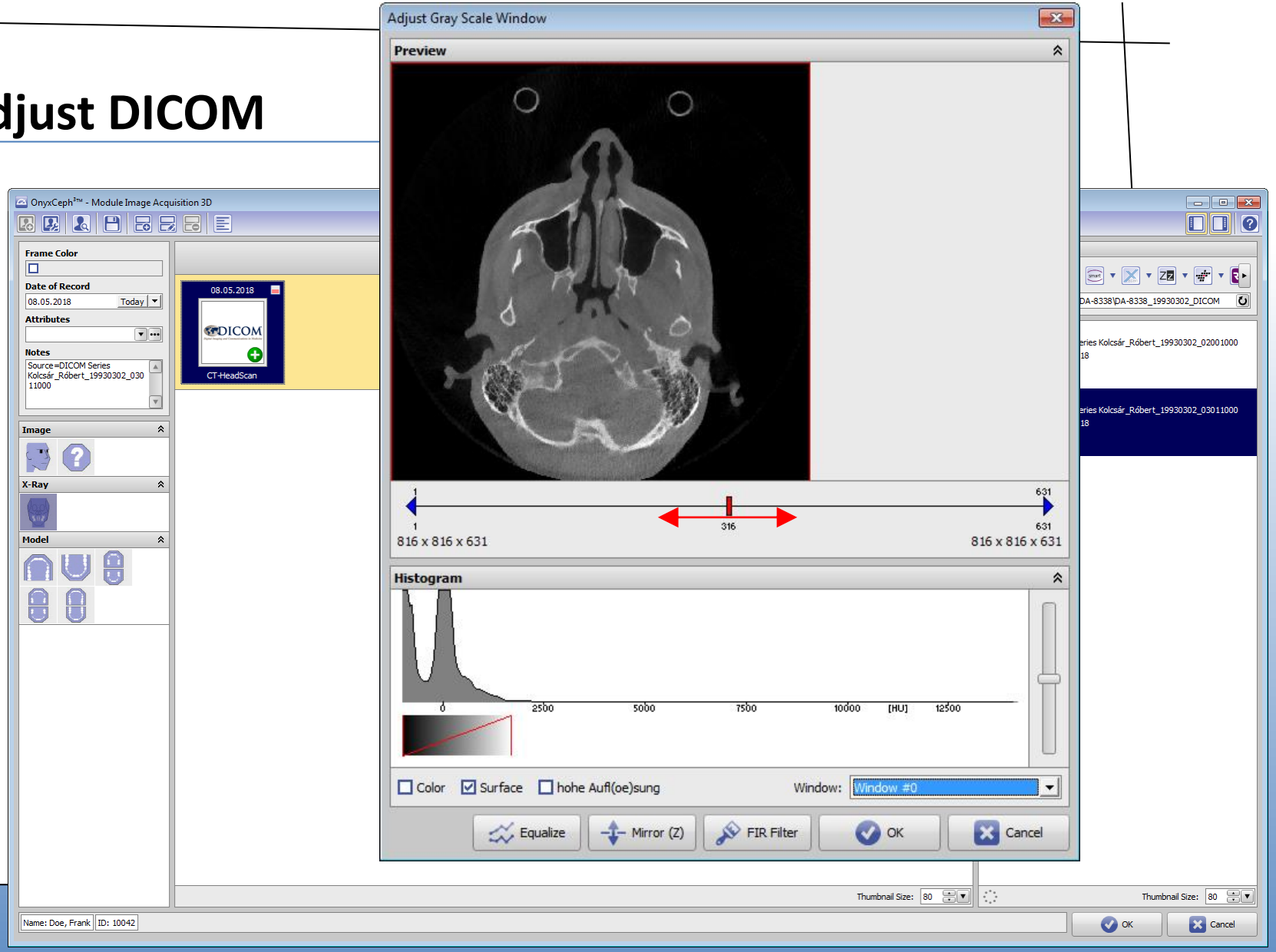
Click icon [Adjust Image] on top or doubleclick on the record series thumbnail to start the loading process.



Adjust DICOM

Once file is loaded into the RAM, the [Adjust Gray Scale Window] comes up.

Use the red handle to browse throug the DICOM layers from bottom (Chin) to top (skullcap).
If direction is mirrored, flip sequence by button [Mirror]

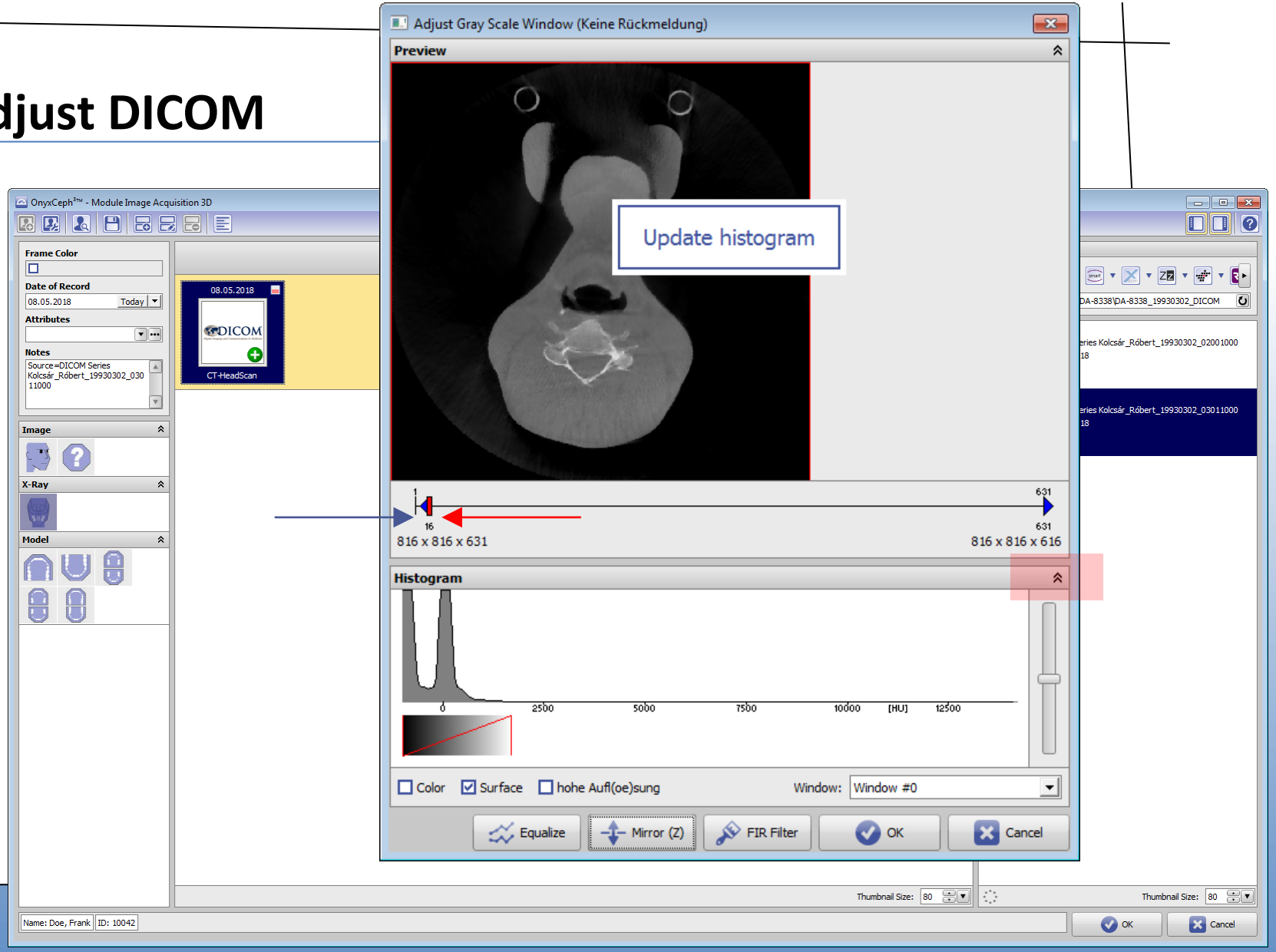


Adjust DICOM

Move hadle to the red left to find the lowest layer of the Region of Interest ROI. Shift the left blue handle to the found position.

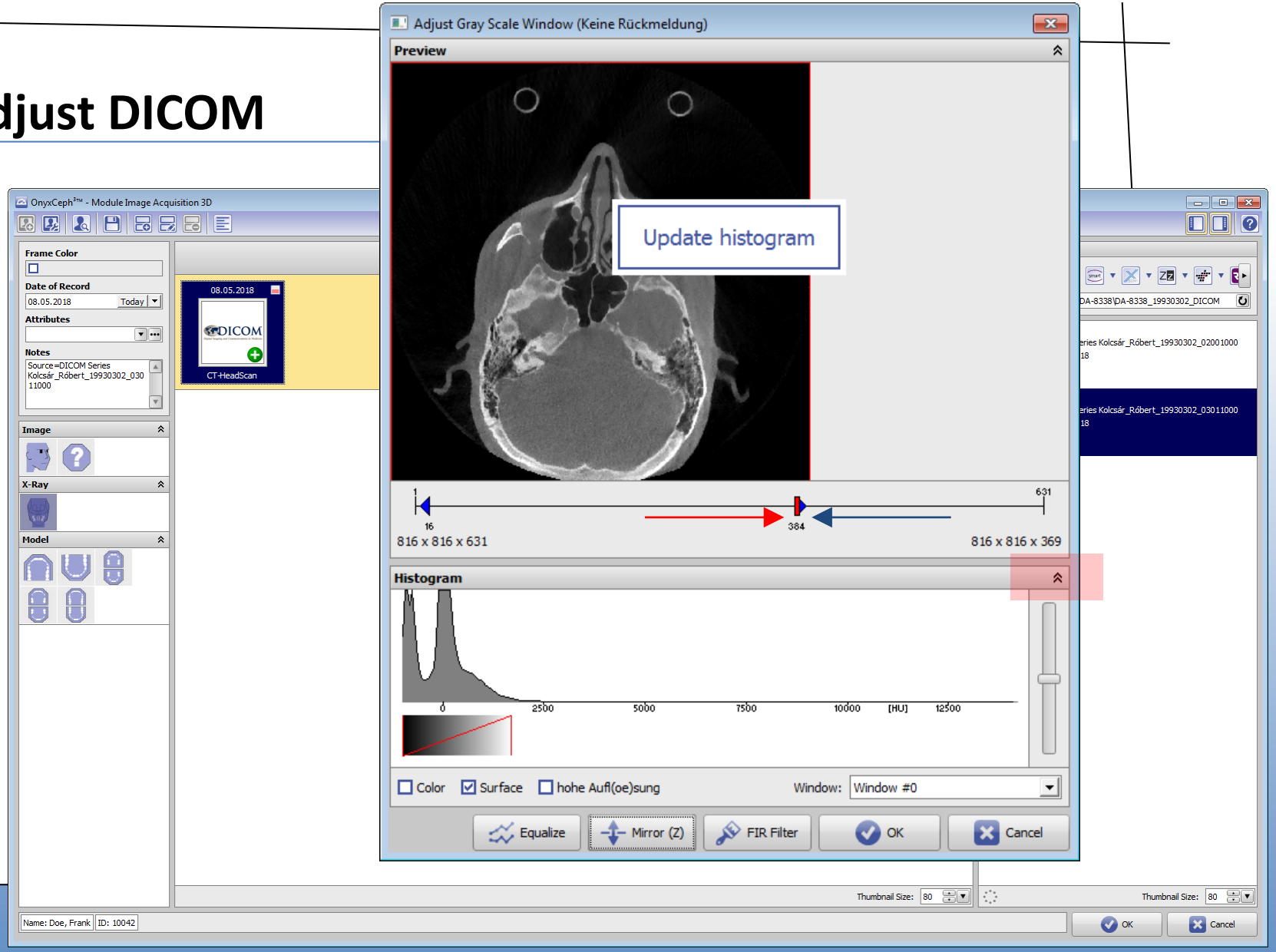
After each ROI modification the intensity histogram (characteristic) is updated since only voxel inside the ROI are taken into account.

Hint:
It is recommented to collapse the Histogram panel before moving the blue handles to avoid time-consuming histogram updates.



Adjust DICOM

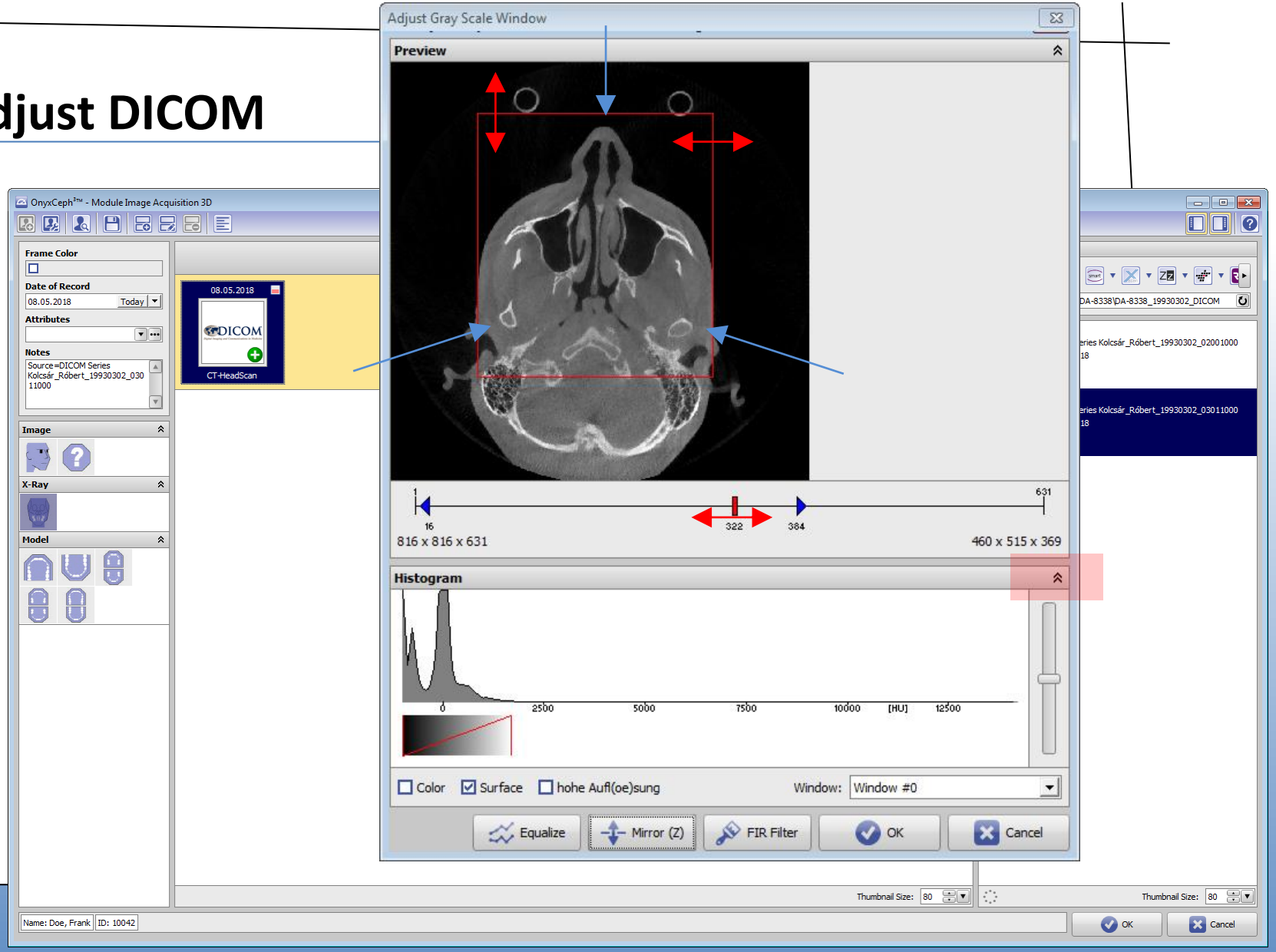
Repeat the same tor the most upper layer of the ROI



Adjust DICOM

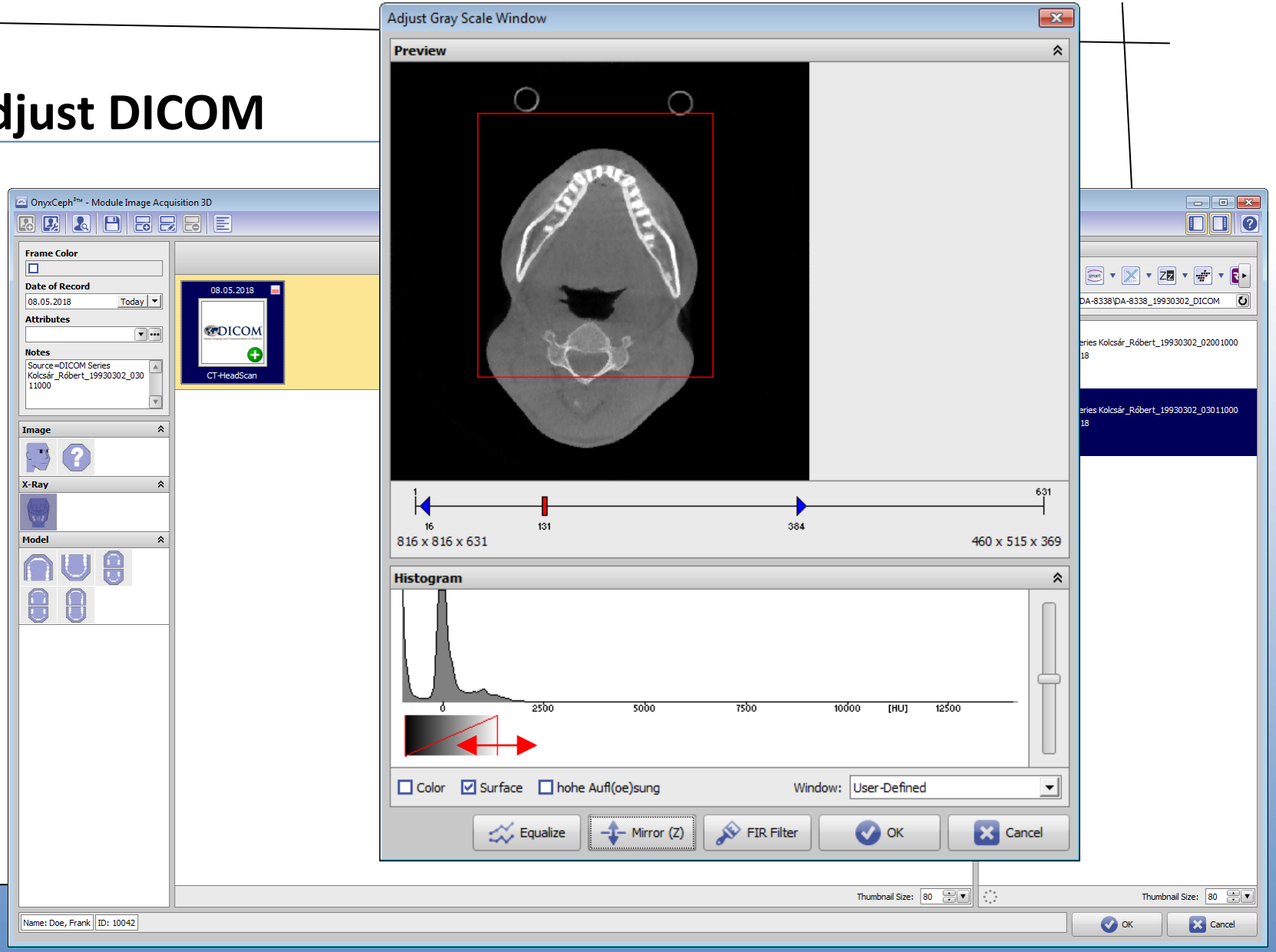
Now, browse through the vertical limited layers by the red handle to define the horizontal ROI borders.

Take care that bony condyles and soft tissue nose are covered completely.



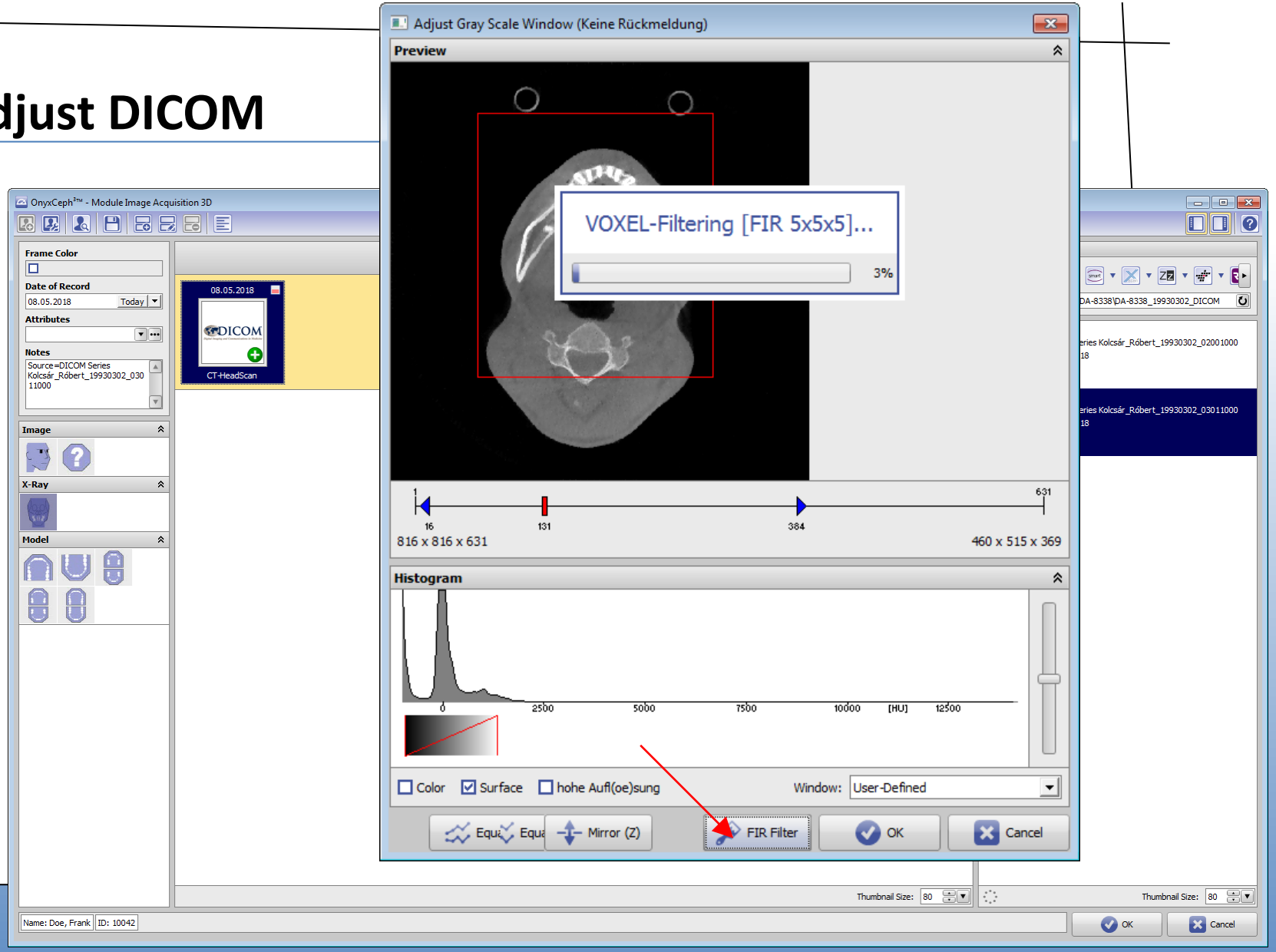
Adjust DICOM

Play arround with the histogram characteristic and controls to ensure an optimal intensity conversion 12 bit to 8 bit.



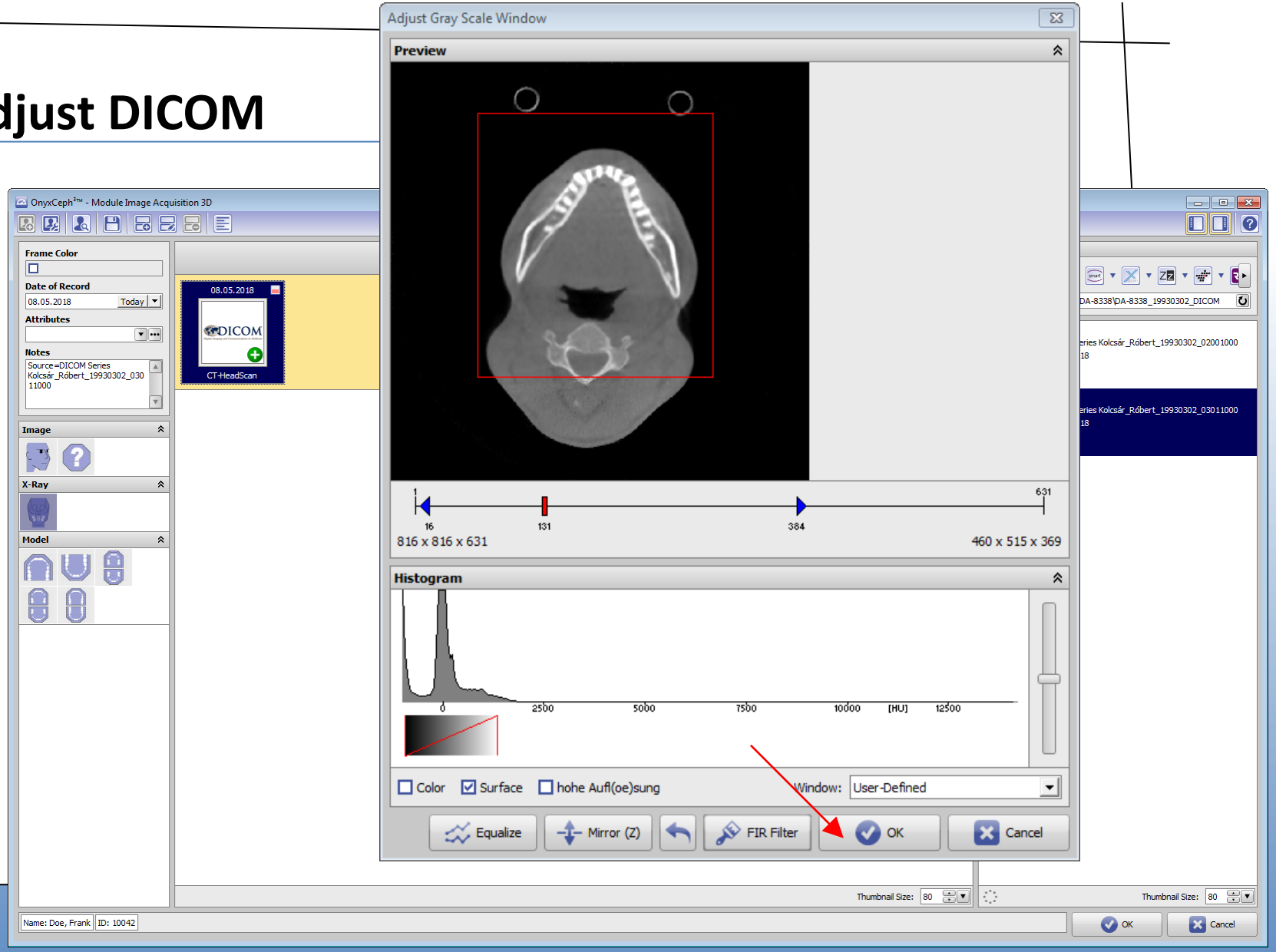
Adjust DICOM

Finally, apply FIR voxel filtering to the defined ROI to smooth intensity and ease surface extraction.



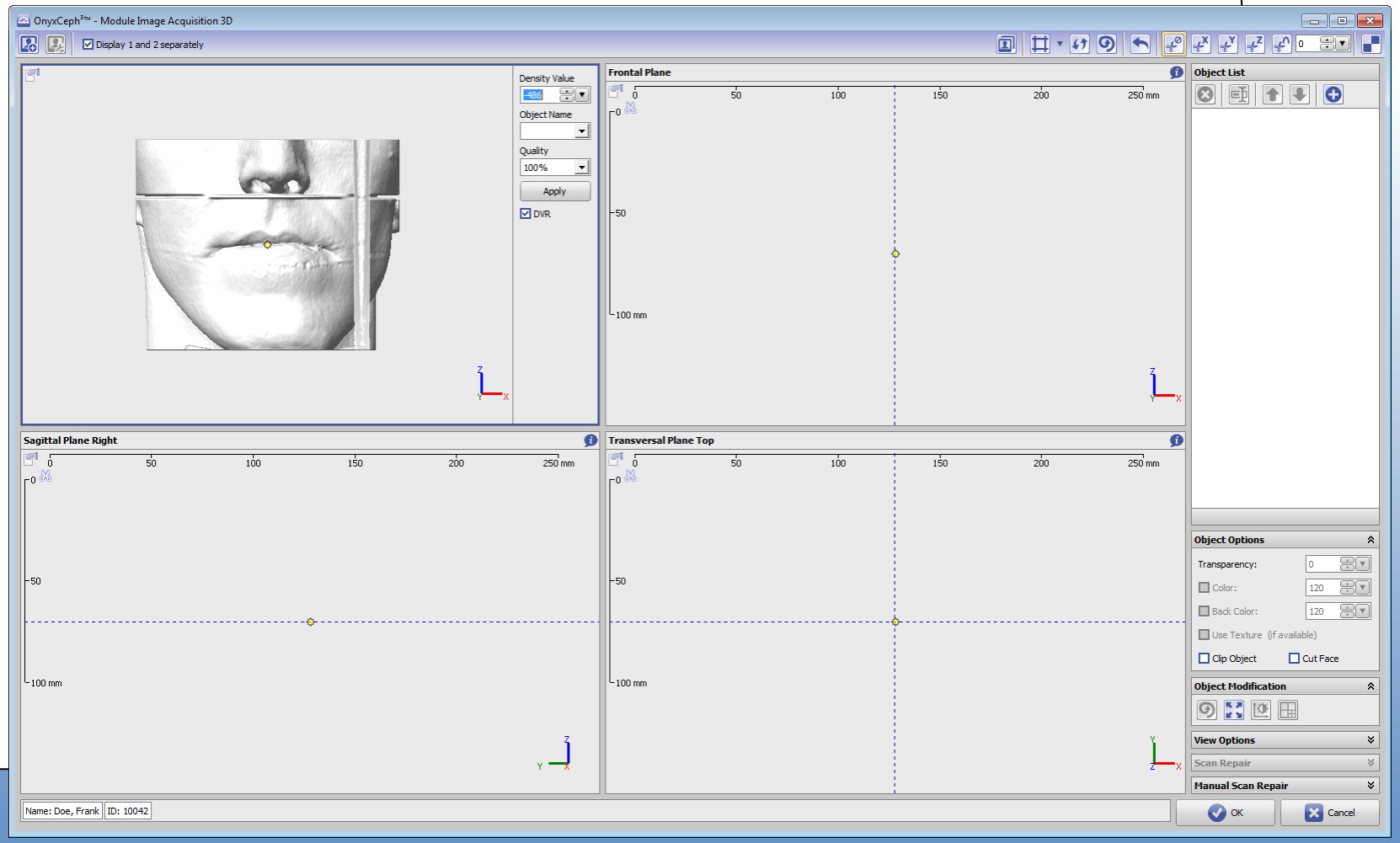
Adjust DICOM

Once done, click [OK].



Adjust Image – Extract Surface

Top left in module [Adjust Image] a fast ray-tracing preview of the extracted surface acc. to the selected intensity (Density Value) is displayed.



Extract Surface

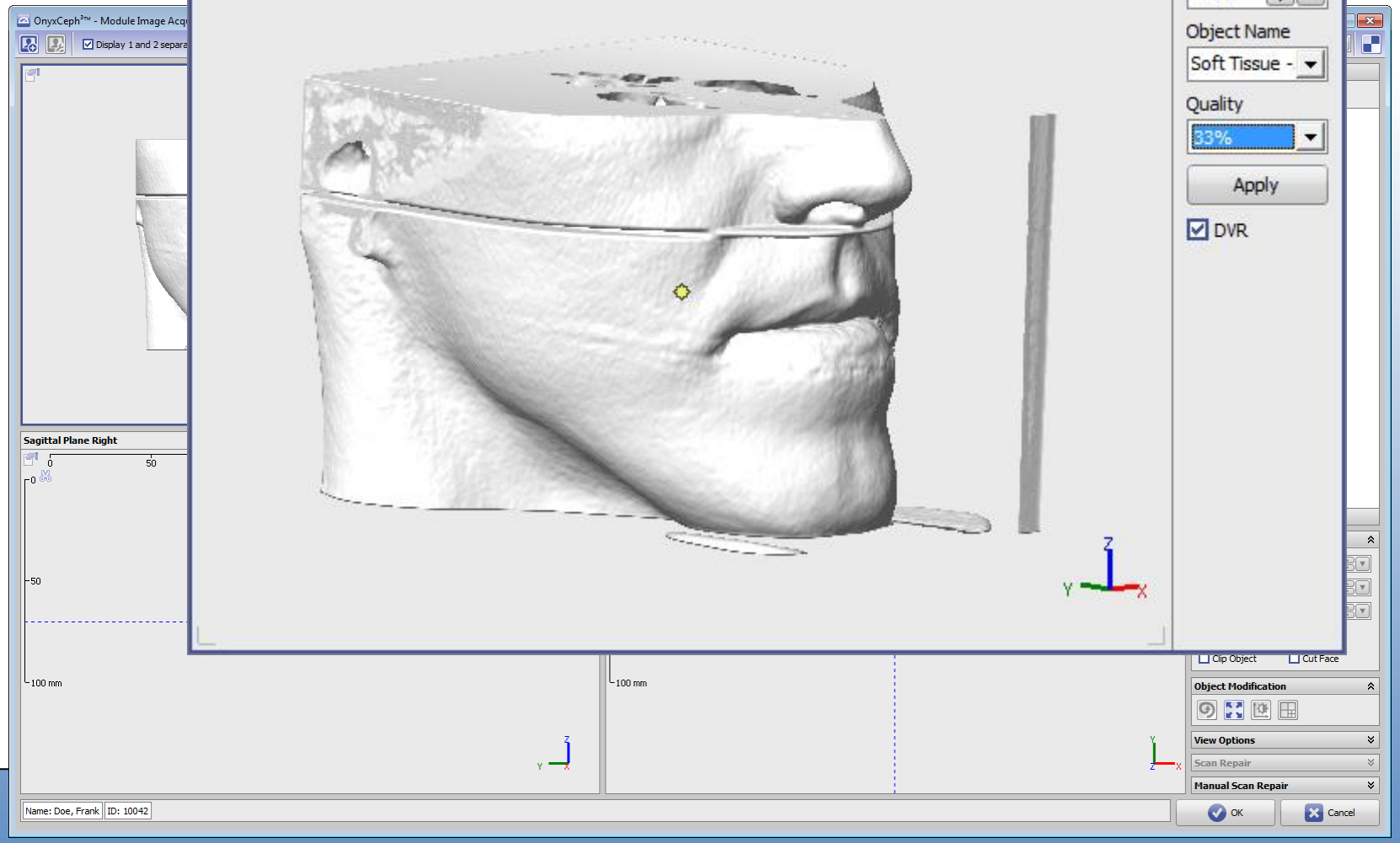
Use the Density Value slider control to find the surface to be extracted*.

Assign a typical Object Name .

Select Quality
(for SIM 3D, depending on quality, 25% for soft tissue and 33% for bony structures is sufficient)

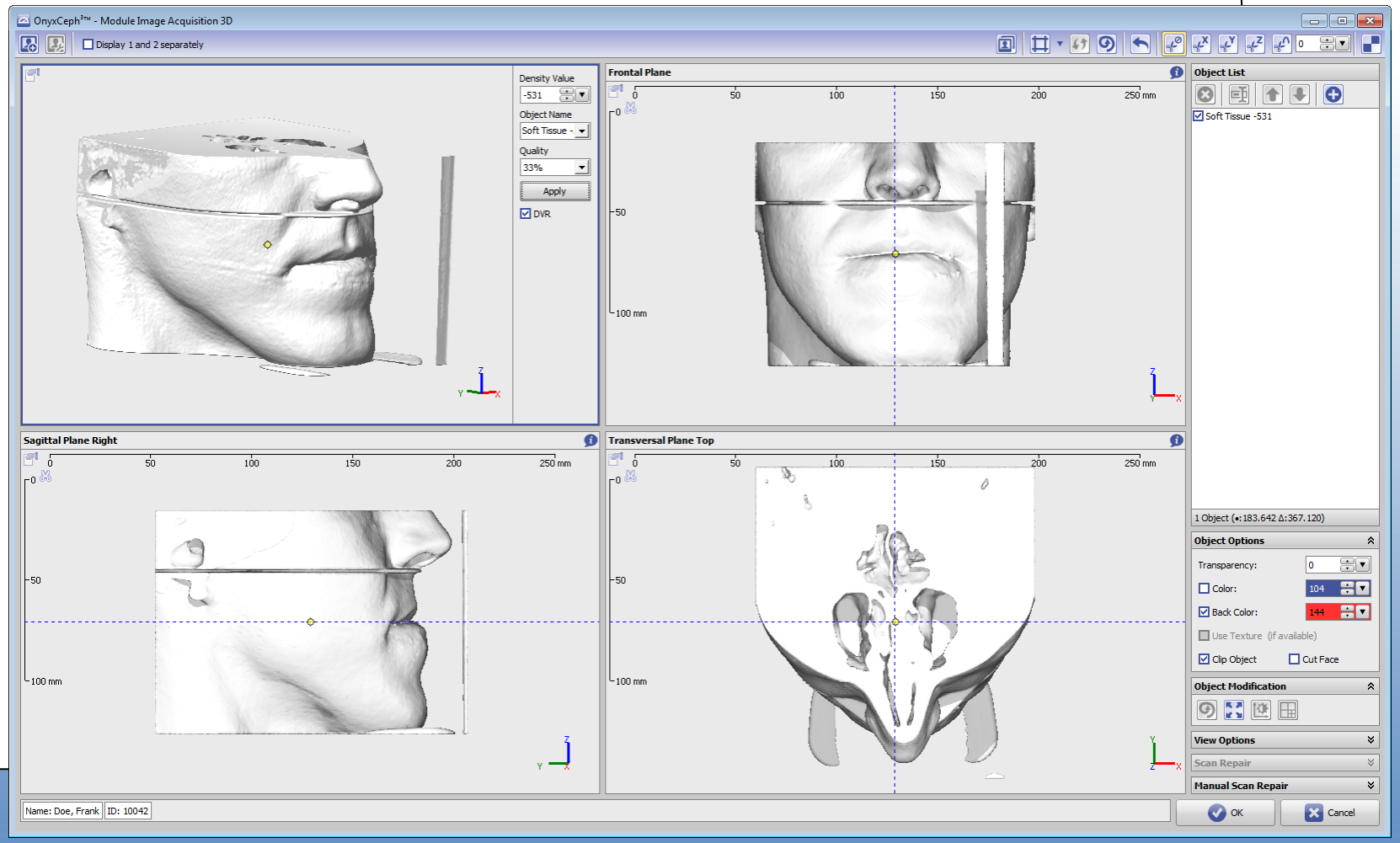
Start marchin cube surface extraction by button [Apply]

* Doesn´t matter if you start with soft tissue or skull surface extraction.



Extract Surface

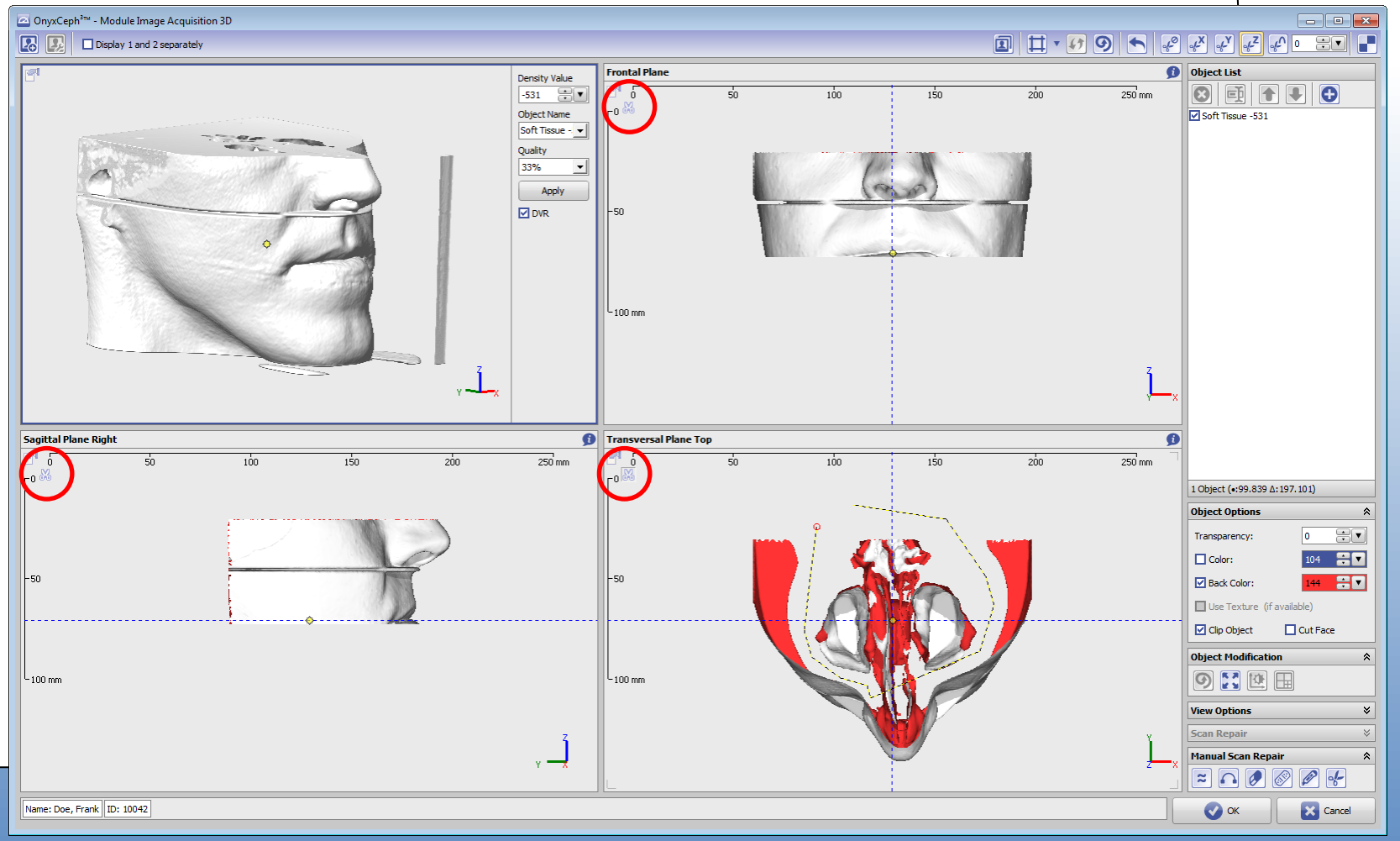
Extracted surface will be displayed in lateral, frontal and transversal view in the other 3 panels.



CleanUp Surface

Use the scissors tools top left in each 3D View and in panel [Manual Scan Repair] in combination with the clip planes X, Y, Z to clean up the surface by removing inner soft tissue and rear face regions.

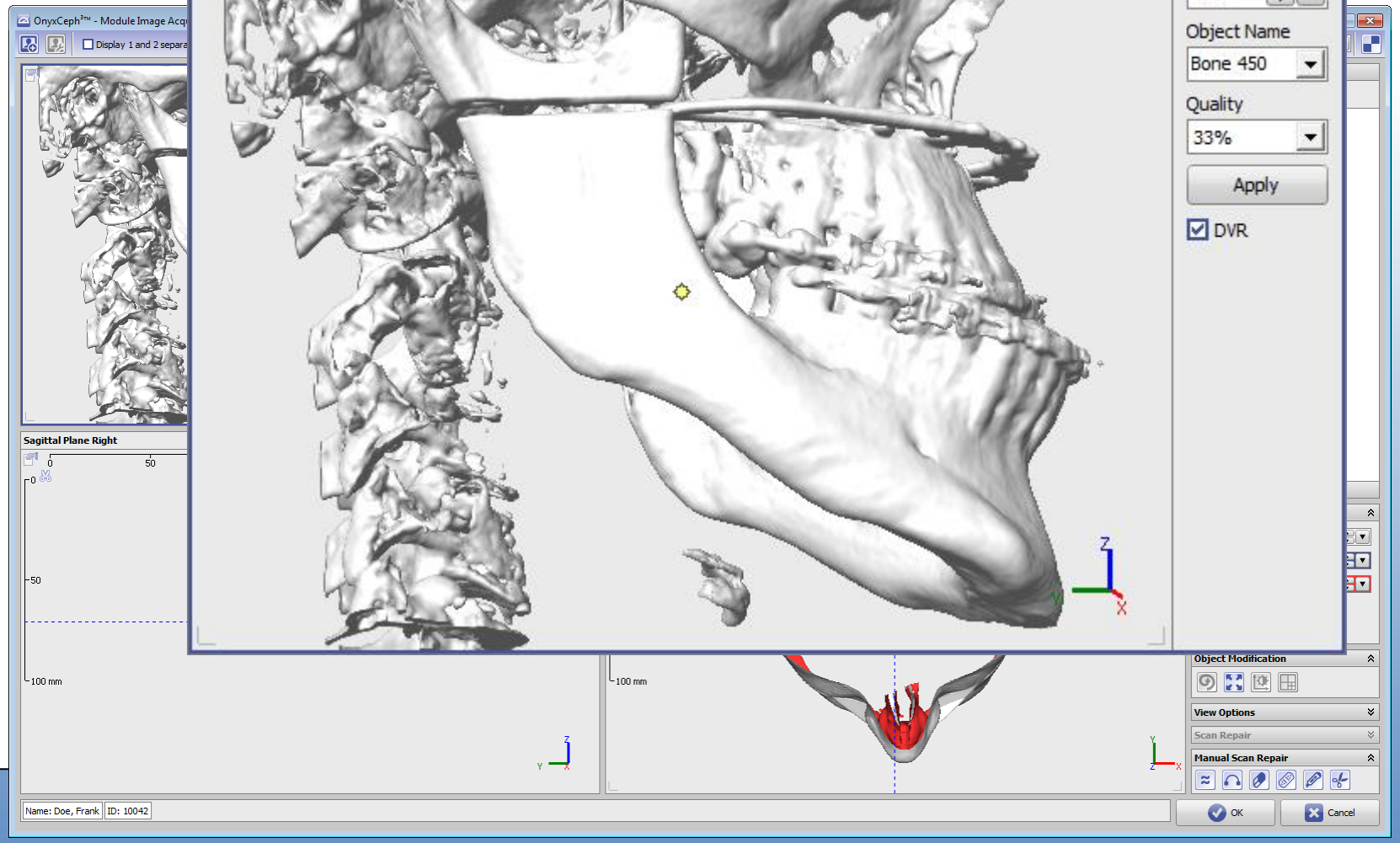
Also remove the top and button „cover“



Extract Surface

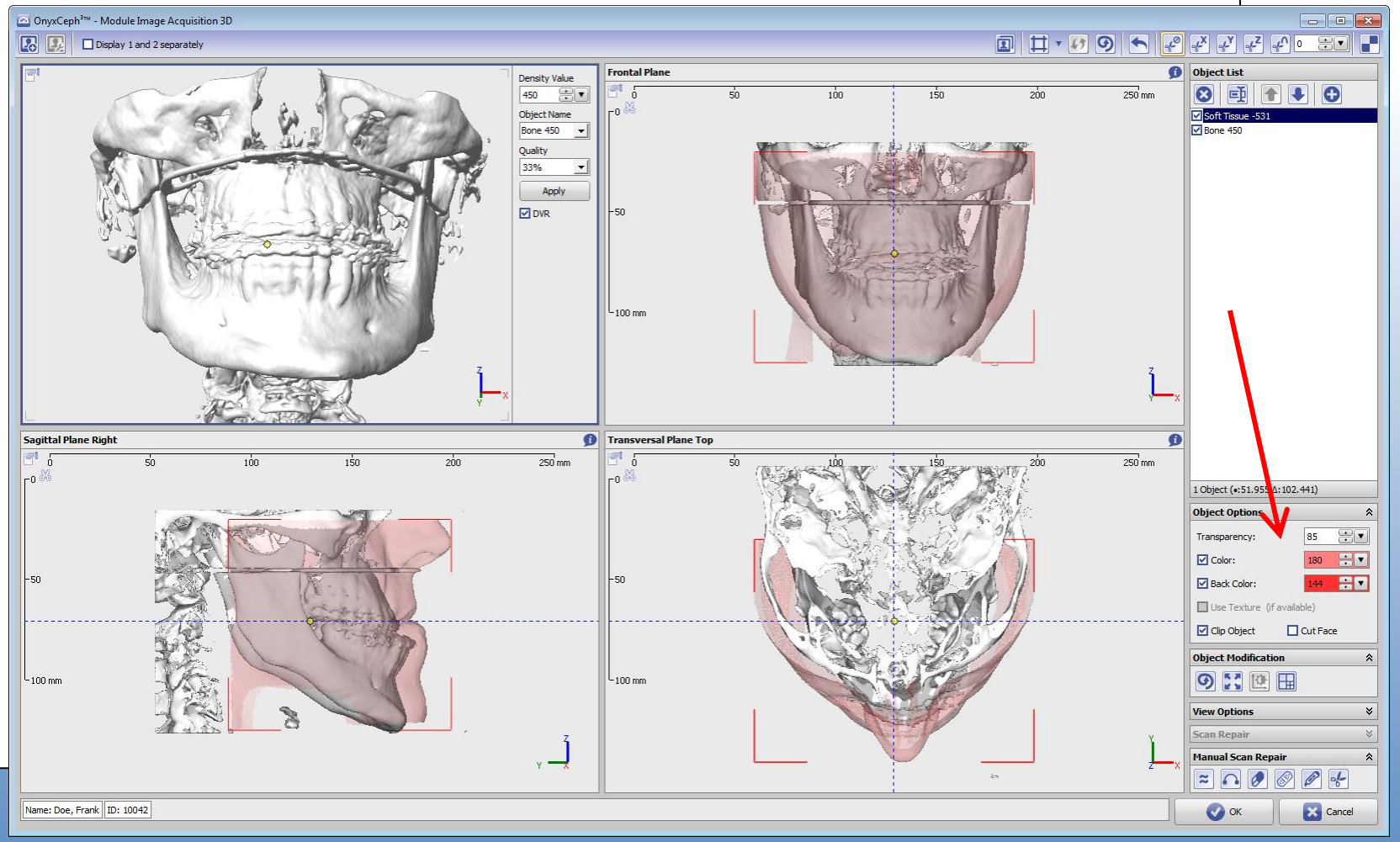
Repeat the extraction process for the skull surface.

It is recommended not to clean up the skull surface at this point.



Improve View

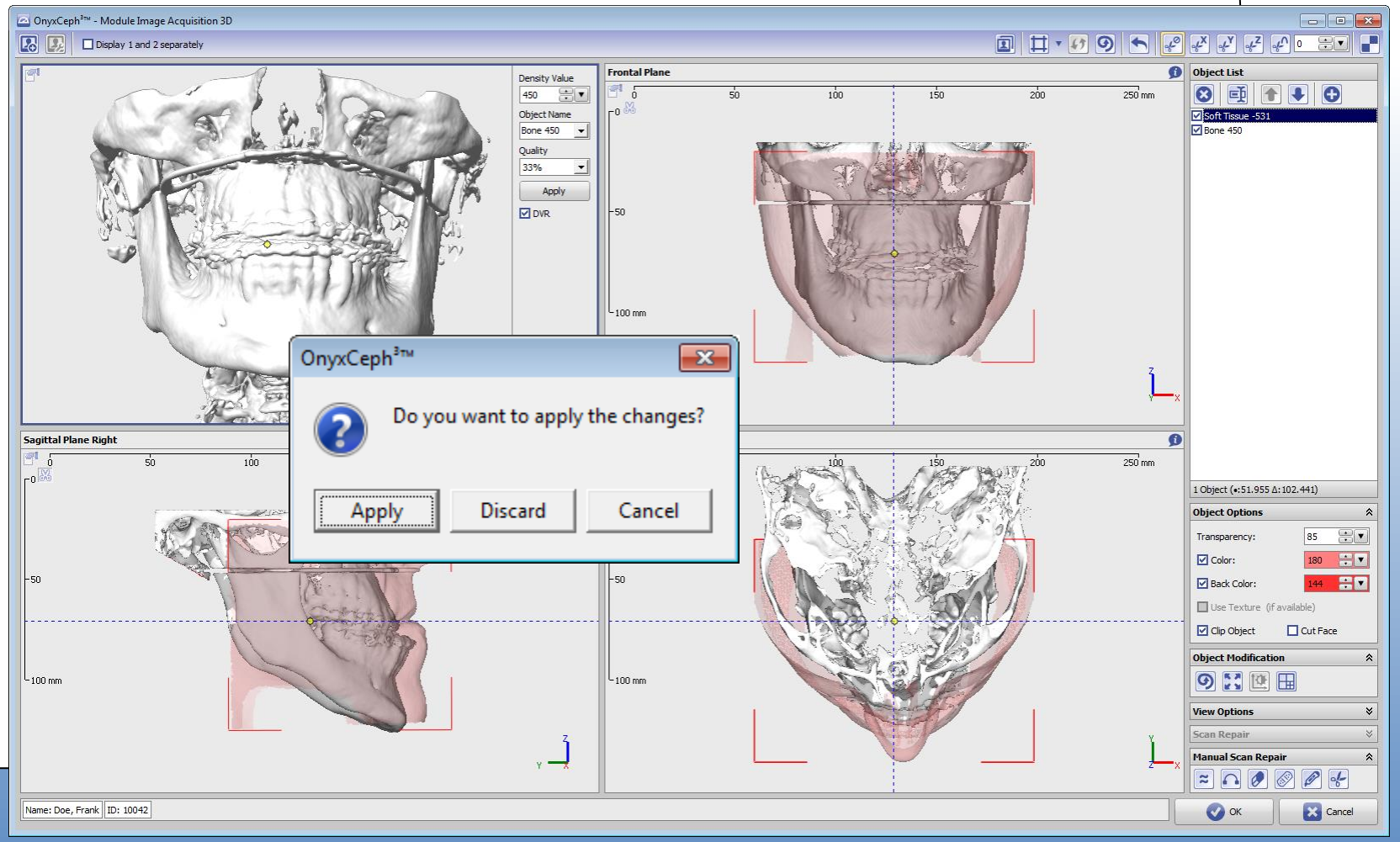
Optionally, change color and transparency for the soft tissue .



Take Over Changes To Data Set

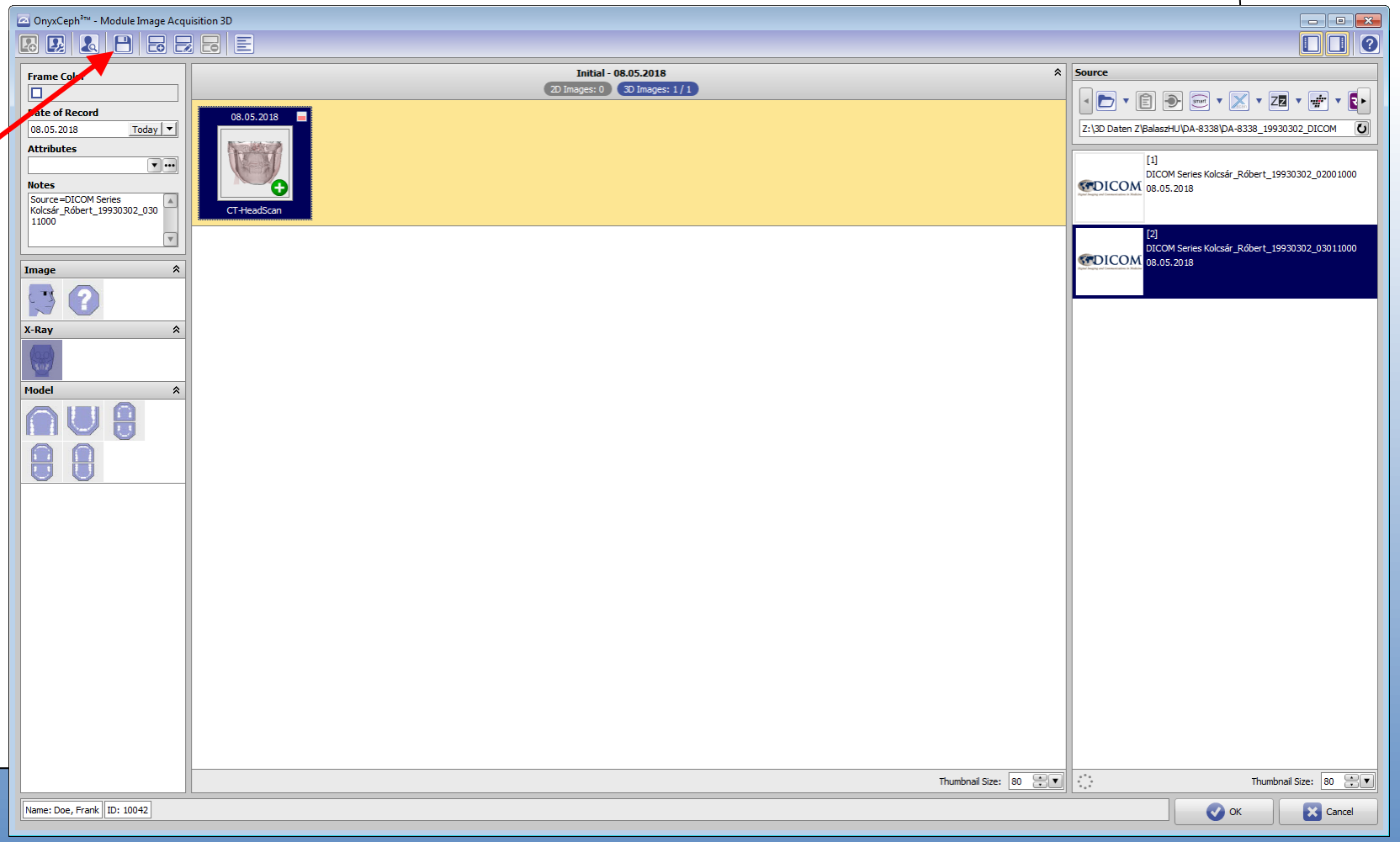
Save the extracted surfaces as a finding by taking over all pre-processing applied so far.

Important:
Before saving, reset position for all elements (soft tissue, skull) in the objekt list by object list context menu.



Save Data Set

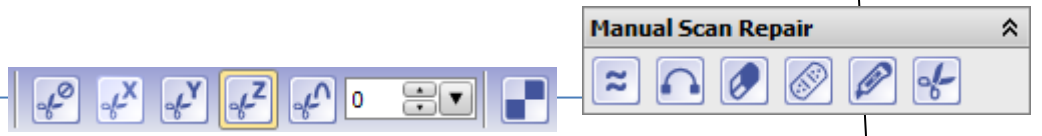
Save finding to data base by the [Disc] icon and re-open module [Adjust Image] by icon or doubleclick on thumbnail.

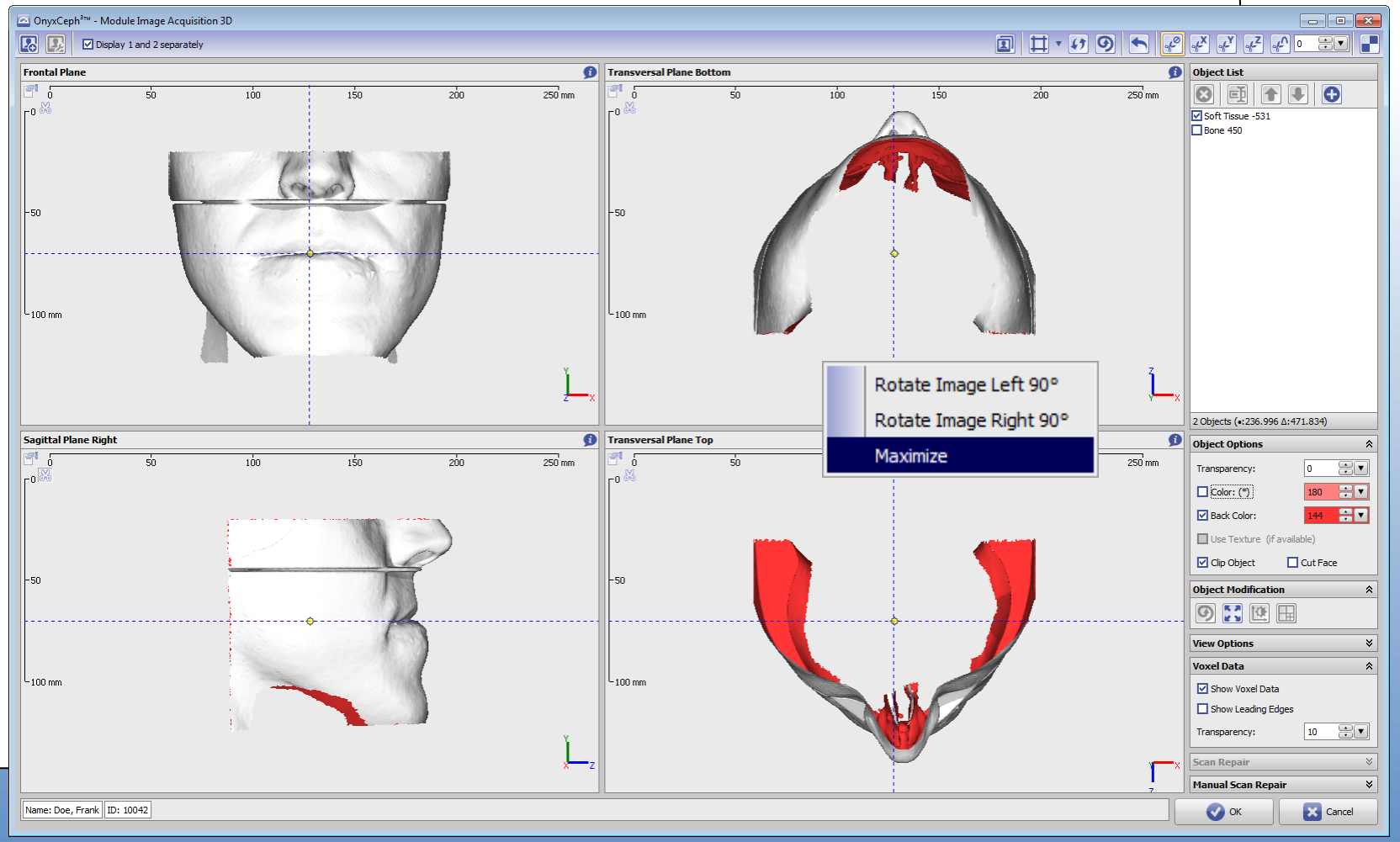


CleanUp Surface

If needed to clean up soft tissue in detail, hide skull in the object list (right) and use again the scissors tool in panel [Manual Scan Repair] in combination with the clip planes X, Y, Z.

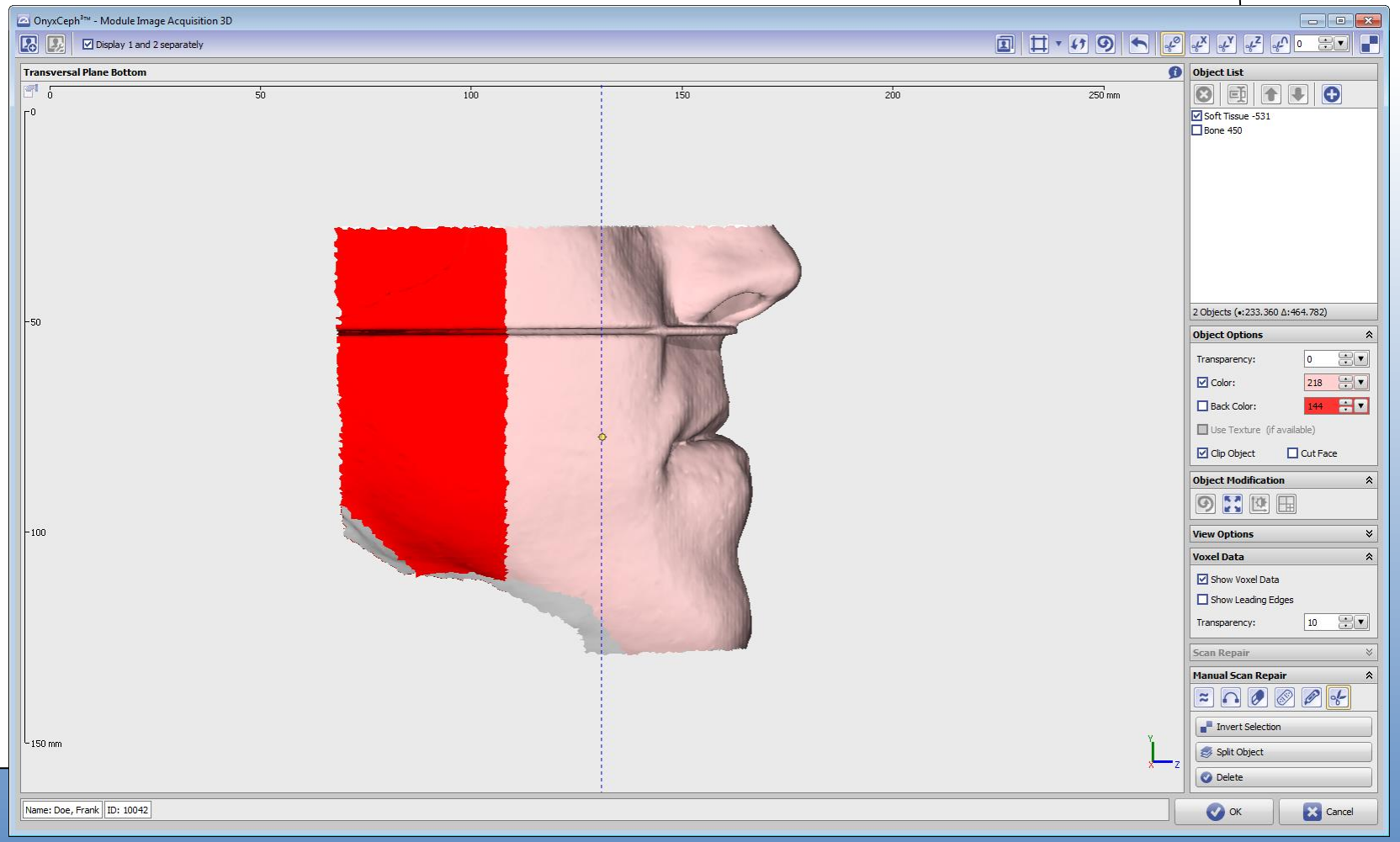
To see more details, maximize any of the 3D panels by context menu.





CleanUp Surface

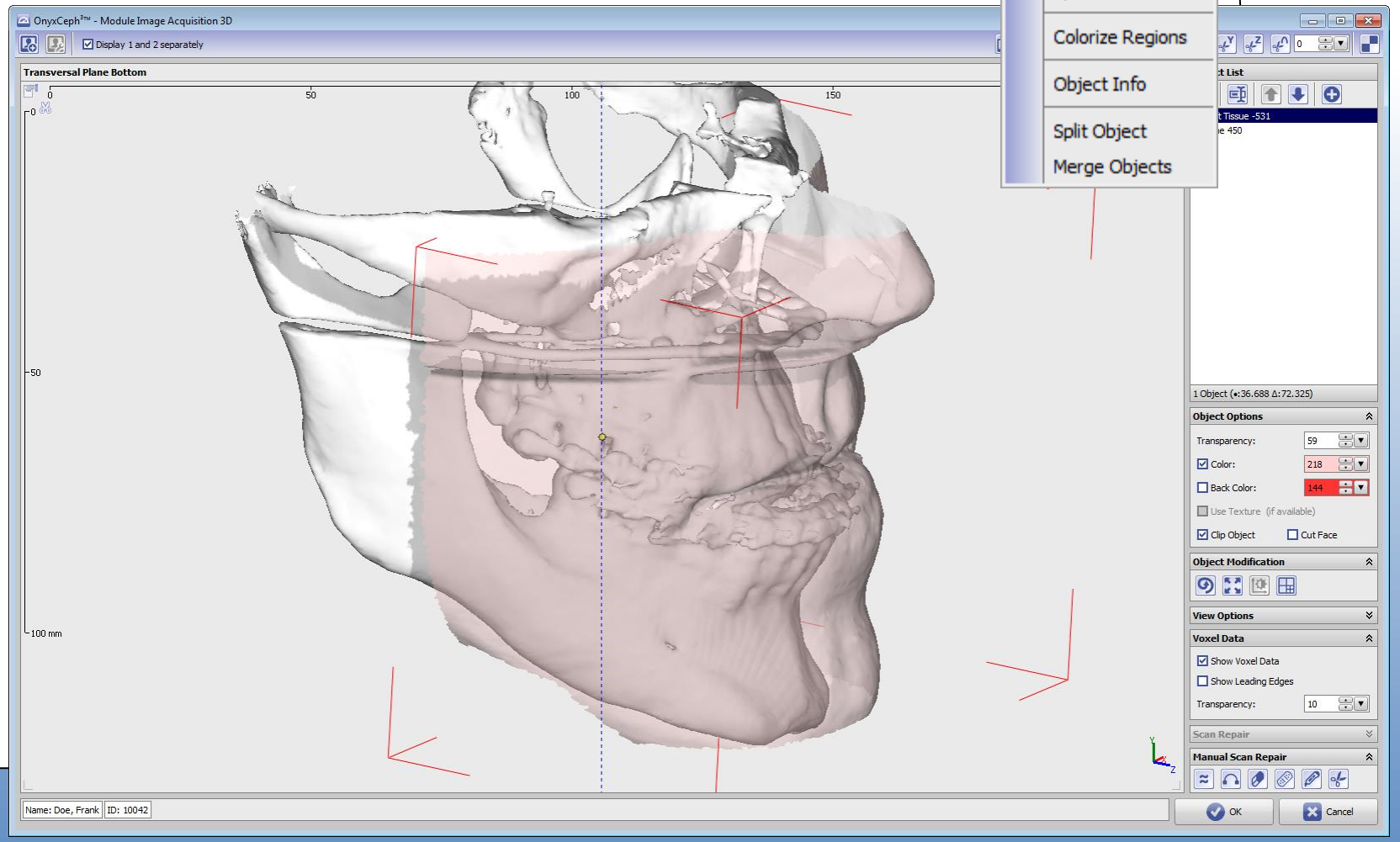
Maximized view panel



CleanUp Surface

Now, clean up the skull the same way. Take care that upper and lower jaw is clearly separated if possible.

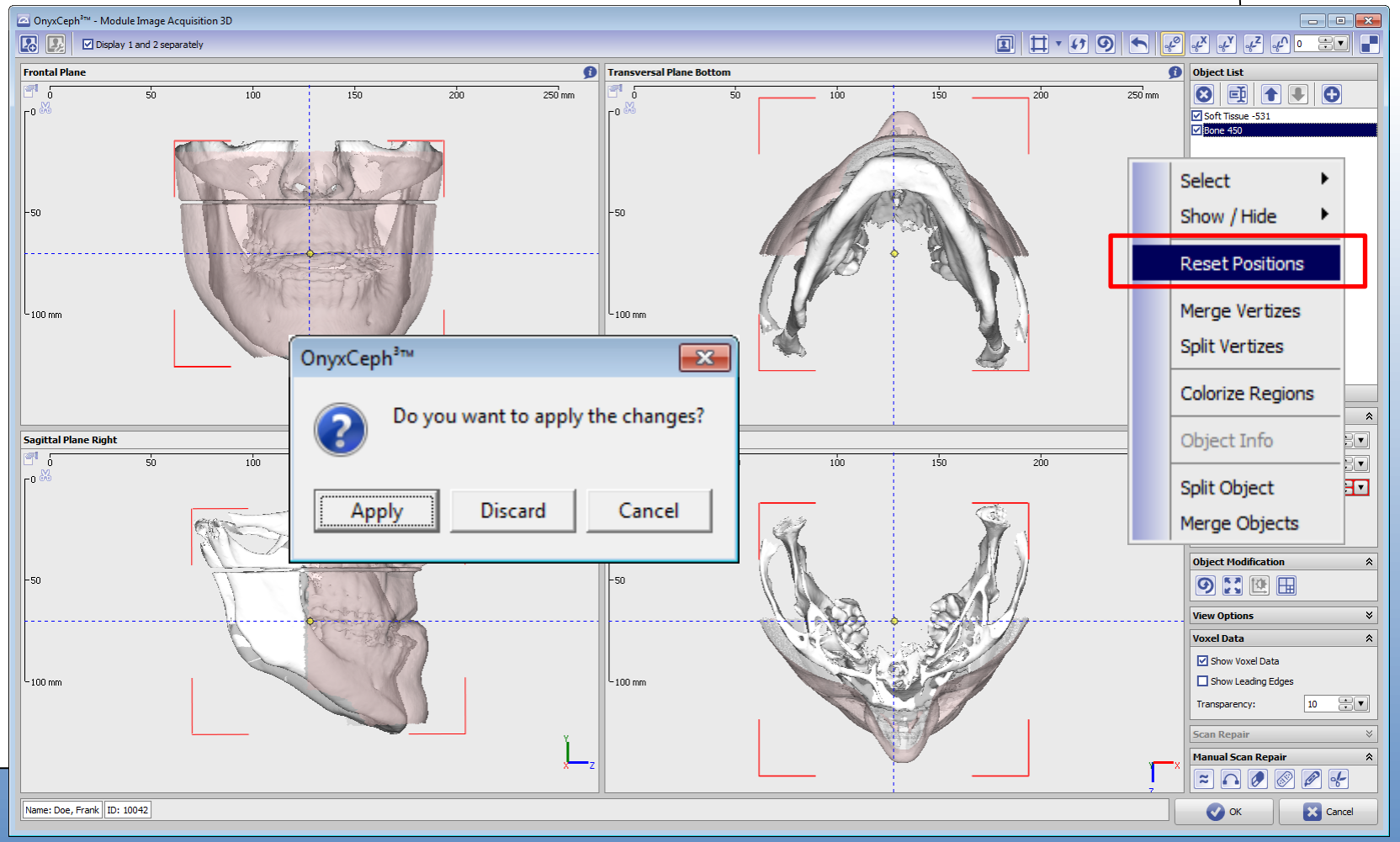
Might not be possible for all teeth in case of artefacts and closed bite .



Take Over Changes To Data Set

When finished, apply changes by [OK].
This will switch to module [Add Image].

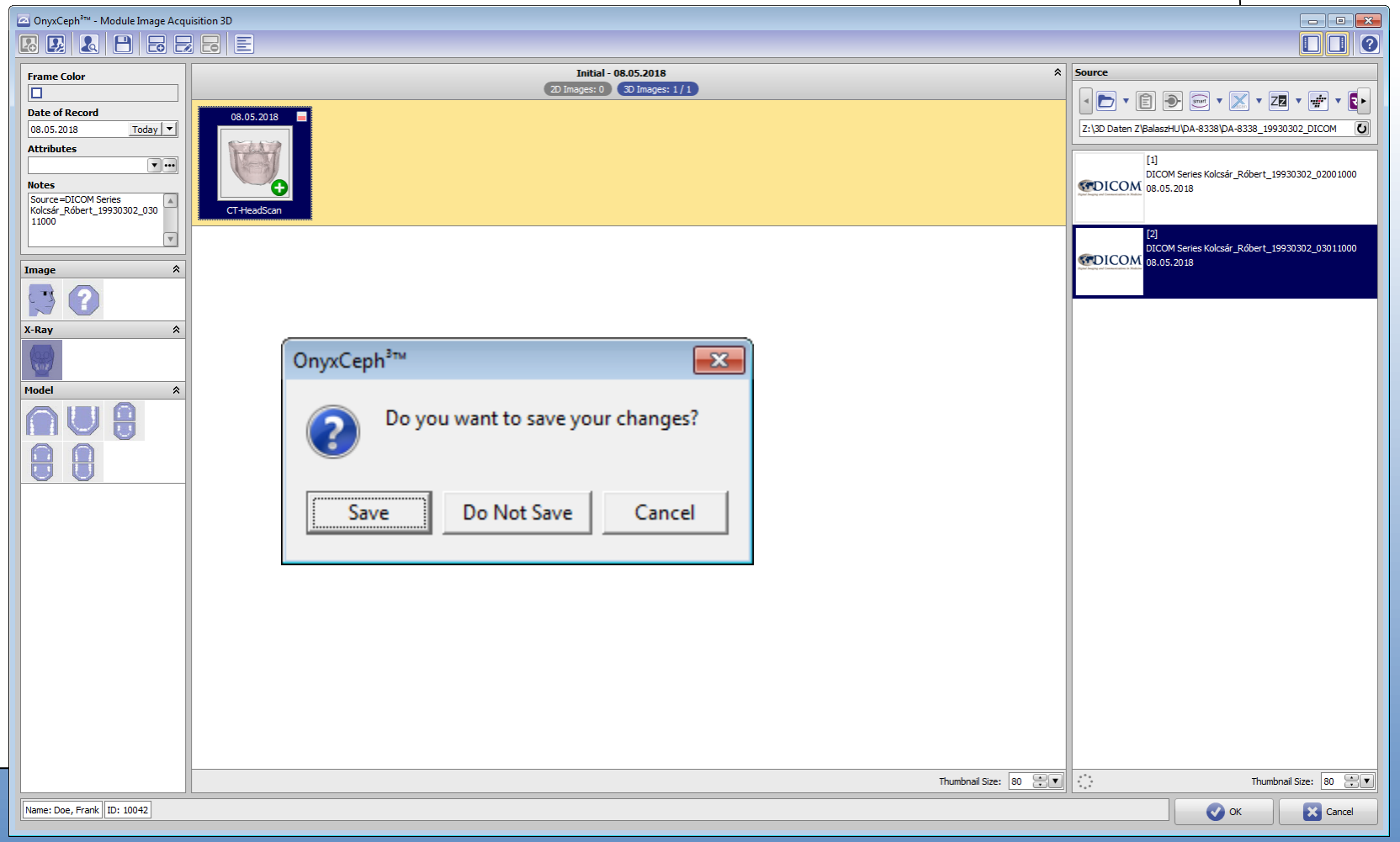
Important:
Before saving, reset position for all elements (soft tissue, skull) in the objekt list by object list context menu.



Save Data Set

If needed, add notes and adjust acquisition and/or series date.

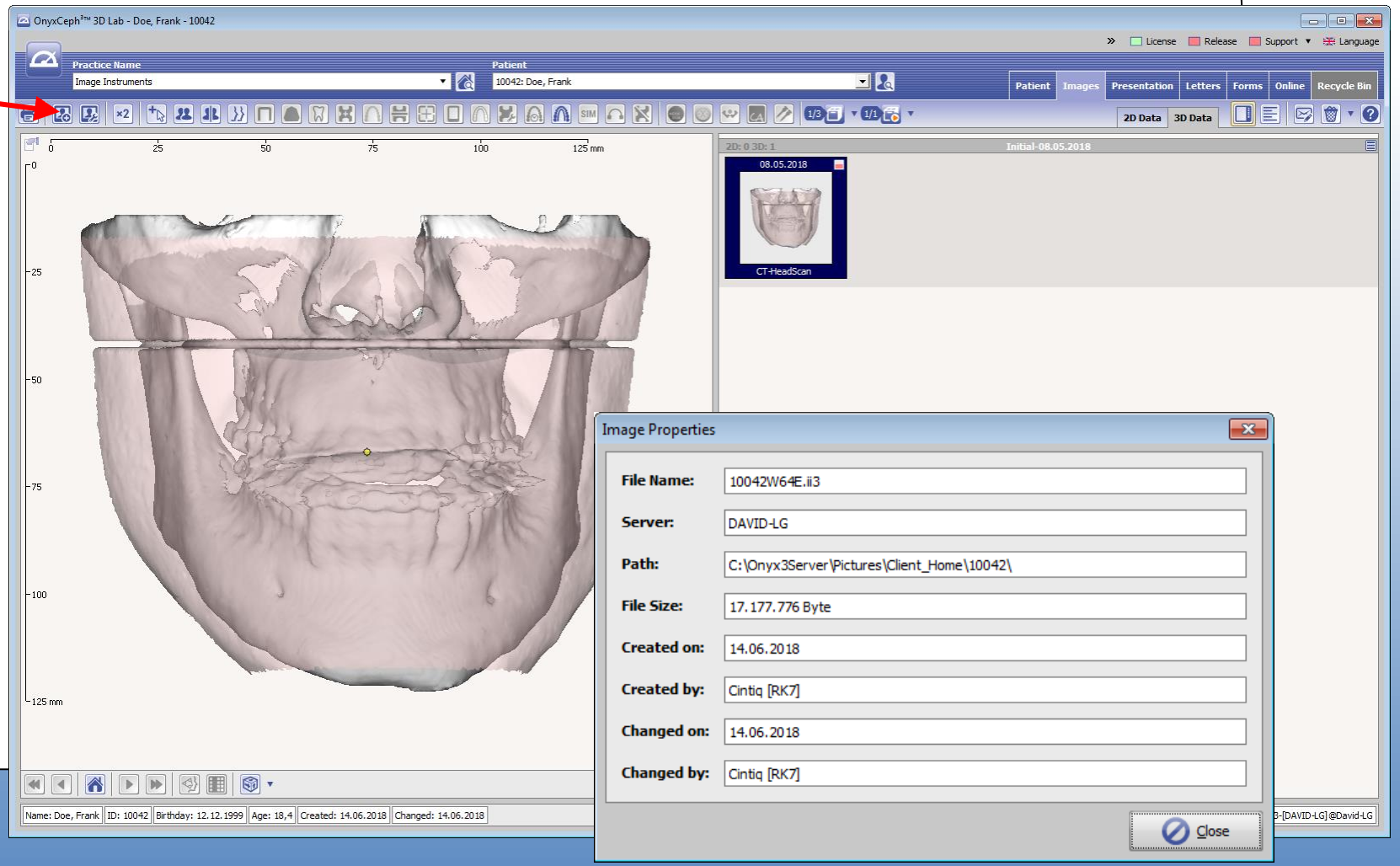
Finally, save to data base by [OK].
This will close the module window.



Add Image

To import the dental scan, click icon [Add Image] top left.

Alternatively, use [CTRL]+3.

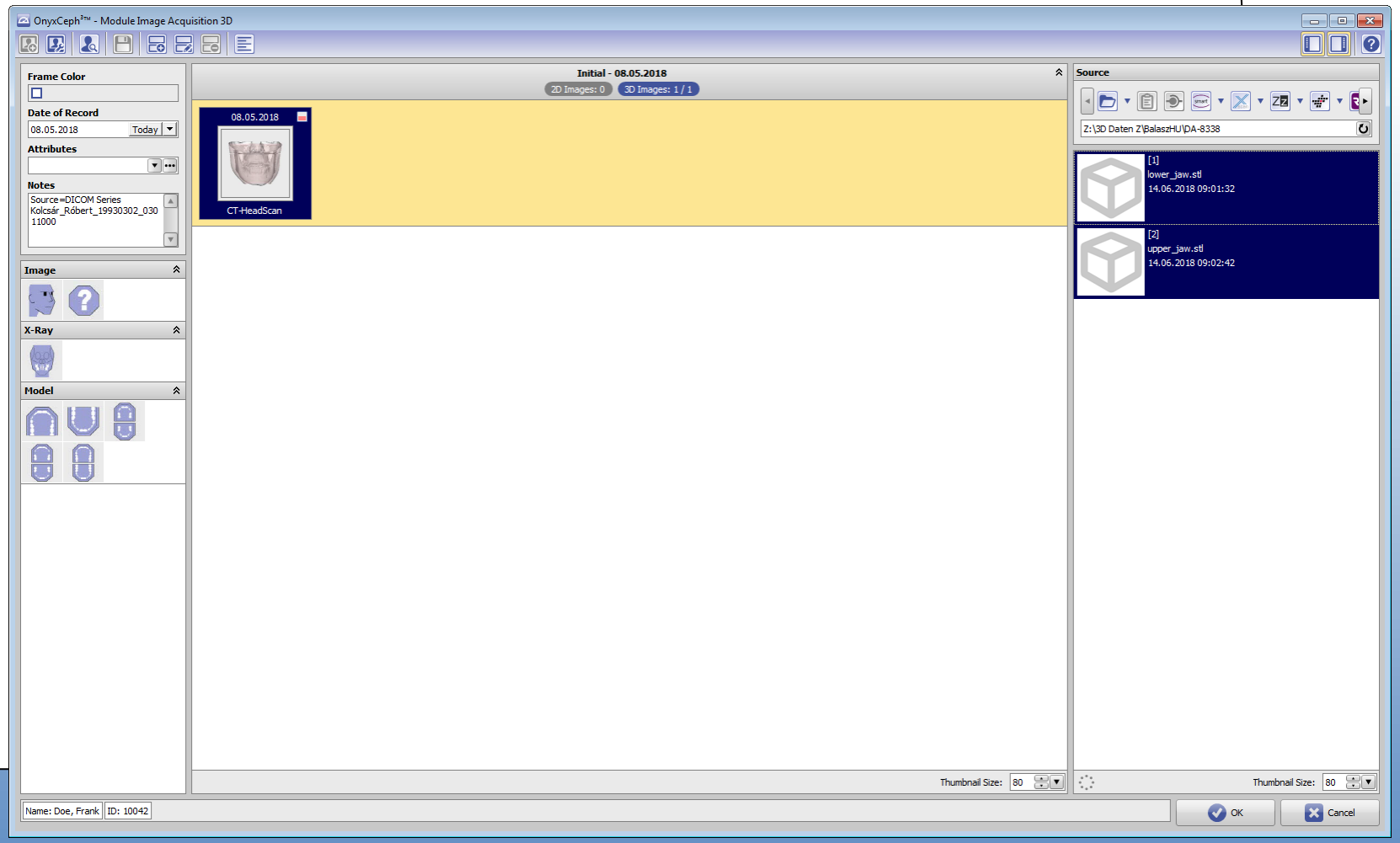


Add Image (Dental Scan)

Dental Scan Import:
Select drive or folder that contains the dental scan.

Place holders for upper and lower jaw scan will be displayed in the image source panel on the right*.

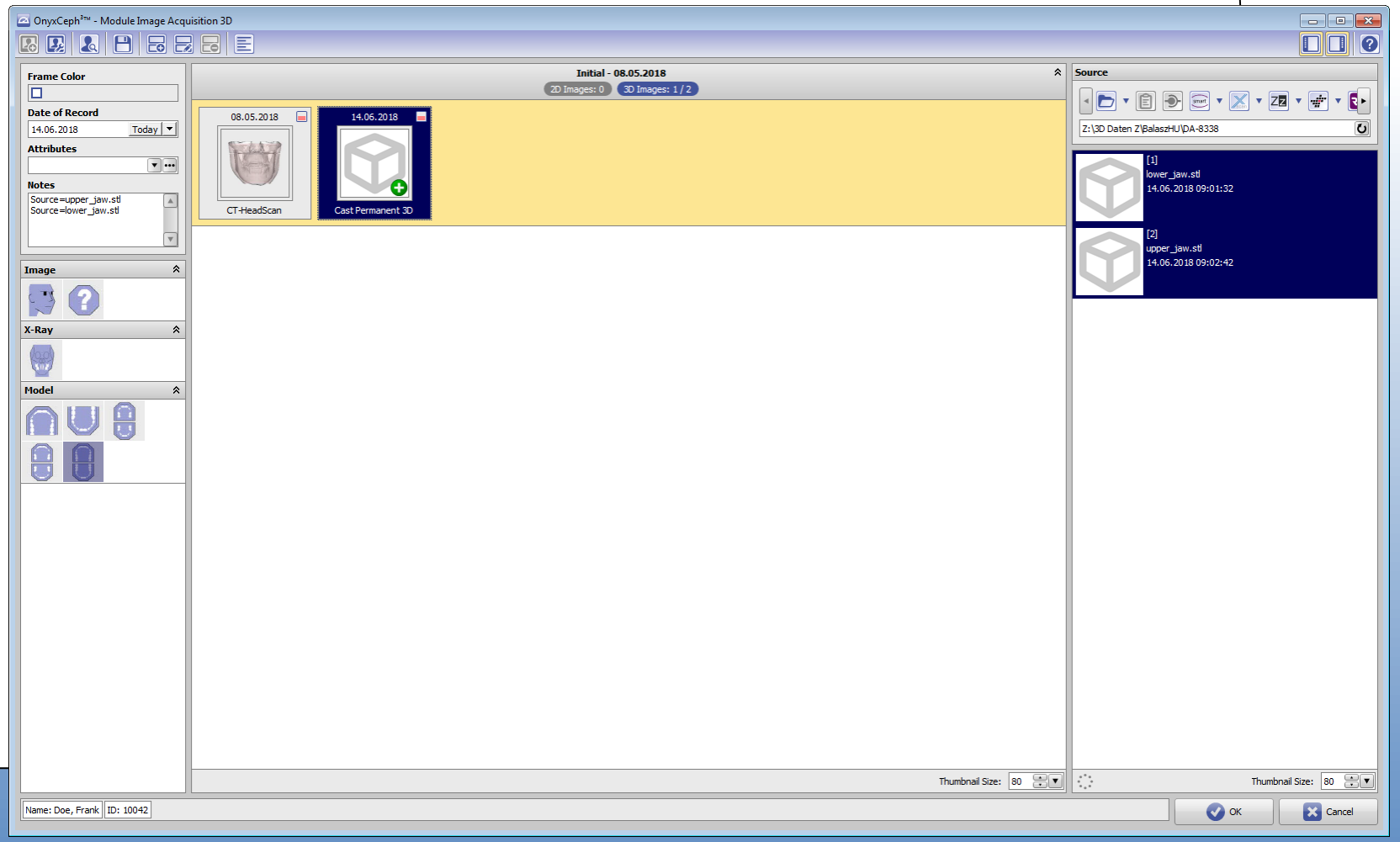
* Specific scan formats like OCXD can include upper and lower scan separated in occlusion by default. In such case, only one thumbnail will appear for import on the right.



Add Image - Classification

Select both thumbnails in the image source panel and drag&drom to the appropriate record series.

Assign image type [Permanent Cast] by d&d icon to thumbnail or vice versa.

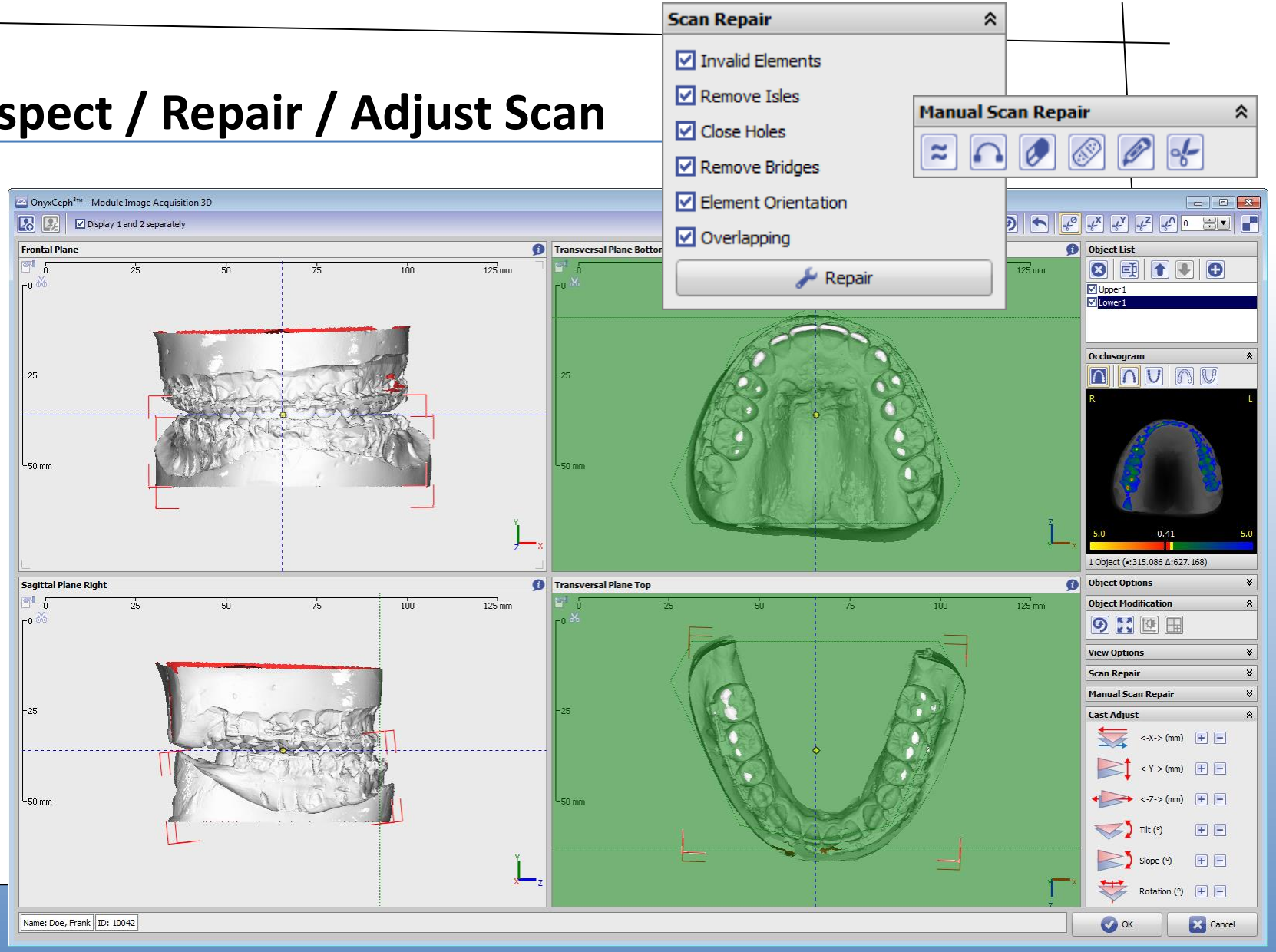


Inspect / Repair / Adjust Scan

Inspect and repair scan data mesh by tools in panels [Scan Repair] and optionally [Manual Scan Repair] .

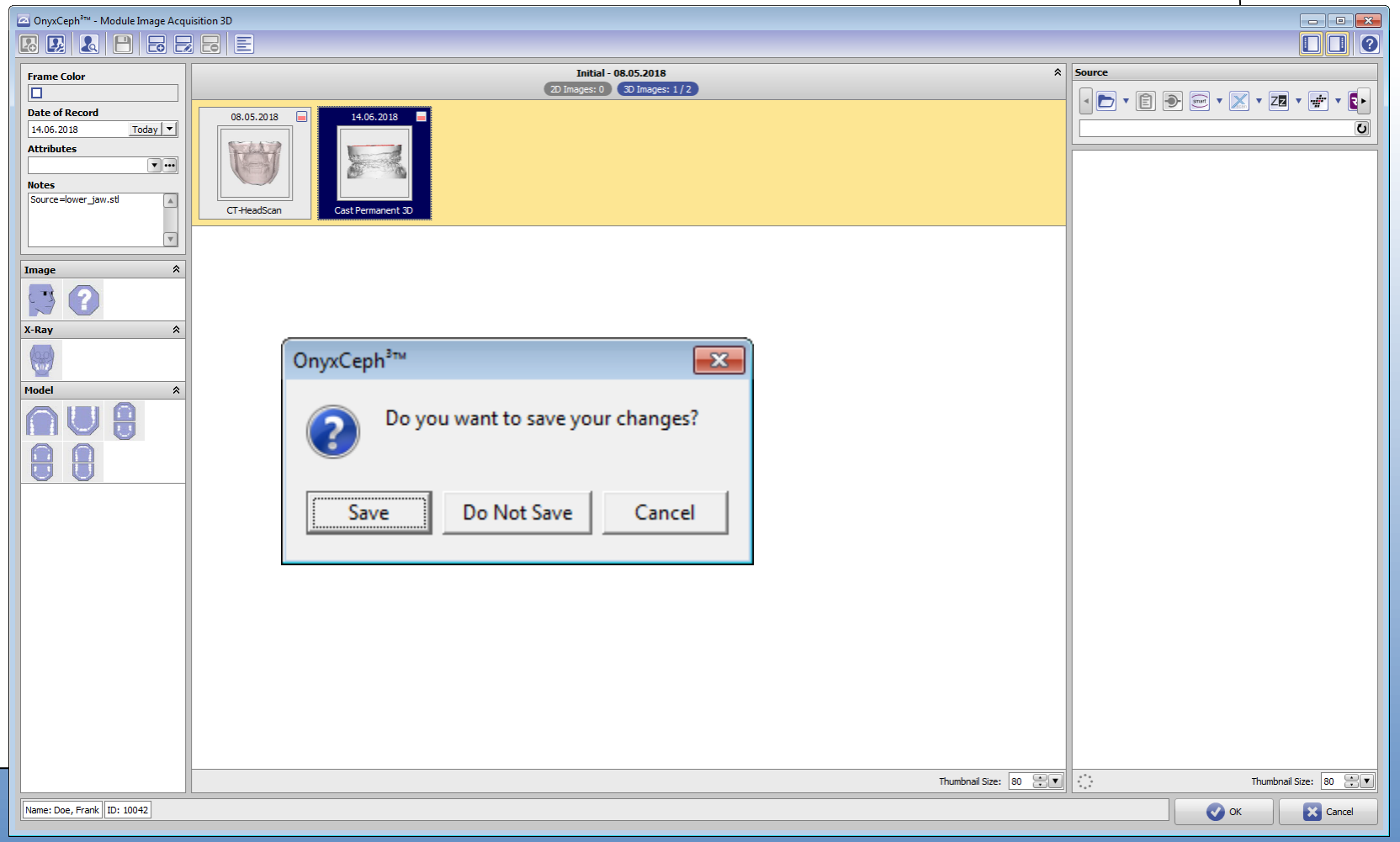
Adjust scan regarding position, dental midline and mid occlusal hight.

Note:
Position and alignment set up here defines the orientation also used for the surgical planning process.



Save Data Set

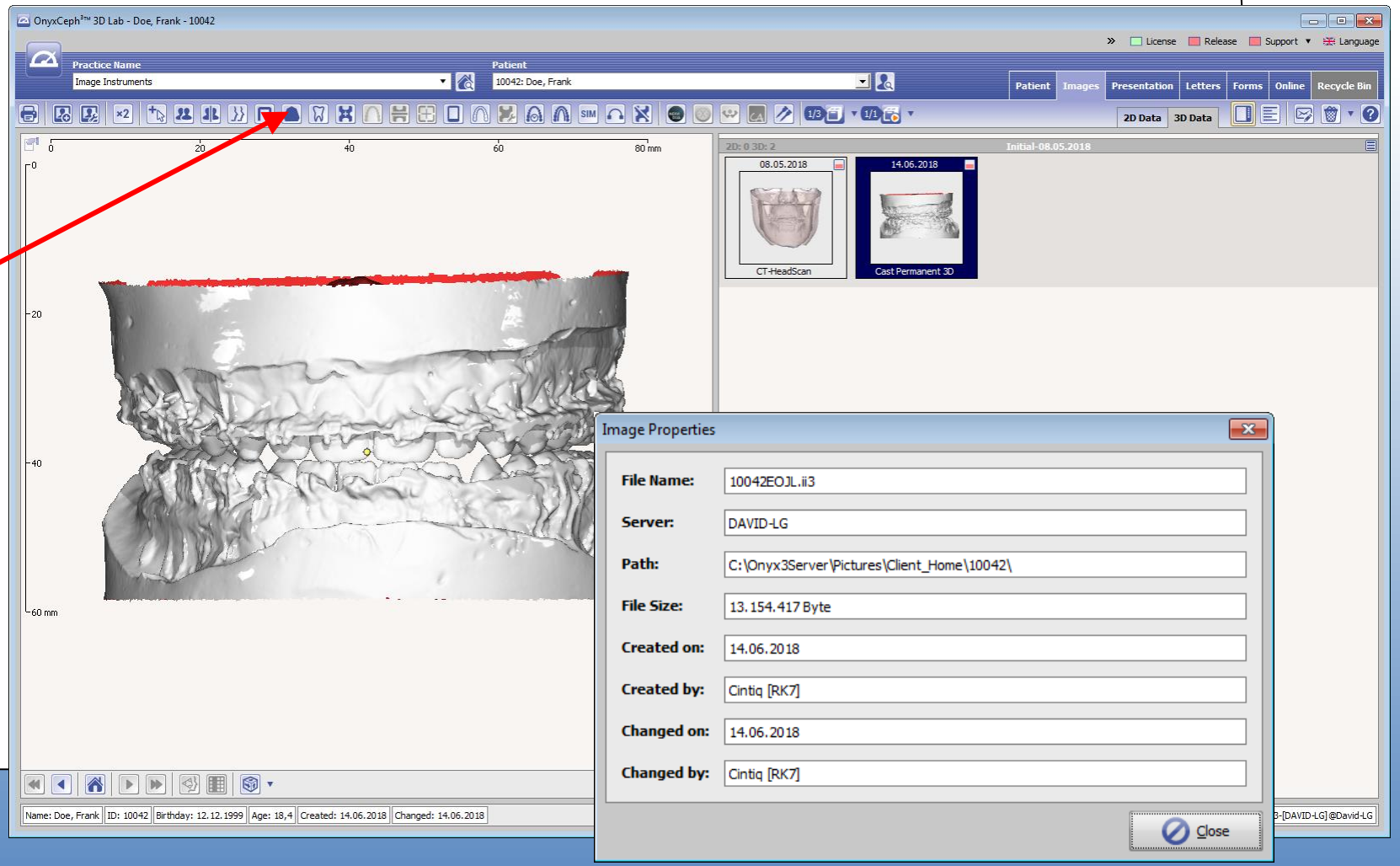
Finally, save to data base by [OK].
This will close the module window.



Launch Cast Adjust For Adding Base Tray

To prepare the model for use in module SIM 3D, a horse shoe base should be attached and the teeth need to be segmented.

Therefore, and to reduce scan file size , open module [Cast Adust 3D] to create the base tray first.



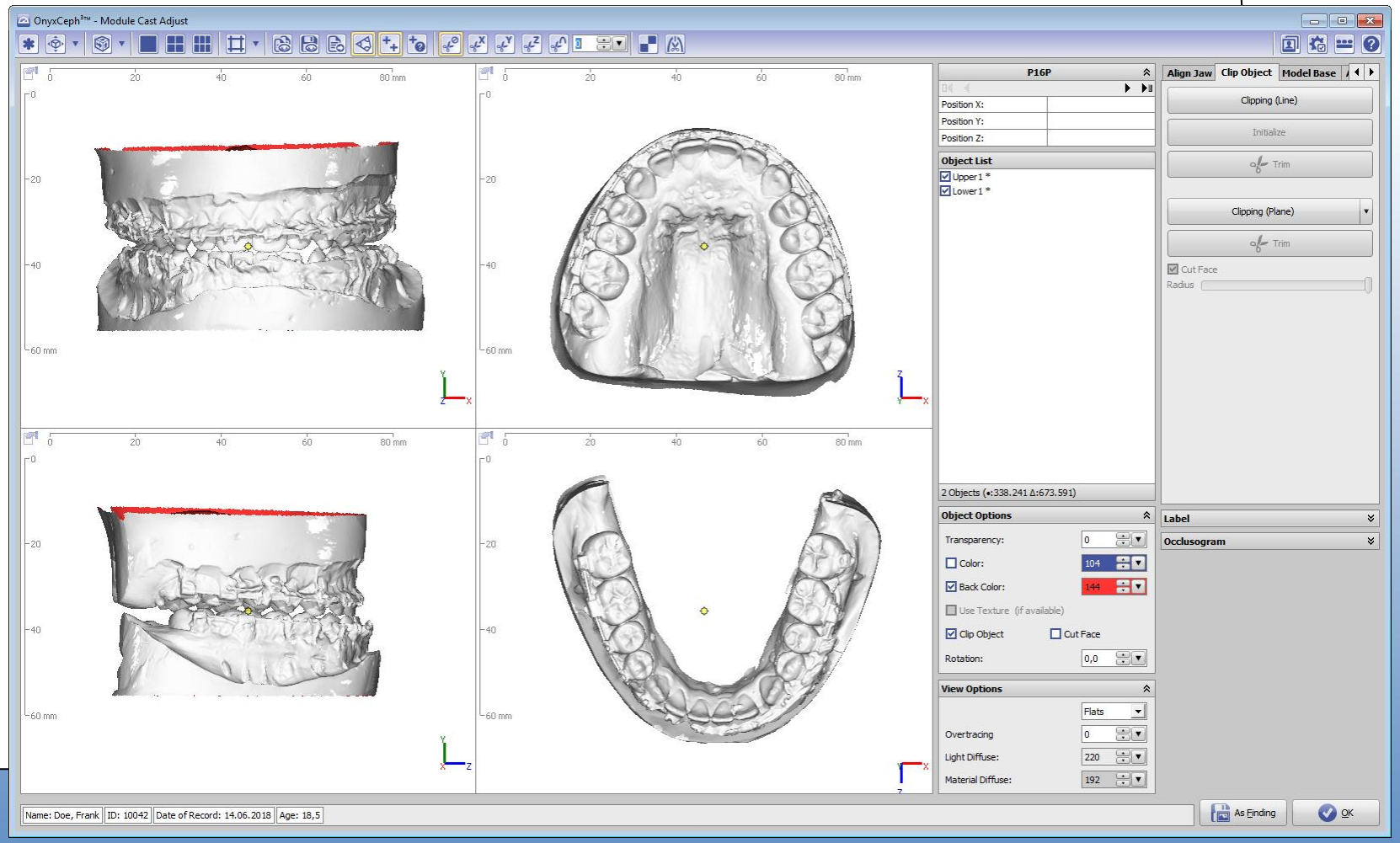
Adding Base Tray

As Finding

Clip and trim upper and lower scan on tab |Clip Object | and attach horse shoe base on tab |Model Base|.

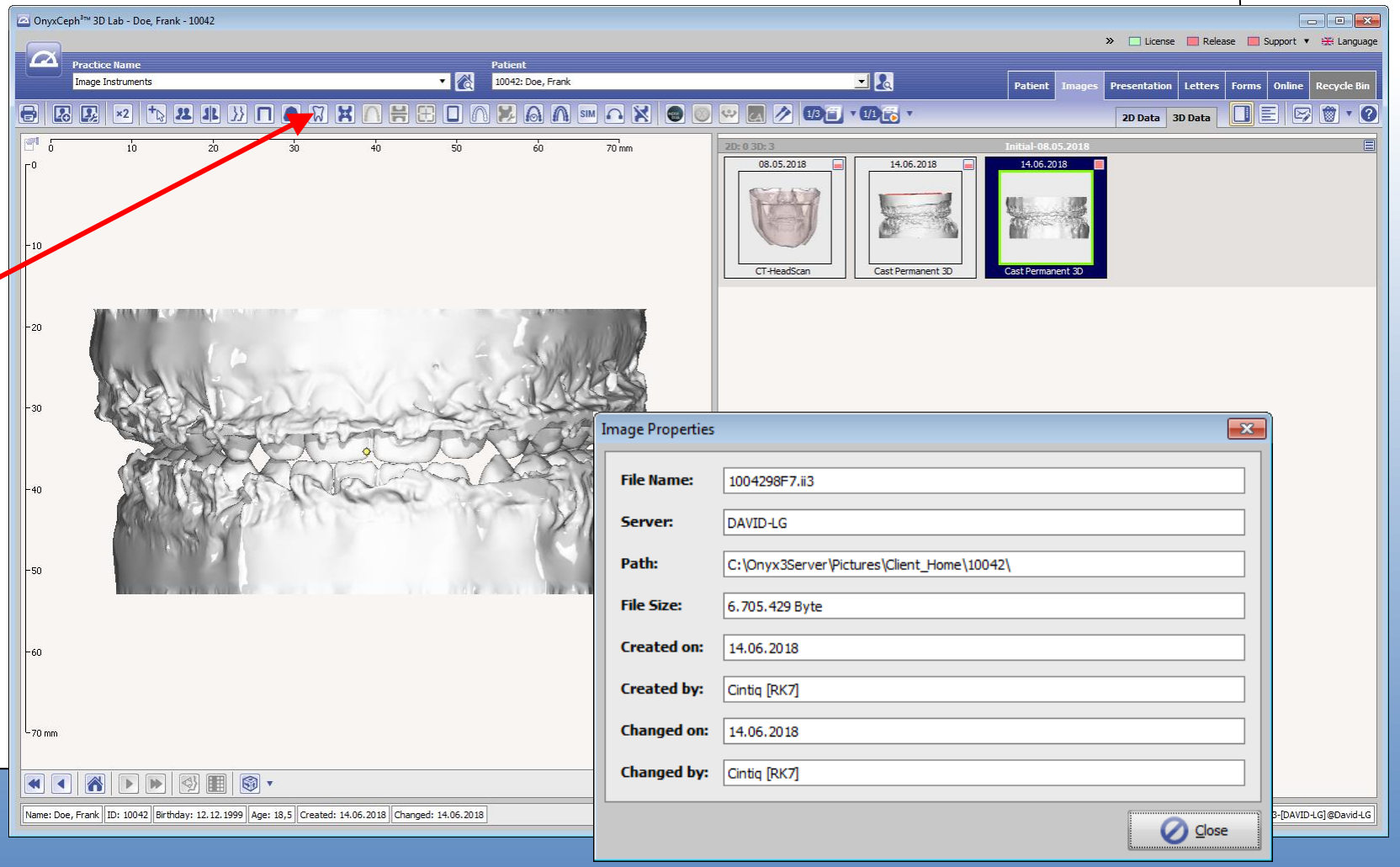
Save as finding by related button.

For a more detailed instruction for module Cast Adjust, see other available documents.



Launch Segmentation

Launch module Segmentation from the horse shoe model by icon [Segmentation] or from thumbnail context menu.



Segment / Separate / Complete Crowns

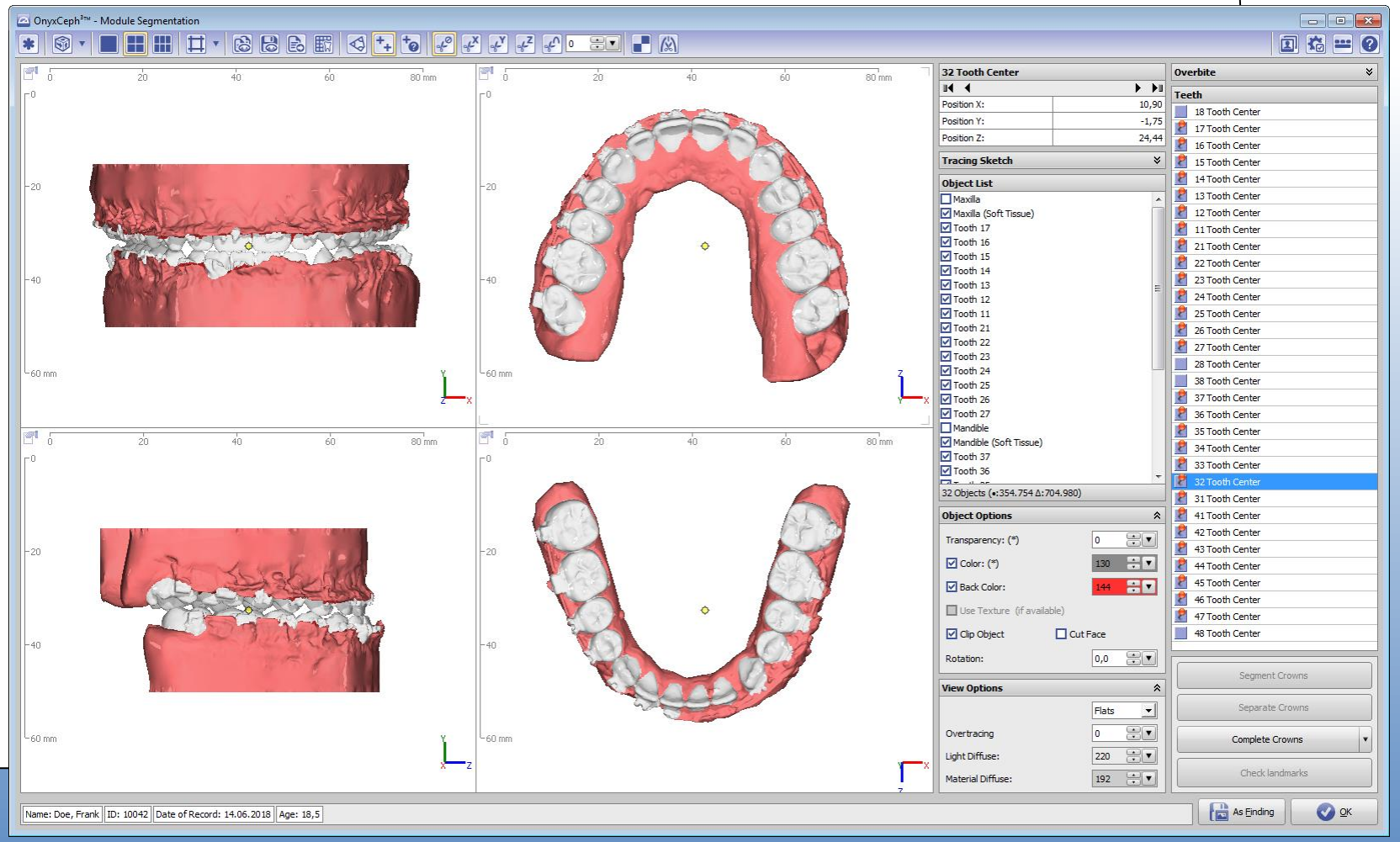
Apply all 4 steps

- Segment Crowns
- Separate Crowns
- Complete Crowns
- Check Landmarks

Note:
Since the surgical pre-treatment situation usually has brackets on the crowns, a manual correction for the crown border will ofte be required.

Try to segent all regions of a crown which later might be covered by the surgical waefers.

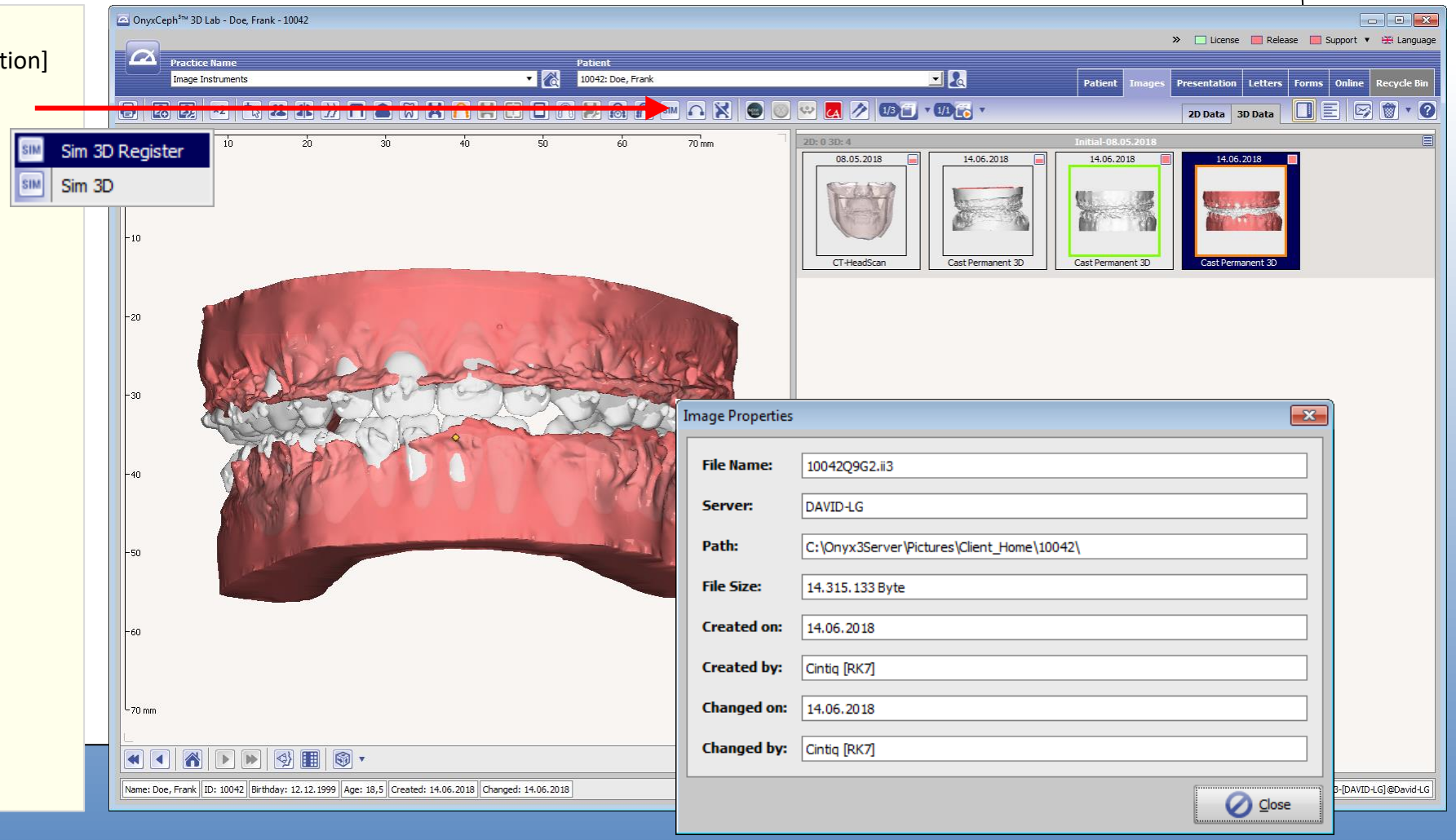
For a more detailed instruction for module Segmentation, see other available documents.



Launch SIM 3D – Registration Mode

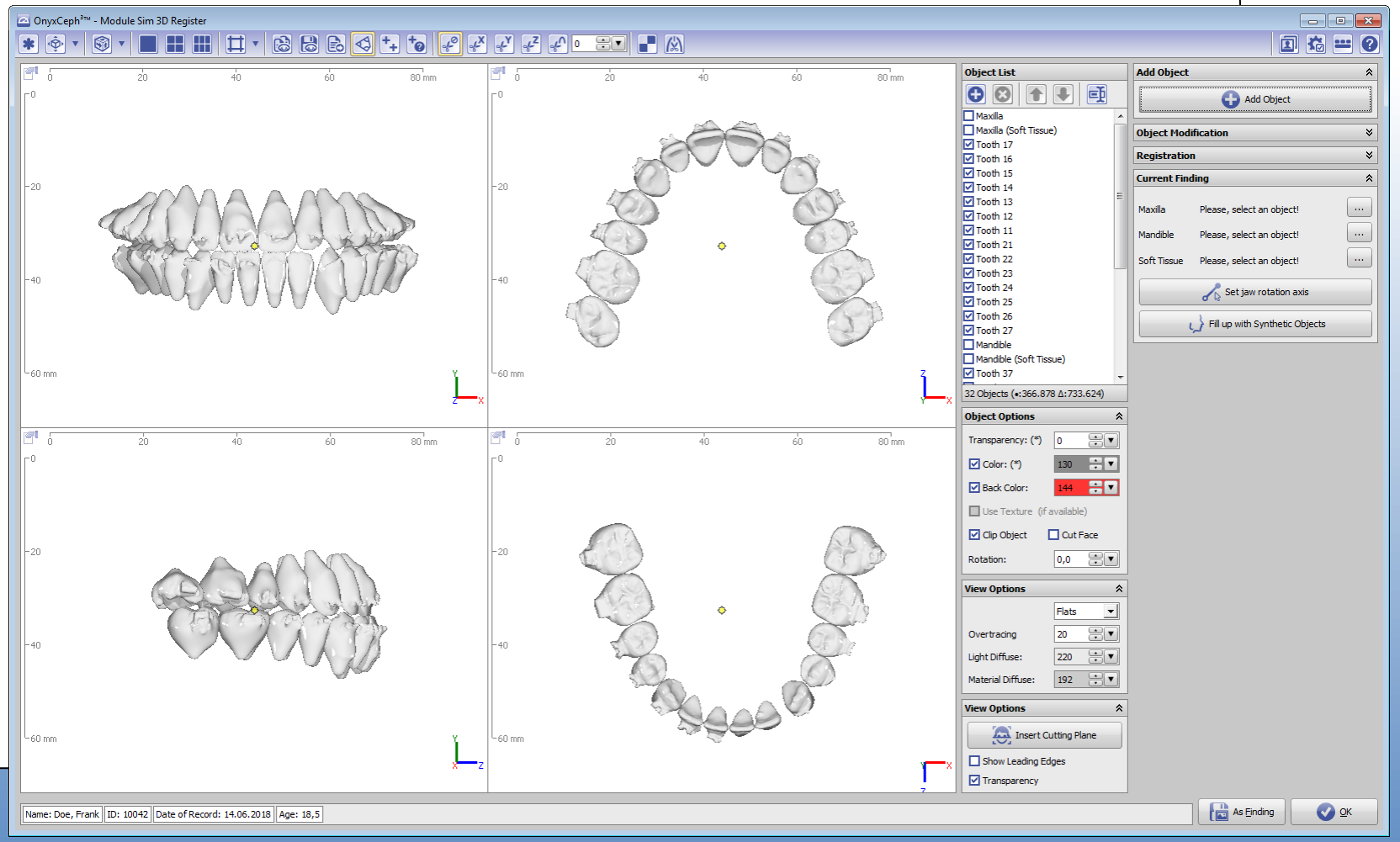
Launch module SIM 3D from the segmented model by icon [Segmentation] or from thumbnail context menu.

Select [Sim 3D Registration] first



Add HeadScan

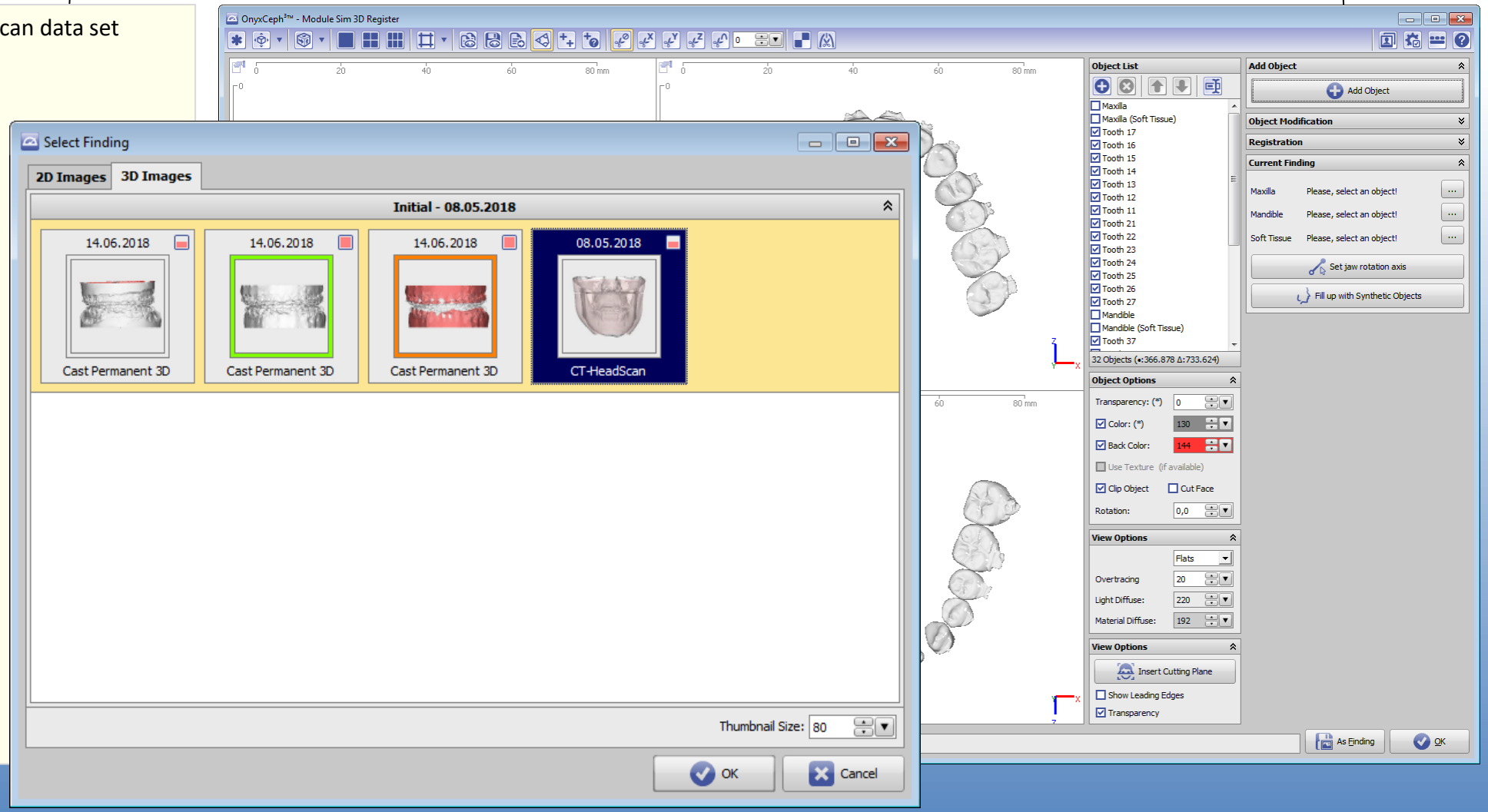
Only segmented teeth are be activated when opening the module in Registration mode.



Select HeadScan Thumbnail

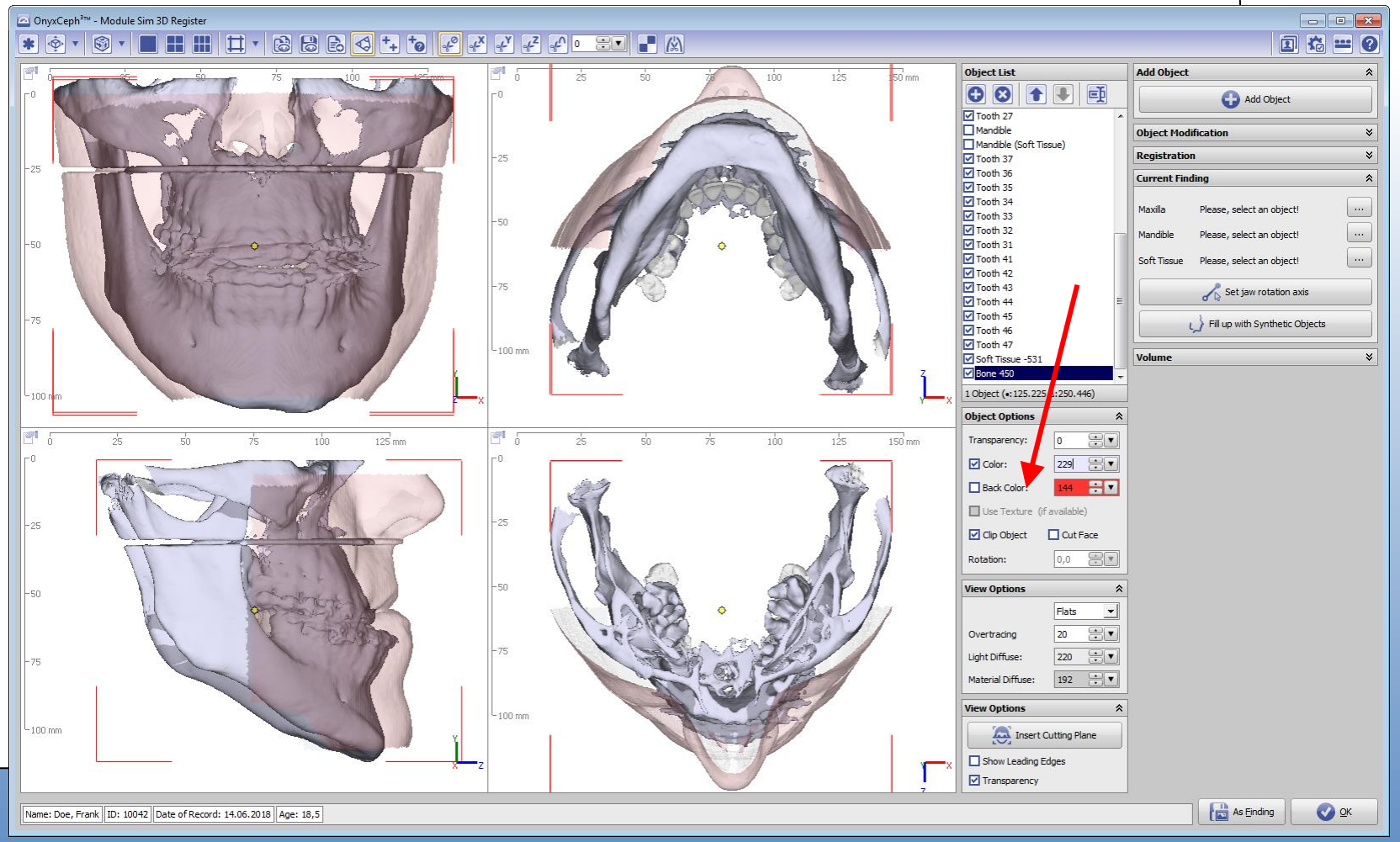
Add Object

Select and add the HeadScan data set belonging to the scan.



Modify View

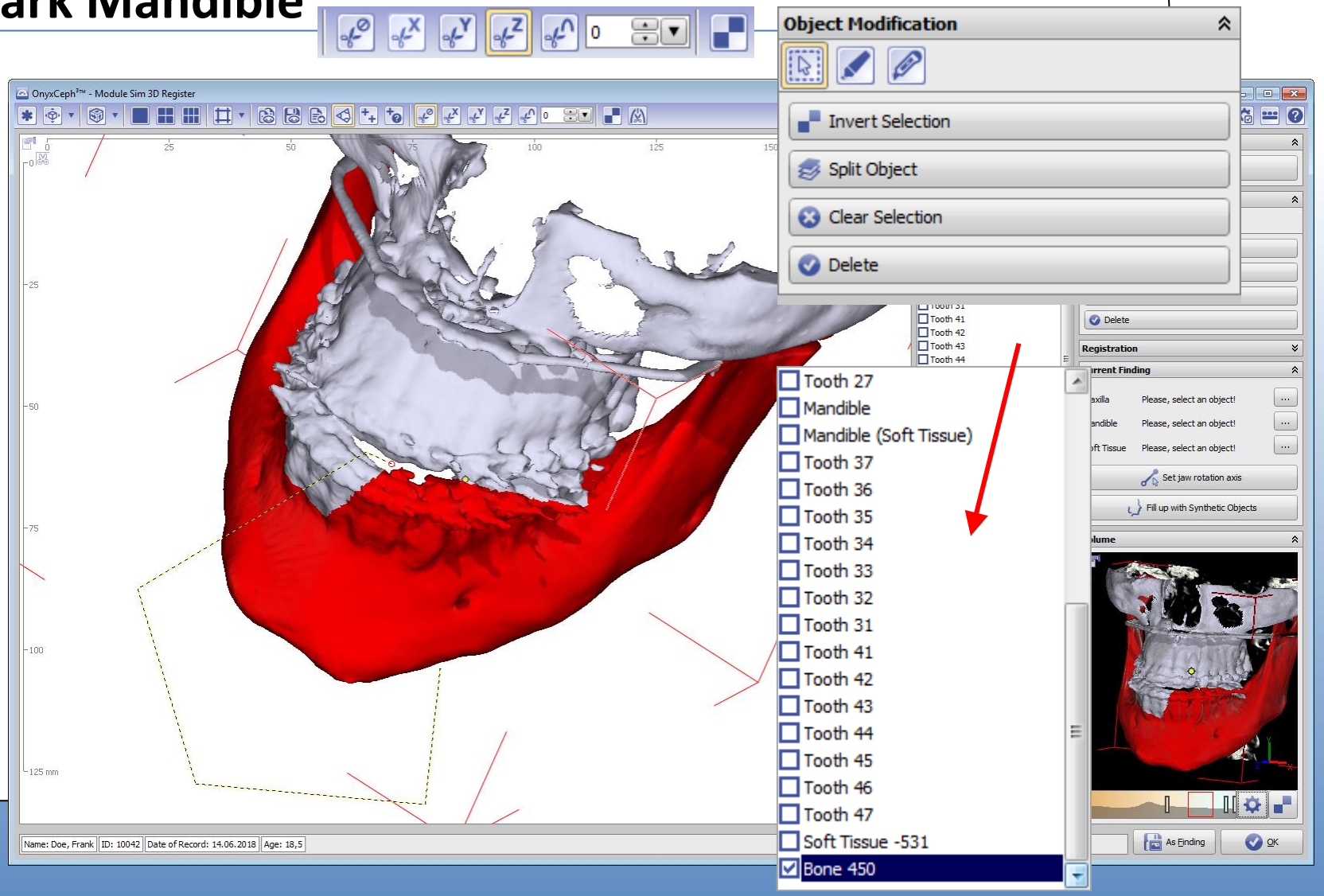
For better overview, single objekts like FaceScan and Skull objects in the object list can be modified in color and transparency.



Mark Mandible

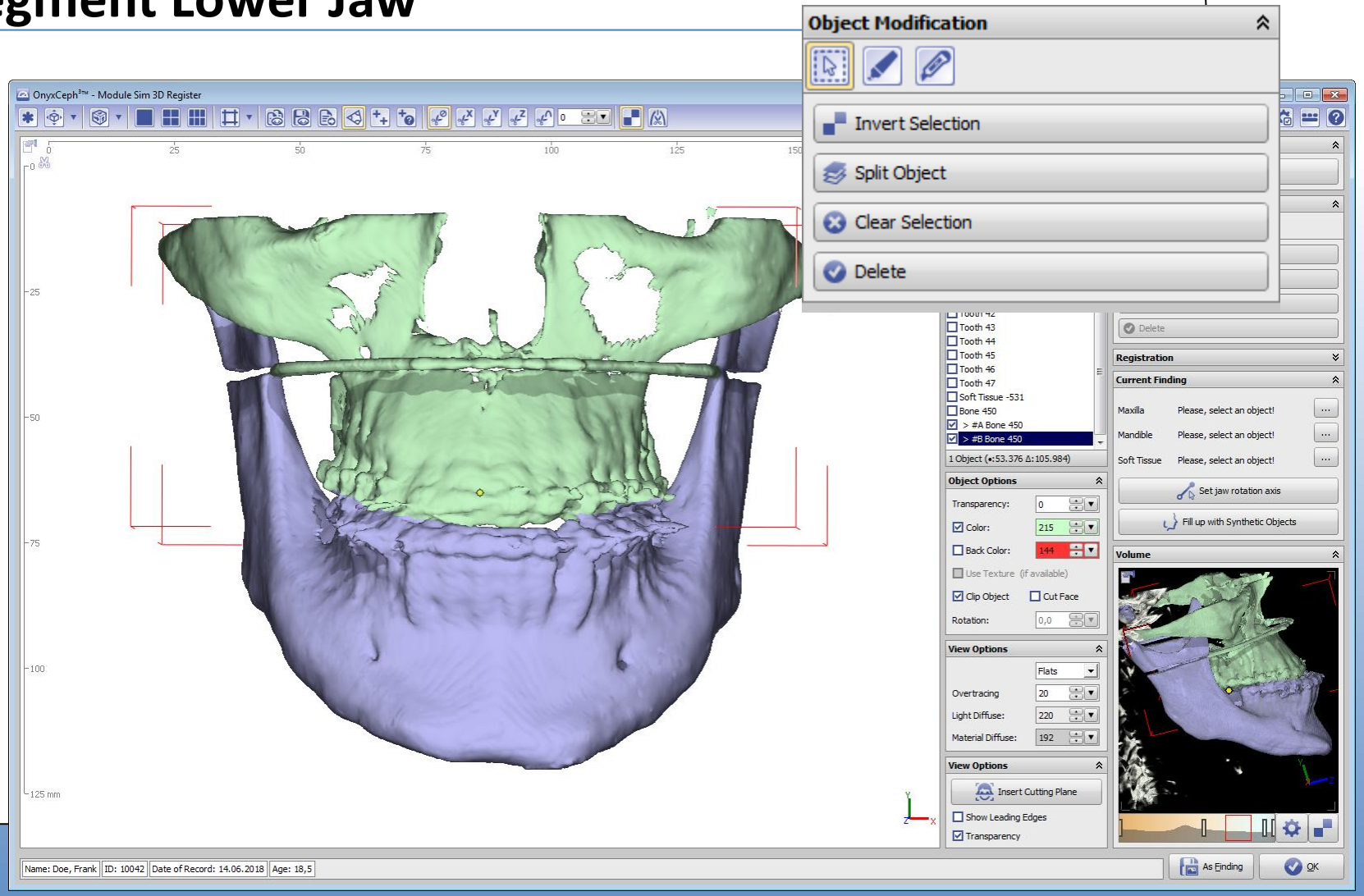
Select and activate only the Skull object in the object list.

Use tools in panel [Object Modification] in combination with the clip planes X,Y,Z to mark the entire lower jax surface.
To unselect regions, press [CTRL]+[SHIFT]



Segment Lower Jaw

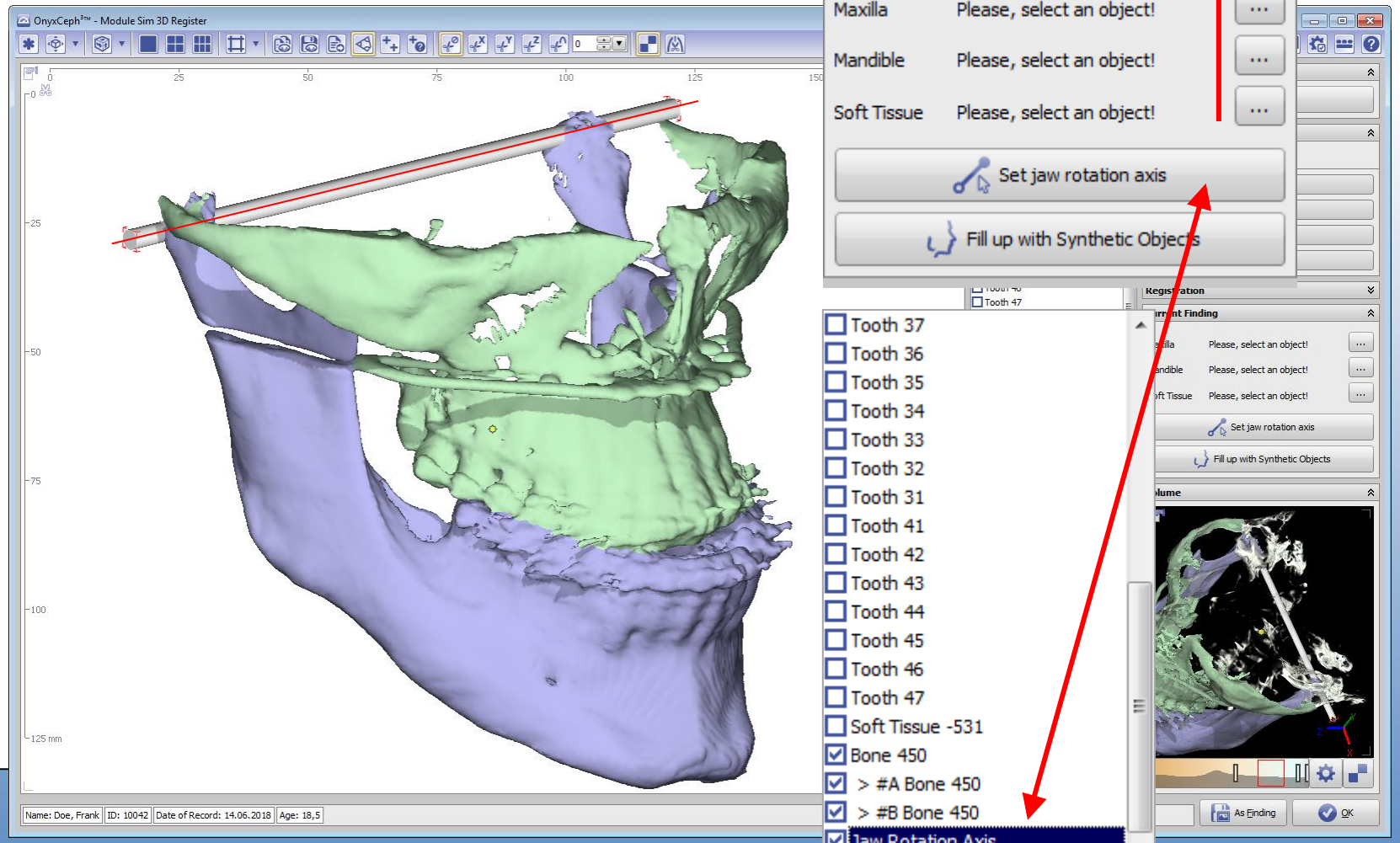
Press [Split Object] when readyto separate skull in mandible and maxilla (remaining object).



Define Jaw Rotation Axis

Set jaw rotation axis by right click on left and right condyle.
Select axis in object list to fine adjust position and alignmentd by pressing [CTRL] when moving the mouse.

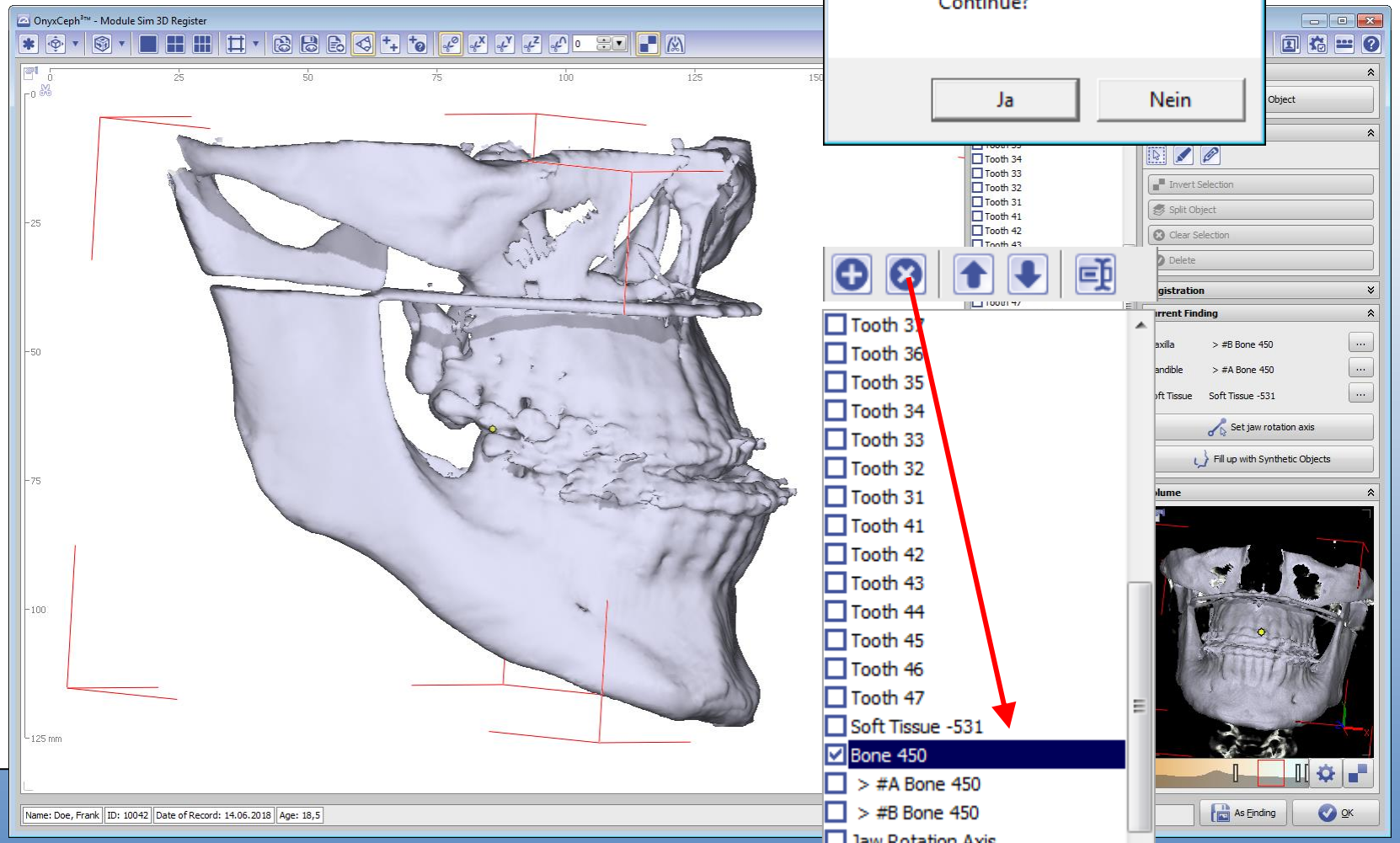
In Panel [Current Finding], assign each HeadScan object by button […]



Remove Redundant Objects

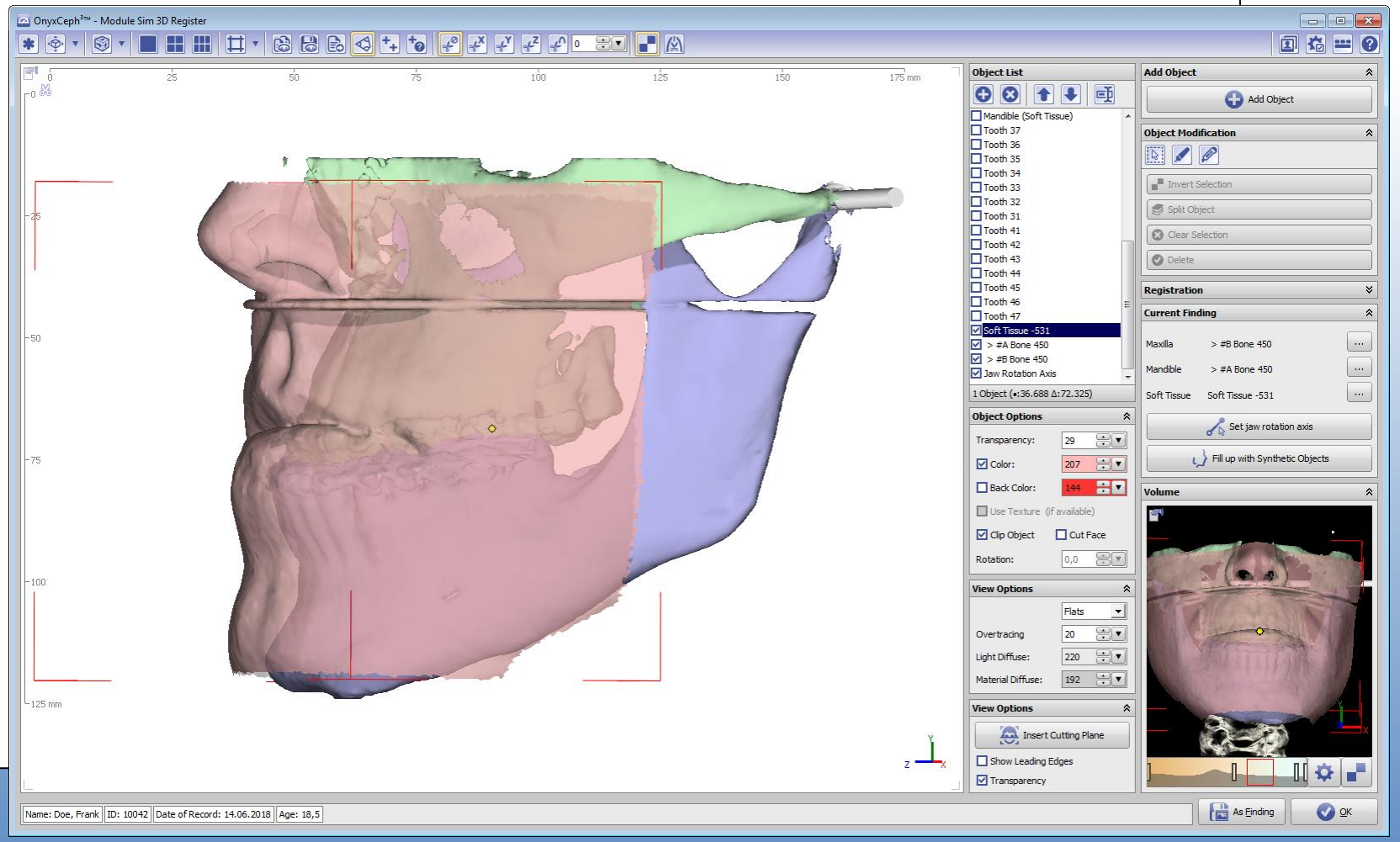
Select and delete parent skull object in the object list (not longer needed).

Optionally, also delete Maxilla, Maxilla (Soft Tissue), Mandible, and Mandible (Soft Tissue) the same way.



View Segmentation Result

Remaining HeadScan objects.

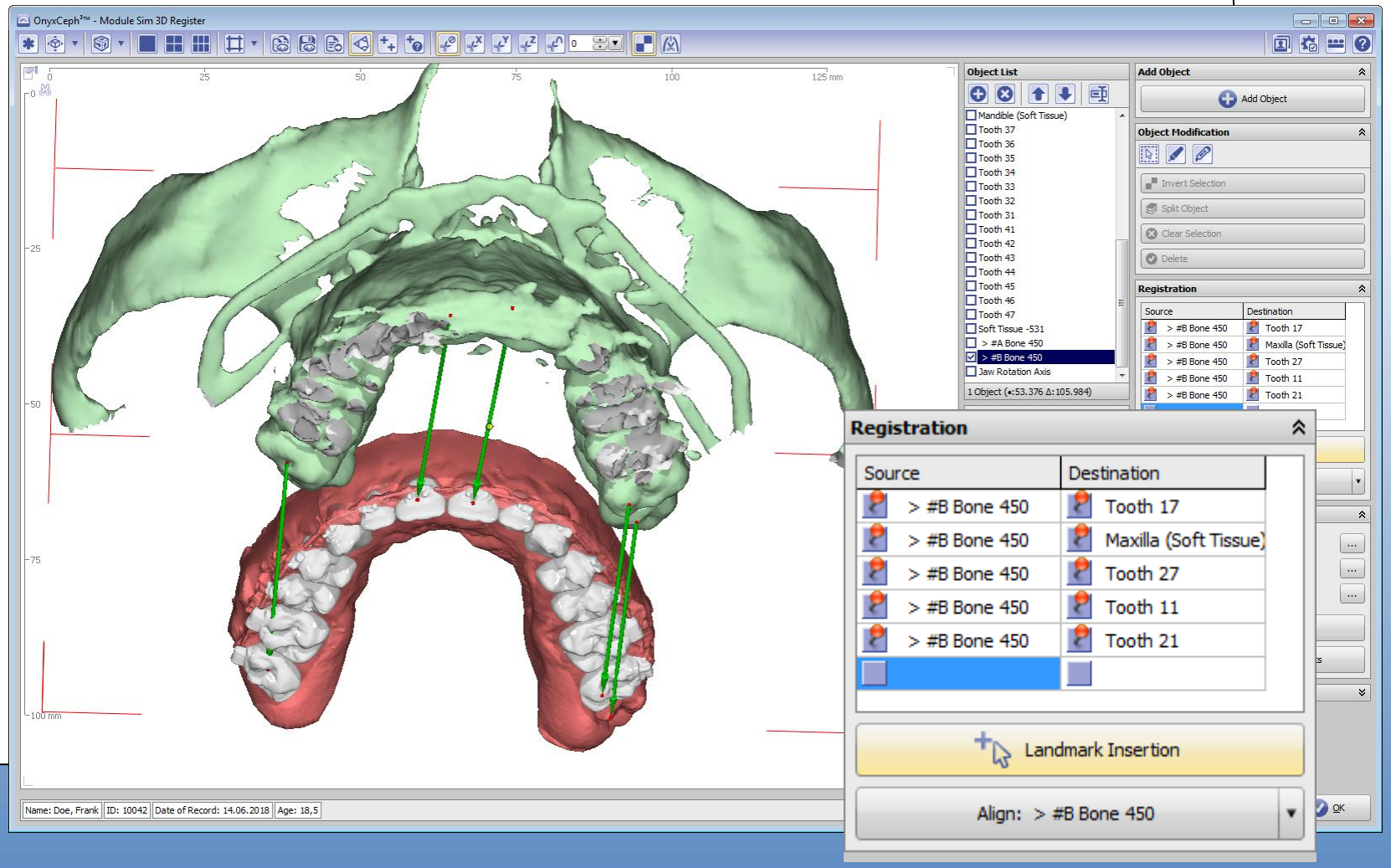


Register Skull vs. Maxilla

Hide all objects except bone and dental maxilla. Move bone object slidly away to view corresponding points separated.

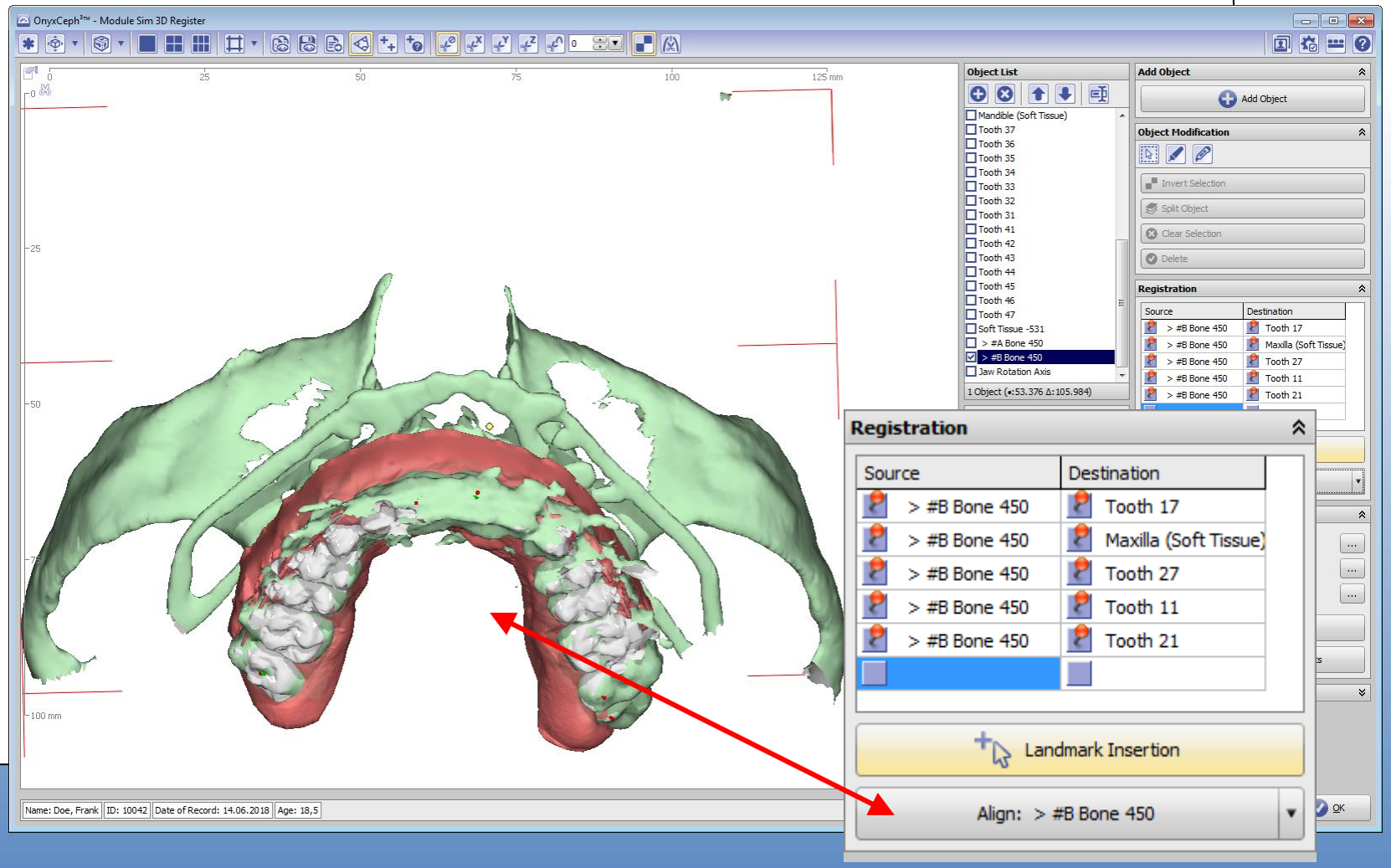
Activate [Landmark Insertion] mode in anel [Registration] and right click pairs of corresponding landmarks

Always First on headscan, Second on dental scan!



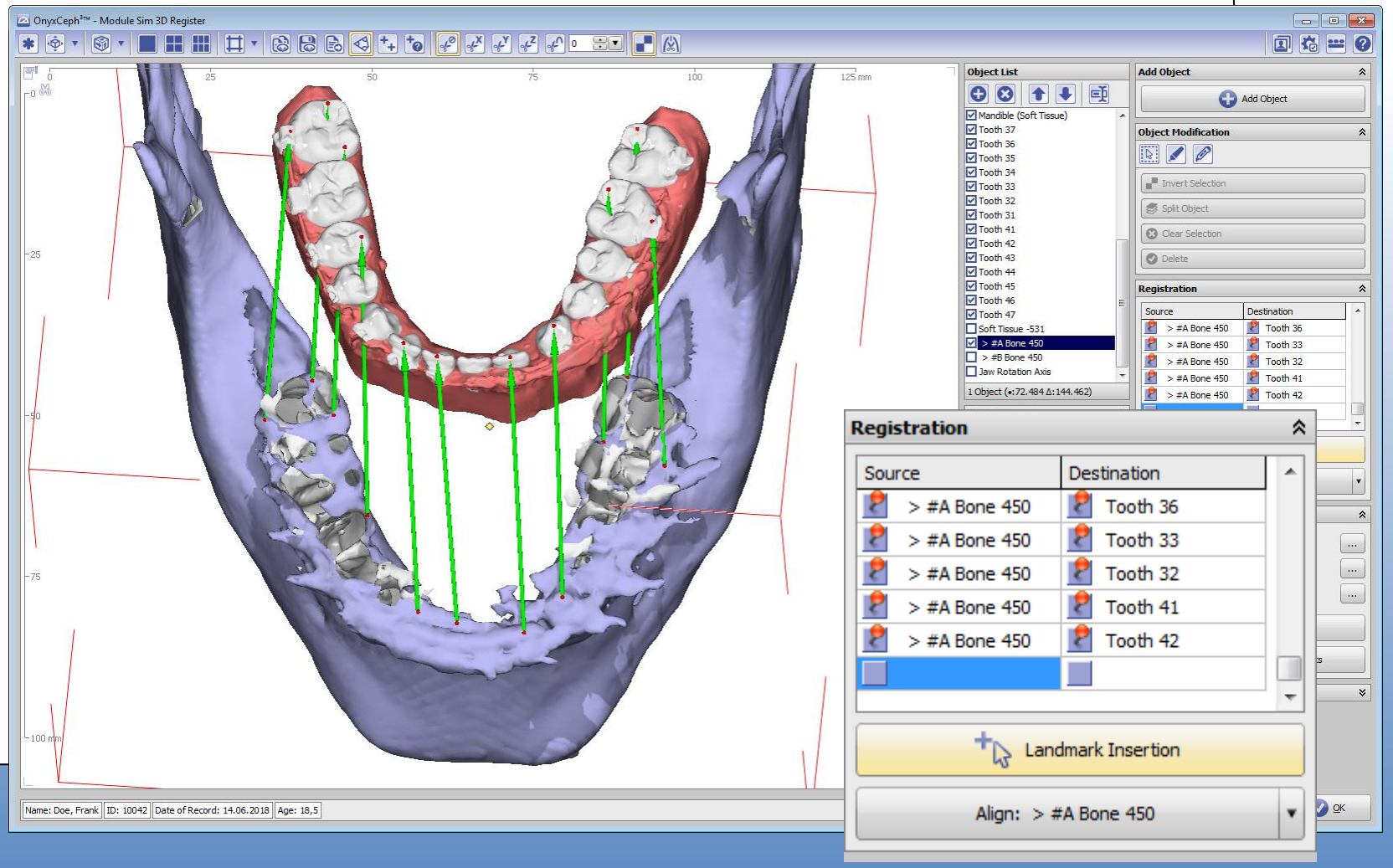
Register Skull vs. Maxilla

Click buton [Align: > (…)] in panel [Registration] to register upper bone vs. upper teeth.



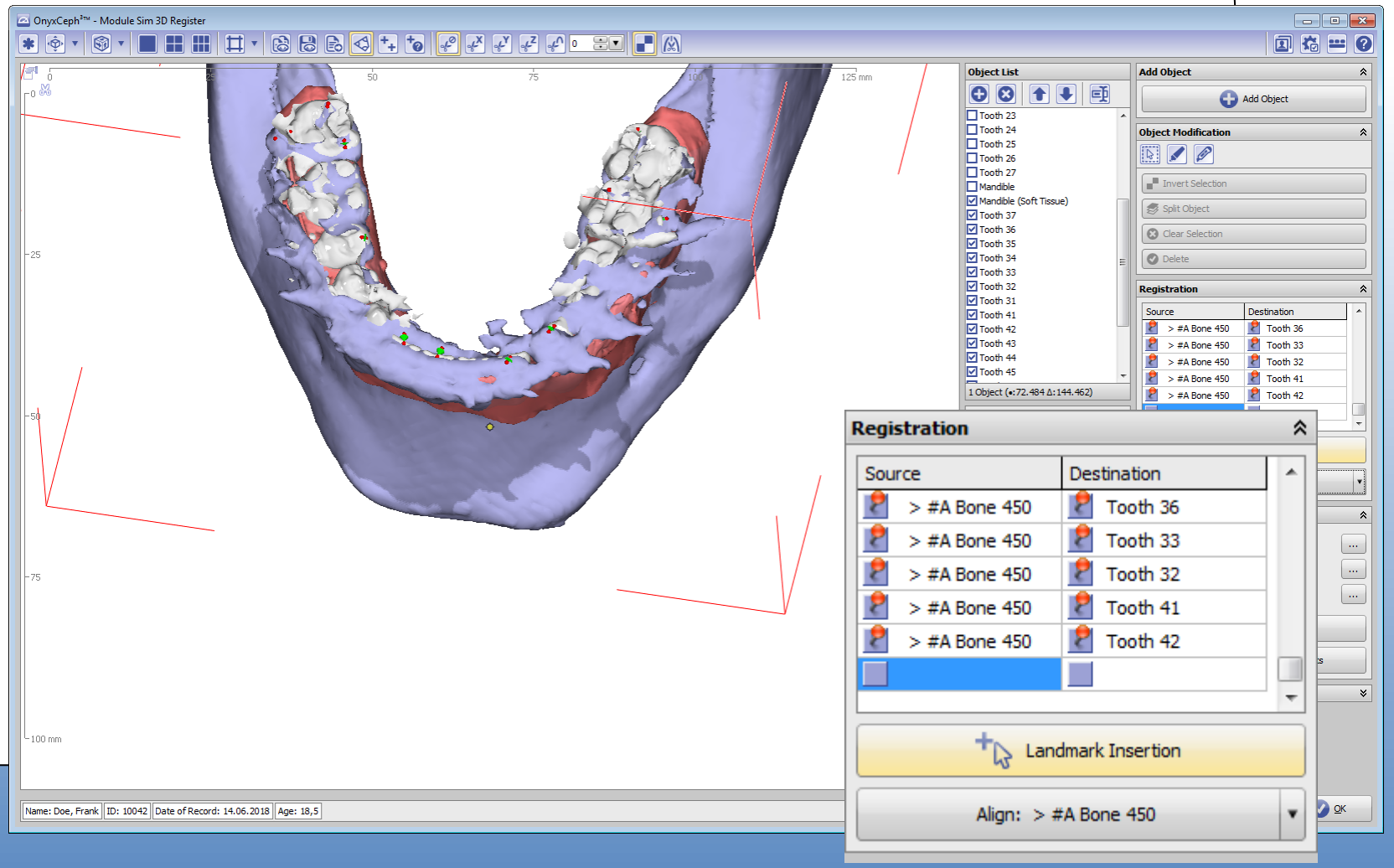
Register Lower Jaw vs. Mandible

Repeate the same procedure for the lower jaw and scan.



Register Lower Jaw vs. Mandible

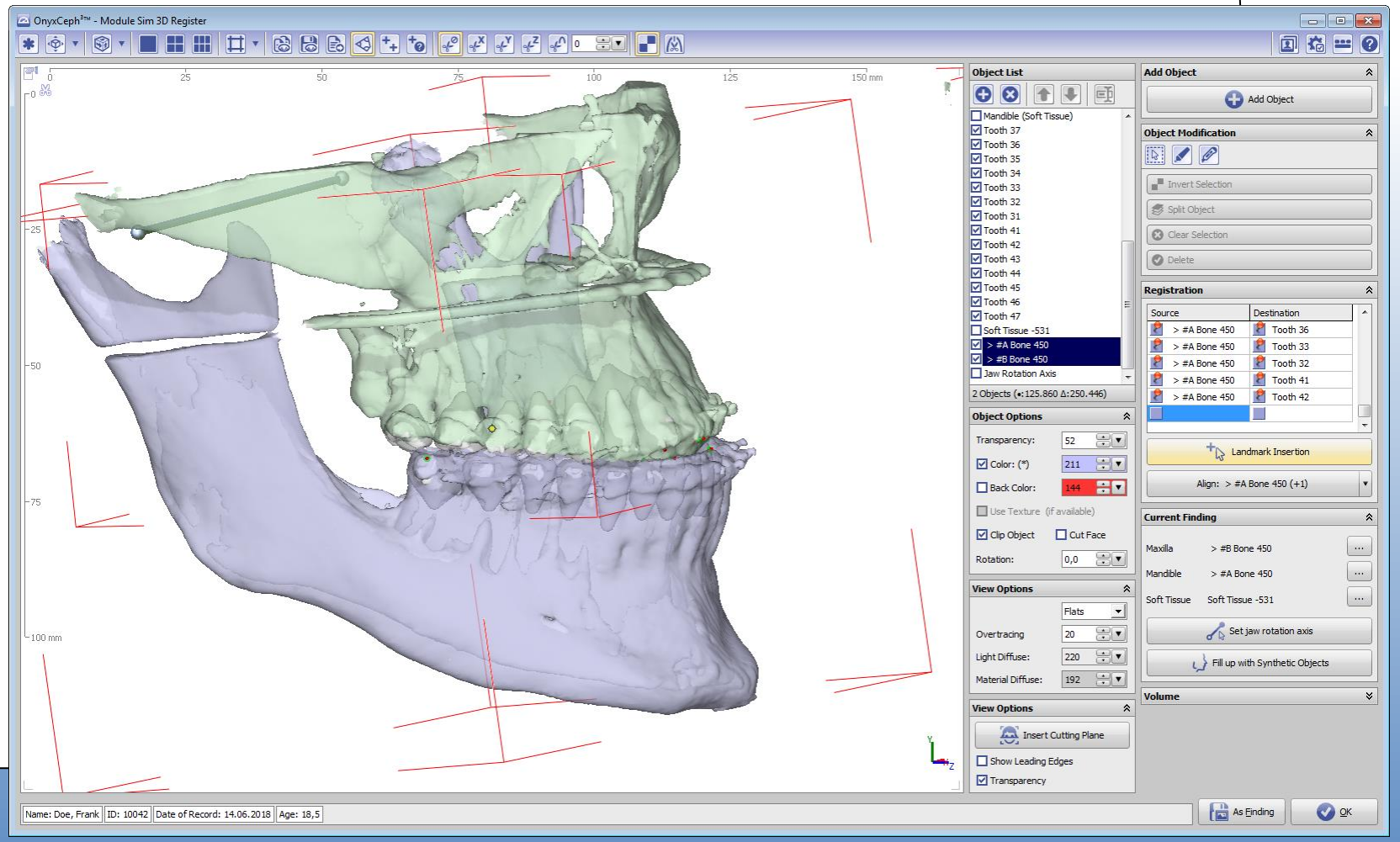
dto.



Improve View

Switch on both bone segments and teeth in object list and adjust colors and transparecy for both skull segments.

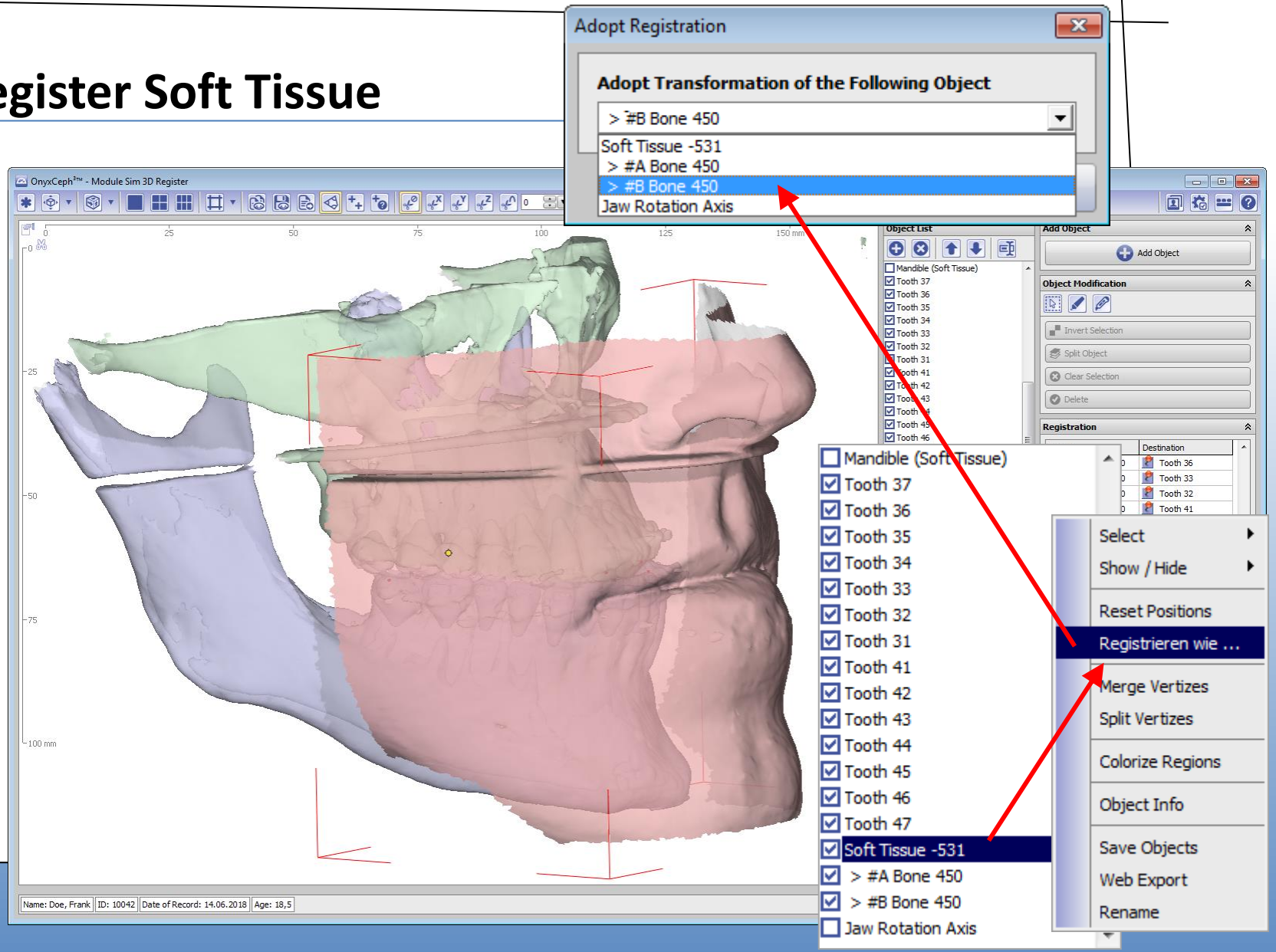
Note :
By separate registration for upper and lower, the bite relation of the dental scan was applied to the jaw relation .



Register Soft Tissue

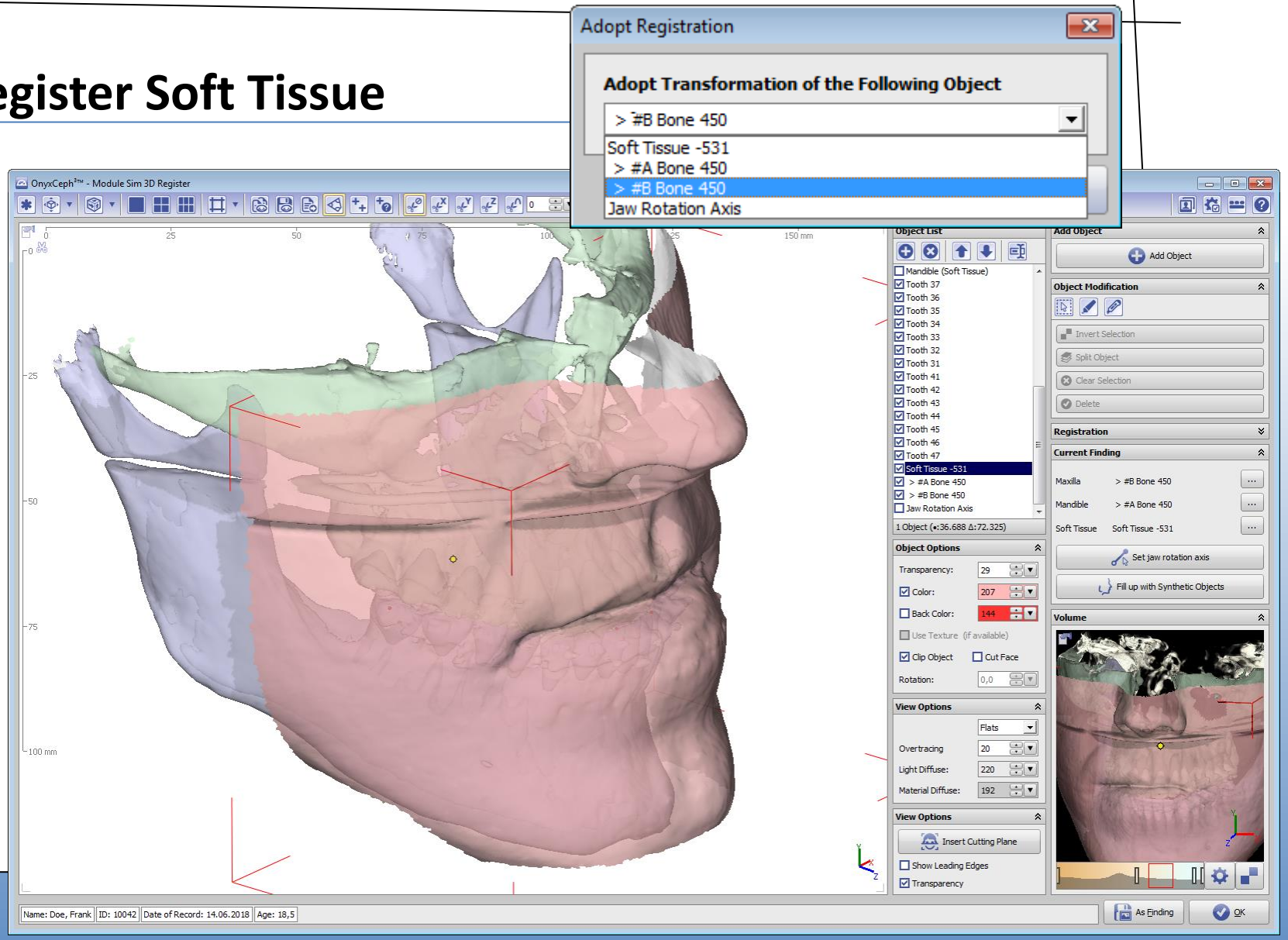
To register soft tissue acc. to the upper skull, focus the soft tissue object in the object list and click [Register as …] in the context menu.

Select the related skull object to adopt registration and apply by [OK]



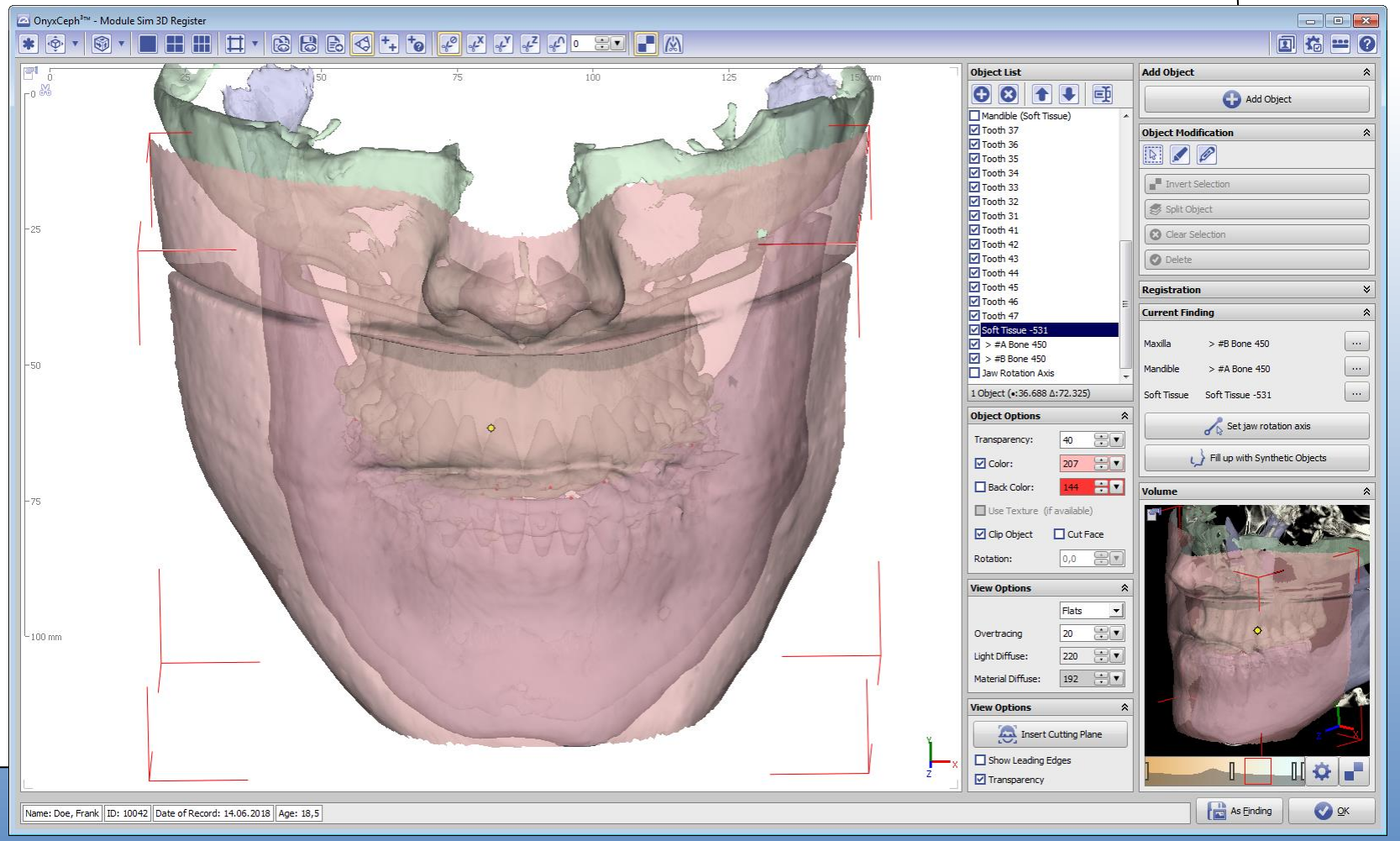
Register Soft Tissue

Now, all objects in the object list are registerd to one common dataset.



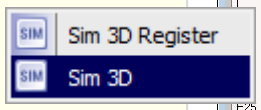
Save Combined Data Set As Finding

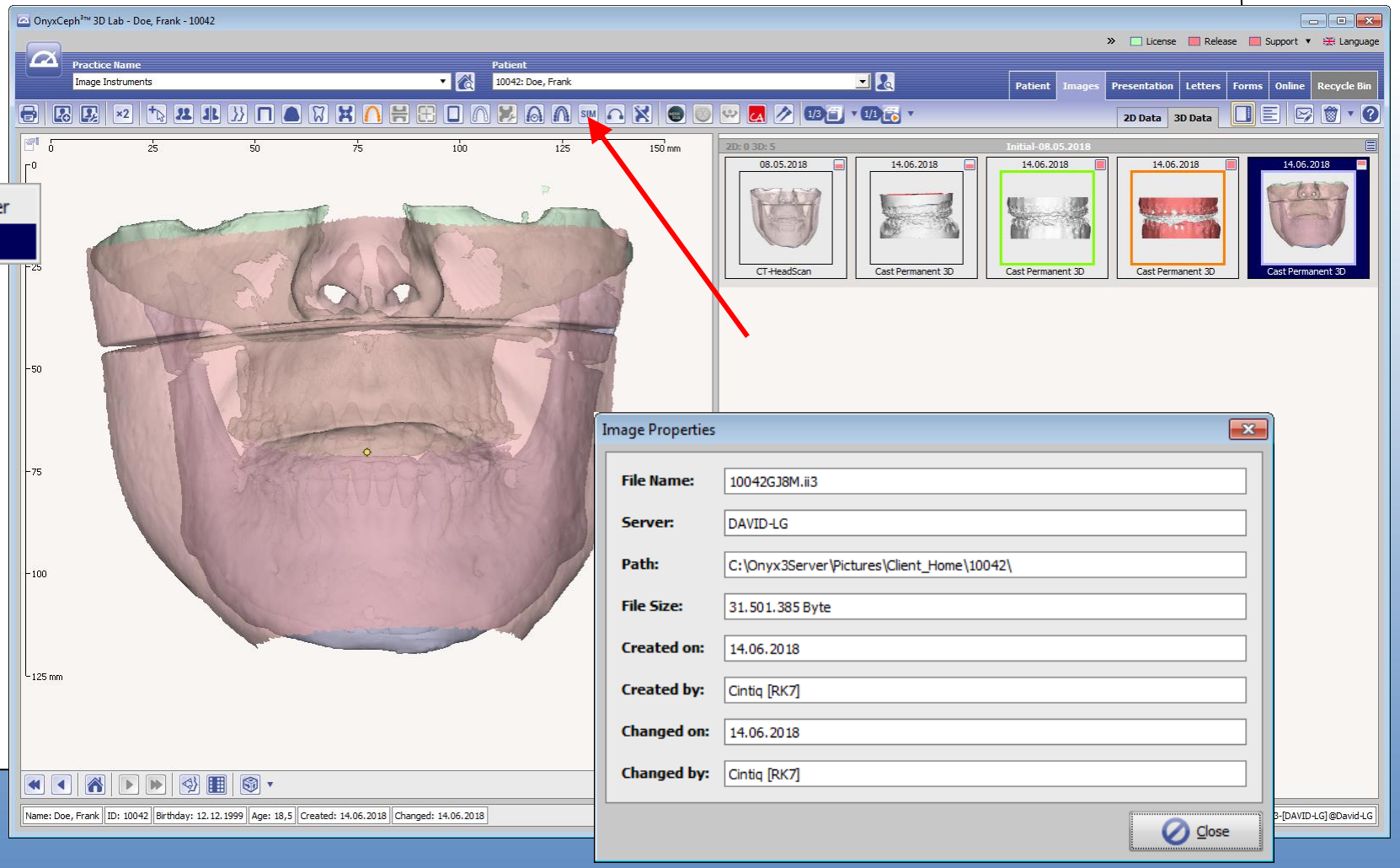
Save to data base by button [As Finding]



PreProcessing Completed

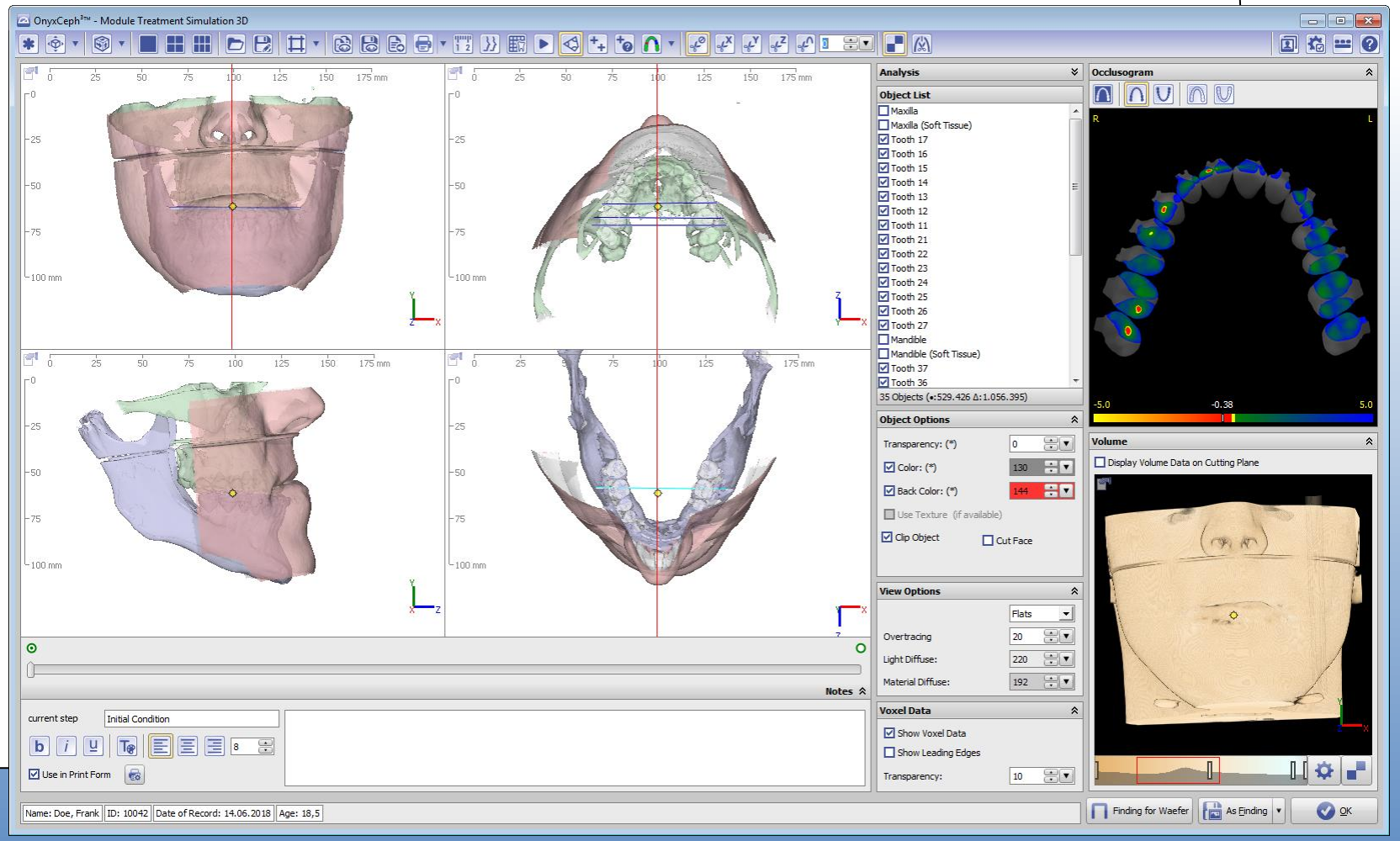
The finding has performed all pre-processing steps needed for applying the SIM 3D plannung mode





Open Sim 3D In Planning Mode

Module Sim 3D opens in treatment planning mode.



Define Step Type

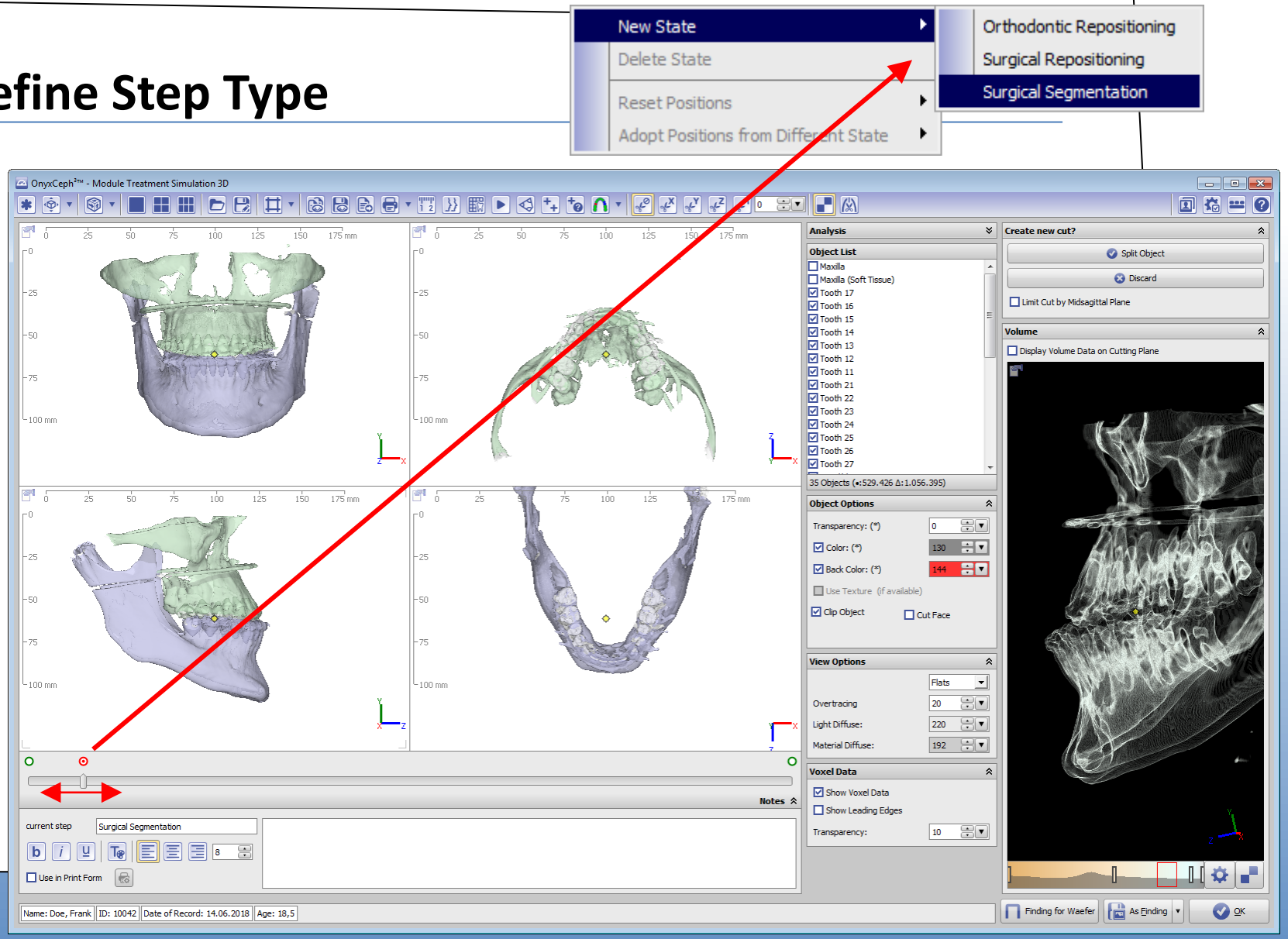
Move time line slider to the right to define a planning step by right click.
There are 3 types of planning steps:

- Orthodontic Repositioning
- Surgical Repositioning
- Surgical Segmentation

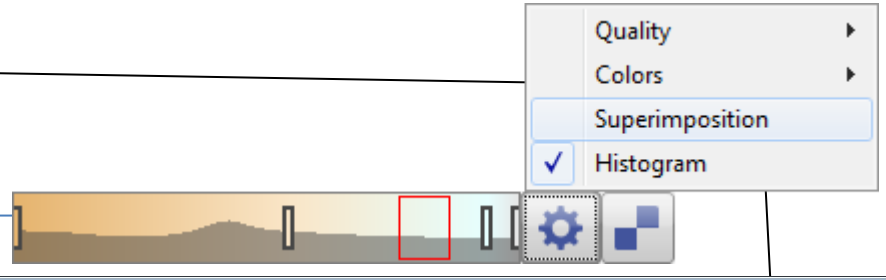
While orthodontic movements will only be planned in case discussion mode, surgical segmentation and segment movements are needed.

Create a Surgical Segmentation step.

Note:
The planning process is not restricted to a specific workflow sequence or treatment philosophy. However, in this example, the step sequence is illustrated acc. to your defaults.

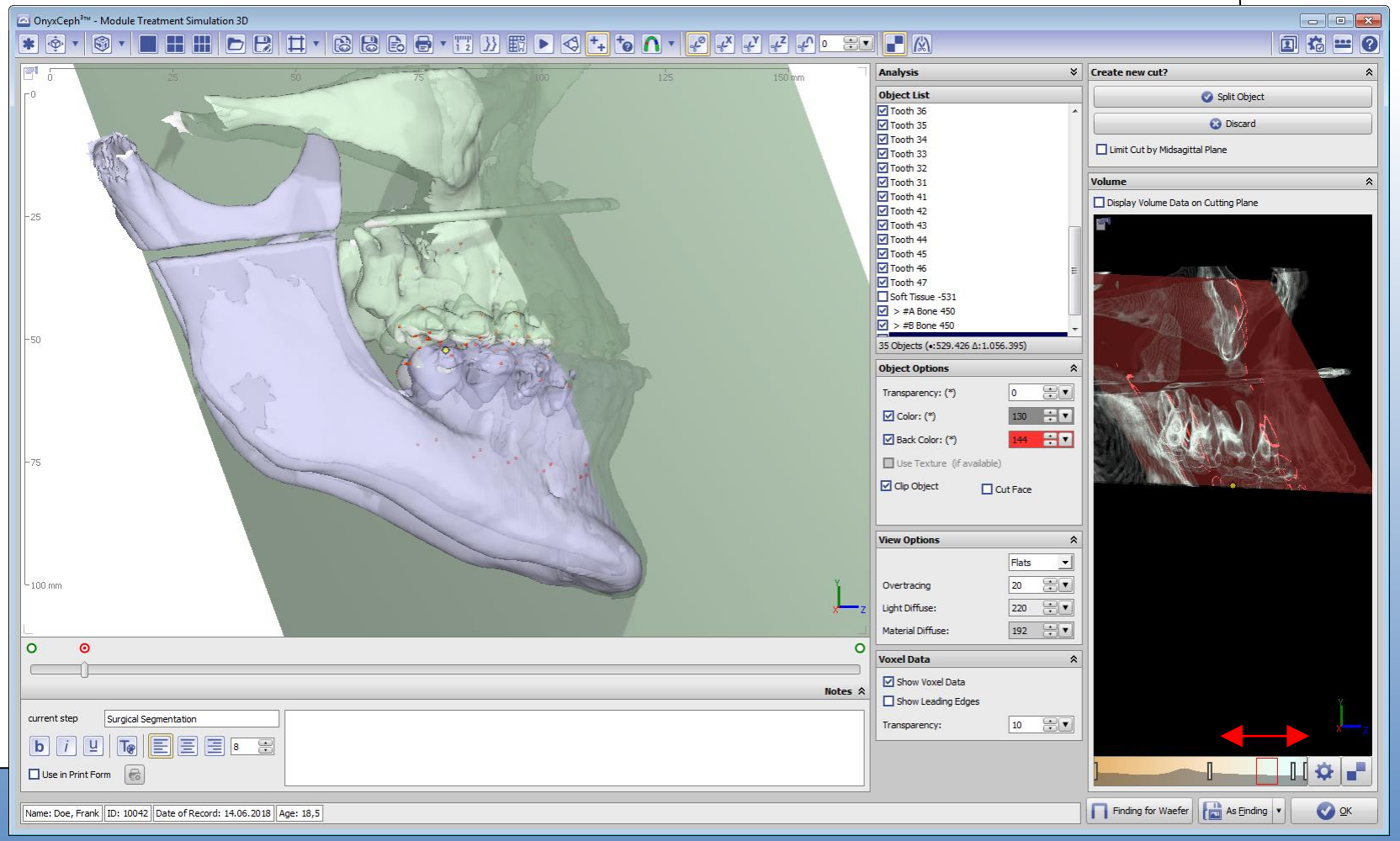


Apply Maxilla Osteotomy



To segment e.g. the maxilla first, right click on a surface region where the osteotomy should be applied.

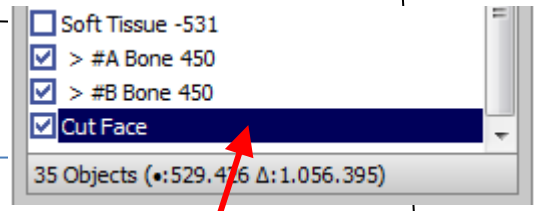
To check position and alignment of the plane also in the volume view window on the right (e.g. to see the roots exactly) select appropriate settings in the volume control panel.

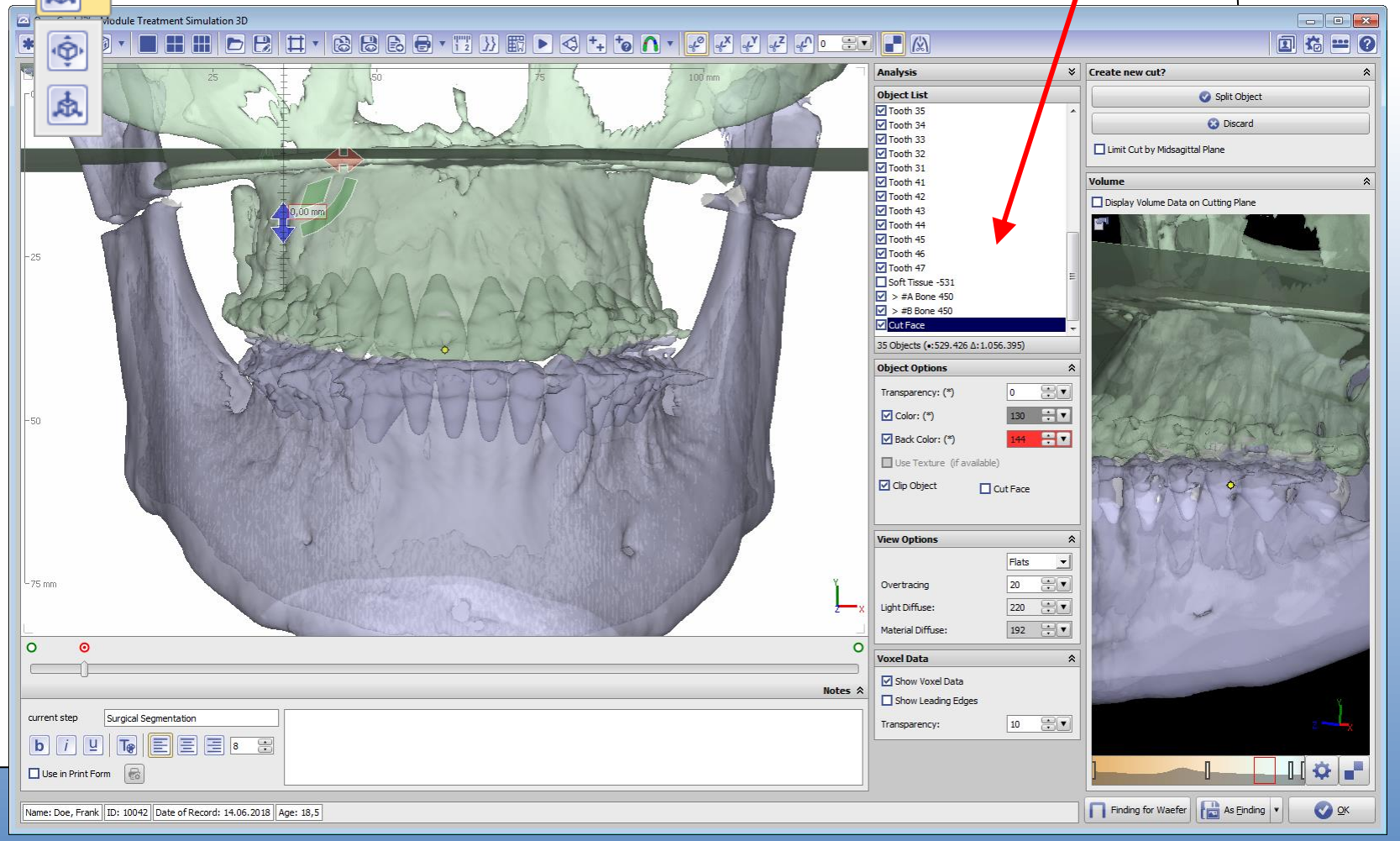


Apply Maxilla Osteotomy

Move the osteotomy plane as usual while holding [CTRL] down or use navigators to do so. Make sure object „Cut Face“ is focussed in the object list.

Check position also in the volume view.

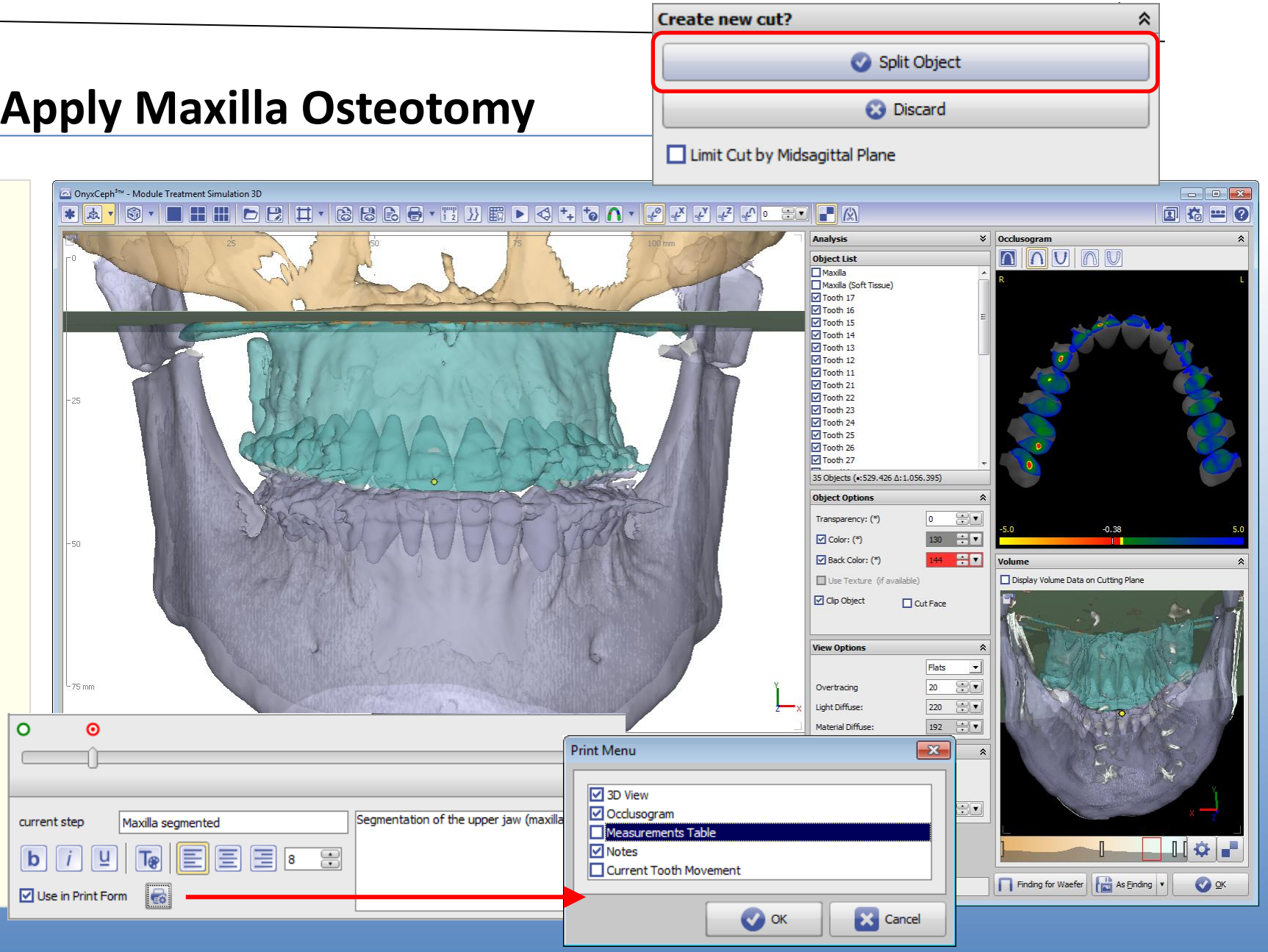




Apply Maxilla Osteotomy

Once located correctly, click button [Split Object]

Name the step and optionaly add a comment. Now or later define by the printer icon button which information for this step should be included in the case planning report.

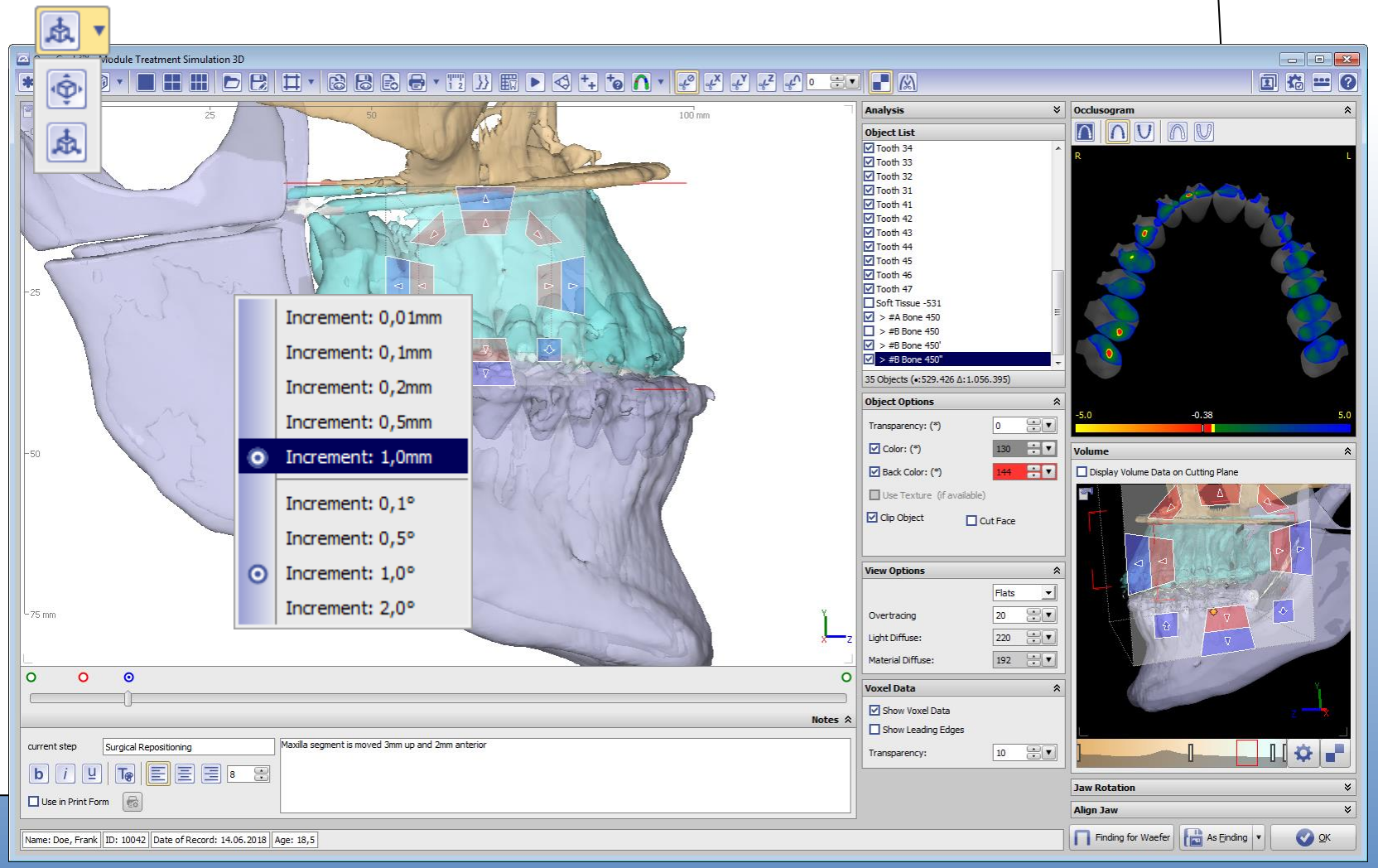


Move Maxilla

To move this segment, create a Surgical Repositioning step by right mouse click in the timeline.

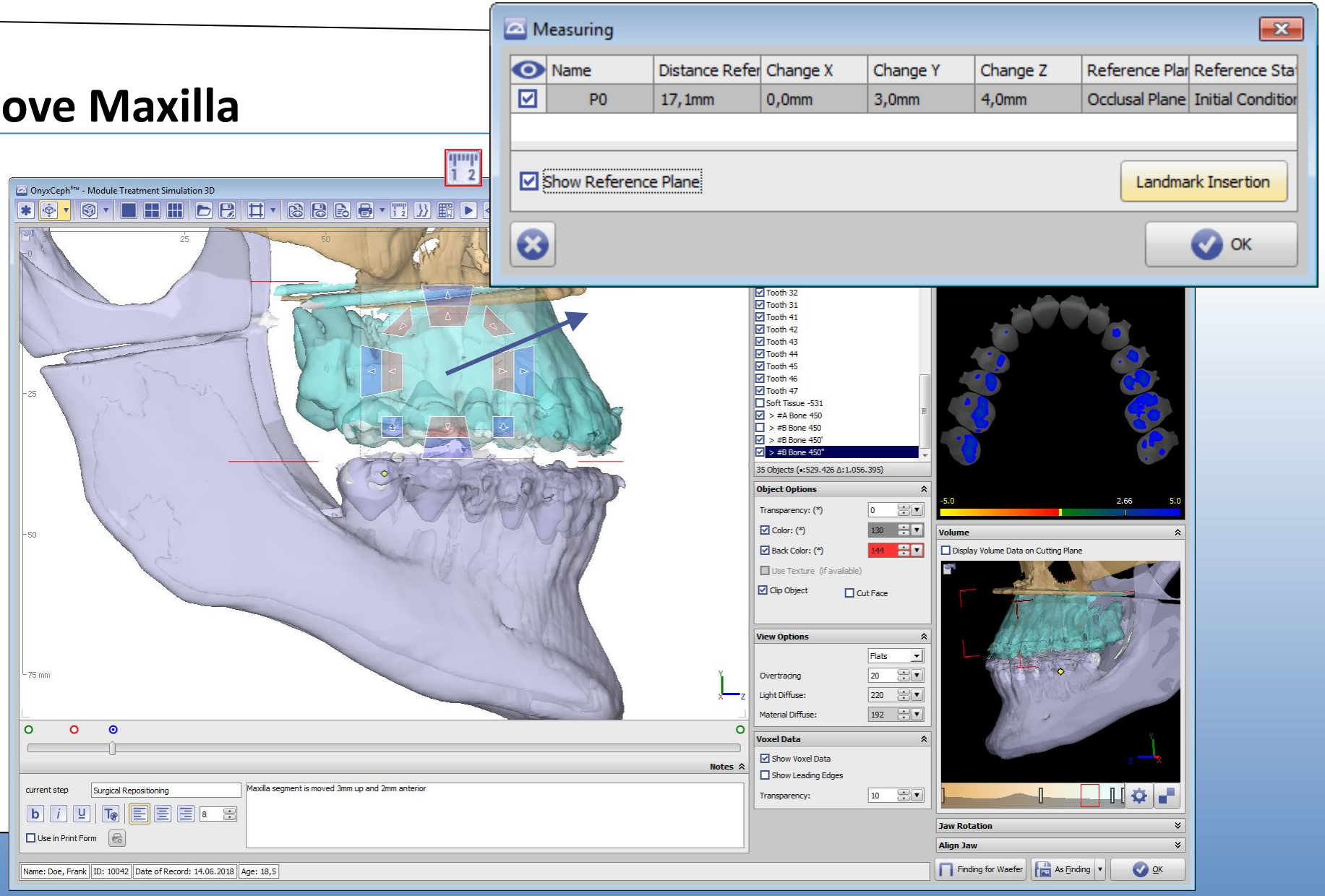
Select the maxilla segment either in the object list or by [ALT] + left click onto the 3D object itself.

Use one of both 3D navigators to move the maxilla 3mm up and 4 mm to the front.



Move Maxilla

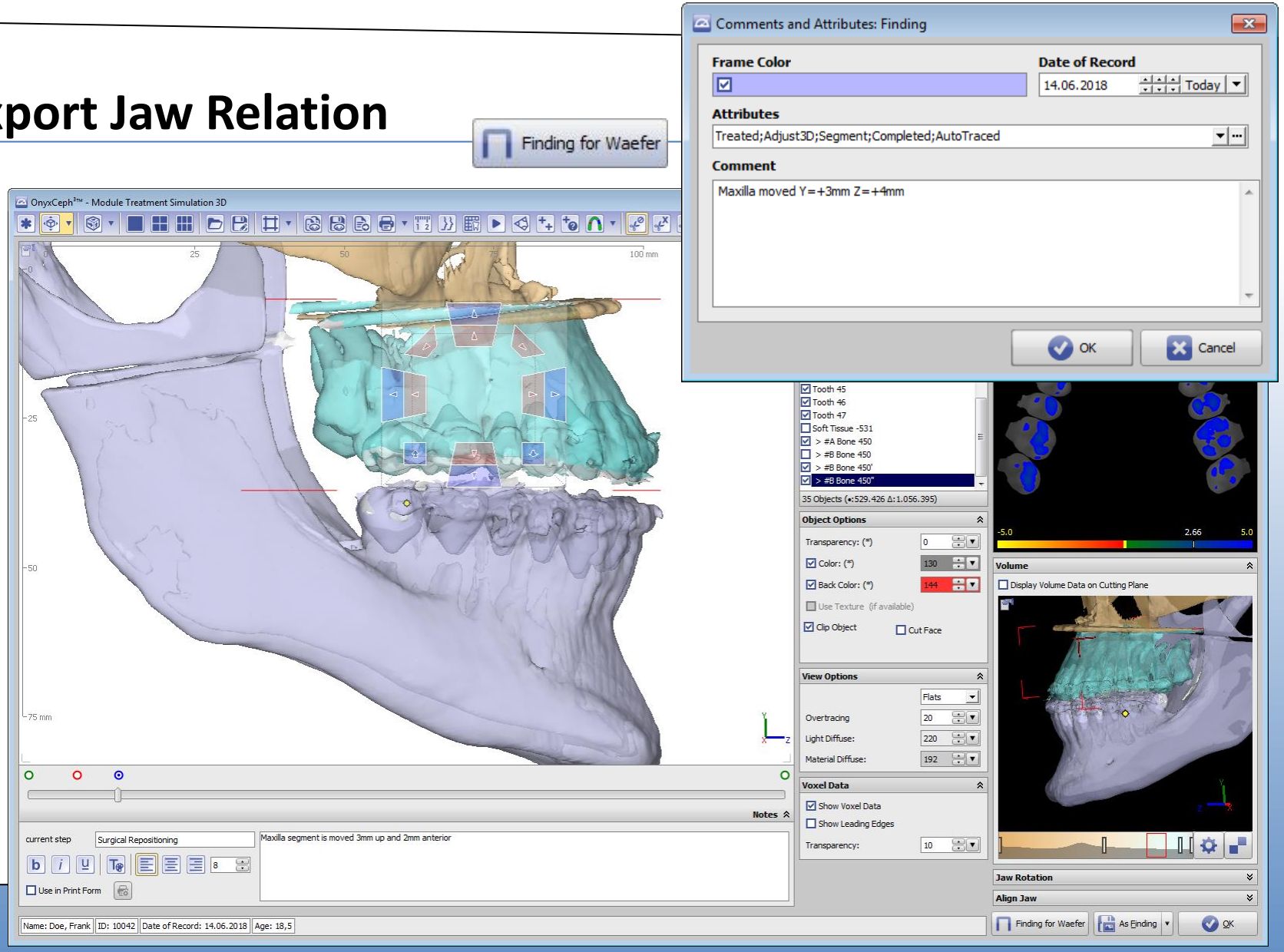
Check the maxilla movement by the ruler icon button. Insert a landmark and watch columns [Change Y] and [Change Z].



Export Jaw Relation

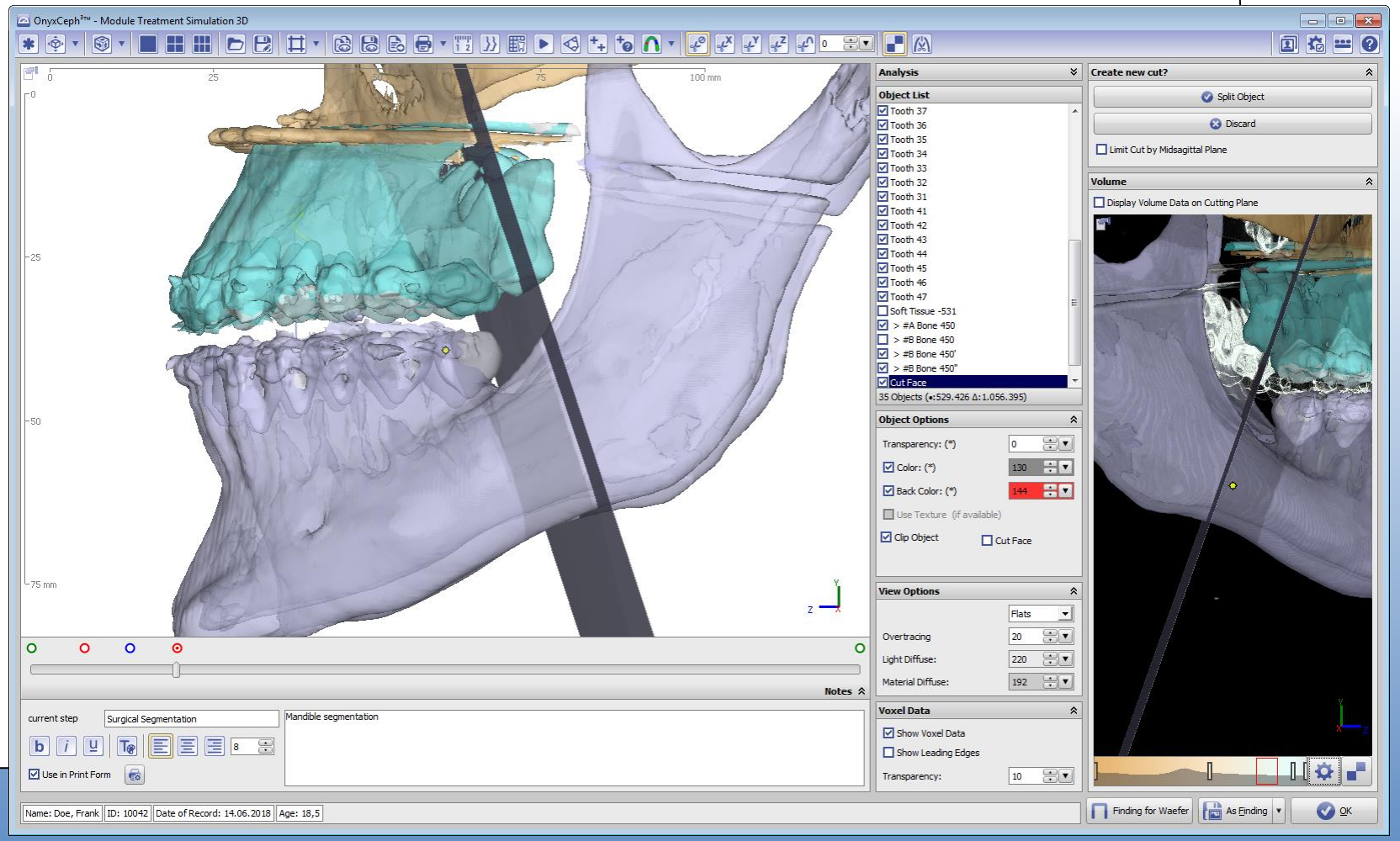
To transfer this jaw relation during surgery by a splint, click button [Finding for Waefer]

Optionally, add name and comments for the planning step and define print objects for the case report for this step.



Apply Mandible Osteotomy

In a next segmentation step, split mandible. If useful, left and right ramus can be segmentes separately in two single steps.

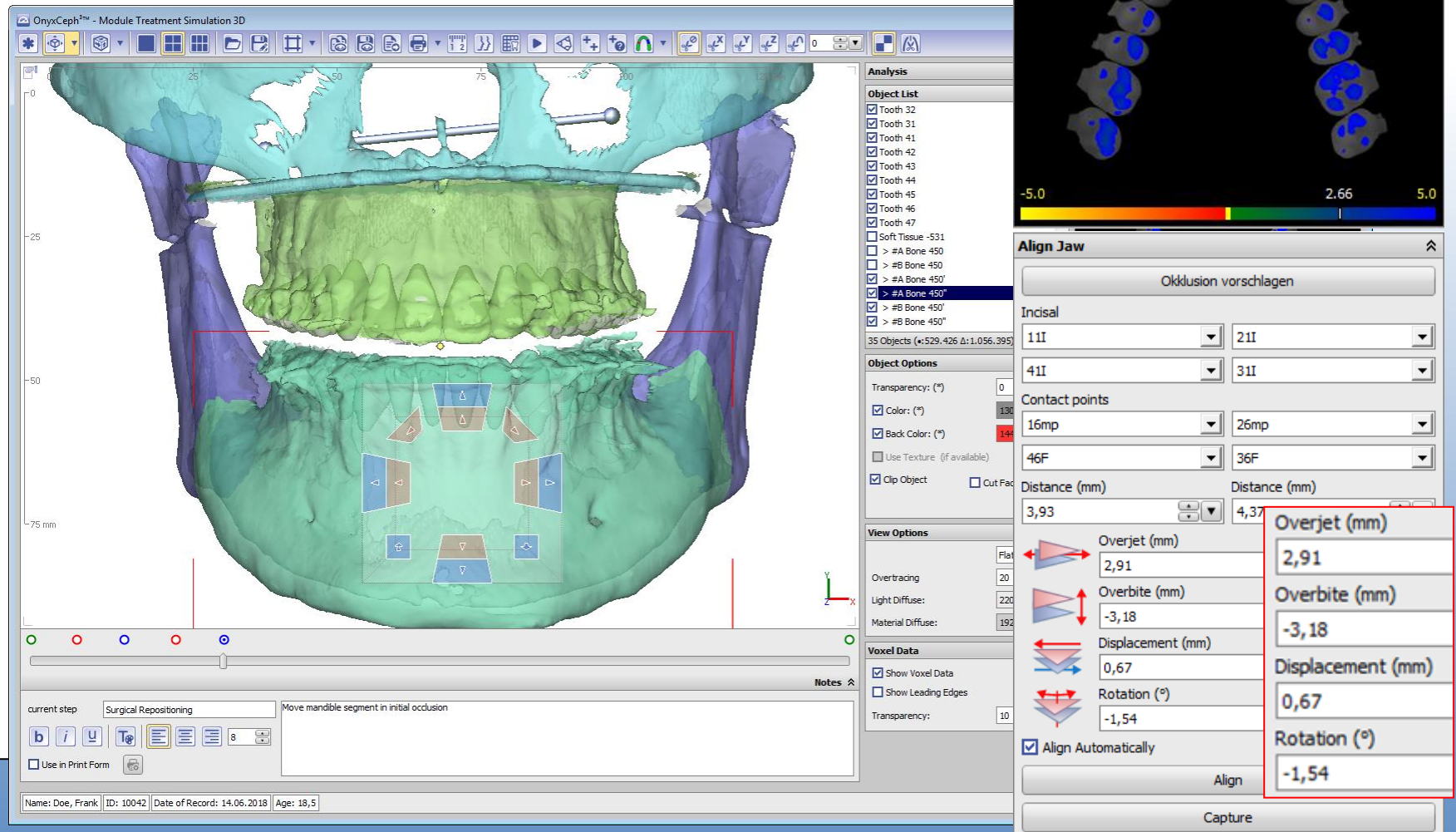


Define Occlusion

If collapsed, expand panels [Occlusoram] and [Aligne Jaw].

By button [Capture], the current jaw relation can be measured.

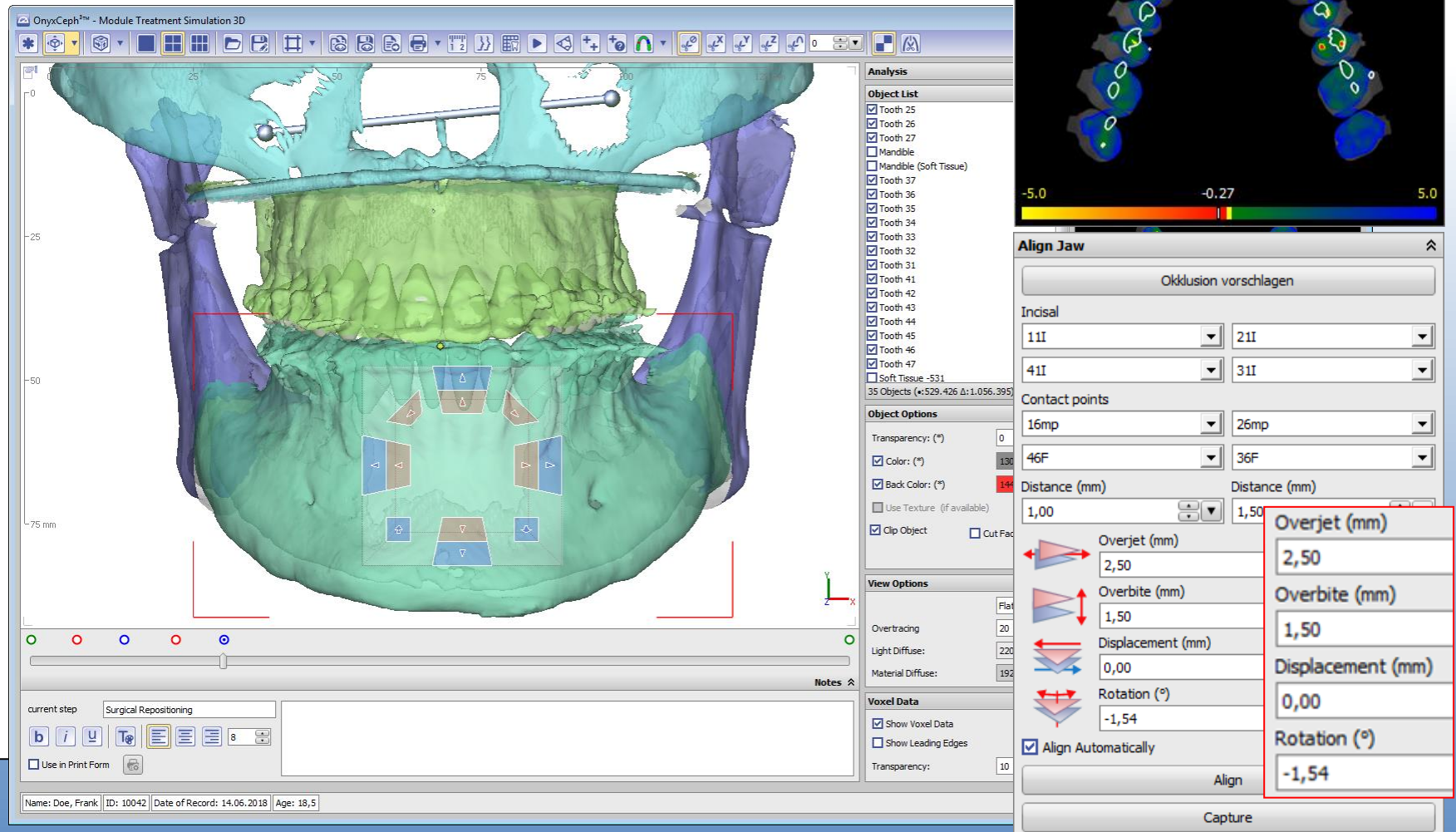
By button [Align], the jaw relation pre-defined by values can be applied.
If checkbox [Align Automatically] is active, changed values are applied automatically.



Define Occlusion

Also, the jaw segment/s to be moved can be selected in the object list and displaced and/or rotated by any of the navigation tools.

Use the occlusogram to check the occlusion.



Define Occlusion

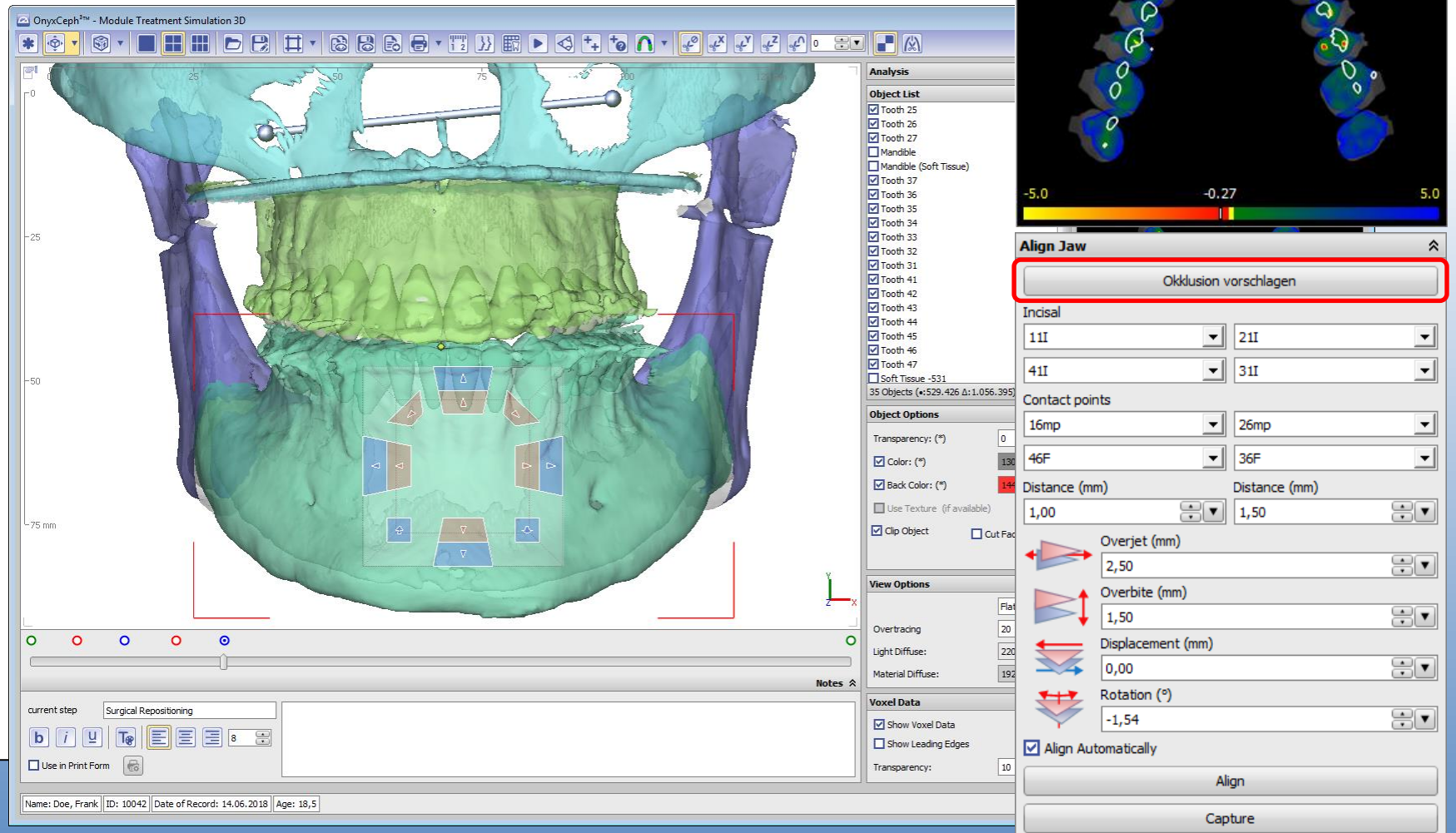
[↓ Releases > 3.2.106]

Use button [Propose Occlusion] to open a separate window.

There, you have different options to find the best occlusion by a iterative simulation.

Either you try to optimize the occlusion startin from the current relation or you let the program select its own starting jaw relation.

Each simulated result is displayed acc. to its score.



Define Occlusion

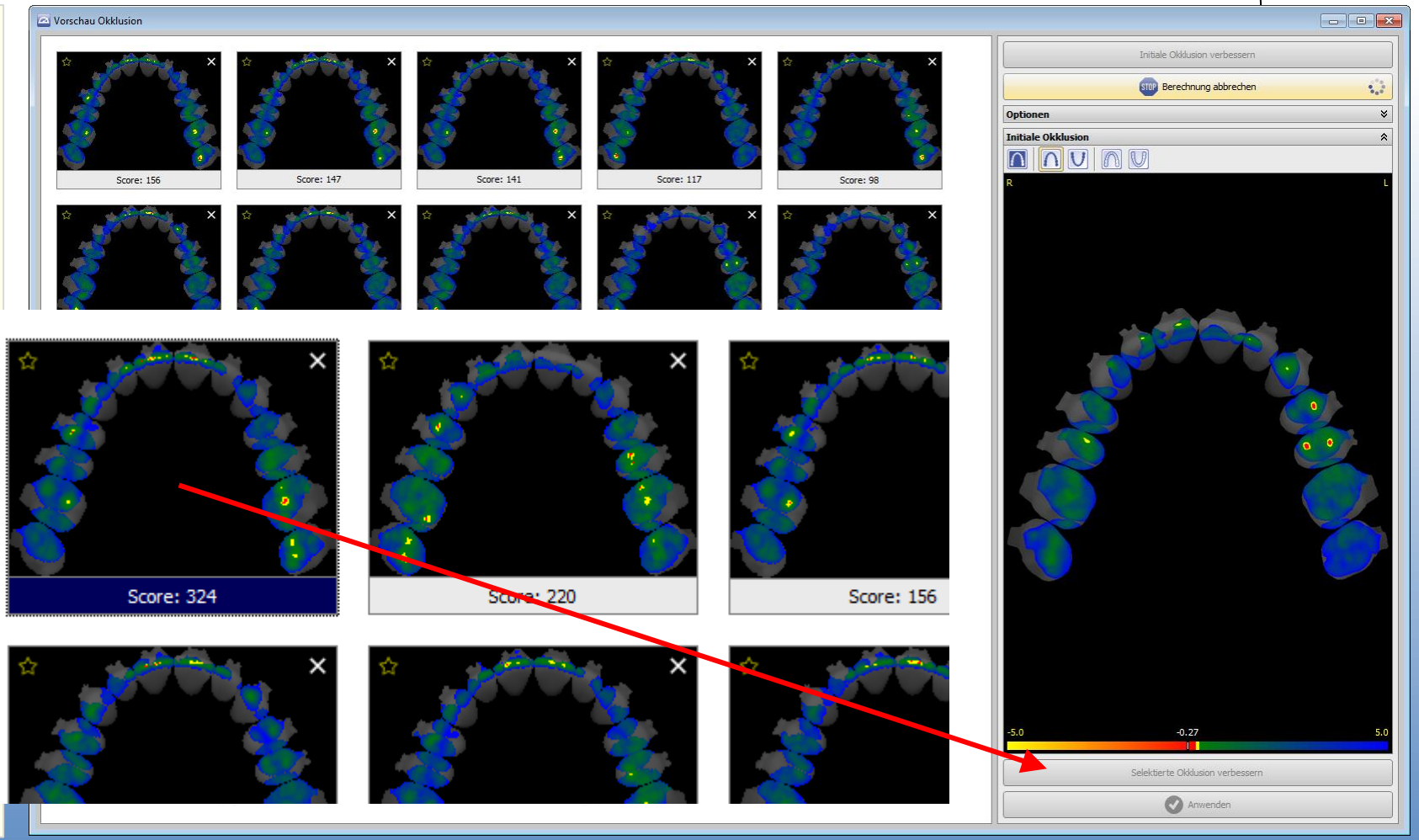
[↓ Releases > 3.2.106]

It is recommended to use the second option.

There is no timeout for the calculation. Stop calculation manually if the best score is not increasing significantly any longer.

Focus the best result and click button [Improve Selected Occlusion]

This will continue the calculation starting with the selected jaw relation and possibly lead to a higher score again.

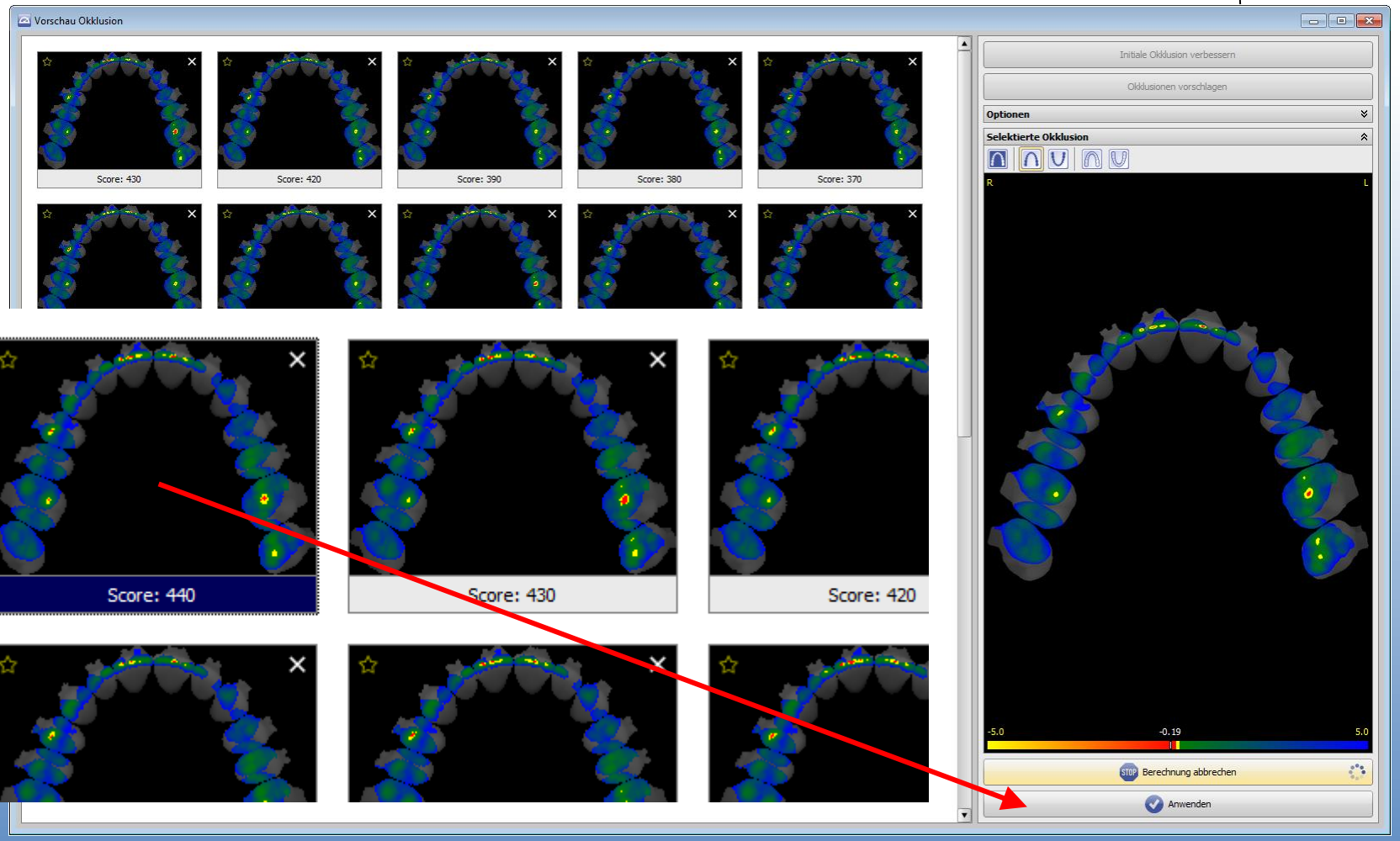


Define Occlusion

[↓ Releases > 3.2.106]

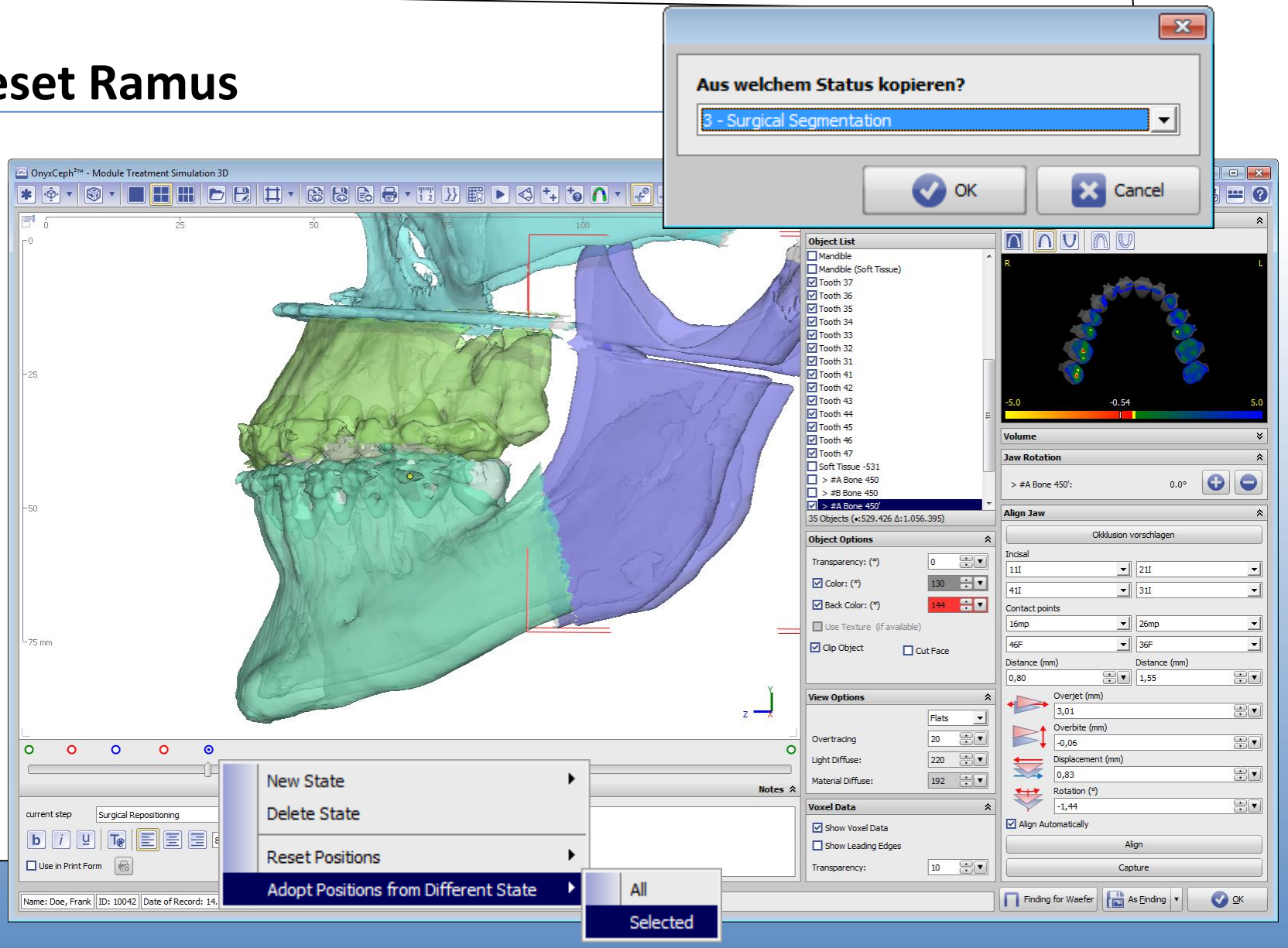
Also stop this calculation manually if the best score is not increasing significantly any longer.

Use button [Apply] to take over the optimized occlusion.



Reset Ramus

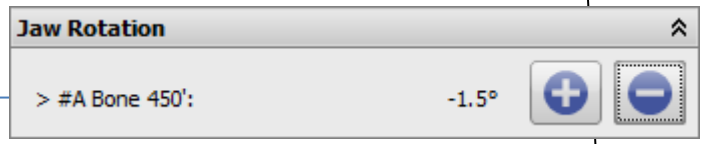
Since the new occlusion applies to the whole mandible, reset the related ramus object movement by step contect menu to the position before.

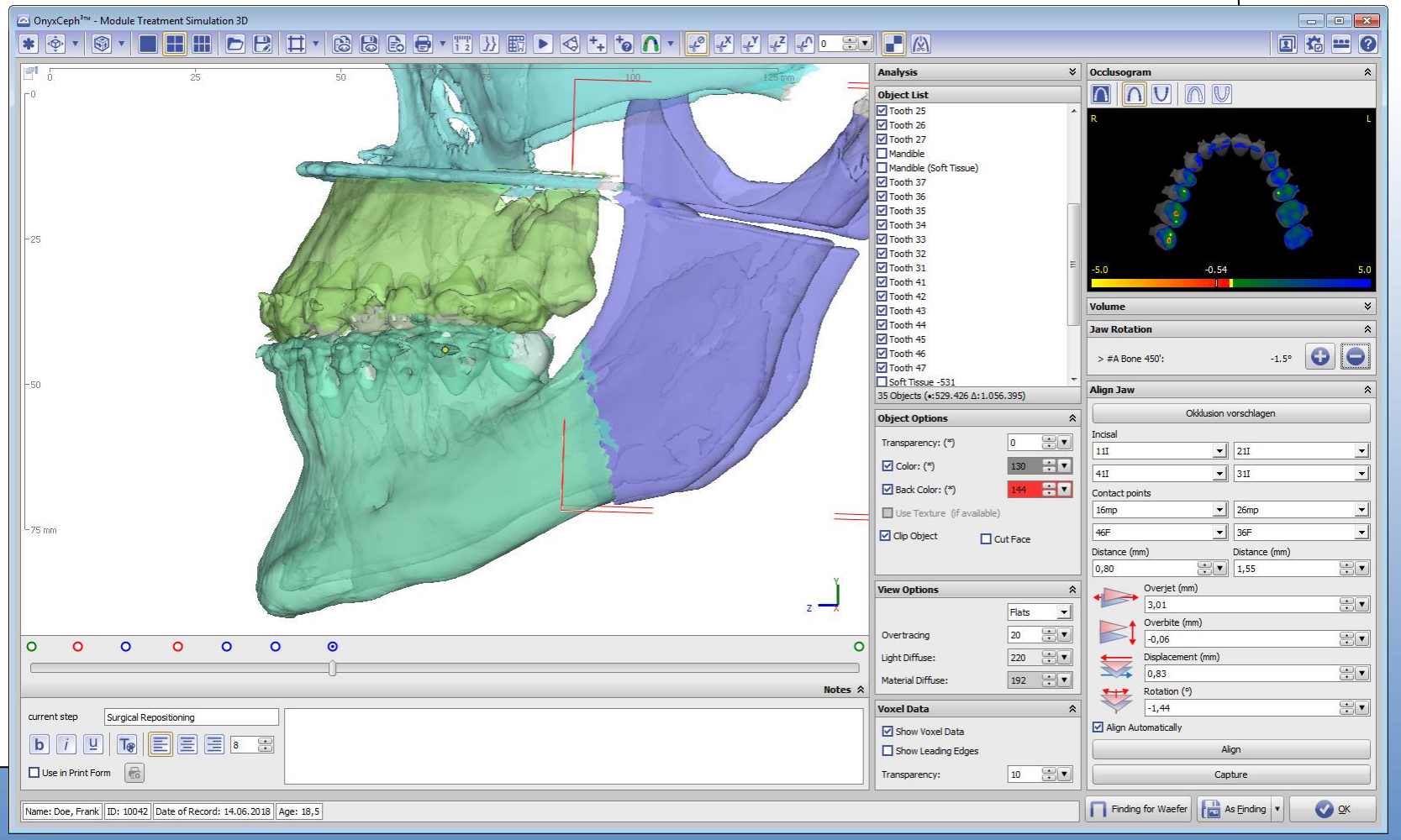


Autorotate Ramus

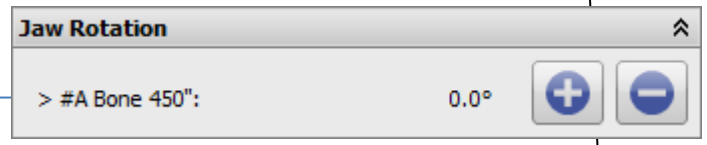
Check mandible-to-ramus relation.

If needed, correct relation by autorotation buttons [+] / [-] in panel [Jaw Rotation]



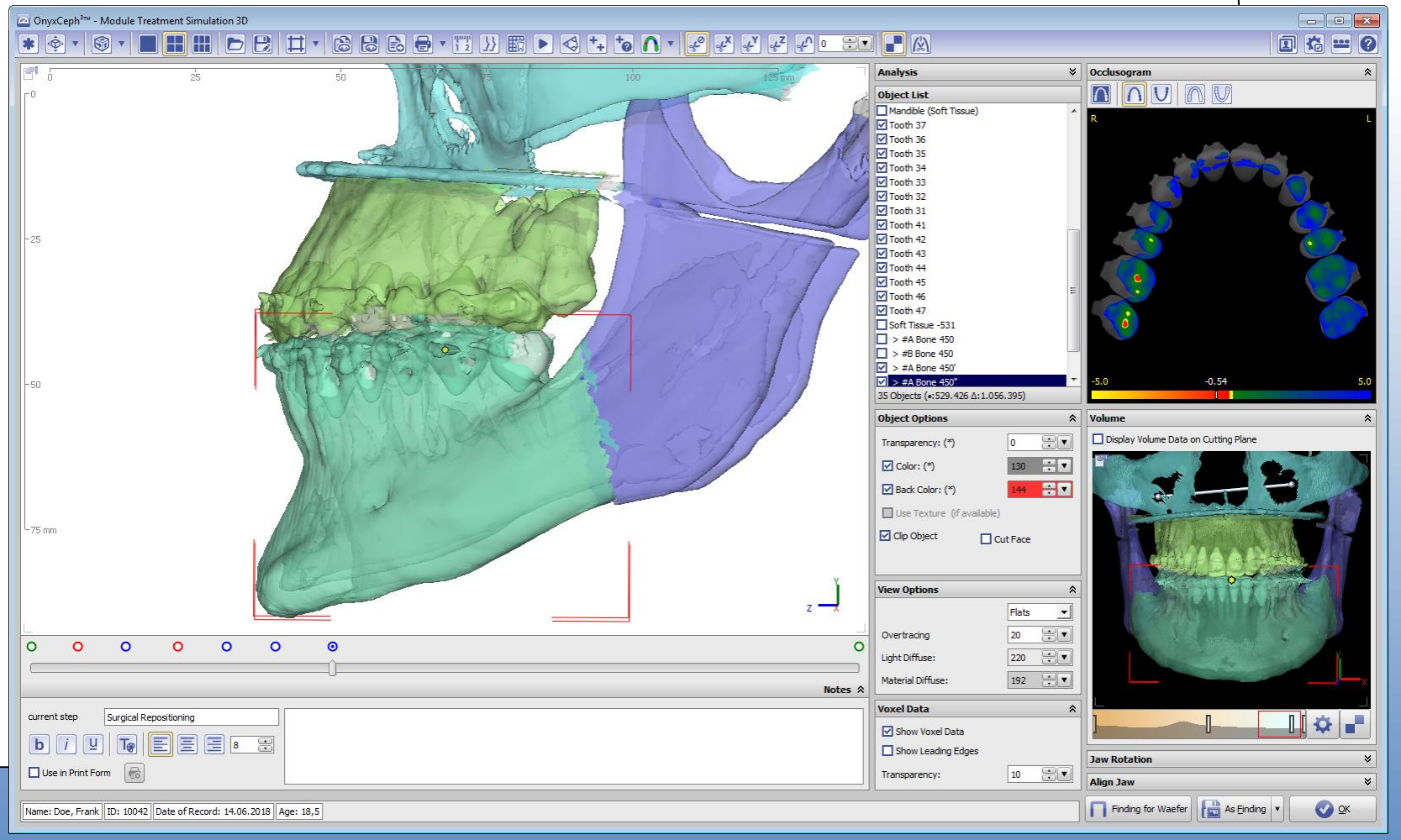


Export Jaw Relation

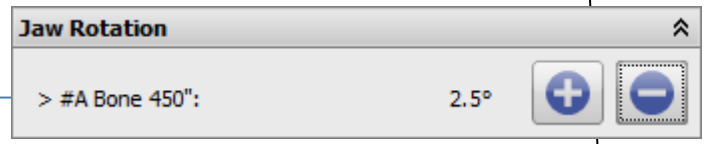


To adopt this dental situation for waefer creation, a slight bite opening by autorotation will be required.

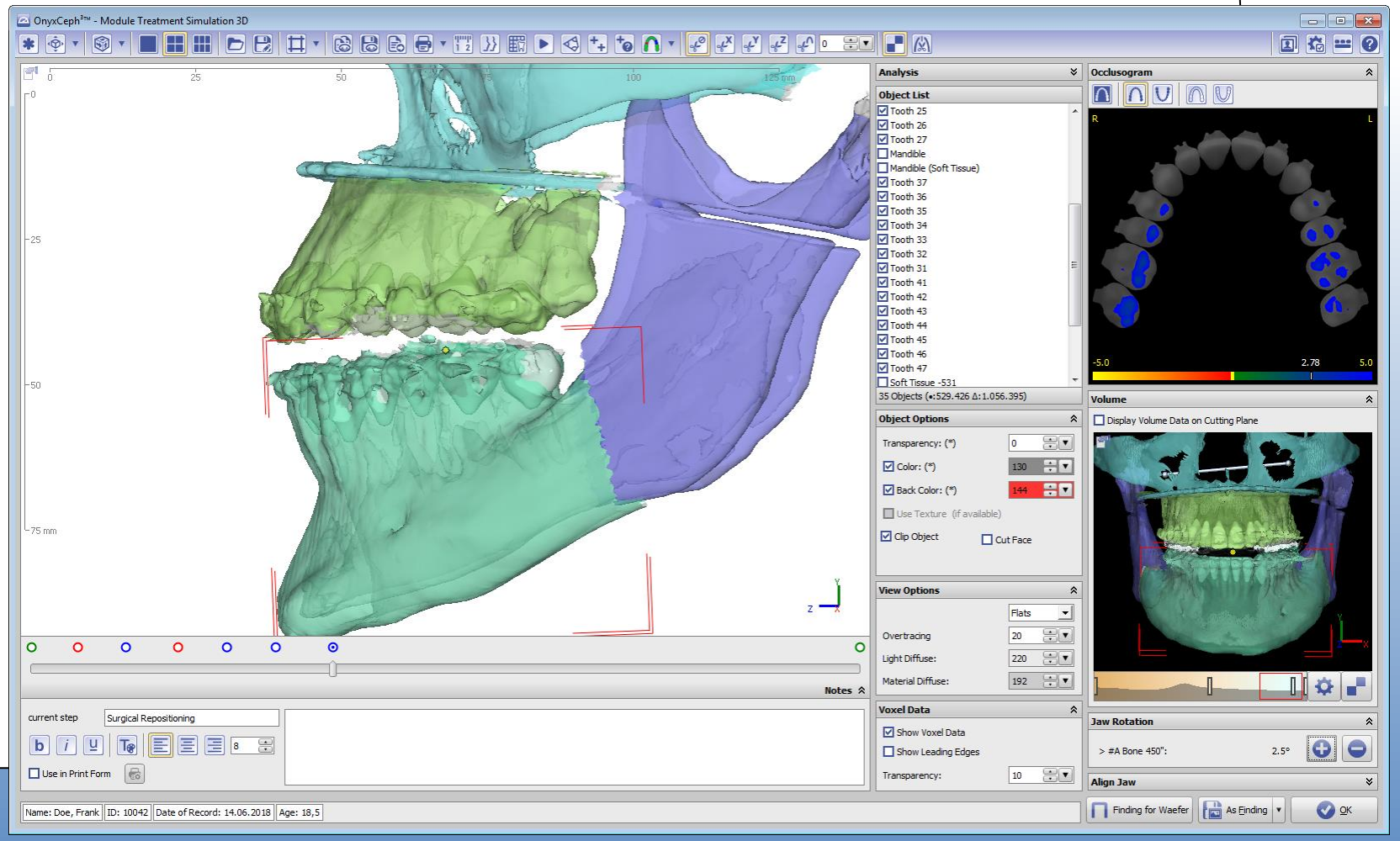
Apply such autoratation to the segmented maxilla first.



Export Jaw Relation



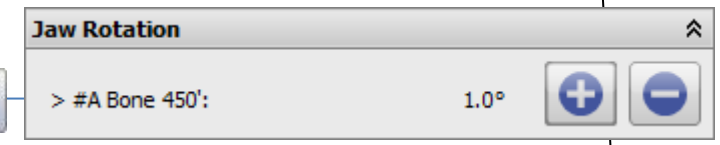
Select 2.5° e.g. or less.

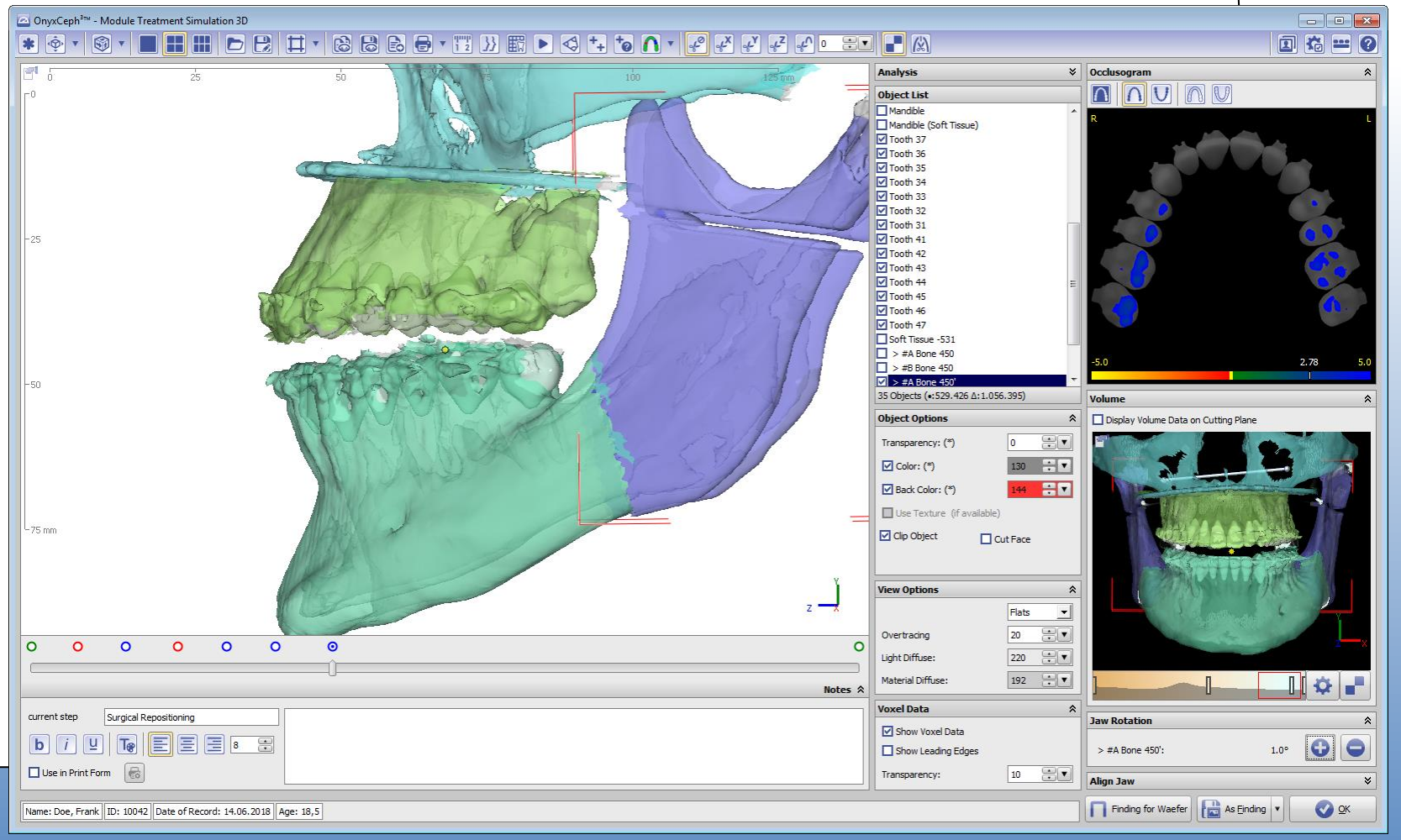


Export Jaw Relation

Thereafter, apply the same autorotation to the ramus segment/s. Take care on any autorotation offset which migh have been applied before.

To transfer this jaw relation during surgery by a splint, click button [Finding for Waefer]

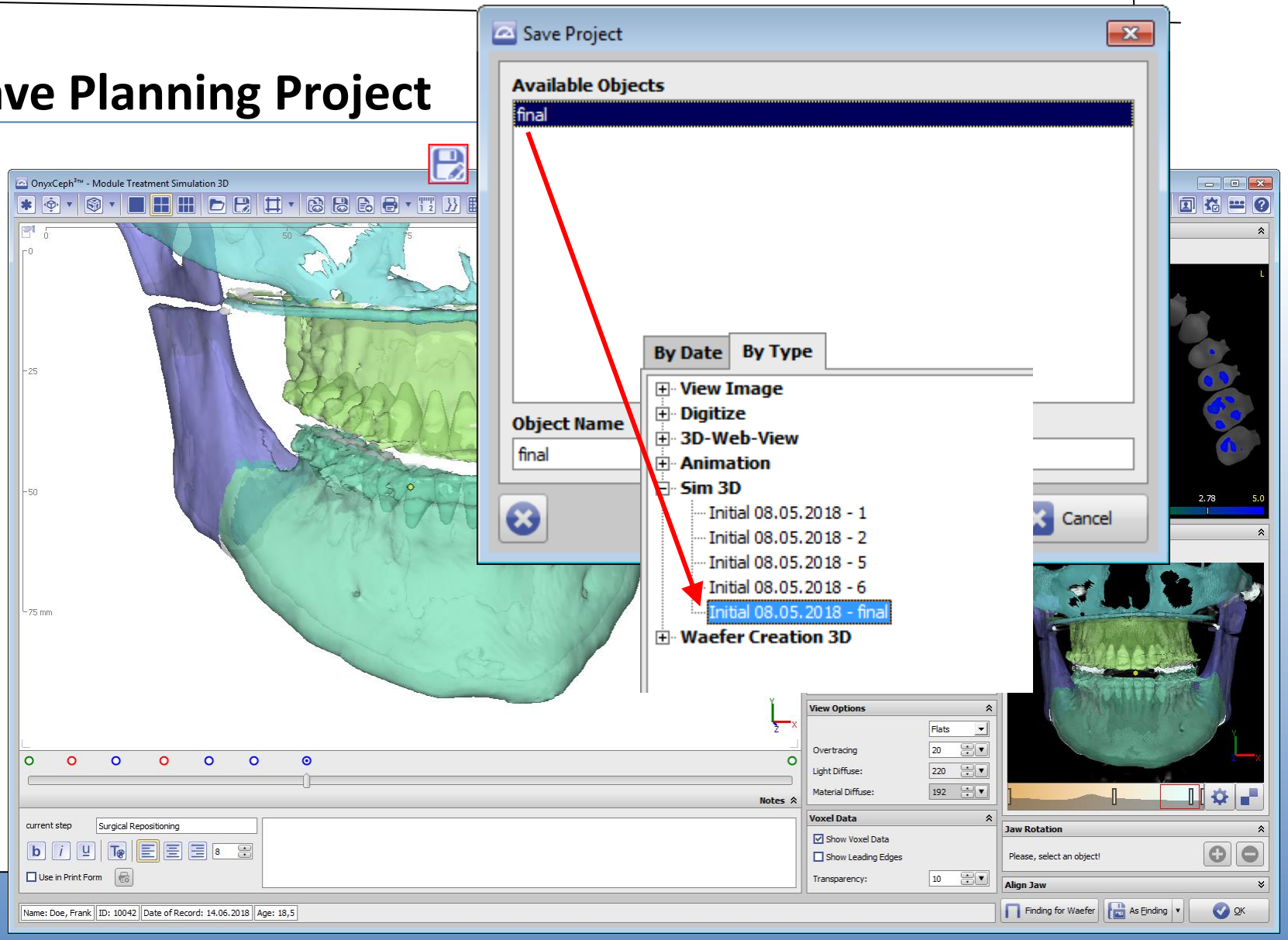




Save Planning Project

Save the planning process as a project.

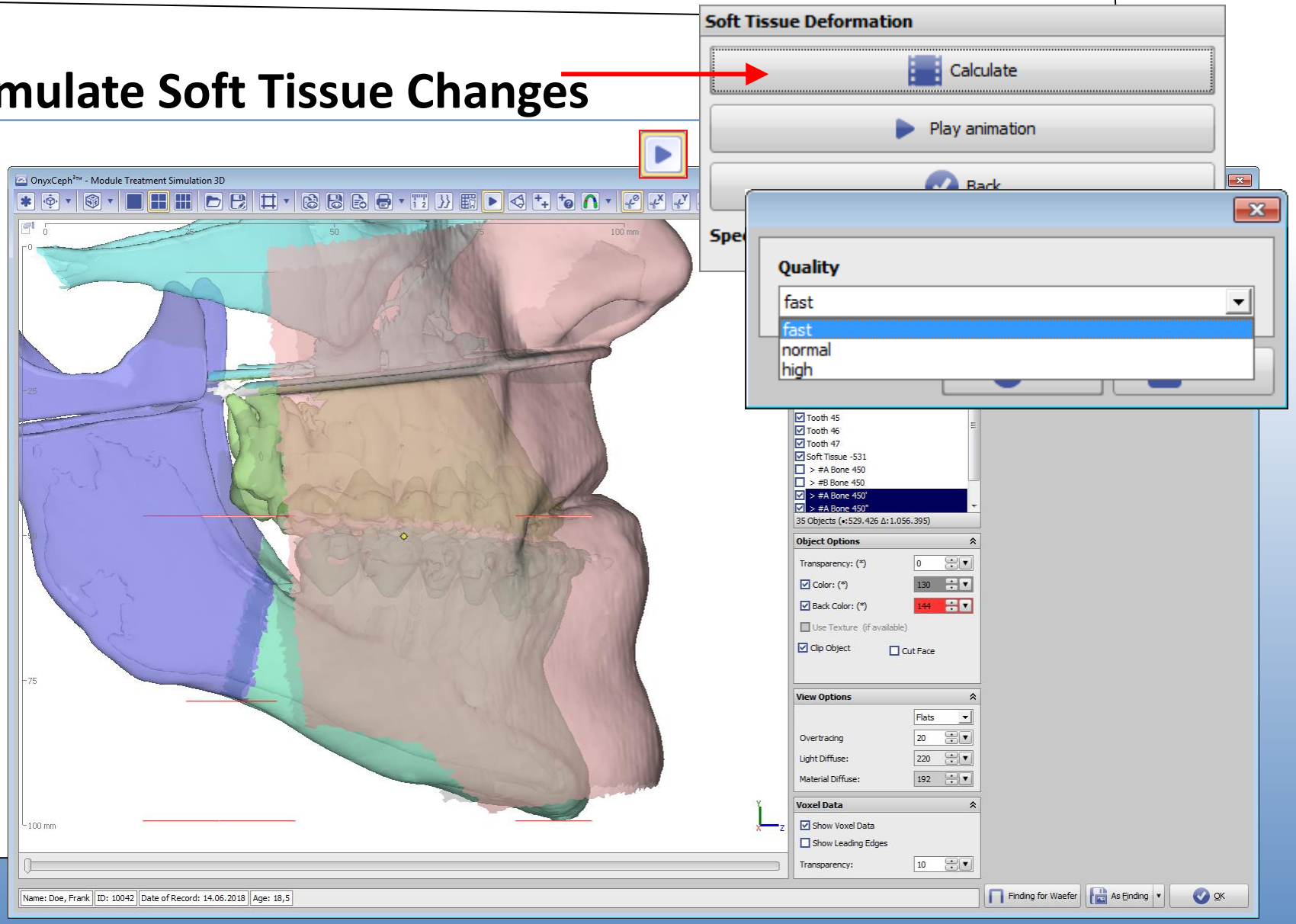
Such project can either be re-opened in module Sim 3D by button [Load Project] or from the document tee on main tab |Patient| .



Simulate Soft Tissue Changes

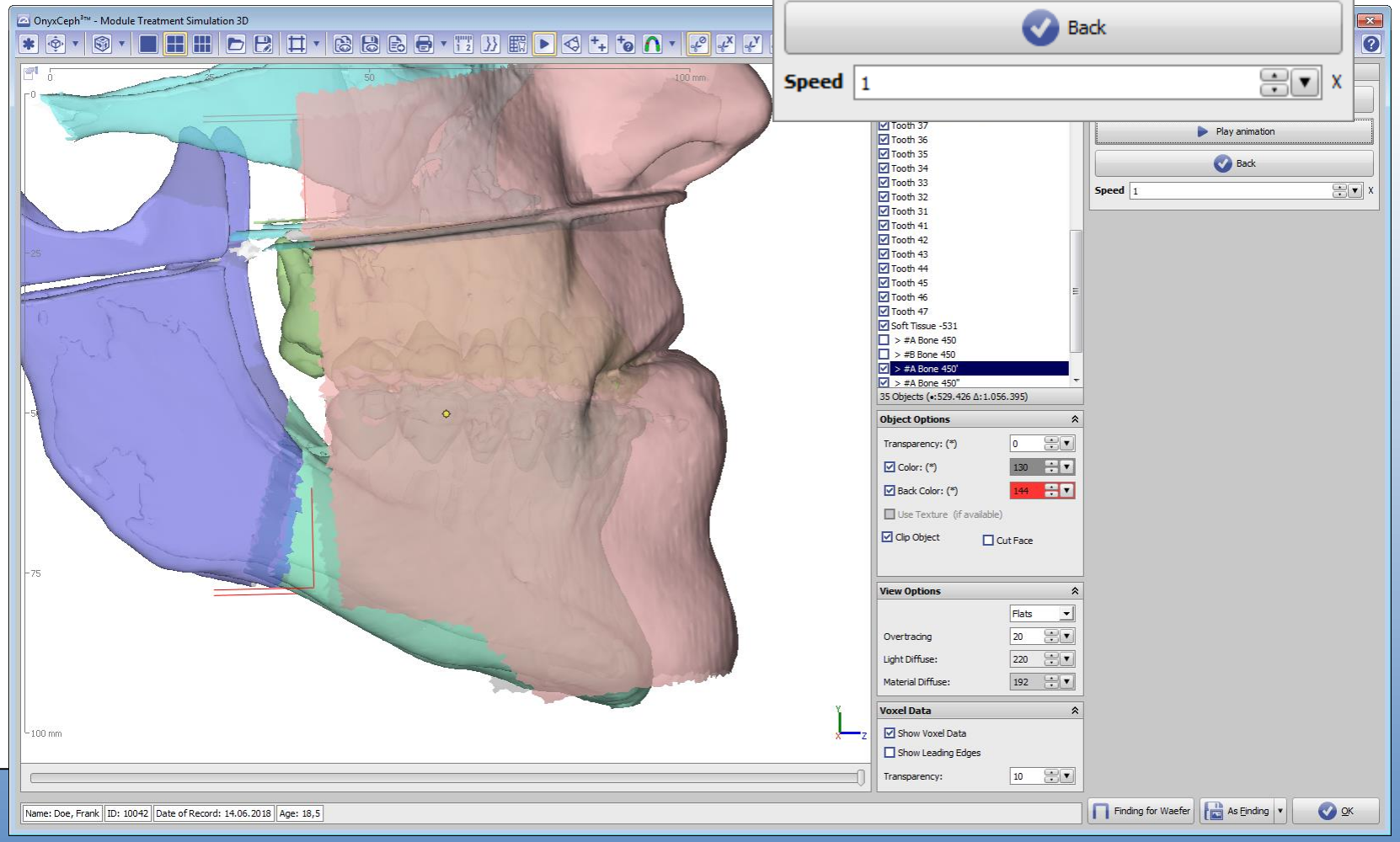
Click the play icon button ► to switch to the animation view.

Click [Calculate] and select a quality for the calculation.



Simulate Soft Tissue Changes

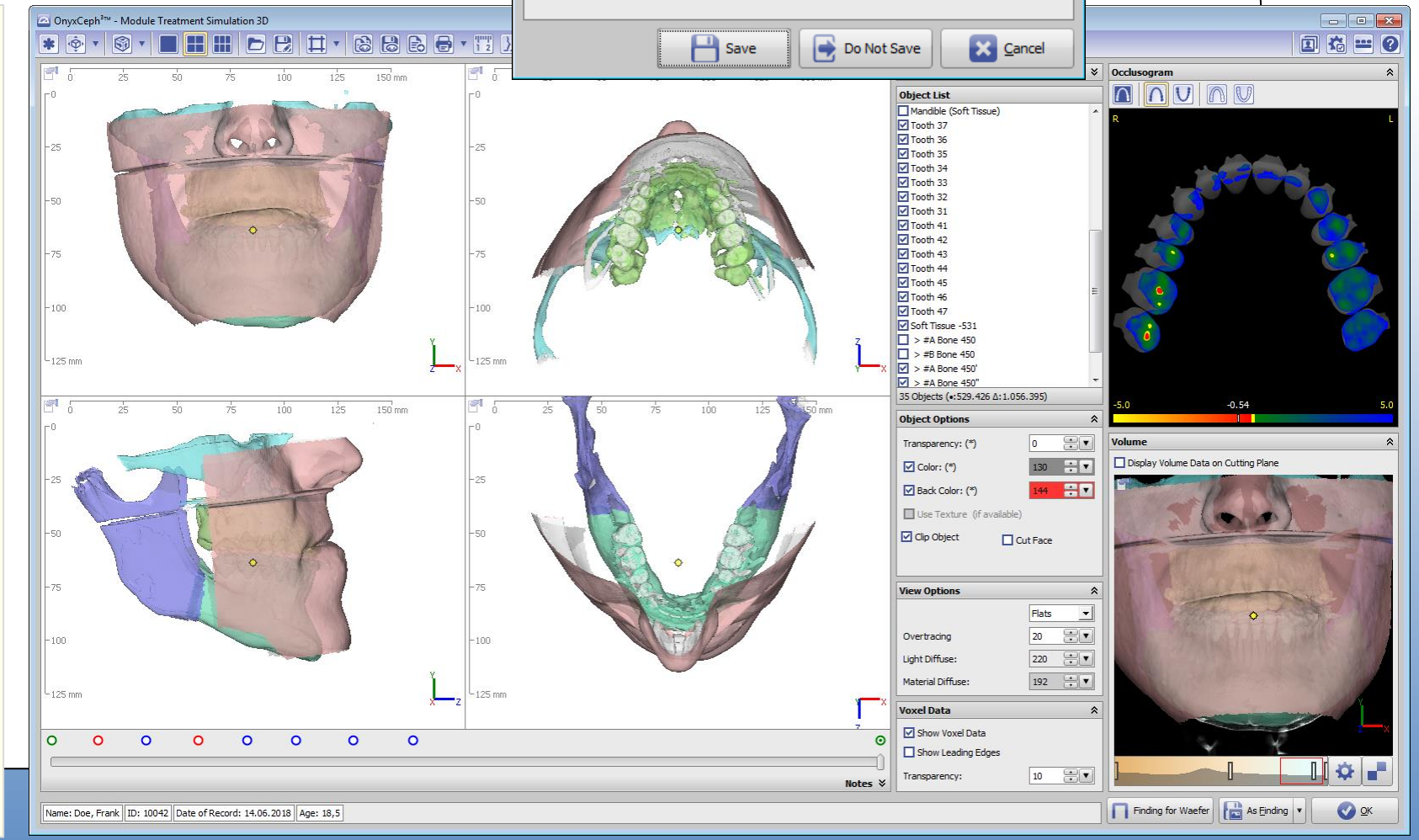
The soft tisue deformation is calculated by a force-minimizing method between step 0 and the planning goal in final occlusal relation.



Close Module Sim 3D

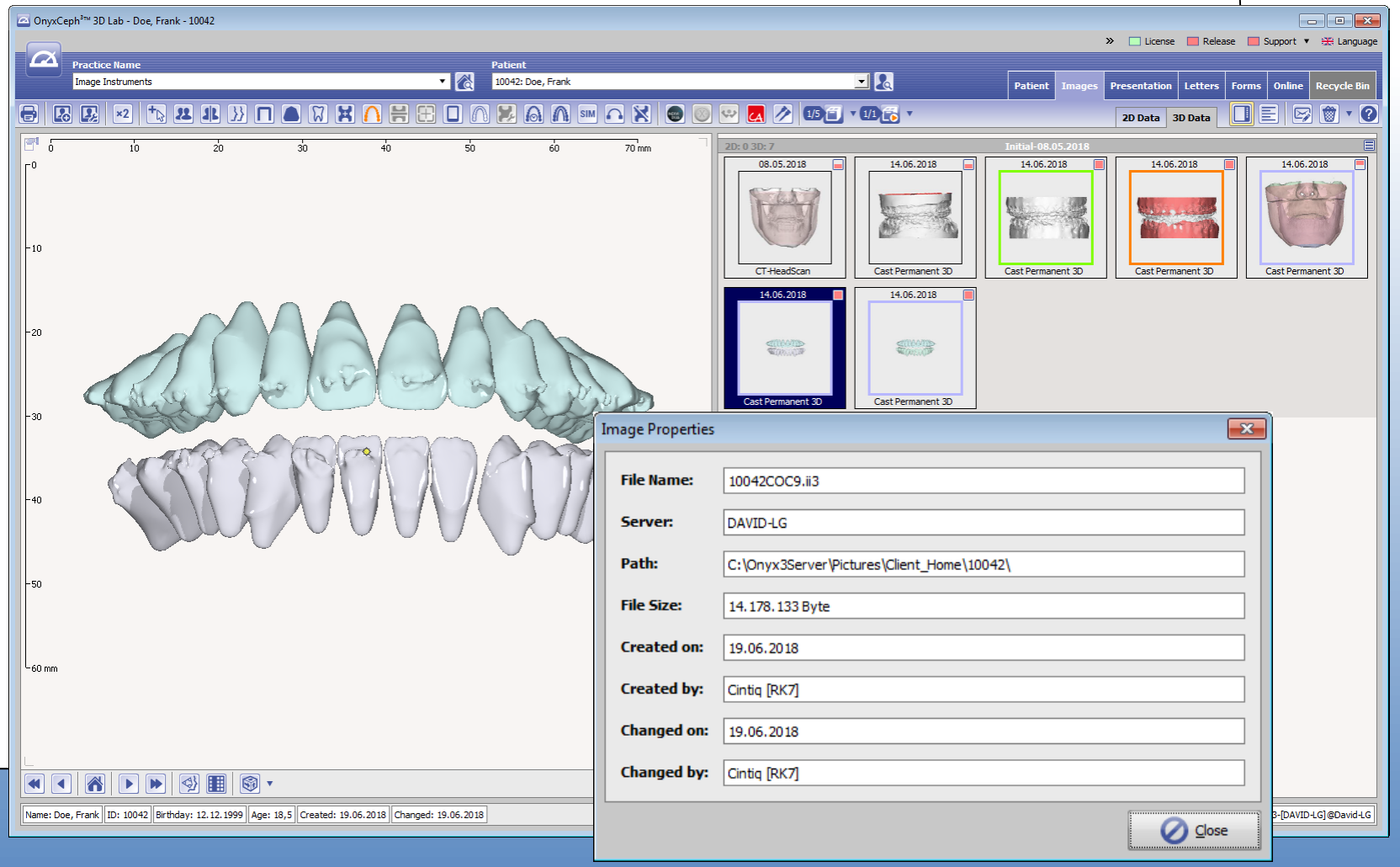
Close module window Sim 3D by button [OK].

If there have been modifications to the project since it was saved, you will be asked to save these changes to be able anytime later to come back and continue at this point.



Use Module Waefer Creation To Design Splints

Exported jaw situations can be used to design surgical splints in module Waefer.



Use Module Waefer Creation To Design Splints

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