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PROPLAN CMF® 3.0.1

Software User Manual

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⚠ Caution, please consult Instructions for Use

CE 0120

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Contents

1 Introduction

1.1. How PROPLAN CMF Software Can Help You

PROPLAN CMF Software allows you to make critical clinical decisions pre-operatively, with great ease of use. Starting from CT, Cone Beam CT or Magnetic Resonance Imaging (MRI) patient data, the software generates 2D and 3D visualizations of pre-operative patient anatomy. Where applicable, this can also be combined with dental cast models, graft site scans and (3D) facial pictures.

With PROPLAN CMF Software You Can:

- Automatically perform cephalometric analyses
- Simulate complex osteotomies and bone repositioning for harvest and reconstruction sites

In just a few mouse clicks, use dedicated wizards to plan:

- Mandible or Midface Reconstructions
- Orthognathic Surgeries
- Distraction Osteogenesis Procedures
- Cranial Reconstructions

Visualize and evaluate different clinical approaches pre-operatively, using virtual planned-outcome models.

Assess the effect of planned treatments on soft tissue, as well as on the overall appearance by using 3D photo mapping.

Facilitate communication with colleagues and patients thanks to life-like virtual visualizations.

1.2. How to Use this Document

In this document, all PROPLAN CMF Software functionalities are described and documented with self-explanatory examples. It is recommended that you read this document section-by-section without switching (e.g. to the final section right away) because basic concepts are explained once and are not repeated in following sections. Try out PROPLAN CMF Software functionalities while reading this document. It will facilitate your understanding. For learning purposes, demo files stored in the folder which were selected during the installation can be used (default location: <*System drive*>:*MedData*).

In case of questions, additional assistance can be requested via proplancmfsupport@materialise.com.

1.3. Intended use statement

ProPlan CMF is intended for use as a software interface and image segmentation system for the transfer of imaging information from a medical scanner such as a CT scanner or a Magnetic Resonance Imaging scanner. It is also used as pre-operative software for simulating/evaluating implant placement and surgical treatment options.

1.4. Instructions for Use

Full instructions for use can be accessed through the Materialise website, http://www.materialise.com/en/medical/electronic-instructions-for-use. This link can also be accessed through the about box, which can be found via the help menu.

1.4.1 For U.S. Customers

Caution: Federal law restricts this device to sale by or on the order of a physician.

1.4.2 Description

PROPLAN CMF Software is a user-friendly scanner-based image-processing software with 3D visualization functions to plan surgical operations on the Cranio-Maxillo-Facial (CMF) region. CT images, CBCT images and MRI images can be interactively visualized and segmented to generate in a 3D rendering of anatomical objects.

1.4.3 Indications

PROPLAN CMF Software is intended for use as a software interface and image segmentation system for the transfer of imaging information from a medical scanner such as a CT or MRI scanner. It is also used as pre-operative software for simulating/evaluating implant placement and surgical treatment options.

1.4.4 Contra indications

None

1.4.5 Warnings

This product should be used by trained professionals. Output must be verified by a responsible clinician.

3D reconstructions must be compared to slice images and verified for approval by a responsible clinician.

It is the clinician’s ultimate responsibility to exercise his/her professional judgment in any decision to follow or not follow the treatment planning made using this medical device (software).

It is advised to use scans with an inter-slice distance of 1 mm. The use of larger inter-slice distances is not recommended.

PROPLAN CMF Guides are to be used by a trained physician in the performance of surgery.

Be aware that any patient-specific guides and/or anatomical models derived from a planning created in the software have been manufactured based on CT/MRI scans of the patient. If the patient’s anatomy has changed significantly since the time of the CT/MRI scan, the guides or models should not be used.

1.4.6 Precautions

The quality of the images in the PROPLAN CMF Software depends on the quality of the scanned images. To obtain optimal results, use scan parameters specified in the scanning protocol.

It is advised to use the guide or anatomical model within 6 months of performing the CT/MRI scans on which they are based. If the patient’s anatomy has changed significantly since the time of the CT/MRI-scan, the guide or model should not be used, even if the time period of 6 months has not expired.

2 Get Ready to Work

2.1. System Requirements

2.1.1 Software Requirements

PROPLAN CMF Software can be used on the following operating systems:

- Windows Vista SP2 x64.
- Windows 7 x64.
- Windows 8 x64.
- Windows 10 x64.

Note: To maximize the full capacity of your PC and process larger datasets PROPLAN CMF Software 3.0 is supporting x64 OS platforms only.

2.1.2 Hardware Requirements

PROPLAN CMF Software can work on a PC with the following configuration:

- Intel Core2Duo or equivalent.
- 3 GB RAM.
- AMD Radeon or NVIDIA GeForce graphics card with 128MB RAM or equivalent.

To ensure optimal performance, we recommend using this configuration (or higher):

- Intel i3 or equivalent.
- 4 GB RAM.
- AMD Radeon or NVIDIA GeForce graphics card with 256MB RAM or equivalent.

Note: it is absolutely essential to use valid drivers for the video card and for all other hardware as provided by the manufacturer of your PC.

2.2. Device Lifetime

ProPlan CMF is software and does not degrade in performance. Its lifetime is determined by commercial requirements, obsolescence of its techniques or obsolescence caused by changes in its host environment (refer to above requirements). Support can in any case not be guaranteed beyond 7 years after the release of this particular version of the software.

2.3. Installation

To install the software, start the PROPLAN CMF installer file that you have received from Materialise. Then follow the instructions of the “Installation Wizard”. Please note that you will need administrator rights to install the software. After successful installation, you are required to reboot of your computer to register system components.

2.4. Starting the Application

To start PROPLAN CMF Software, double-click the *PROPLAN CMF Software icon* on your desktop or via Start > All Programs > Synthes > PROPLAN CMF 3.0> Run.

Alternatively double click on Proplan CMF Project files (*sppc, *sgc).

2.5. License Registration

When you first start PROPLAN CMF Software, the “Password Request Wizard” will appear. Choose the option which corresponds to your type of purchase:

Evaluation

- I want to apply for an Evaluation key file – use this option to contact our sales representatives and request an evaluation license key.

- I want to register an Evaluation key file I received via e-mail – use this dialog to register a received Evaluation key file. Click “Browse” and locate the key file you received. Also in this dialog, you can view your System ID which is required to generate a license key file.

License

- Instant activation – use this option if you know your CCKey (unique client identifier - this code can be found on the Certificate of Authenticity sent with each licensed copy of Materialise software). PROPLAN CMF Software will be registered automatically once all information is provided.
- Apply for a key file via our website – redirects to Materialise’s website where you can manage your licenses interactively.
- Apply for a key file via e-mail – use this option to contact our sales representatives and request a license key.
- I want to register a License key file I received via e-mail – use this dialog to register a received key file. Click “Browse” and locate the key file you received. Also in this dialog, you can view your System ID which is required to generate a license key file.

Floating License Server – use this option if your organization has a floating license server configured.

Please contact your sales representative at Materialise if you have any issues with your software registration.

2.6. Scanning the Patient

To ensure optimal planning results and the high quality of anatomical models and surgical guides ordered from Materialise, we highly recommend that you follow our PROPLAN CMF Surgical Planning CT scan guidelines. These guidelines can be found at the following location: http://cranio-maxillofacial.materialise.com/customer-support.

Make sure you send this protocol to the radiology department, together with the scan order.

3 Software overview

3.1. Quick start guide

3.1.1 Starting the application

To start the application, double click the ProPlan icon to start the application, or double click on Proplan CMF Project files (*sppc, *sgc)

If the application is started without a project file the start page will be opened. Here it is possible to select either to

- open a project
- to import images

3.1.2 Open Project

Project files can be opened in the following ways:

- Click “Open Project” on the “Start” Screen or from the “File” menu.
- Double-click on “PROPLAN CMF project files” (*.sppc, *.sgc).
- Locate a project file in your system by using the “PROPLAN CMF Open Project” or “Open File” menu.
- Drag & drop a project file to the opened application.
- If a project was previously opened it can be opened again by clicking the name of the file in the overview page.
- Click “Import Images” on the “Start” Screen to import DICOM. (more information in section 0 and 4.1)

Note: PROPLAN CMF Software 3.0 has following restrictions for project opening:

It will not allow you to open projects created in version 2.0 or older.

It will not allow you to read cephalometry analysis created in version 2.1 (though the project will be opened).

If you create a new project in version 3.0 you will not be able to open it in any previous version.

Once a PROPLAN CMF Software Project is opened, the “Overview” screen gives you insight into all available wizards and services. The wizards are briefly explained in the next sections and in more detail in chapter 4.

Hover over a menu item on the left side of the “Overview” screen to display more information or click on a menu item to enter a wizard.

Note: A separate license can be obtained to read files created in Mimics Medical 17 and higher and Mimics inPrint in PROPLAN CMF Software. The additional license will support Images, Masks and 3D objects.
Not every license supports all functionality. If you cannot access certain functionality described in the manual this could be because of the license.

Once a project is opened, the axial view and 3D view of the selected project are displayed on the right side of the “Overview” screen.

To return to the “PROPLAN CMF Overview” screen in any wizard, click “Back to Overview” at the top of the left pane.

3.1.3 Import Images

To start a completely new project DICOM images will first need to be imported into the application. To start the wizard, use the corresponding button in the “Start” screen or in the “File” menu.

Step 1: Select the media or files that contain images to import them.

Step 2: Check the study and convert it.

Step 3: Select the study to open.

Note: PROPLAN CMF Software only supports DICOM images. Any other formats will not be imported even if they are selected with the Import Wizard.

A more detailed instruction on importing images can be found in IMPORT IMAGES, 4.1.

3.1.4 Segmentation

The *Segmentation Wizard* will guide you step-by-step through the process of segmenting bone parts and soft tissue. The result will be a 3D object that can be used in planning wizards.

Step 1: Choose between creating a new 3D and creating a 3D object starting from an existing 3D.

Step 2: Set the threshold range

Step 3: Remove unconnected parts

Step 4: Remove parts of the masks

Step 5: Name the 3D Object, adjust the color

Step 6: Convert the masks into 3D objects.

For more detailed information on Segmentation, please see SEGMENTATION, 4.2.

For the segmentation of the mandibular and maxillary nerves, the panoramic view, together with the curve annotation can be used. More information on the panoramic view can be found in MENUS, 3.2.3, and more information on the curve annotation is provided in section 3.2.4

3.1.5 Natural head Position/Horizontal reference

The axial slice orientation can be adjusted using the *Natural Head Position* wizard. Three modes are available to set the Horizontal Reference:

- Manual mode
- According to the Frankfurt plane
- According to the Occlusion plane

More information on the setting the natural head position can be found in NATURAL HEAD POSITION, 4.3

3.1.6 Cephalometry

The *Cephalometry Wizard* allows you to indicate anatomical landmarks on objects in the 2D, X-ray or 3D view to perform a Cephalometric analysis.

Step 1: Select a cephalometric analysis.

Step 2: Indicate the cephalometric landmarks on the X-ray, 2D or 3D view. When the cephalometric landmarks were indicated on the X-ray view, they can be moved onto the 3D object to link them to an object.

Step 3: Use the Cephalometric analyses overview to check the measurements. If normal values files have been created and selected, the normal ranges for measurements will be indicated in the overview.

For more detailed information on Cephalometry, please see CEPHALOMETRY, 4.4.

3.1.7 Soft Tissue Simulation

The *Soft Tissue Simulation* module allows you to map a picture of the patient on top of the soft tissue, and to simulate how the soft tissue will adjust according to new bone positions.

Step 1: (Optional) Select a photo to and amp it to the soft tissue

Step 2: Simulate the soft tissue according to the new bone positions.

Step 3: Play the soft tissue simulation

Step 4: compare the soft tissue simulations

For more detailed information on Soft Tissue Simulation, please see SOFT TISSUE SIMULATION, 4.5 and the explanation on the Soft Tissue Simulation mode in section 3.2.4

3.1.8 Design Tools

The *Design tools* allow for:

- repositioning of objects
- performing generic 3D operations, as mirror, merge, unite and subtract
- create Cylinders and Spheres
- place labels on 3D objects

For more detailed information on Design Tools, please see DESIGN TOOLS, 4.6.

3.1.9 Osteotomy

The *Osteotomy* wizard allows the user to cut and split the 3D objects. The osteotomy wizard is available via the wizard panel and consists of four steps:

Step 1: Draw osteotomy Plan

Step 2: Adjust Osteotomy Plane

Step 3: Perform Osteotomy

Step 4: Reposition

A more detailed description on how to perform Osteotomies can be found in OSTEOTOMY, 4.7.

3.1.10 Distraction

The *Distraction* Wizard will guide you through all the necessary steps to simulate a distraction:

Step 1: Place New Distractor

Step 2: Adjust Distractor Position

Step 3: Cut the 3D object

Step 4: Simulate the distraction

A more detailed description of the Distraction wizard can be found in DISTRACTION, 4.8.

3.1.11 Reconstruction with Fibula

The *Reconstruction with Fibula* Wizard allows you to plan the reconstruction of the mandibular and/or maxillary defects using the fibula as the donor site. To perform a reconstruction with the Fibula you need to:

Step 1: Create New Reconstruction

Step 2: Select Fibula Bone

Step 3: Perform Osteotomy

Step 4: Indicate curve

Step 5: Adjust planning

A more detailed description of the Reconstruction with Fibula Wizard can be found in RECONSTRUCTION WITH FIBULA, 4.9.

3.1.12 Orthognatics

The *Orthognathics* module in allows you to plan Orthognathics surgeries.

Step 1: Prepare for planning by combining dental cast with 3D segmented objects

Step 2: Plan osteotomies

Step 3: Register and move the bone fragments to create optimal occlusion

Step 4: Reposition the bone fragments to the desired position

Step 5: Design dental splints to assist with performing the surgery as planned

A more detailed description of the Orthognatics wizard can be found in ORTHOGNATHICS, 4.10

3.1.13 Splint design

The *Splint design* module allows you to design dental splints.

To create a dental splint you need to

Step 1: Select the maxilla and mandible bone fragments to be used for splint creation

Step 2: Create a splint preview and adjust it

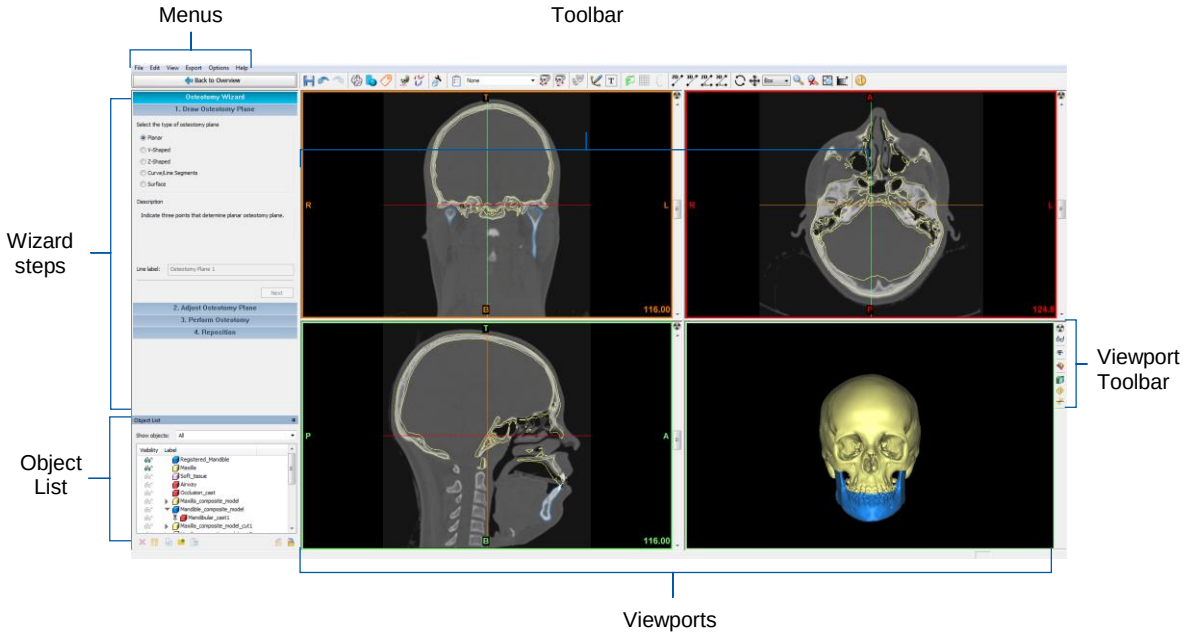
Step 3: Create the splint

Step 4: Export the splint STL and send it to a 3D printer

For more detailed information on designing a Splint, please see SPLINT DESIGN, 4.11

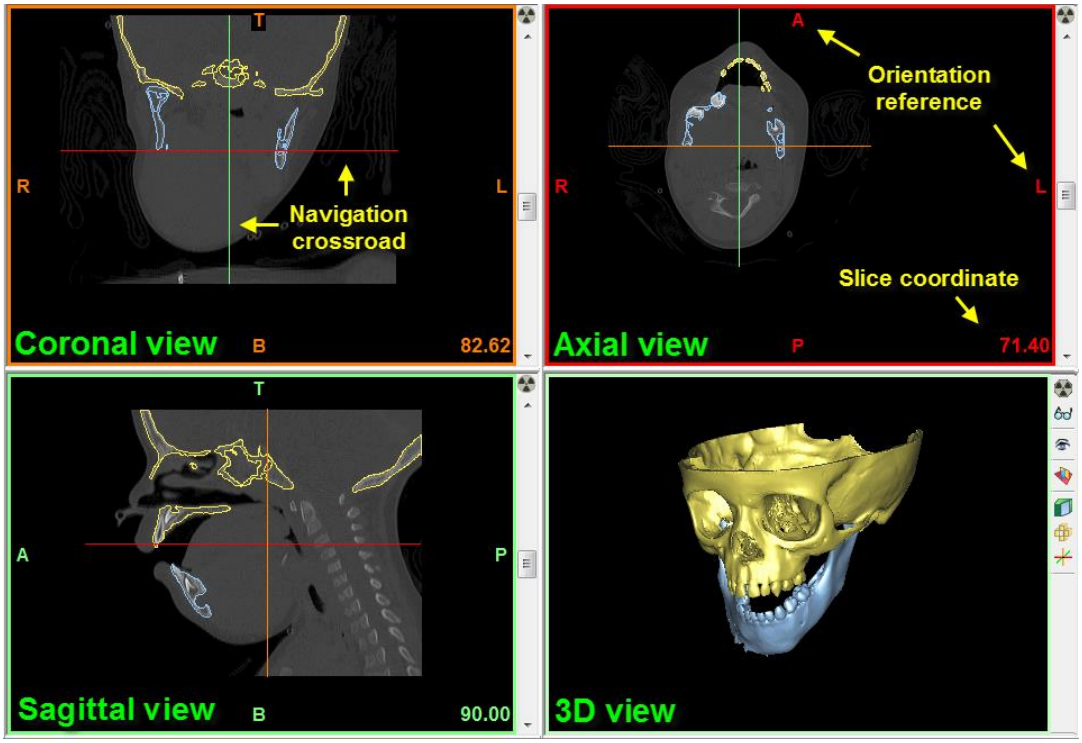
3.2. User interface

3.2.1 General Overview of User Interface



3.2.2 Viewports

PROPLAN CMF Software is a planning tool with 3D and imaging functionality. In the default configuration, four windows and a task panel on the left are displayed.



The 2D and 3D windows can be resized by moving the edge between the images (click and drag to move the edge).

The colored border around each view indicates the view planes:

- Axial – Red.
- Sagittal – Green.
- Coronal – Orange.
- 3D – Light-green.

The colored letters located on each view show the orientation reference.
A/P stands for Anterior – Posterior, L/R for Left – Right and T/B for Top – Bottom.

Clicking on images or 3D objects will re-allocate the navigation crossroad. By default, it is placed in the middle of all views. The position of the crossroad shows the current location in the dataset. The relation between the different views is indicated by the colors of the intersection lines.

The slice coordinate is shown in the lower right corner of the 2D view.

Using the View Menu → Indicators, these indications can be enabled and disabled.

3.2.3 Menus

In this section, you will find a reference list for all features available in the *Main Menu Bar* (top left corner of the screen). For more information about each specific feature, refer to the corresponding section in this document by following the link. Please note that some functionality may not be available if the required license is not available.

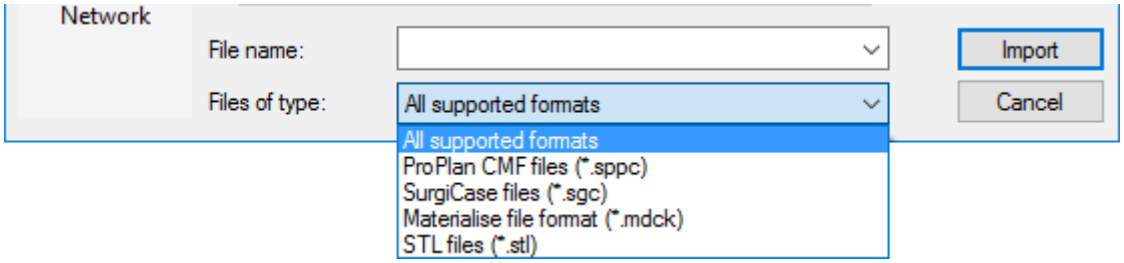
File Menu

The *File Menu* contains the following items (most are also available in the toolbar):

- *Open Project* [Ctrl+O] (More details in OPEN PROJECT, 3.1.2)
- *Save Project* [Ctrl+S]
- *Save Project as*
- *Close Project* [Ctrl+W]
- *Import 3D object* [Ctrl+T]
- *Import Images* [Ctrl+G] (More details in IMPORT IMAGES, 3.1.3)
- *Import online viewer file*
- *Project information*
- A numbered list of previously opened cases
- *Exit* (closes application)

The *Import 3D object* option allows you to import:

- Objects from another PROPLAN CMF project
- Objects from SurgiCase CMF files
- mdck files (this proprietary file format allows you to exchange 3D objects within relevant Materialise software solutions)
- STL files



Edit Menu

The *Edit Menu* contains the following items:

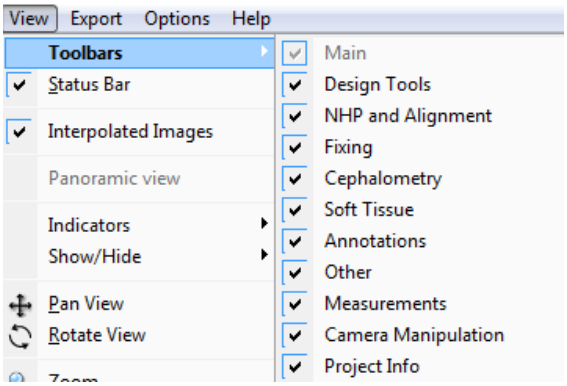
- *Undo* [Ctrl+Z]
- *Redo* [Ctrl+Y]
- *Undo List*.

View Menu

The *View Menu* contains the following items:

- *Toolbars* (more details in TOOLBARS, 3.2.4)
- *Status bar*
- *Interpolated Images*
- *Panoramic View*
- *Indicators*
- *Show/hide*
- *Pan View*
- *Rotate View*
- *Zoom*
- *Unzoom*
- *Zoom to Full Screen*
- *Adjust Gray Scale*

Toolbars allows you to show/hide parts of the Main toolbar. The individual toolbars are described in detail in TOOLBARS, 3.2.4.

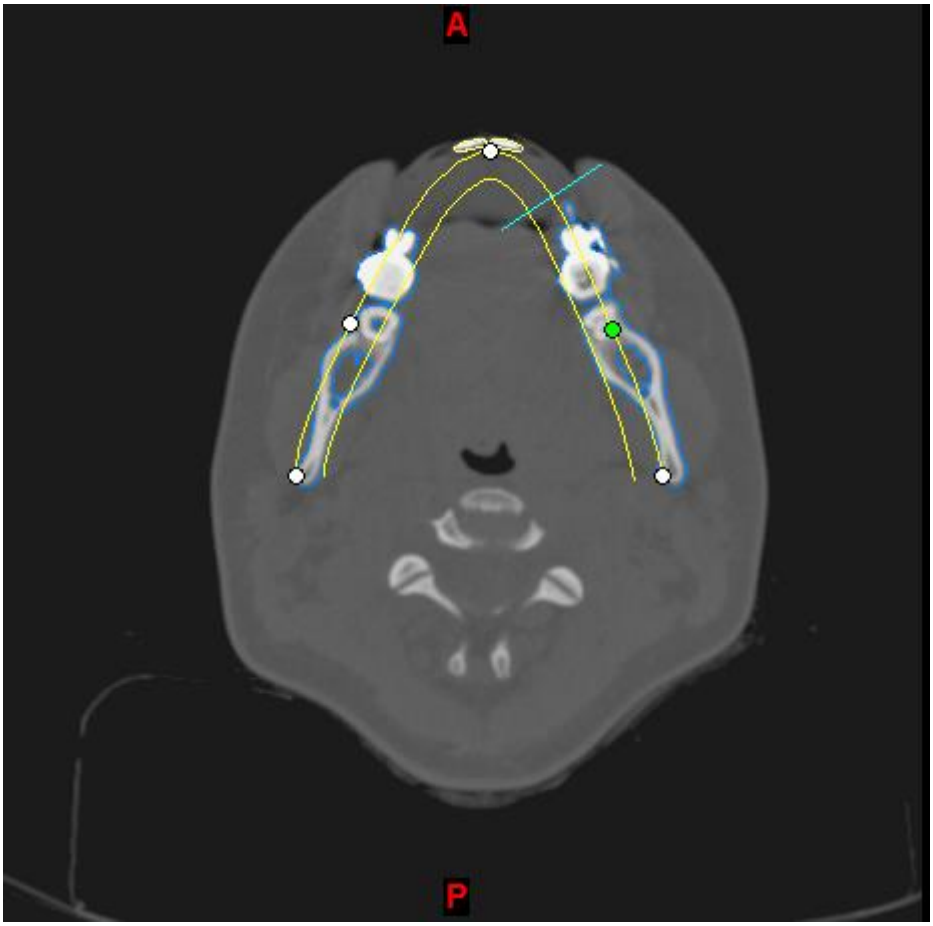


Status bar allows you to show/hide the bar at the bottom of the screen. It shows tips, current gray scale value and cursor position.

Interpolated images turns image interpolation on/off

Panoramic view enables or disables the panoramic view mode. When enabling the panoramic view the axial viewport will be enlarged to the full screen, and the cursor changes to panoramic view curve indication.

Using [LMB click] place the panoramic view curve points. Use the scroll wheel to scroll through the axial slices to get a more clear indication where to place the points. Double click to finalize the curve. As soon as the curve is finalized the screen will return to the normal layout with 4 viewports, however, the coronal and sagittal viewports are replaced with cross-sectional and panoramic viewport. In these viewports the images are resliced according to the panoramic curve.



In the axial viewport the panoramic curve is visible. [LMB drag] to adjust the curve points. [RMB click] to remove a point. Double click LMB to add a point. To delete the curve LMB click to select it and press [Delete].

The Panoramic view curve is based on the slicing of the images in the axial view. If the horizontal reference is adjusted after a panoramic view curve is created the curve will be deleted, as the axial slicing will have changed.

Scrolling through the panoramic view port will display the different panoramic view slices. A second yellow line on the axial view port is displayed to indicate the current panoramic slice position.

Scrolling through the cross-sectional view will show the different slices perpendicular to the panoramic view curve. The small blue line on the axial view indicates the location of the current cross-sectional slice. 2 yellow lines can appear in the cross-sectional view if the cross-sectional view intersects twice with the panoramic view curve. Curve annotations will not be shown on the cross-sectional view.

To create a panoramic X-ray, press the X-ray button in the Viewport toolbar.

To enlarge the panoramic viewport press the enlarge viewport button .

Via *Indicators* the following indicators can be shown or hidden:

- Tick marks
- Intersection lines [Ctrl+L]
- Slice position
- Orientation settings

More information on these indicators can be found in VIEWPORTS, 3.2.2

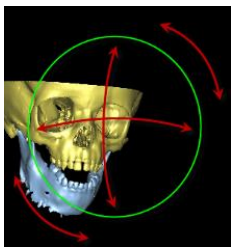
Show/Hide enables or disables the volume rendering. More info can be found in volume rendering, in VIEWPORT TOOLBAR, 3.2.5

Pan view allows to pan images or objects in any viewport once. Alternative ways to pan images or 3D objects are:

- [Shift+ RMB drag].
- Press and hold the scroll wheel
- [Shift+arrow keys] for precise panning
- [Shift+Home] or [Shift+ End] for quick Left or Right panning.

Rotate view allows to rotate the objects in a 3D viewport once using [LMB drag]. Alternative ways to rotate object in 3D viewport are:

- [RMB drag]
- Use the arrows keys for precise rotation.
- [Home] or [End] to rotate 10 degrees Left or Right.
- [PgUp] or [PgDn] to rotate 10 degrees Up or Down.
- [Tab] to loop through the predefined views: Left, Right, Top, Bottom, Front, Back and Isometric



Please note: there are two rotation modes. By repeating the same actions on different parts of the 3D view, different rotations can be achieved. An imaginary green circle on the picture to the right indicates the boundary of these two modes. Red arrows show the rotation type.

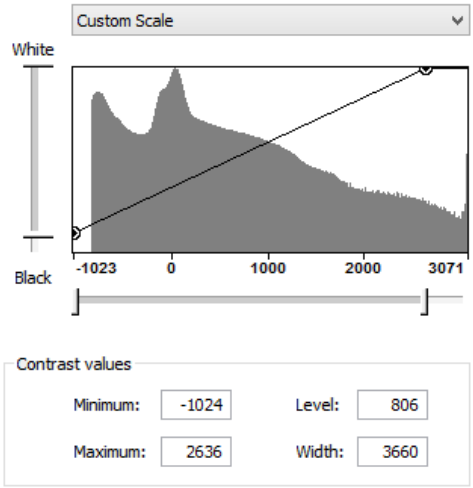
Use *Zoom* and *Unzoom* from the view menu to zoom and unzoom once. Other ways to zoom and unzoom are:

- [Ctrl+RMB drag]
- Scroll wheel, on 3D view only

Select *Zoom to Full Screen*, and click on the viewport that should be zoomed to full screen. Alternatively, use [Space] while hovering over any of the viewports

The *Gray scale* tool which allows to adjust the contrast of the images to better visualize certain areas. To adjust the contrast grab one of the points, or the whole line, and moving it with [LMB drag]. Fill a value in the Minimum and Maximum fields to define the position of points.

Instead of defining the contrast yourself, you can choose one of the predefined scales from the dropdown list.



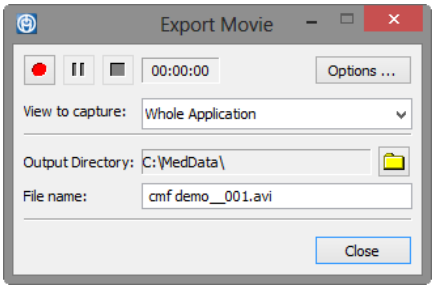
Export Menu

The *Export Menu* contains the following items:

- *Export Screenshot…* [Ctrl+H]
- *Export Movie…* [Ctrl+Shift+M]
- *Export Online Viewer file…*
- *Export selected 3D objects*

Export Screenshot…opens a standard “Save As” dialog to select a folder to store the captured screenshots. Screenshots of the whole application window will be made.

Export Movie opens a dialog where it is possible to control the recording process (start, stop, and pause):



- Select the appropriate view for your interest (Whole Application, Top Left, Bottom Left, Top Right, Bottom Right)
- Select the Output Directory
- Enter File name

It is possible to adjust additional options for capturing the picture by clicking *Options*

General Options

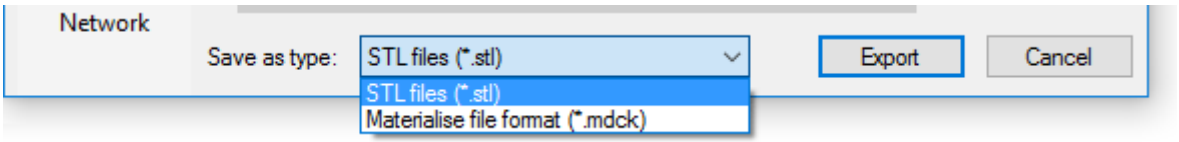
- Minimize before starting capture
- Capture mouse cursor
- Play movie after recording
- Auto-rotate 3D View (20°/sec)

Movie Options

- Frame rate (adjust through dropdown list)
- Video Codec
- Compression (adjust through slide bar)

Export selected 3D objects allows you to:

- Use the object list to define which objects should be exported
- Export 3D objects as .stl files (only available for objects segmented within the active case)
  Export 3D objects as mdck file (this proprietary file format allows you to exchange 3D objects within relevant Materialise software solutions)



Options Menu

The *Options Menu* contains the following items:

- *Register Licenses…* (More details in LICENSE REGISTRATION, 2.5)
- *Modules…*
- *Preferences…* [Ctrl+Shift+F]

Modules… shows you the list of program modules registered in the system. Fill in the password you received to upgrade your license.

The following tabs are available in the *Preferences…* dialog:

- *General*
- *Visualization*
- *3D Settings*
- *Other*

General contains settings for undo, auto-save, etc.:

- *Default Working Directory*
- *Pixel Unit*
- *Maximum Undo Disk Space*
- *Auto-save Frequency*
- *Stl fixing*

Visualization contains settings for visualization of indicators, views, etc.:

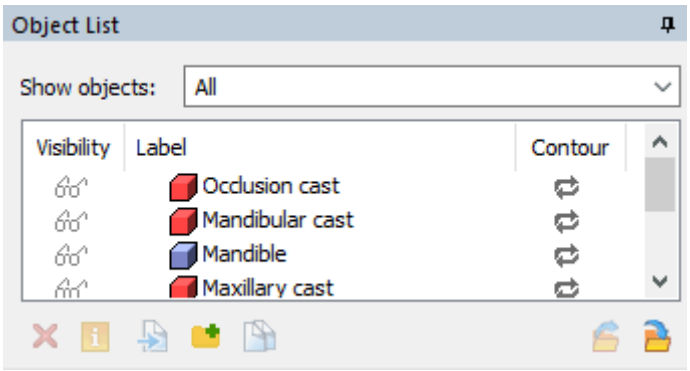
- *Default indicators* preferences, which define whether corresponding controls will be shown on 2D views:
  - Slice position
  - Intersection lines
  - Tick marks
  - Orientation
  - 3D locator
- *User Interface* (reset layouts and toolbars positions)
- *X-ray* (adjusting the depth value/distance over which the image data is summarized to generate the X-ray image)
- *Measurements and annotations* (change the font size for labels of 2D/3D measurements and text/curve annotations)

3D Settings contains settings concerning 3D view, like the type of rendering, reference planes, and performance:

- In the *Rendering* section, you can adjust technical parameters for rendering. It is recommended to keep default settings (Direct3D).
    - Select “OpenGL” or “Direct3D” rendering and select “Use Hardware” if you have a graphic card with hardware acceleration. With this rendering, you get an optimal graphical visualization as the software will automatically search for the graphic card and use the memory on the graphic card for visualization. If you do not have a graphic card with hardware acceleration, select “OpenGL” or “Direct3D” (“Use hardware” not checked) or “Software” rendering
- In the *Visualization and Navigation* section, you can define the color of the background in the 3D view
- *Performance* allows you to make technical adjustments for the 3D view. It is recommended that you keep default settings. Default settings are Faster 3D interaction and 10.0 FPS.
- The *Light* section allows you to make adjustments for the light source in the 3D view. Default values are set to 34, 25, and 85, respectively.

Other contain minor other settings which allow you to:

- Switch the “Collision Detection” functionality on/off in the *Reposition* tool of the *Design Tools wizard*
- Switch on the “Contour*”* colum*n* in the Object List. This option will add an additional column to the "Object List” to toggle the visibility of object contours in 2D image views



- Switch on “Memory optimization” for segmentation of large objects. This takes more time to create 3D objects from masks, but allows you to work with larger datasets
- Show labels for fibula parts. This option show/hides numeric labels for fibula parts in the *Reconstruction with Fibula Wizard.*

Help Menu

The *Help Menu* contains the following items:

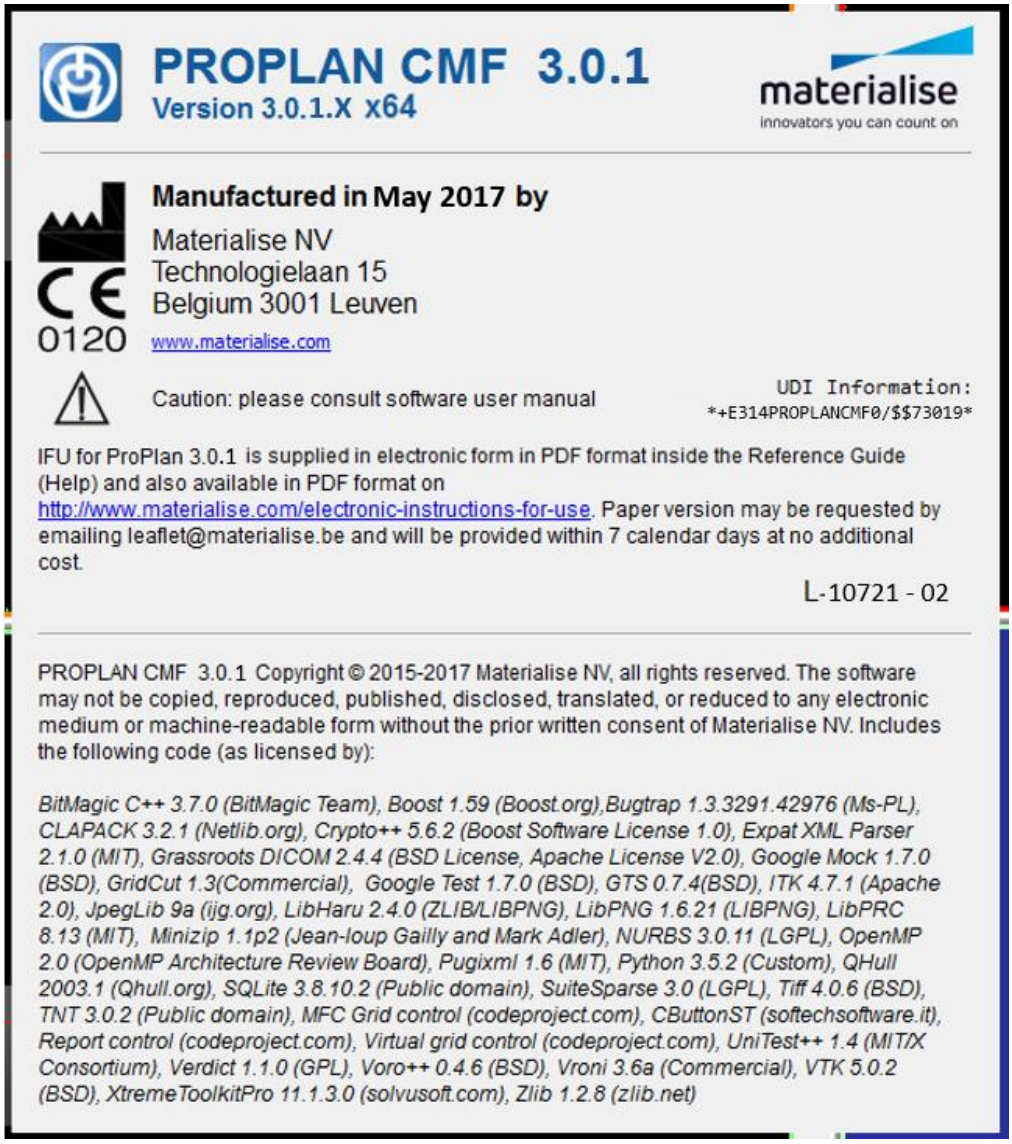
- *Help…*
- *Reset all Tips*
- *Reset Learning mode*
- *About…*

Help shows the reference guide/user manual for PROPLAN CMF. This can also be brought up via [F1].

Selecting *Reset all Tips* will result in all tool tips and warning messages to be shown again, same as after the first installation.

Reset Learning mode will result in the quick guide for Reconstruction with Fibula wizard to be shown again.

About shows system information. If you encounter any problems with the software, please forward it to us together with your system information. Click on the about box to close it.



PROPLAN CMF 3.0.1
Version 3.0.1.X x64

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Caution: please consult software user manual

UDI Information:
+E314PROPLANCMF0/$$73019

IFU for ProPlan 3.0.1 is supplied in electronic form in PDF format inside the Reference Guide (Help) and also available in PDF format on http://www.materialise.com/electronic-instructions-for-use. Paper version may be requested by emailing leaflet@materialise.be and will be provided within 7 calendar days at no additional cost.

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3.2.4 Toolbars

The toolbar is divided into several sub groups which can be hidden or shown via the *View Menu*. Each of the sub groups will be explained in more detail in this section.

If no parts of the toolbar are hidden, the toolbar looks like this:

Main 

The *Main* toolbar consists out of a *Save* [Ctrl+S], *Undo* [Ctrl+Z] and *Redo* [Ctrl+Y] function.

Design Tools 

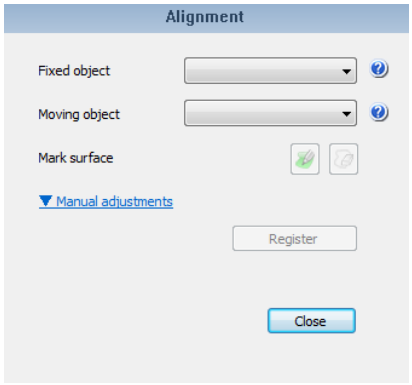
The icons in the *Design Tools* toolbar will open respectively the *Reposition*, *Standard shapes* and *Labelling tool* in the *Design Tools* Wizard. More details on these tools can be found in DESIGN TOOLS, 4.6.

NHP and Alignment 

The first icon will open the *Natural Head position* tool and the second the *Alignment* tool.

More details on the NHP tool can be found in NATURAL HEAD POSITION, 4.3

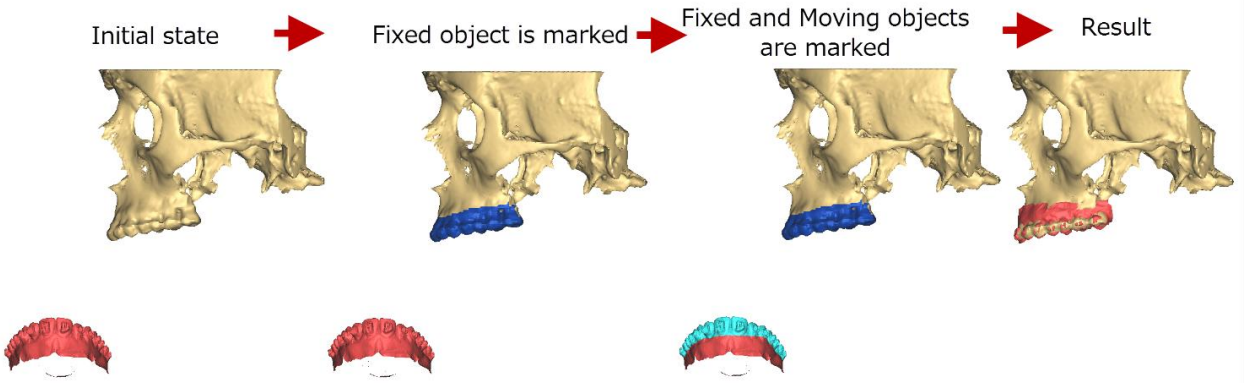
The *Alignment* tool allows you to align the position of one 3D object to the position of another 3D object. By clicking the *Alignment tool* icon the following dialog will appear in the left panel:



- *Fixed object* allows you to define the object to which another one will be aligned
- *Moving object* allows you to define the object which will be aligned. Also note that if the selected object has linked objects, these will be moved along
- *Mark surface* switches on drawing mode (cursor will be shown as a circled brush). By using this brush an area of interest can be highlighted on the surface of the selected objects (fixed, moving or both) to increase the accuracy of the alignment tool. The marked surface(s) will be taken into account during the alignment.
- *Unmark All* removes all marked surfaces
- *Manual adjustments* contains standard interactive Rotate/Translate controls. It allows to manually fine-tune the alignment without opening the Reposition tool.
- *Register* initiates the alignment algorithm

The following shortcuts are available for marking:

- Change brush size [Alt+LMB drag]
- Unmark a specific marked region [Ctrl+LMB drag]



Fixing

When clicking the Fix stls icon the STL Fixing dialog box will open where the user can analyze the created STL(s) and fix if needed.

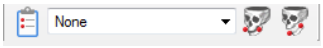
Select the STL that might need fixing from the *STL to be fixed:* drop down list

Select *Analyze* to run analysis on the selected STL.

Based on the result, select *Fix* to fix the STL, or to continue to the next STL.

Note: A fixed STL does not guarantee a good result when 3D printing the object. The user is responsible for checking and confirming STL's are compatible with a 3D printer before 3D printing.

Cephalometry



These tools refer to the Cephalometry analysis that was performed on the case. The first icon will open the *Cephalometry analyses overview* which shows the results of the selected analysis. Next to that a list of *Active analyses* is shown in a dropdown menu where it is possible to choose which of the created analyses should be shown on the viewports. The two other icons allow to *Show/Hide Pre-Op objects* and *Planned objects*. More details can be found in CEPHALOMETRY, 4.4.

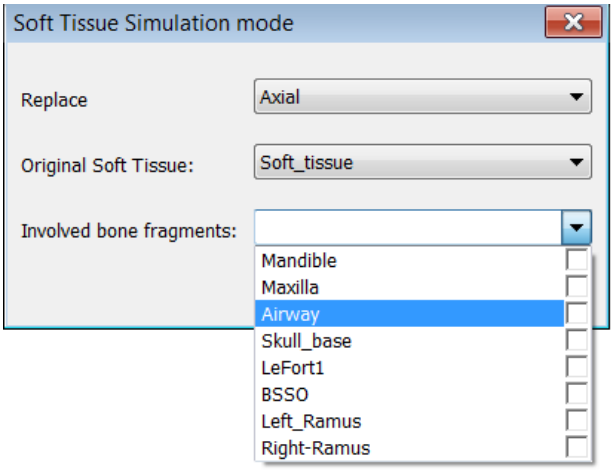
Soft Tissue simulation mode

This tool enables to simulate in real-time the new soft tissue situation when applying various displacements to the bone fragments using the repositioning tools. This functionality will display an immediate preview/update of the soft tissue simulation.

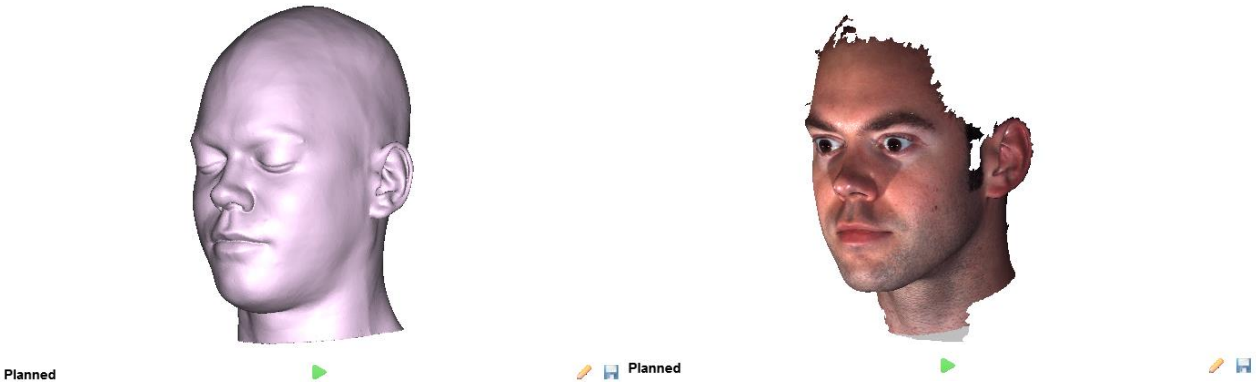
The tool can be only be activated from the reposition step within the *Orthognathics* wizard or the *Osteotomy* wizard.

The Soft Tissue Simulation mode dialogue box enables to select 3 different parameters:

- Replace: the soft tissue simulation mode will replace one of the existing 2D views (axial, coronal or sagittal)
- Original Soft Tissue: this parameter enables to select the previously segmented pre-operative soft tissue of the patient, which may have undergone the photomapping step as explained in PHOTO MAPPING, 4.5.1 (the photomapping step is not mandatory though)
- Involved bone fragments: a drop down list of the 3D objects will appear, you will need to choose the desired post-osteotomy bone fragments

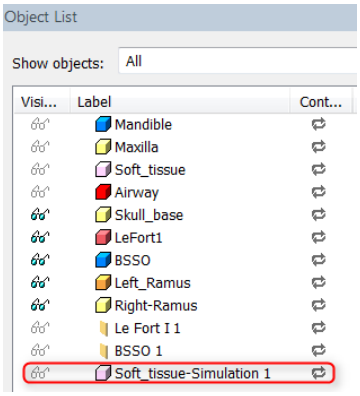


The soft tissue simulation mode then appears in the replaced 2D view and it includes 4 buttons:



From left to right: soft tissue simulation mode without and with the photomapping step

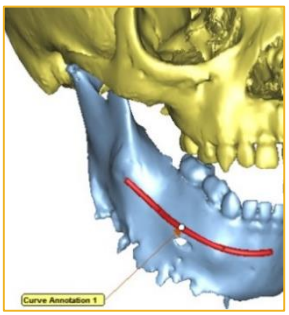
- **Planned** / **Pre-Op** : this button enables a switch between the currently simulated soft tissue configuration and its pre-operative configuration.
- / : this play/stop button enables to play or stop the simulated soft tissue configuration, this is very similar to the play simulation step seen in section 4.5.3
- : this Edit button enables to modify the simulation by displaying again the Soft tissue simulation mode dialogue box (change the used 2D view, soft tissue 3D object or bone fragments)
- : the Save button enables to save one or several simulations, which will be saved as a new entity within the 3D objects list



Annotations

These tools allow to place a *Curve annotation* or *Text annotation*.

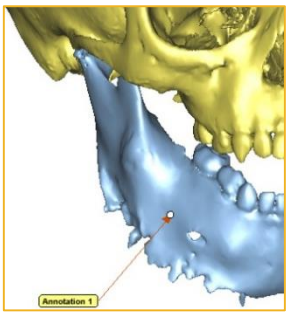
Click the *Curve Annotation* to activate the curve annotation tool. Indicate points in the 2D or 3D view to define a curve. Double-click to finish the curve.



The following controls are available:

- Reposition the curve to a new location using [LMB drag]
- Each curve point can be repositioned using [LMB drag], and deleted via [RMB click]
- [RMB click] on the curve to delete or hide it.
- After creating a Curve Annotation, the object will be present in the object list.
- The properties, including thickness and transparency can be adjusted via the properties icon .

Click Text Annotation to indicate a text annotation in the 2D or 3D view. To create a label that will be merged with 3D object and will remain visible when 3D printing the object, use the labelling tool.



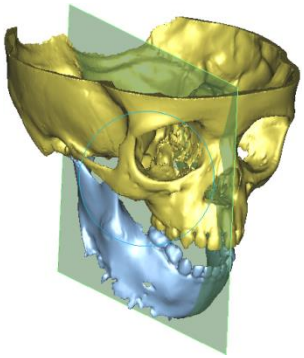
- Indicate a point in a 2D or the 3D view to which you want to link your annotation
- A dialog box will open where a text can be added in the *Description* field.
- The text of the annotation can later be adjusted via the object properties .

Other

The icons in the Other toolbar enable the user to adjust the sagittal plane, enable the reference grid and show the object contour curve.

The *Adjust Sagittal Plane* function allows you to adjust the position of the sagittal plane.

By default, the Sagittal plane is calculated in the middle of the images dataset. Use the circle shown in the Axial, Coronal and 3D view to fine-tune its position:

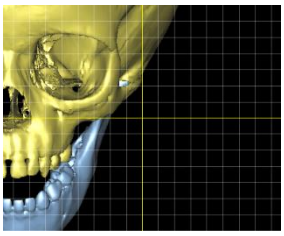


- To translate the Sagittal plane, move the cursor in the 3D view over the edge of the Sagittal plane. The cursor will change into the hand cursor with translation. Drag the Sagittal plane to its new position.
- To rotate the Sagittal plane, move the cursor over the blue rotation circle. The cursor will change into the hand cursor with rotation. Drag the rotation circle to rotate the Sagittal plane.

The following functionality are available in the “Context” menu (right-click on the MidSagittal plane in the 3D view):

- Disable Plane Manipulation – Hide rotation circle.
- Reset Sagittal Plane – Reset the Sagittal plane back to its original position.
- Hide – Hide the Sagittal plane.

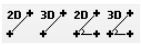
The *Reference Grid* function allows you to show or hide the grid on the viewports.



The *Contour curve for 3D objects* tool allows for a contour curve to be created from the intersection of a selected 3D object and a plane. The resulting intersection can be used during planning sessions for references.

You can choose any 3D object and any Cephalometric plane or the Midsagittal plane. There is no restriction to a certain number of intersection curves.

The resulting curve will appear in the *Object List.* Please note that after one intersection, multiple curves could be created. This happens when the selected 3D object has several closed contours in the intersecting plane. Curves that are not needed can be deleted via the *Object* List.

Measurements 

Via the icons in the measurements toolbar it is possible to measure a distance or an angle in 2D or in 3D.

2D measurements are used to measure a distance/angle projected to the screen on the 2D images or 3D objects (it is like an imaginary ruler which is placed on top of your screen).

3D measurements are linked to 3D objects so whenever the camera is rotated, they stick to 3D objects and rotate together. 3D measurements can only be used in the 3D view.

To create a measurement click on the icon in the toolbar. The cursor will change to respectively  or  showing if it is a 2D or 3D measurement. For a distance measurement indicate two points, beginning and end-point. For an angle measurement indicate three points. The measurement can be adjusted via [LMB drag] points to a different location.

Created measurements are stored in the *Object List*.

To find the location of a measurement, use Locate in the *Object List*. Depending on the location of the measurement, *Locate*d will adjust the view of the images or rotate the camera to show the selected measurement.

The detailed information of a created measurement is available via the *Information* tool  on the bottom on the Object list.

Setting the horizontal reference will change the fixed 3D view angles. Therefore, it is advisable to set horizontal reference (if it is necessary) before indicating any measurements. 2D measurements that become invalid after setting the natural head position will be deleted automatically to avoid confusion.

Camera Manipulation 

In this group navigation tools are available which allow the user to use the left mouse button to navigate through the images or view the 3D object(s). The functionality of the icons is, from left to right:

- Rotate Once (3D view only)
- Pan Once
- Adjust the Zoom Factor

- Zoom
- Unzoom
- Zoom to full screen
- Adjust Gray scale dialog

These controls are also present in the context menu by right-clicking on any of the views. More detailed explanation of these icons is given with the corresponding section in the *View Menu* in MENUS, 3.2.3

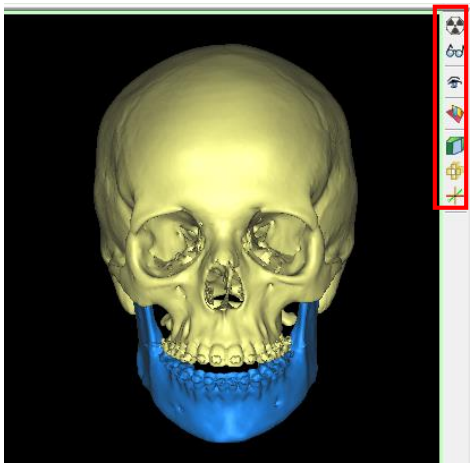
Project Info

The *Project Information* tool will show the information that is available about the patient and images of the opened dataset.

Note: some information may not be shown if it is not present in the DICOM images.

3.2.5 Viewport Toolbar

The 2D/3D toolbars are shown on the right side of the 2D/3D viewport.



2D viewports have the only the *X-ray View* tool available which will allow to create an X-ray image of that specific view.

The panoramic viewport also has an enlarge button, allow the viewport to span the full width of the screen.

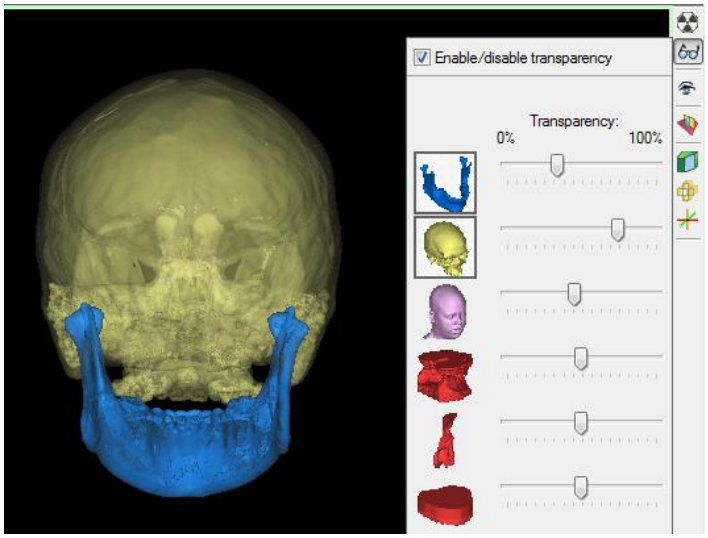
For the 3D viewports the following tools are available:

Toggle X-ray View

Ability to toggle on or off the X-ray view of the images.

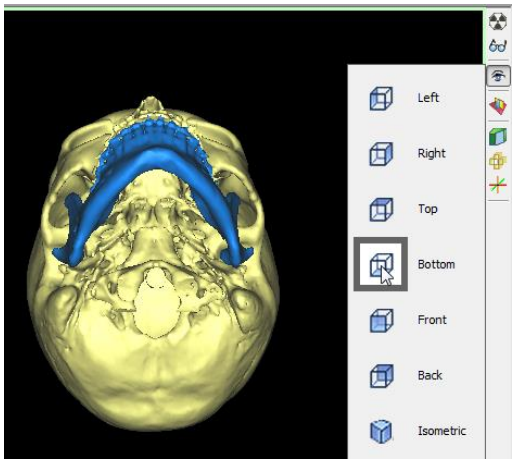
Toggle Transparency

A dialog box will open where it is possible to enable or disable the transparency for the 3D objects. Underneath a list of all present 3D objects is shown where the level of transparency can be adjusted for each separately.



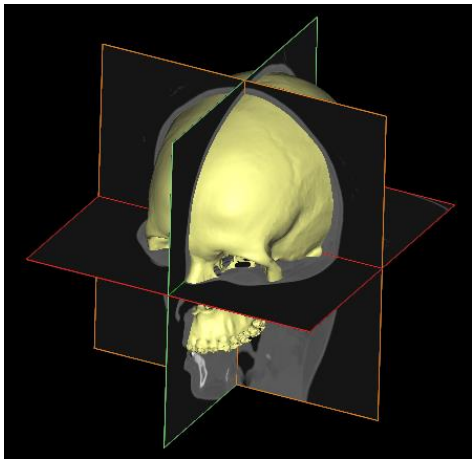
 Select 3D View

A list of standard 3D views is shown from which the user can choose. When clicking on one of the standard views the 3D view will change accordingly. Use [Tab] to loop though the standard views without opening select 3D view.



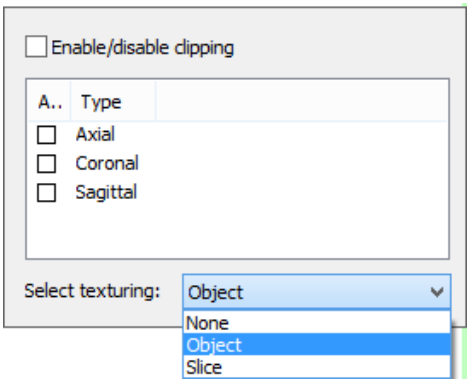
 Toggle Reference Planes

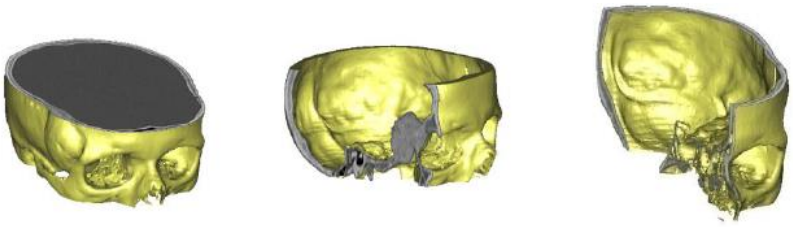
With this button it is possible to toggle on or off the reference planes in the 3D view. The reference planes represent the 3 different 2D views.



Enable/disable clipping

Clipping allows you to visualize the 2D image data in a cross section of the 3 models. It can be used to evaluate gray values on the section boundaries or to look inside the model to get a better understanding of the anatomy and bone density. The section can be made in different planes: *Axial, Coronal* and *Sagittal*. Several clipping planes can be activated at the same time, enabling you to isolate the part of interest.



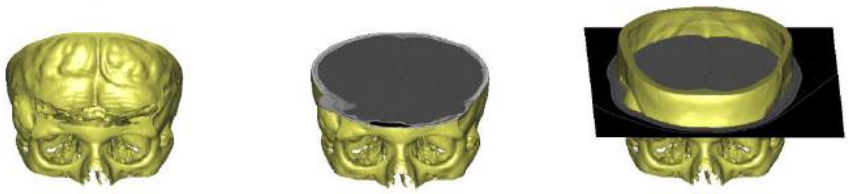


Axial clipping | Sagittal clipping | Combined clipping

The position of the clipped plane in the 3D view corresponds with the position of the active Axial, Sagittal or Coronal image. Scrolling through the 2D images updates the clipped plane in the 3D view. Navigation of the clipped 3D is also possible by clicking on visible parts of the 3D image. When you rotate the 3D image along the clipped plane, the visibility automatically reverses.

It is also possible to choose between different *Texturing* methods:

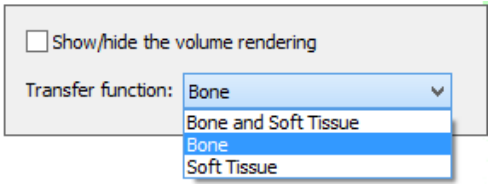
- No texturing: Only the 3D object is clipped and you can see inside the 3D object.
- Object Texturing: A texture corresponding with the 2D slice is placed in the contours of 3D objects.
- Slice texturing: No 3D object clipping, but the whole 2D slice is visible in the 3D window.

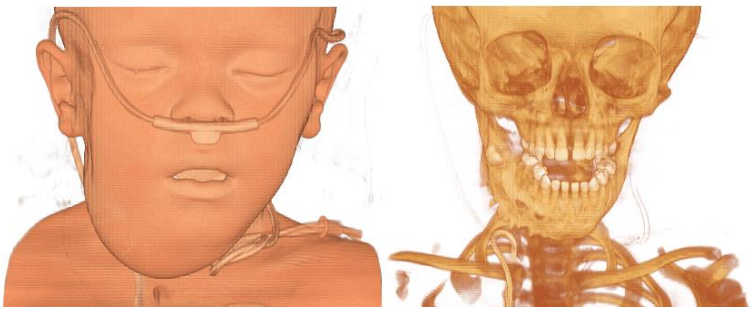


No texturing | Object texturing | Full slice texturing

Show/hide the volume rendering

Volume rendering allows you to visualize 2D image data as a 3D object without any segmentation. The 3D object is built out of the voxels representing the dataset. The transparency of the voxels is determined on their gray value. Volume rendering is a pure visualization tool and cannot be used for anything else (e.g. exporting).





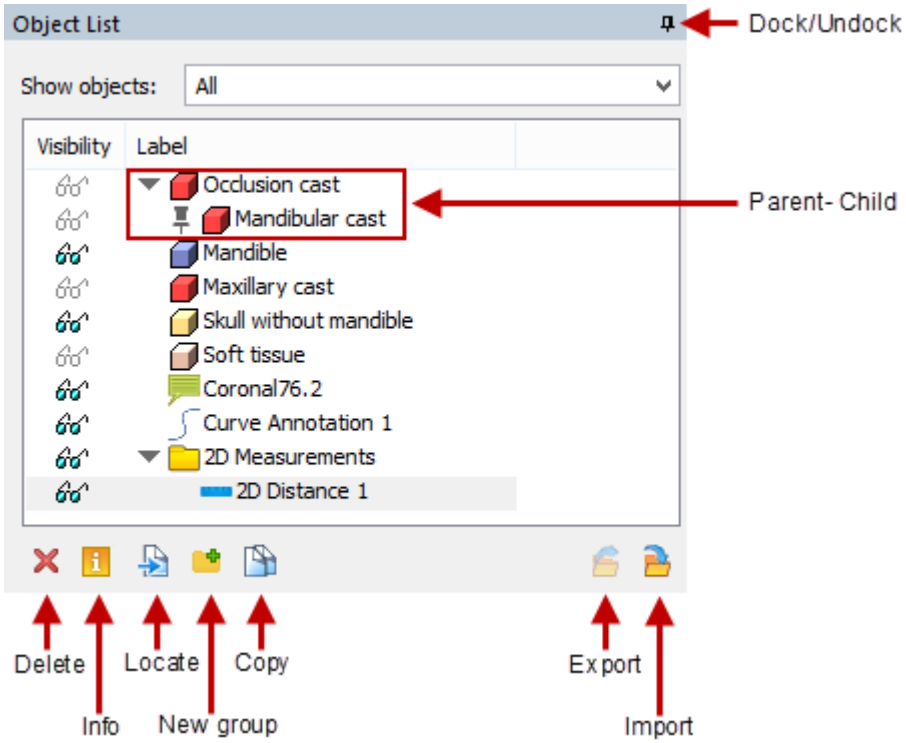
On the bottom of the volume rendering interface, there is a dropdown list with predefined settings. Predefined settings are optimized for CT imaging and allow you to quickly select bone, soft tissue or both.

Show/hide 3D-Navigation Locator

With the 3D-Navigation Locator the user can see where the intersection of the three 2D viewports is located. The intersection point of the images and the 3D-Navigation Locator are always synced. When a user clicks somewhere in one of the views then the 2D views will update according to the new intersection point and the 3D-Navigation Locator will also update in the 3D view.

3.2.6 Object List

The *Object List* is available in all wizards, giving you full control of your project and its objects.



The *Object List* dialog can work in a docked or undocked mode. Choose between the following ways to change modes:

- Click the *pin icon* in the top right corner of the “Object List” dialog.
- Double-click on the dialog title bar.
- To undock: drag the title bar of the dialog.
- To dock: move the dialog to the left pane of the screen.

The “Object List” dialog is resizable in both modes (docked and undocked)

Use the “Show objects” filter on top of the dialog to temporarily hide some types of objects

Toggle Visibility of individual objects or whole groups by clicking on the glasses icon in the *Visibility* column

Drag an object to the 3D model to introduce the *Parent-Child* link. This type of linking will ensure that operations applied to the Parent object will be also applied to the Child (e.g. translate Parent and Child will be translated as well). Alternatively, use the “Properties” dialog of the individual object to assign it to a parent.

Drag & drop objects within the dialog to organize them and create your own arrangement.

Actions on objects

The following actions can be performed on objects:

- Delete
- Info
- Locate
- New group
- Copy
- Export
- Import

Select (an) object(s) and click *Delete* on the bottom of the dialog to delete object(s), or use [Delete]

Select an object and click *Info* on the bottom of the dialog to review and/or change the object’s properties.

Select an object and click *Locate* on the bottom of the dialog box to find measurements and annotations

Create a new empty Group by clicking *New group* on the bottom of the dialog:

- Drag & drop objects to move them to a new group.
- Or first select the objects and click *New group* to immediately move the objects to the new group.

For some objects, like measurements and cylinders, groups are automatically created.

Select (an) object(s) and click *Copy* on the bottom of the dialog to Duplicate objects

Use Export to export selected 3D objects as .stl or .mdck.

Use *Import* to Import 3D objects from other PROPLAN CMF projects, SurgiCase CMF or .stl files.

Properties of objects

Via the info button several properties of the object can be set, including Name, Link, Color and Transparency.

Rename any object by

- pressing [*F2*]
- double-clicking on it
- use the Properties/Info dialog

Change the color via the color button

Change the Transparency via the Transparency slider

For the Curve annotation the info dialog can be used to change the thickness of the curve.

4 Wizards

This chapter gives a detailed overview of the functionalities of the different wizards that can be accessed via the overview page.

4.1. Import Images

After scanning your patient, you must import the images to the PROPLAN CMF Software. To start the wizard, use the corresponding button in the “Start” screen or in the “File” menu.

Note: PROPLAN CMF Software only supports DICOM images. Any other formats will not be imported even if they are selected with the Import Wizard.

4.1.1 Select the Media or Files that Contain Images to Import

Select DICOM images you want to use:

You can click immediately on the drive or folder in the “Favorites” column.

The following folders are listed as “Favorites”:

- *Browse* - Browse through folders on your computer.
- *DIA* - Display images received via a DICOM network (if the DICOM Input Application module is installed and licensed).
- *Floppy* - Display images stored on a floppy disk (if a floppy drive is available).
- *CD* - Display images stored on a CD (if a CD drive is available).

To add a new folder as a “Favorite”, browse the folder in the Windows Explorer tree and click “Add Favorite” in the toolbar. Right-click on a “Favorite” folder (except in the Browse folder) to delete or rename the folder. Each Favorite folder can be dragged to another position in the list.

Or browse for the drive or folder in the Windows Explorer tree.

As soon as you select the source directory, all images within the directory are displayed in the “Files” List (at the right side of the Import Image window). They will be immediately selected. To restrict the selection of all images, you can:

- [Ctrl +LMB] to select images one-by-one.
- [Shift+ LMB] to select the first and last image in your selection.

Please consider using the following features:

-  Add selected folder to the *Favorites* column (quick access bar)
-  Select all images/projects in the *File* lists
-  Merge two or more image sequences of one patient
-  When there is a DICOMDIR file available in the folder, you can toggle between viewing the studies as specified in the DICOMDIR and viewing the files
-  Search DICOM images in the subfolders of the selected folder

Click *Next* (>>) to continue with the conversion.

4.1.2 Check Studies to Convert

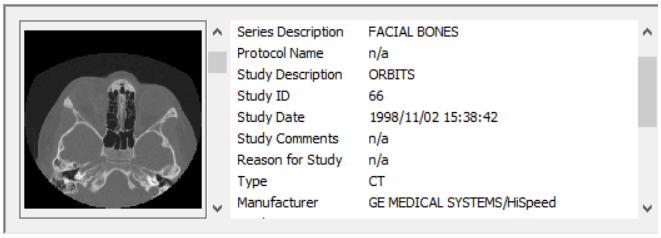
Information about the studies you are planning to convert are shown here. All selected studies will be converted and a PROPLAN CMF Software file will be made in the default working folder. To unselect a study, click on the checkmark in front of the study. Click the *Convert* to start the conversion.

Click *Back* to add more studies to the list. You can perform a batch conversion using this method.

If multiple image sequences of the same patient are displayed, it means that not all image parameters are equal. The differences are highlighted in bold. To merge one or more sequences to a PROPLAN CMF Software project, select sequences by using *Shift* and left mouse button, and click *Merge*. Merging multiple images is not allowed when patient name, pixel size or image orientation are different.

Note**:** PROPLAN CMF Software checks several parameters while importing images. If one of these parameters is different, PROPLAN CMF Software splits the dataset in different parts. PROPLAN CMF Software checks the following parameters: height, width, pixel size, gantry tilt, orientation, label, patient information, study information and reconstruction center of images.

During the conversion, you can find information (number of images, type of compression, pixel size, etc.) about the study you are converting. You can also select which studies should be converted by changing the checkmark in the *Convert* column.



There are different types of *Compression* images to choose from:

- *CT* - This compression is typically used for the removal of background noise for CT images. It is a lossy compression and changes the gray value of all voxels with a gray value between 0 - 200 to 0.
- *MR* - This compression is typically used for the removal of noise for MR images. It is a lossy compression and sets the gray value of all voxels with a gray value between 0 - 10 to 0.
- *Lossless* - When choosing the lossless compression, nothing is changed to the voxels of the images.

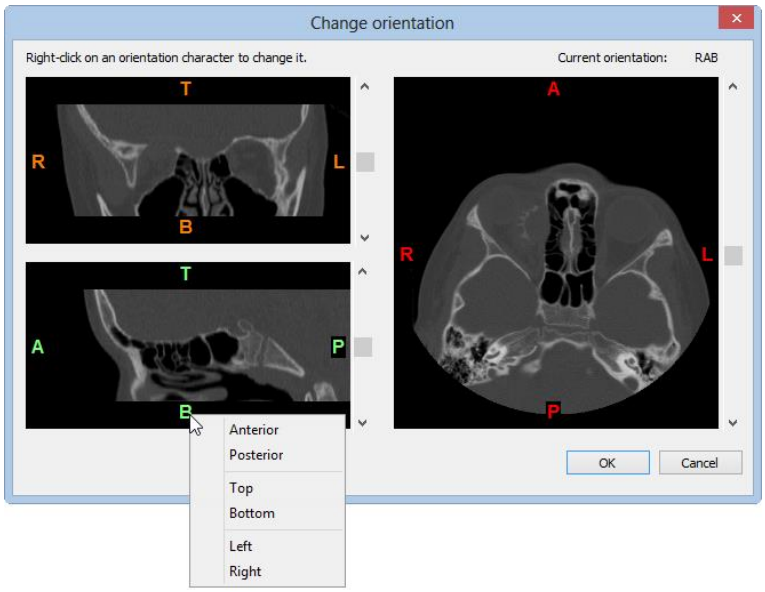
Note: For technical CT images, it is best to use the lossless compression.

4.1.3 Select Studies to Open

Select the study you want to open in PROPLAN CMF Software. If the data contains only one study, you will automatically skip *Step 3* and go from *Step 2* to the next step.

4.1.4 Change the Orientation

By default PROPLAN CMF Software always sets all conversion parameters automatically. However “Change orientation” window will be displayed on top of the images so that the user can double check if everything is fine. The parameters can be changed by clicking side letters.

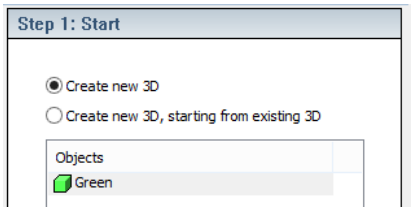


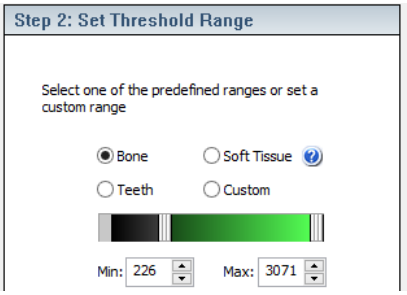
4.2. Segmentation

Convert your 2D images into 3D models by using the *Segmentation Wizard*.

4.2.1 Segmentation Wizard

The *Segmentation Wizard* will guide you step-by-step through the process of segmenting bone parts and soft tissue. The result will be a 3D object that can be used in planning wizards.





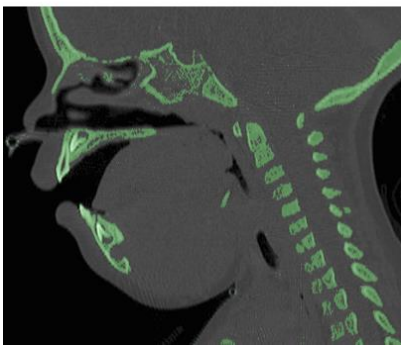
Bone treshold

<u>Step 1: Start</u>
Choose between creating a new 3D and creating a 3D object starting from an existing 3D. Click *Next* to go to the next step.

<u>Step 2: Set Threshold Range</u>

Set the *threshold range* to include the density range of the tissue you are interested in (bone, soft tissue, teeth). You can select another threshold range with the Custom option. Click “Next” to go to the next step.

Thresholding means that the 3D object will contain only those voxels of the image with a value higher than or equal to the lower threshold value and lower than or equal to the upper threshold value. A higher and lower threshold are usually needed. The segmented object will contain all pixels between these two values.



A low threshold value makes it possible to select the soft tissue of the scanned patient. With a high threshold, only very dense parts remain selected.

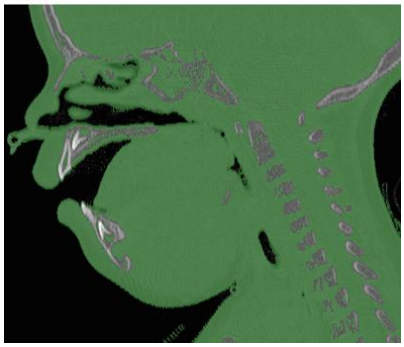
Some predefined threshold ranges can be chosen (Bone, Soft Tissue or Teeth). To set a custom range, press the left mouse button on the slider in the Threshold Toolbar and move the slider by moving the mouse (while holding the left mouse button).

To select an adequate threshold value, look at the selected voxels in the 2D images and adjust the threshold value until the desired range of voxels is selected.

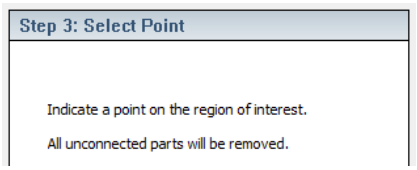
You can change images of any view by:

- Using the arrow keys or the page up and page down keys.
- Using the slider on the right in the window border.
- Moving the slice indicators.

Soft Tissue treshold



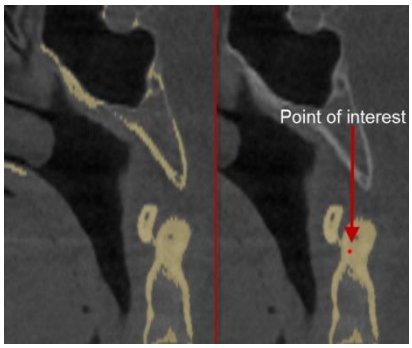
Step 3: Select Point



At this step, the mask most likely contains multiple unconnected parts (e.g. noise or scatter in the scan). To remove these undesired parts:

The cursor will become cross-shaped when you move it over the 2D images.

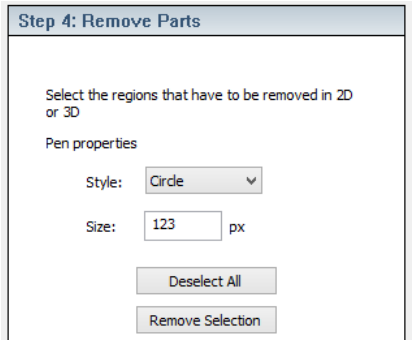
Click the left mouse button on one point in your area of interest (which is a part of the current selection of voxels, i.e. part of the skull). A new selection of voxels will automatically be calculated, and all floating (unconnected) voxels will be removed from the selection



You can also proceed to the next step without indicating a point of interest. If you would like to keep all voxels from the current selection, you can immediately click *Next*. However, keeping all parts of the segmentation, especially on noisy image sets, can slow down calculations throughout the software (in 3D calculation and when planning osteotomies and calculating soft tissue simulations)

Click “Next” to go to the next step.

Step 4: Remove Parts

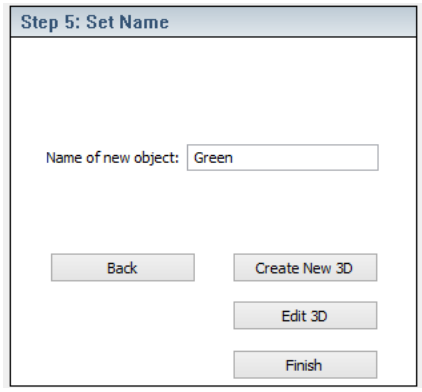


This step allows you to remove regions from the current selection of voxels. This can be done in 2D slices or in the 3D window.

- Select the pen you want to use and set its properties
- Select the region you want to remove. You will see that your selection is colored differently. If you want to undo the voxels selection, click *Deselect All* or *Undo.*
- To remove selected voxels, click *Remove Selection*

Click “Next” to go to the next step.

Step 5: Set Name



Set the name of the new 3D object. The default name is the color of the 3D object. This name, as well as the color, can be changed anytime.

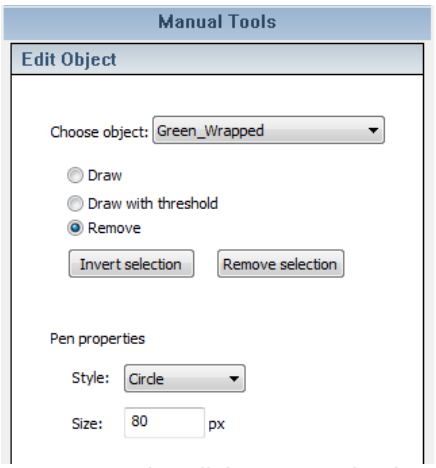
Click *Create New 3D* to go to the "Start" step of the wizard and create a new 3D object

Click *Edit 3D* to open the "Manual Tools" tab, where the 3D object can be edited

Click *Finish* to open the "Finish" tab. Click this tab when you have segmented all the 3D objects that you need in your surgical planning.

4.2.2 Manual Tools

This tool allows you to edit a 3D object that is created in the *Segmentation Wizard*.



Edit Object

Choose the mask to be modified

Choose an editing option:

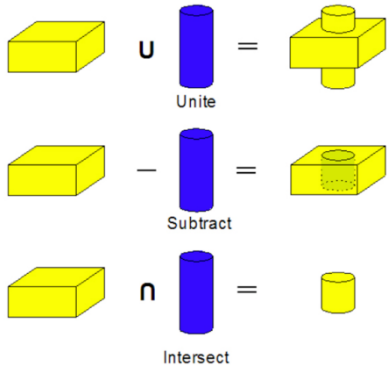
- With the *Draw* feature, you can add pixels to the selected 3D in the 2D slices
- The *Draw with threshold* feature is an advanced tool that will add/remove pixels to the selected 3D object. When you click on the 2D slices, only pixels will be selected that have gray values that falls within the threshold range.
- The *Remove* feature works the same as in the *Segmentation Wizard*. First make a selection of pixels, and then click *Remove Selection* to remove them from the 3D object. You can also click *Invert Selection*.

Choose the Pen/Brush shape and size. Shortcut for brush size adjustment is [Ctrl+LMB drag] on 2D images

Adjust the mask on 2D and/or 3D views to ensure that it contains all needed voxels and does not contain redundant information.

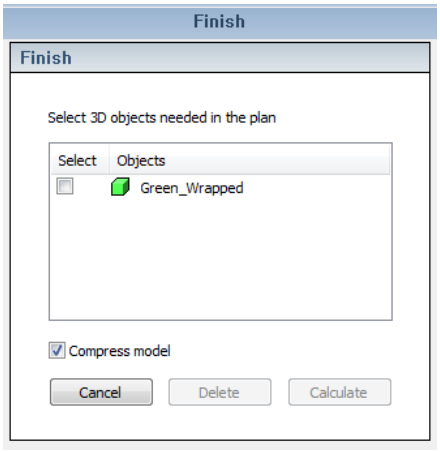
Boolean Operations

Boolean operations on different masks allow you to unite, subtract or intersect 3D objects. Here are some visual examples of how different operations perform for two objects (masks):



4.2.3 Finish

In this final step, select the 3D object you want in your surgical planning.



Tick the box next to required masks.

Choose whether you want to compress the models. The application will work faster with compressed 3D models so it is recommended to use this option. Non-compressed models may be used in exceptional cases when outstanding planning accuracy is needed.

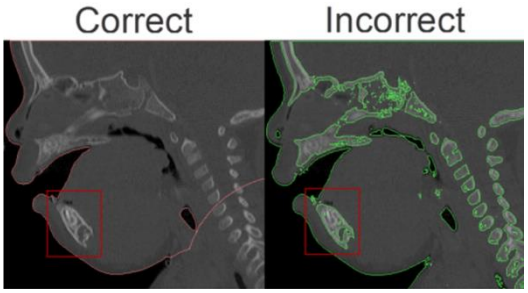
Click “Calculate” and see created 3D objects in the “Objects List”.

4.2.4 Constraints and Restrictions

Segmenting for the *Soft Tissue Simulation Wizard*

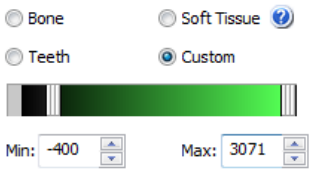
The *Soft Tissue Simulation Wizard* might be less accurate when the Soft Tissue is segmented incompletely or inaccurately.

The *Soft Tissue Simulation Wizard* should not include any contour of bones that are intended to be repositioned during pre-operative planning. If it does, the Soft Tissue Simulation and/or Comparison may result in incorrect predictions.

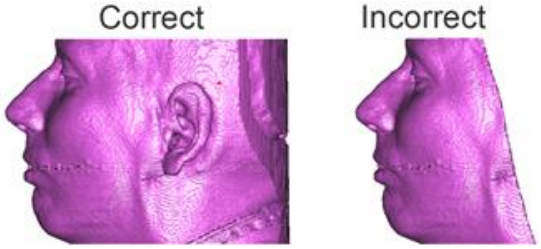


During the Segmentation of the Soft Tissue, this can be avoided:

Choose a max value of 3071 when selecting a threshold value for the soft tissue object. This ensures that all grey values typically associated with the bone will also be included in the object:

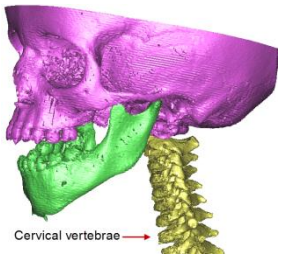


Ensure that no large parts of the Soft Tissue are missing:



Use the Compressed mode in the last step of the *Segmentation Wizard*.

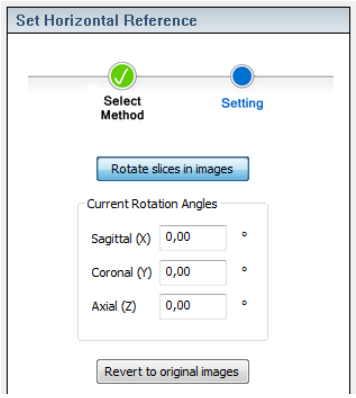
Make sure to segment the cervical vertebrae as a separate object for simulations including the ramus or mandible. Also select the cervical vertebrae for the Soft Tissue Simulation:



4.3. Natural Head position

If it is necessary, the axial slice orientation can be adjusted using the *Natural Head Position wizard*. Three modes are available to set the Horizontal Reference:

4.3.1 Manual mode



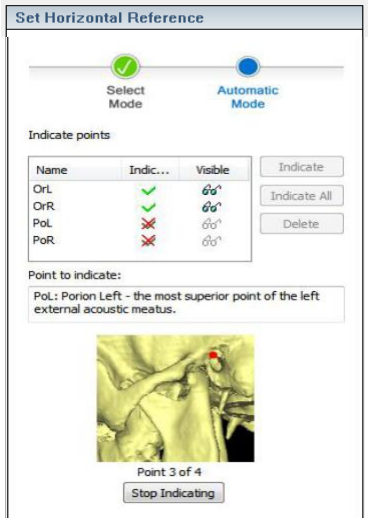
Toggle the *Rotate slices in images* button to enter the interactive rotation mode, allowing you to adjust the axial slice orientation manually to the occlusal plane by interacting with the rotation circles in both 2D and 3D views. By default, this mode is toggled.

Under *Current Rotation Angles*, angles between the original and current orientation in the Axial, Sagittal, and Coronal slices, are shown respectively. These values are editable, therefore it is possible to enter rotation angles manually.

In the 3D view, the rotation is visualized as a red (re-slicing) plane. All three rotation circles are shown, making it possible to adjust the new slicing direction of the axial images along these three directions. Each circle has the same color as the border of the corresponding 2D image.

Click *Revert to original images* to revert the images back to their original position.

4.3.2 According to the *Frankfurt plane*



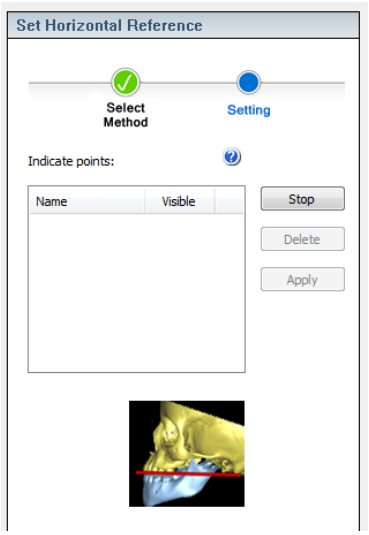
Four landmark points (PoL, PoR, OrR, and OrL) based on the Frankfurt horizontal plane must be indicated to set the natural head position.

Click *Indicate All* to enter the point indication process. During the point indication process, four landmark points are required to be indicated. Click on the 3D object according to the example image to indicate the point, from the first point to the last point.

To stop the point indication process before all points have been indicated, click *Stop Indicate*. All indicated landmark points will be saved (a green tick mark will appear under the *Indicate*d column).

Once all points have been indicated, the natural head position will be set. To delete and re-indicate a specific point, select the point in the points list, click *Delete*, and then click *Indicate*.

4.3.3 According to the Occlusion plane



Indicate at least three points and you will see a blue preview plane being created. Continue indicating until the occlusion plane is in your desired position.

To align images and objects to the defined occlusion plane, click *Apply*. The indication will remain active allowing you to continue.

Stop the indication by clicking *Stop* and adjust indicated points by dragging & dropping.

Clicking *Finish* will save the last position and move you to the next step. Clicking *Back* will also save the last position but it will move you onto the horizontal reference selection step so you are able to, for example, make an adjustment in the manual mode.

Setting the horizontal reference will alter fixed 3D view angles and X-ray views. Therefore, it is advisable to set the horizontal reference position (if it is necessary) before indicating any measurements or before indicating a panoramic view curve. The panoramic view curve will be deleted when changes are made to the horizontal reference. 2D measurements that become invalid after setting the horizontal reference position will be automatically deleted to avoid confusion.

Note: After setting/changing the Horizontal Reference, the following values will be recalculated since they are calculated as projections on planes:

- Delta X/Y/Z values and directions in the Cephalometric measurement overview
- Delta Sagittal/Coronal/Axial values in the “Measurement Properties” dialogs

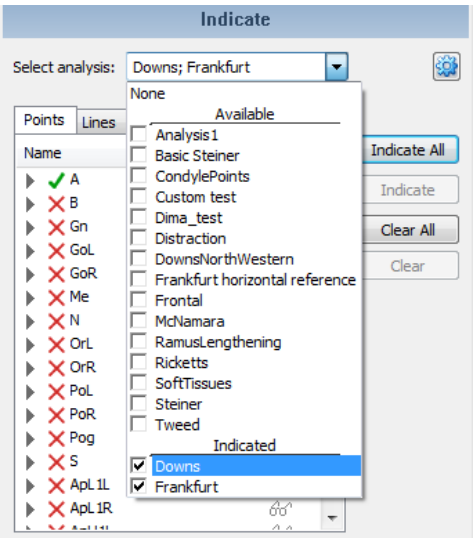
4.4. Cephalometry

The *Cephalometry Wizard* allows you to indicate anatomical landmarks on objects in the 2D, X-ray or 3D view to perform a Cephalometric analysis. Select the analysis in the dropdown list at the top of the left task panel. All points, lines, planes and measurements will be listed automatically.

4.4.1 Cephalometric analysis

The following predefined analyses are available:

- CondylePoints.
- Downs.
- DownsNorthWestern.
- Frankfurt.
- Frontal.
- McNamara.
- RamusLengthening.
- Ricketts.
- SoftTissues.
- Steiner.
- Tweed.

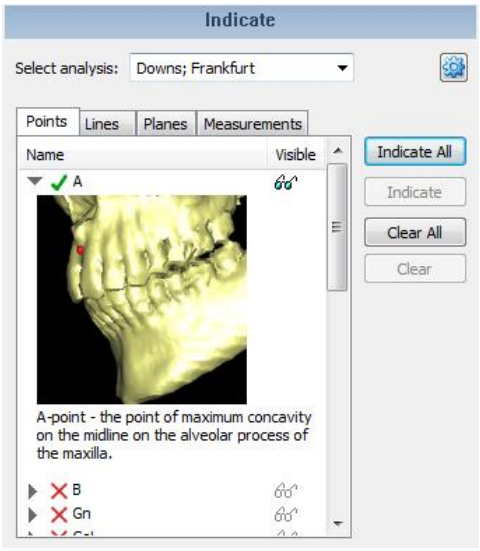


If you do not find a template that coincides with your requirements, you can create your own template by clicking button (see description below). When you have chosen or created the template you wish to use, indicate the appropriate points, planes and/or measurements as described in the following sections.

The list of cephalometry analysis allows you to select one or several analysis at a time. All the analysis in the list are split up into two groups: Available and Indicated.

4.4.2 Indicate Cephalometric Landmarks

To indicate the Cephalometric landmarks, choose the required analysis from the list.



View the list of available points to be indicated for the selected analysis. Only available points should be indicated. Lines, Planes and Measurements will be calculated and shown automatically.

There are two options for indication:

- “Indicate All” – to indicate all points one after another
- “Indicate” – to indicate only selected points

While indicating points, a description of the current point is shown.

It is possible to adjust the position of the points during indication on the fly or when indication is stopped: [LMB] to add points.

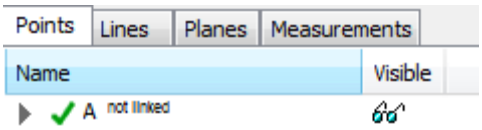
- [LMB drag] to move a point.
- [RMB] on a point to remove that indicated point.

You can show/hide landmarks by using Cephalometry buttons on the main toolbar.

Objects that are indicated will be marked with a green checkmark. It is also possible to show/hide them.

Points can be linked to a 3D objects by placing them on the object. Points that are linked to a 3D object will be red, points that are not linked will be orange.

The list of points will give an indication if the point is not linked.



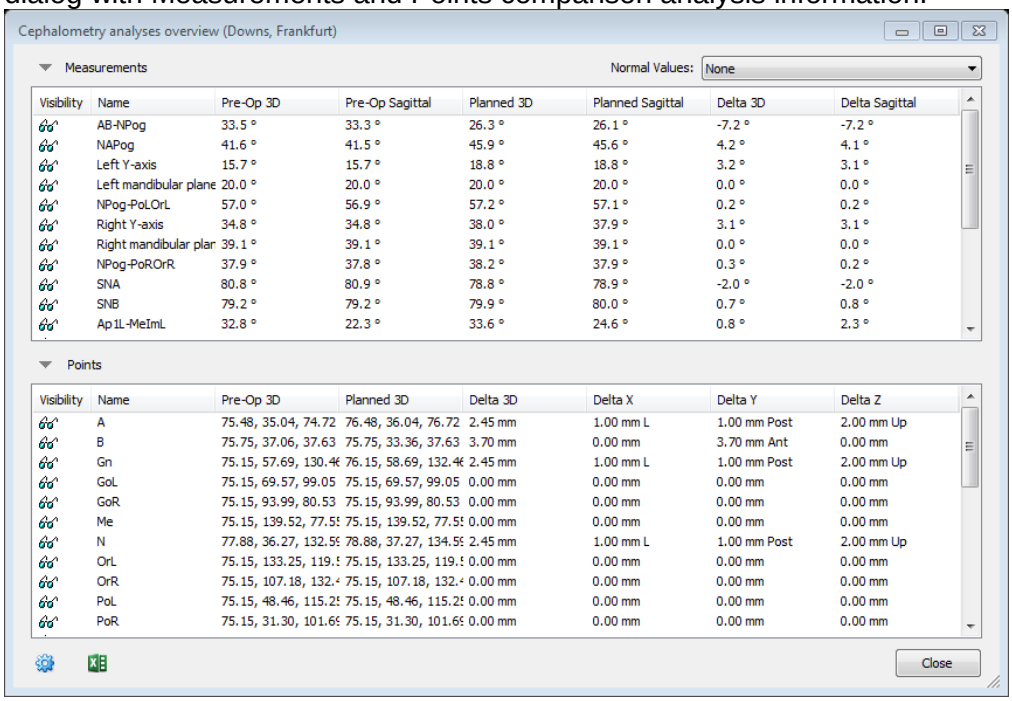
Hovering with the mouse over a linked point in the points list will give the name of the object it is linked to.

To remove an indication, select the required object(s) and click *Clear*. If planes or lines are deleted, all points which are related to these objects will also be removed.

To stop an indication, press *Stop* or [Esc]

4.4.3 Cephalometric analyses overview

After repositioning bone fragments, it is possible to compare the Pre-Op and Planned position of indicated points. Click *Cephalometry analysis overview* button on the main toolbar to open the dialog with Measurements and Points comparison analysis information.



<u>Measurements</u>

Available 2D parameters (angles and/or distances):

- Pre-op Axial - 2D value before simulation in axial plane
- Pre-op Coronal - 2D value before simulation in coronal plane
- Pre-op Sagittal - 2D value before simulation in sagittal plane
- Planned Axial - 2D value after simulation in axial plane
- Planned Coronal - 2D value after simulation in coronal plane
- Planned Sagittal - 2D value after simulation in sagittal plane
- Delta Axial - Difference [Planned Axial] - [Pre-op Axial]
- Delta Coronal - Difference [Planned Coronal] - [Pre-op Coronal]
- Delta Sagittal - Difference [Planned Sagittal] - [Pre-op Sagittal]

Available 3D parameters (angles and/or distances):

- Pre-Op 3D - 3D value before simulation.
- Planned 3D - 3D value after simulation.
- Delta 3D - Difference [Planned 3D] - [Pre-Op 3D].

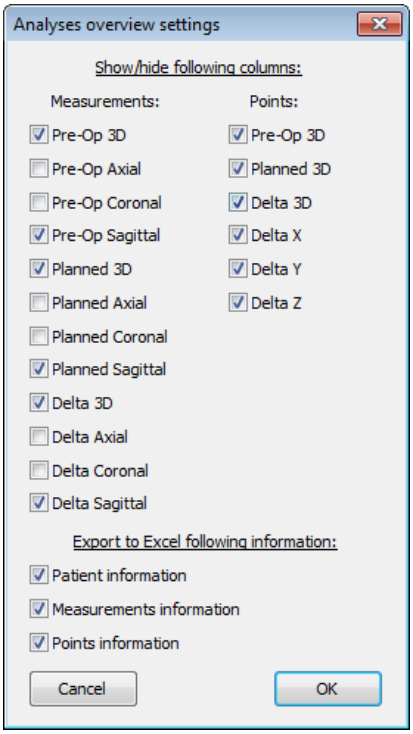
<u>Points</u>

This tab shows the distance the 3D Cephalometry points have been moved while repositioning a planned object.

When you reposition a planned object in the 3D view, the values in the table are updated in real time.
Available parameters:

- Pre-Op 3D and Planned 3D – The position of each 3D Cephalometry point is indicated by x, y, and z coordinates (x, y, z).
- Delta 3D – Shows the total 3D movement of a point, which is the distance between the Planned and Pre-Op position of the point.
- Delta X, Delta Y and Delta Z - Shows the movement a point has made in X direction, Y direction and Z direction respectively.

Use the settings button in the bottom left corner to customize content of the Cephalometry overview table.



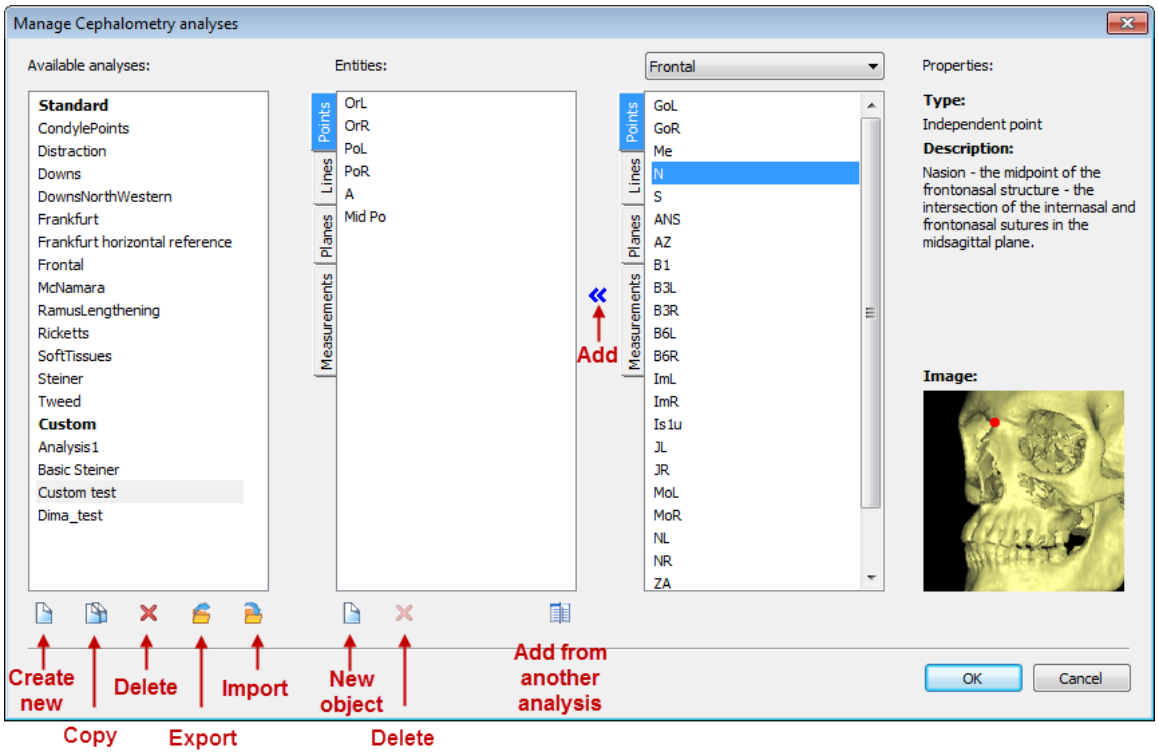
Export Analysis to Excel

It is possible to *export* the overview analysis to an Excel file by clicking “Export” in the bottom right corner. It is possible to customize the information exported to Excel using the settings button.

Note: Projections (Delta X/Y/Z) are recalculated after setting/changing the horizontal reference. For more information on this feature, see NATURAL HEAD POSITION, 4.3.

4.4.4 Manage Cephalometry analyses

You can create both custom and standard analyses. Click button to open the dialog to create a new analysis.



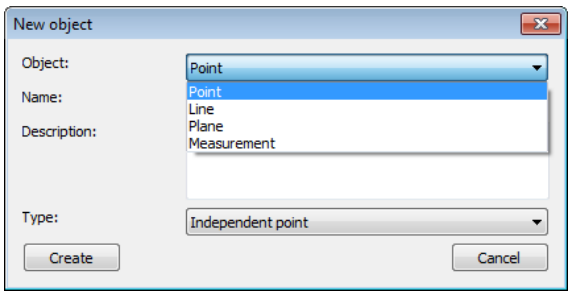
The “Available analyses” list gives you an overview of all analyses and their points. Lines, planes and measurements will be automatically shown when analysis is selected.

A custom analysis can be created (field *Entities* on the screenshot):

- From scratch by clicking *New*
- Or by selecting an existing analysis and making a copy of it. Adjust it by clicking *Copy*. Once an analysis is selected, Measurements, Points, Lines and Planes of the analysis are displayed in the field *Entities*.

To add a new cephalometric object, click New in *Entities* field and fill out necessary information:

- Object: Point, Line, Plane, Measurements
- Name
- Description
- Type to define selected object (e.g. define the plane with the three points)



To add a cephalometric object from another, existing analysis click *Add existing object* button. In expanded part select analysis and objects you would like to use. By clicking “Add” button selected objects will be added to your new analysis.

To delete a point, line, plane or measurement, select the item in the list and click “*Delete*” in “*Entities*” field.

If the item you are deleting is used to construct other items, you will be prompted with a warning message displaying which items will be deleted.

To change the order of indication, drag and drop the point in the *Entities* list

All custom analyses will be added to the Cephalometry under category *Custom*

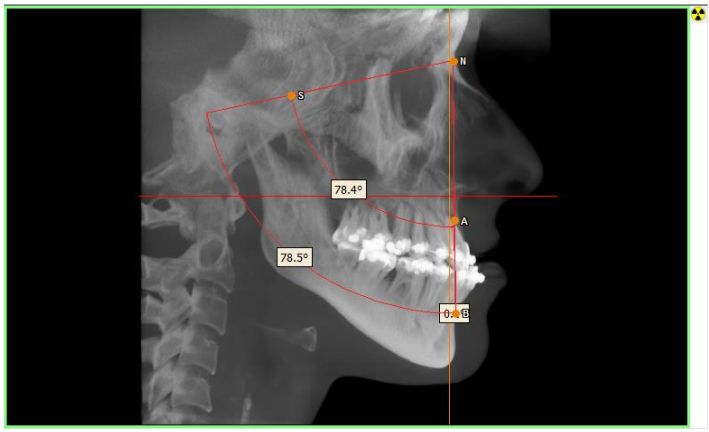
4.4.5 Pre-Op and Planned Mechanism

Initially, all new 3D objects will be in a *pre-op* (pre-operative) state. This means that the object has not been modified in any way. If Cephalometry points are indicated on original objects, they will also be in a *pre-op* state. Once the *pre-op* 3D object is modified, for example by cutting or repositioning, it will take on a *planned* state. This has the following effects:

- A copy of the modified 3D object will be created. This copy will have the same name as the modified PRE-OP object, and the original *pre-op* object will be renamed with the suffix "_original".
- If *pre-op* points have been already indicated, *planned* copies of these points will be created. *Pre-op* points will remain on the newly-created original object, while the *planned* points will be attached to the *planned* object. Visibility of *pre-op* and *planned* points can be controlled via Cephalometry analysis in main toolbar.
- From now on, all newly-indicated points, lines, planes and measurements will be in a *planned* status, and corresponding *pre-op* points will be created.
- When you delete a *planned* point, its corresponding *pre-op* point will be deleted as well.

4.4.6 X-ray Cephalometry

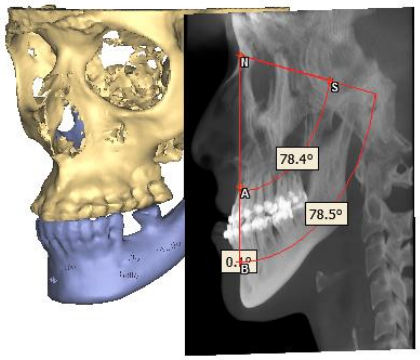
The Cephalometry wizard allows you to indicate anatomical landmarks on the sagittal X-ray, and move the points to the corresponding 3D object in the 3D view. In order to place the points on X-ray, switch the Sagittal view to X-ray mode using the x-ray button . It is not possible to place the landmarks on Coronal X-ray or Axial X-ray views.



Follow the regular steps indicating the points. Please note that there are no default X-ray cephalometric analysis templates. All default templates assume placing points on the 3D object, so a template must be create with the expected anatomical landmarks.

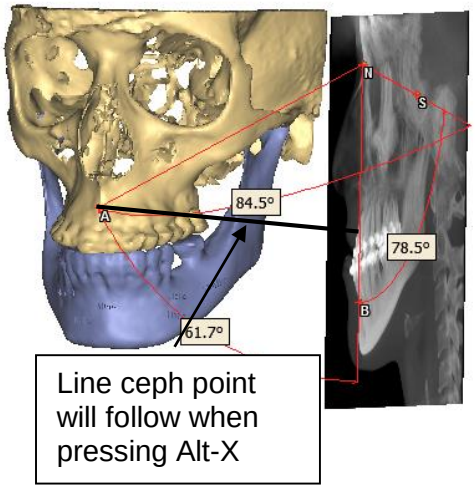
As soon as the landmarks are placed on the sagittal X-ray, the points, angles and measurements will appear in a separate X-ray plane in the 3D view. Rotating the 3D view will make this visible.

All points will be orange, because there is no linkage to a 3D objects.



It is possible to drag the cephalometric points from the 2D X-ray plane in the 3D view to a 3D object. Press [Alt+X] and use left mouse button drag to drag the point along the sagittal line from the X-ray to the corresponding location on the 3D object. Dragging without pressing [Alt-X] will allow the points to move freely in 3D space.

As soon as the point is placed on a 3D object the color will change to red, as the point is linked to the object.



Line ceph point will follow when pressing Alt-X

4.4.7 Normal Values

Normal values for cephalometric analysis (2D and 3D measurements and angles) can be imported into the software via a special normal values file. No default file is provided with the software. If you are interested in using normal values for cephalometric analysis, please contact Materialise via proplancmfsupport@materialise.com

Once a normal values template is created and added to the correct location the template can be selected via the Normal Values dropdown list.

For all measurements and angles that are present in a selected normal values file, the normal ranges will automatically be applied. Measurements that are outside the normal range will be marked in red and if they are inside the normal range they are marked in green. They will be colored in all views: 2D, X-ray and 3D and also in the cephalometric analyses overview window.

Visibility	Name	Pre-Op 3D	Pre-Op Sagittal	Planned 3D	Planned Sagittal	Delta 3D	Delta Sagittal
	SNA	80.8 °	80.9 °	78.8 °	78.9 °	-2.0 °	-2.0 °
	SNB	67.6 °	65.4 °	66.0 °	63.4 °	-1.5 °	-2.0 °
	ANB	25.5 °	15.5 °	25.5 °	15.5 °	0.0 °	0.0 °
	SNA-SNB	13.3 °	15.5 °	12.8 °	15.5 °	-0.5 °	0.0 °

The Normal values template can also be selected via the cephalometric analysis overview. The Sex, Age and Ethnicity that were entered in the Normal range values template will be shown underneath the Normal values template selection box.

4.5. Soft Tissue Simulation

After you have simulated the maxillofacial surgery with the planning functions (Reposition, Osteotomy, Distraction or Orthognathics), you can check how the soft tissue will change according to new bone positions. The Soft Tissue Simulation module also allows you to map a picture of the patient on top of the soft tissue.

Ensure that the Soft Tissue 3D object is calculated correctly (please see the constraints and restrictions section in “Segmentation Wizard” description) before following the steps described below.

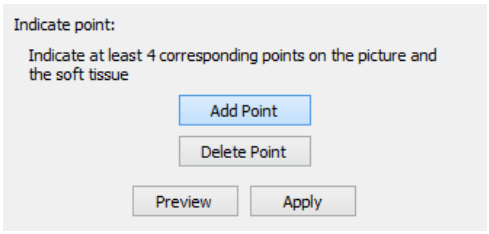
Disclaimer

A soft tissue simulation displays a prediction of the behavior of the patient’s soft tissue after surgically repositioning segments of the facial skeleton. Although the biomechanical algorithm behind the simulation has been successfully validated on real-life Orthognathics cases, no guarantees are given to the accuracy of the predicted outcome on specific patients or other surgical routines. Interpret the results with clinical judgment.

4.5.1 Photo Mapping

This part of the Soft Tissue Simulation module allows you to map a picture of a patient on the soft tissue 3D object. Both 2D and 3D pictures can be mapped on the soft tissue of the patient. The following picture formats are allowed to be used: *.bmp, *.gif, *.jpg, *.jpeg, *.tif, *.tiff, *.wrl and *.obj.

Select Pre-Op Soft Tissue in the list and load a picture by using *Select picture*.



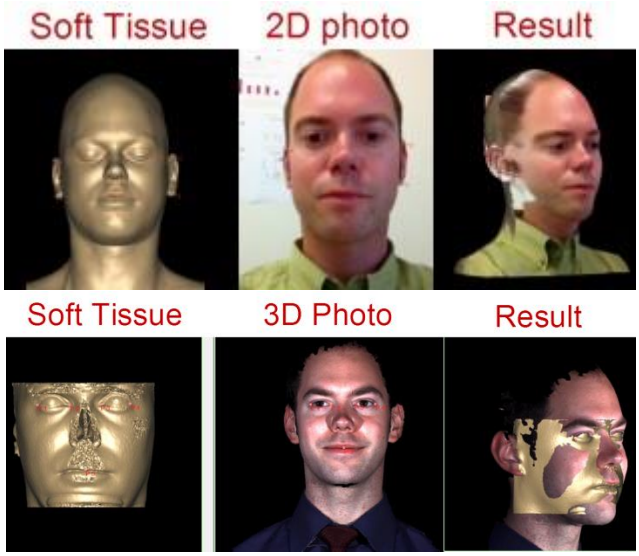
When using *.obj or *.wrl format, make sure the texture information (*.mtl) is in the same folder as where the images are stored.

To map a picture on the Soft Tissue, you must register your picture. Use *Add point* and *Delete point* to indicate at least four pairs of corresponding points on the Soft Tissue and picture, in areas that not affected by the surgery to assure relevant registration.

When four pairs of points are placed, perform photo mapping by clicking *Apply.*

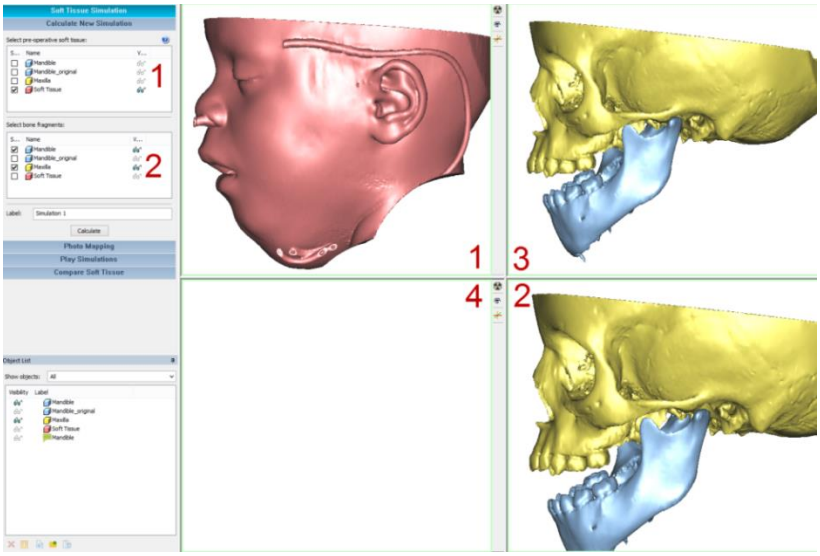
With a 3D photo, there are additional tools you can use to adjust the registration: *Mark Surface*, *Clear Marking* and *Size.* With these options, you can indicate corresponding regions on the Soft Tissue and 3D photo that are used as extra information to perform the registration. In this way, the accuracy of the registration can be improved. It marks areas that are least sensitive to changes due to facial expressions. The best areas to mark are the forehead, Nose Bridge and areas of the cheeks right next to the nose. [Alt+LMB drag] can be used to change the size of the brush, and [Ctrl+LMB drag] can be used to unmark the surface.

Examples of 3D and 2D photo mapping:



4.5.2 Calculate New Simulation

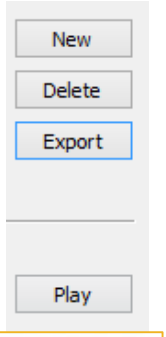
To calculate a new soft tissue simulation, select both the original (pre-operative) soft tissue in list 1 and all bone fragments (repositioned and stationary) constituting the entire area to be simulated in list 2. For simulations including the ramus or mandible, make sure to include the cervical vertebrae in the selection whenever it is available in the imaging data. The original position of bone fragments is automatically shown in screen 3, and the repositioned position in screen 2. When you click *Calculate*, new soft tissue will be created in screen 4 and the application will switch to the *Play Simulation* step.



4.5.3 Play Simulation

This step allows you to play an animation of a soft tissue simulation:

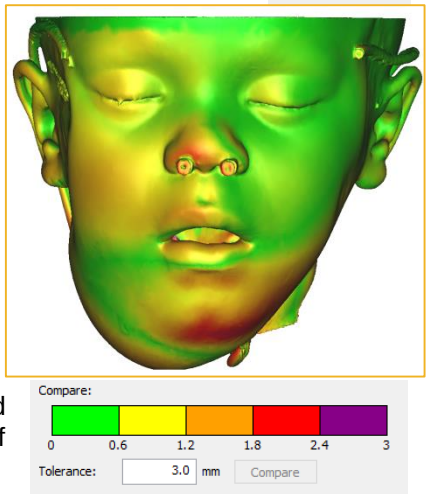
- All simulations in your planning file will be listed. Select the one you want to play with.



- Create a new simulation by clicking *New.* The application will proceed to the corresponding step to define new inputs for another soft tissue calculation.
- Delete a simulation by clicking *Delete*. In this case only the simulation will be removed, the original and calculated Soft Tissue will remain in the *Object List*.
- To record a video, click *Export* to open the *Export Movie* dialog. Choose a quality level for the recording, select the view to be captured and change the output directory before recording.
- To play an animation of the soft tissue simulation (transition from Pre-op situation to Planned in a continuous loop), click *Play*. Choose an appropriate playback speed.

4.5.4 Compare Soft Tissue

This section allows you to compare a pre-op soft tissue with a planned soft tissue:



- Select two 3D objects you would like to compare in list 1 and 2. You can browse another project that contains a planned soft tissue 3D object by clicking *Import 3D objects* in the *File* menu. The 3D objects from another project will be loaded into the current project.
- You can perform comparisons immediately after selecting two objects or first align the two objects (required if one soft tissue is uploaded from another planning file and has a different position). To perform a registration, use *Add Point/Delete Point*.
- Click *Compare* to see a color mapping, indicating deviations. You can see the correspondence between color and deviation and change the tolerance level to include the entire range of values of interest. Deviations outside of this range will be colored gray.

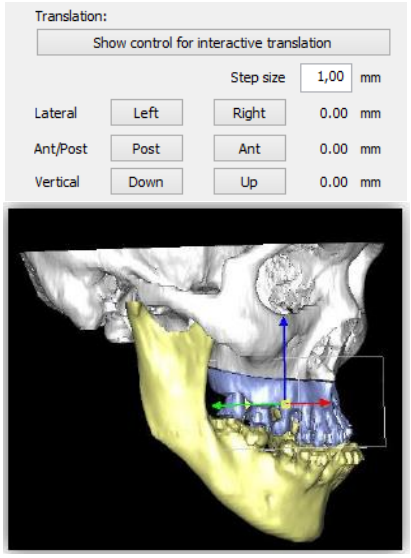
4.6. Design Tools

The design tools wizard contains 4 different sets of tools that can be used during several stages of the planning. The tools can also be accessed through the design tools toolbar.

4.6.1 Reposition

With the *Reposition Wizard*, 3D objects can be repositioned. Select the 3D object that you want to reposition in the 3D Object List. You can select a 3D object by clicking the checkbox corresponding to the name of the 3D object.
All linked objects will be repositioned together, even though they are not selected in the list.

<u>Translation</u>



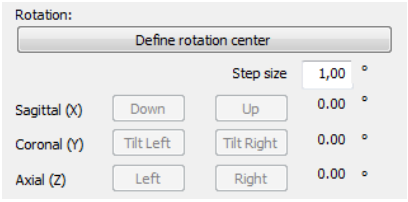
Selected 3D objects can be translated with the translate buttons (*Left/Right, Post/Ant, Down/Up*) for precise translation.

Adjust the step size by changing the value in the *Step size* box.

To use an interactive translation, click *Show control for interactive translation*. Once activated, three translation axes will be displayed on the 2D and 3D views. Select and drag one of the axes with the left mouse button to translate the 3D object along the axis. You can also select and drag the yellow square (the origin of the axes) to translate the object without any restriction.

All translation changes will be displayed on the right side of the display.

<u>Rotation</u>

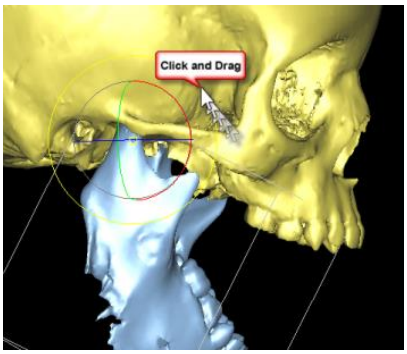


The selected 3D object can be rotated with the rotation buttons (*Down/Up, Tilt Left/Tilt Right, Left/Right*) for precise rotation.

Adjust the step size by changing the value in the *Step size* box

To use interactive rotation click *Define rotation center*:

- Click anywhere on the 3D object to define the rotation center.
- Hover the small rectangle in the center of control and drag it.
- Click anywhere on the shown circles in the 3D and start dragging to rotate object.

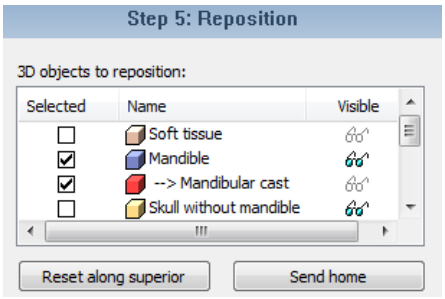


Note: every time the rotation center is replaced, rotation values will be reset to zero.

Revert to Original Position

There are two options to restore the original position for selected object(s):

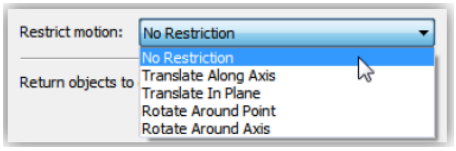
- *Send home* moves all selected objects to their original positions
- *Rest along superior* only parent objects to the original position while linked objects will just follow. Parent object is a 3D object which has another objects linked to it. *Reset along superior* is enabled only if selected object is a parent



Motion Restriction and Collision

You can restrict the degrees of freedom while repositioning a 3D object.

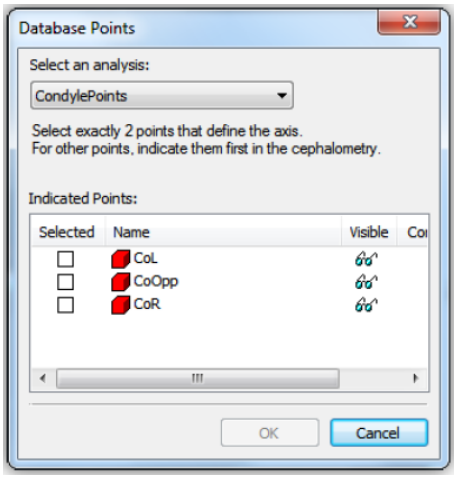
Select the type of repositioning in the *Restrict Motion* dropdown box:



- No Restriction.
- Translate Along Axis.
- Translate In Plane.
- Rotate Around Point.
- Rotate Around Axis.

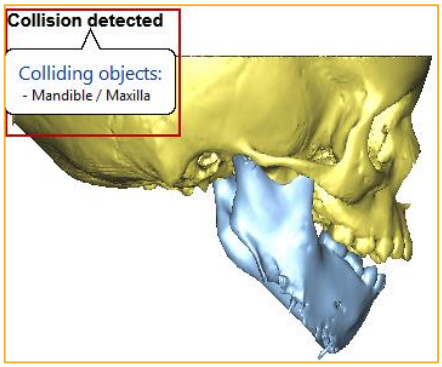
Depending on the type of repositioning selected, a point or plane database dialog will be opened.

Select any existing analysis from the dropdown to indicate points or planes.

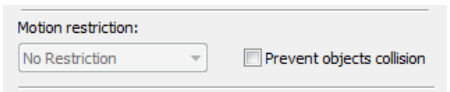


Collision can be detected whenever visible objects collide with each other:

- A Collision detected message will be shown in the top left corner of each 2D/3D view.
- Click on this message to see which objects have collided.
- Disable this feature by using the checkbox in Preferences: Options/Preferences/Other/Check collision for visible objects.

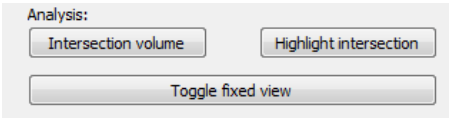


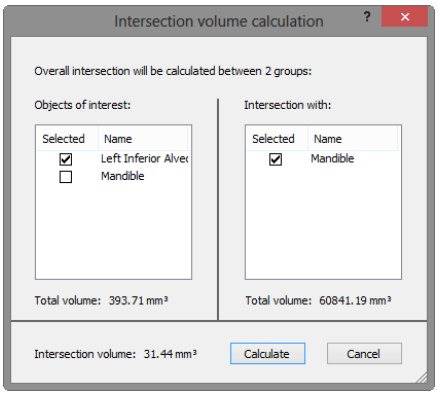
Tick the *Prevent objects collision* checkbox in the *Main Task* dialog of the wizard to block further movement whenever moving objects collide.



Analysis

Under the Analysis section of the *Main Task* dialog, you can get more information on Intersection volumes, Highlighting intersections and Cephalometric comparisons (*Toggle fixed views*).





If a collision is detected, you can make a fast impaction analysis and calculate the intersection volume. Click *Intersection Volume* in the main task dialog of the wizard to open the volume calculation dialog.

First select the *Objects of interest* (left list). All visible colliding objects are shown in the list. In the case of three or more colliding objects, different intersection volumes can be calculated.

When at least one object is selected as *Objects of interest* (left list), all objects that *Intersect with* the selected *Object of interest* (right list), will be automatically shown.

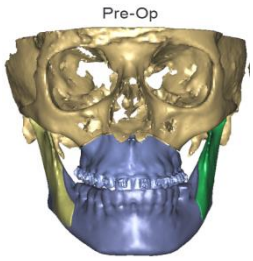
When the wanted object combination is selected in both lists, click *Calculate* to calculate the Intersection volume.

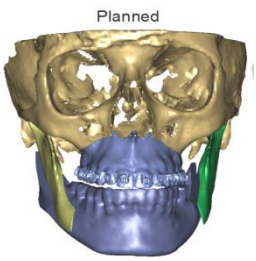
If a collision is detected, you can highlight the impactions on the objects. Use *Highlight intersection* in the *Main Task* dialog of the wizard to activate the Highlight mode.

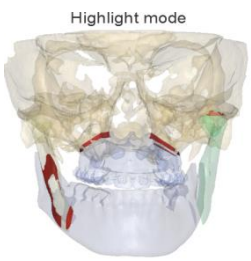
All visible objects will become transparent, only impactions would be opaque and highlighted in red.

All calculated impactions will be added and available in the Object List. See folder with the name *Intersection.*

Click on the switch button at the lower end of the 3D view to switch between Planned and Pre-Op modes. During switching, highlighted impactions will be shown.





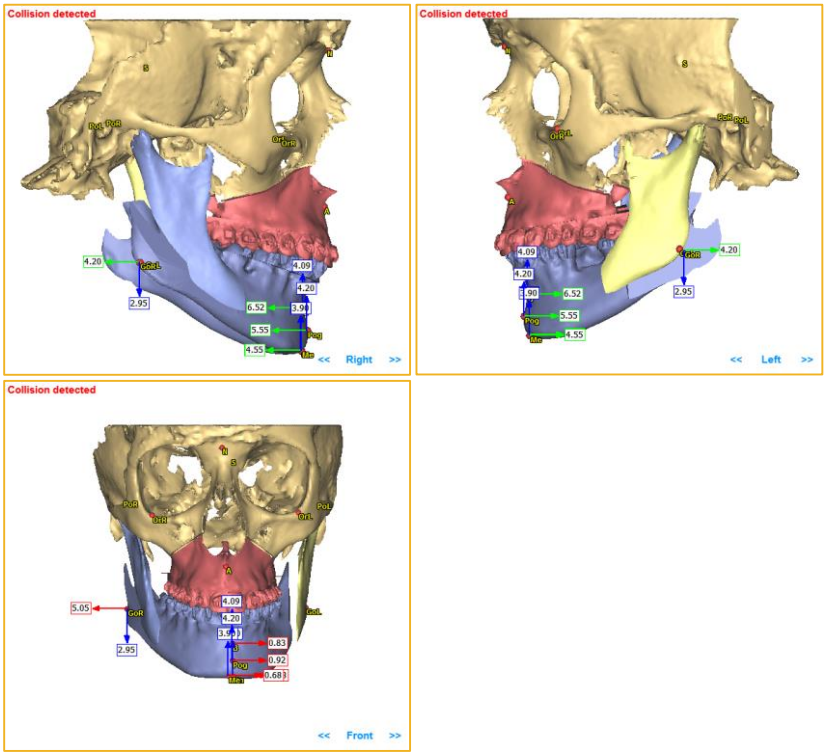


If there is cephalometry analysis indicated you can activate fixed view mode by clicking *Toggle fixed views*.

This mode visualizes comparison of the Pre-Op and Planned position of indicated cephalometric points in 3D views.

Fixed view mode consists of following controls:

- Four 3D views where three of them have fixed camera positions (rotation is blocked) and one standard 3D view
- All fixed views have labels with the view names. By clicking on the arrow near the label you can switch different cameras positions (Left, Right, Top, Bottom, Front, Back)
- Near the each cephalometric point there are arrows which show in which direction this point has been moved during the planning. Depending on the selected view arrows could be different as they represent 2D projections of the movement.



It is not restricted to keep working with the planning while fixed mode is activated. All directions and numbers will be updated on the fly.

You can also show/hide specific points/measurements via the *Cephalometric analyses overview* dialog.

Numbers and directions can also be seen in the Cephalometric analysis dialog in columns Delta X, Y, Z.

4.6.2 General 3D operations

This tool allows you to perform the following Boolean operations with objects:

Mirror

Allows you to mirror objects around a mirroring plane. Cephalometric planes can be selected as mirroring planes.

Merge

Allows you to combine or group several objects.

Split

Allows you to ungroup merged objects.

Unite

Preserves the outer surface of selected objects.

Intersect

Calculates the intersection of selected objects.

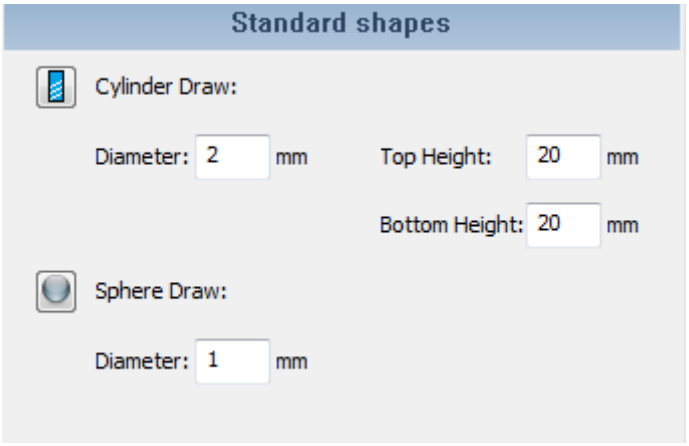
Subtract

Allows you to subtract the part selected in list 1 from the part selected in the list 2.

Keep original

Allows you to save or remove original objects after performing simulations.

4.6.3 Standard shapes



The standard shapes tool allows you to create Cylinders and Spheres.

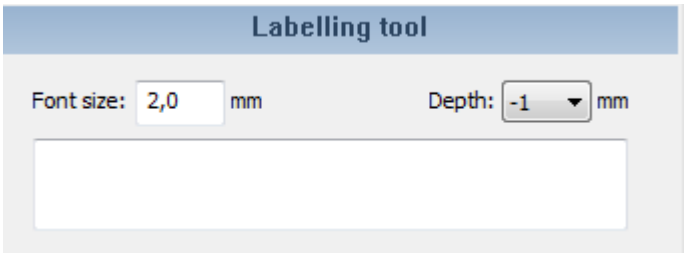
To create cylinders set the diameter and the length of the cylinder above and below the surface of the 3D object. Diameter and height can be set from 0.1mm to 500mm. Select Cylinder draw by clicking cylinder draw icon  . Left click on an existing 3D object to place a cylinder.

To create holes in an object, use the subtract functionality in the General 3D operations to subtract a cylinder from a 3D object.

To create spheres, set the sphere diameter. Sphere diameter can be set from 0.1mm to 10mm.

Select the Sphere Draw icon  and left click on an existing object to place a sphere.

4.6.4 Labelling tool



Use the labeling tool to create a label on an object.

Type the text of the label in the text field. (Labels with 2 sequential capital Y's cannot be created)

Set the font size. Font size can be set between 1.0 and 10 mm.

Depth will determine the height of the label compared to the surface of the object. A negative height results in a label that is subtracted from the object.

Hover over the object to see a preview of the text. The text will always be orientated horizontally.

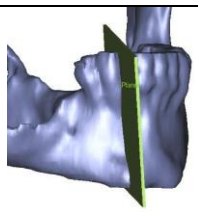
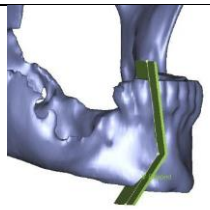
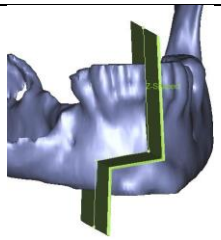
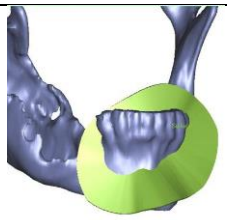
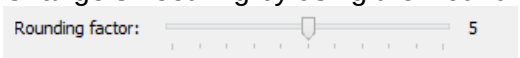
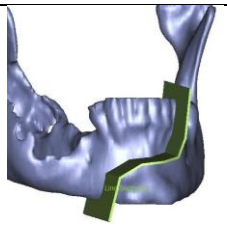
If the surface of the object at the location of the start of the label is curved the label sometimes cannot be placed. The workaround is moving the cursor slightly.

4.7. Osteotomy

4.7.1 Draw Osteotomy Plane

Different osteotomy plane types can be selected:

- Fixed shape: Planar, V-Shaped, Z-Shaped or Surface
- Custom type: Curve/Line Segments

Planar	Place three points to define the cutting plane	
V-Shaped	Place three points to define shape of the osteotomy	
Z-Shaped	Place four points to define the shape of the osteotomy	
Surface	Place as many points as you need, double-click to finish Resulting cut plane will have a closed shape	
Curved / Line Segments	Place as many points as you need. the resulting cutting plane will be shaped according to indicated points During indication, it is possible to: 1. Change smoothing by using the *Rounding factor.*  2. Add/Remove points – Left/Right mouse key. 3. Finish indication – Double-click. 4. Close curve – Double-click on the first point.	

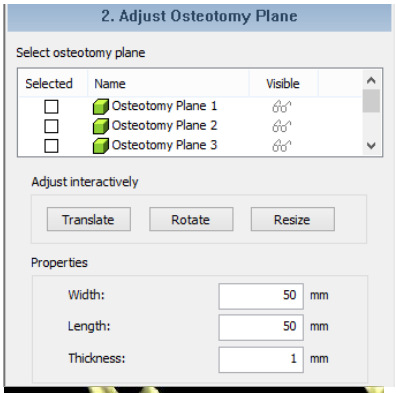
Indicate the cutting path on 2D or 3D views once the osteotomy plane type has been selected:

In the 2D or 3D view, the cursor will change to a pencil. Click once with the left mouse button to indicate a point. While indicating points, you can zoom, pan and rotate the 3D object. When all points are indicated, an osteotomy plane is displayed.

Click *Next* to finish the Draw Osteotomy Plane step and to proceed to the Adjust Osteotomy Plane step.

4.7.2 Adjust Osteotomy Plane

This step allows you to translate, rotate and resize a selected osteotomy plane.



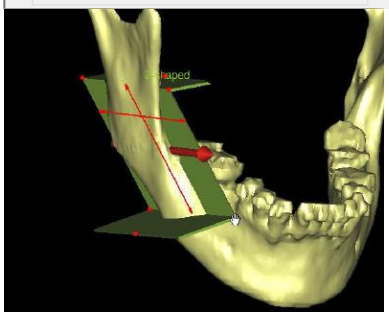
Select the required osteotomy plane in the list by clicking the corresponding checkbox in front of the name of the osteotomy plane. By default, the last created osteotomy plane will be selected.

Planes can be visualized or hidden by clicking the glasses next to the name of the osteotomy plane.

To Translate a selected plane, click *Translate* and move it by dragging & dropping it in the 2D or 3D views.

To Rotate a selected plane, click *Rotate* and perform the rotation by dragging & dropping it in the 2D or 3D views.

To Resize a selected plane: Click *Resize* to enable the interactive mode. Select and drag the arrowheads or red dots to resize the osteotomy plane. Or change the properties of the selected osteotomy plane in the *Properties* box.



Click *Next* to finish the Adjust Osteotomy Plane step and to proceed to the Perform Osteotomy step.

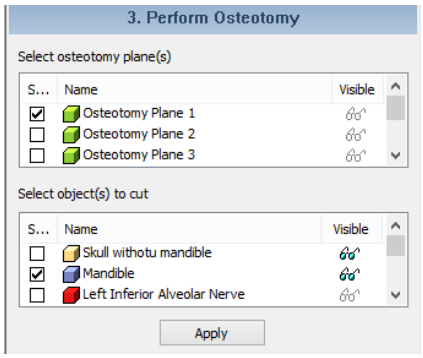
4.7.3 Perform Osteotomy

In this step, you must select the osteotomy plane and an object to simulate the osteotomy.

It is possible to select several objects and planes so that several osteotomies can be performed at a time.

When *Apply* is clicked, selected objects will be split.

In the Rename New Parts section, you can rename new parts that were created from the osteotomy operation by clicking on their name.



Click *Next* to finish the Perform Osteotomy step and to proceed to the Reposition step.

4.7.4 Reposition

See 4.6 DESIGN TOOLS.

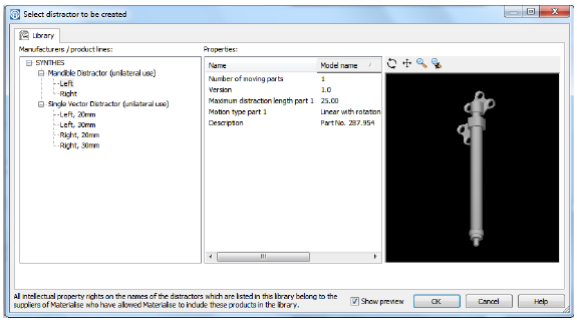
4.8. Distraction

The *Distraction Wizard* will guide you through all the necessary steps to simulate a distraction. Each step will explain what needs to be done before you can proceed to the next step.

4.8.1 Place New Distractor

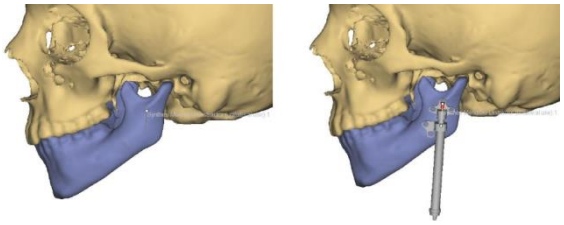
First indicate the type of surgery you want to perform:

- Unilateral Ramus.
- Bilateral Ramus.
- Maxillary.



The *DePuy Synthes CMF* distractor library will be opened once *Next* is clicked.

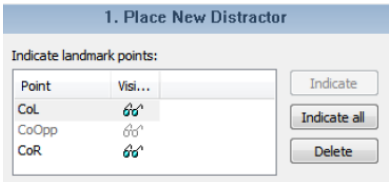
After selecting a distractor, your cursor will change to a pencil. With two mouse clicks in the 3D window, the distractor can be located. The first mouse click must be on the fixed part of the bone, the second mouse click on the part that will be distracted.



When the distractor has been placed correctly, click *Next*.

The wizard will ask you to indicate landmark points that are appropriate for the type of distraction you have chosen. The landmarks will appear in the Cephalometric window at the left side of your screen.

If you have previously completed a Cephalometric analysis, some or all landmarks may have already been indicated. When all landmarks have been indicated, the *Next* button will be enabled and you can proceed to the next step.



You can change the default name for the distractor.

Click the *Next* button to go to the *Adjust Distractor Position* step.

4.8.2 Adjust Distractor Position

This step allows you to fine-tune the position of the distractor.

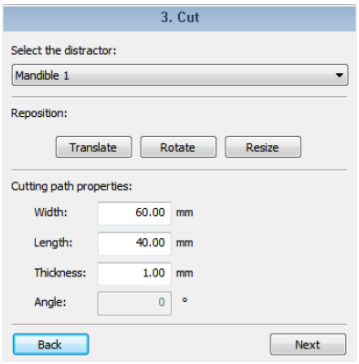
Select the distractor you would like to reposition in the dropdown box, and use the "*Translate*" or "*Rotate*" buttons to switch on the interactive reposition controls in 2D and 3D views to reposition the selected distractor.

There are three aligning options that can help you adjust the distractor position: it is possible to align the distractor vector to Cephalometric, Sagittal or Axial planes.

To align the vector of the distractor: Use available keys in the "*Wizard*" dialog box, or use the red arrow by moving your mouse to the top of the arrow, and left clicking. Drag the arrow (the vector) towards the direction you desire.

Click "*Next*" to go to the next step.

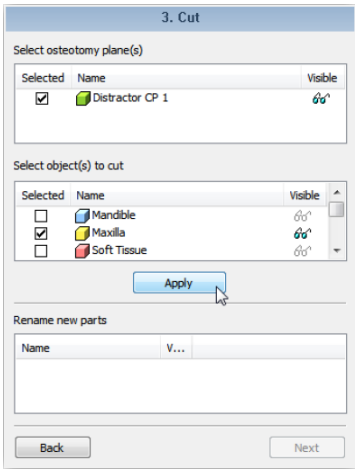
4.8.3 Cut



This step allows you to manipulate the cutting path so it is perfectly adjusted to the patient's 3D model. The cutting path can be adjusted in both 2D and 3D views to ensure that needed bone will be completely cut:
Use "*Translate*" and "*Rotate*" to interactively reposition the cutting plane.

Use "*Resize*" to enable resizing in the interactive mode, or resize manually by specifying values in corresponding cutting path properties fields.

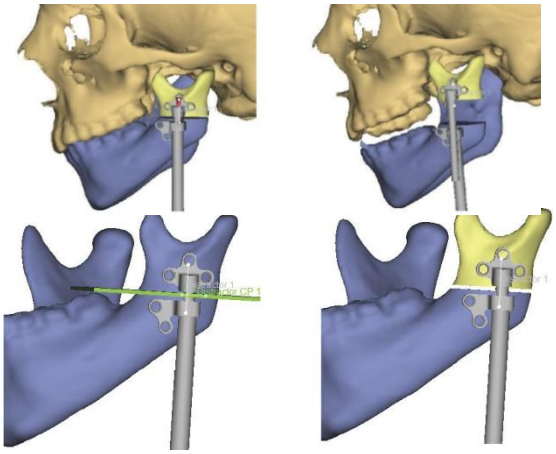
Once position and parameters for the cutting plane are fine-tuned, click "*Next"*.



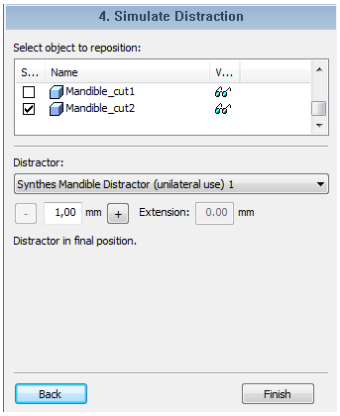
Select cuttings paths in the cutting path list that will simulate the osteotomy. Select object(s) to cut in the 3D Object List. Click "*Apply*" to perform the split of the 3D object.

In the "*Rename New Parts*" section, you can rename new parts that were created by cutting the selected 3D object.

Finish this step by clicking "*Next*".



4.8.4 Simulation Distraction



In this step, you can simulate the distraction by opening the distractor. Select the 3D object that you want to reposition by the distractor in the 3D Object List.

Select the distractor that will perform the repositioning in the dropdown list (if only one distractor is placed, you can only select that one).

Open or close the distractor by clicking the + or - button.

Click "*Finish*" to end the simulation and to exit the *Distraction Wizard*.

4.9. Reconstruction with Fibula

The "*Reconstruction with Fibula Wizard*" allows you to plan the reconstruction of the mandibular and/or maxillary defects using the fibula as the donor site.
In this wizard, the fibula segments to harvest will be defined based on the reconstruction curve of the area of interest, i.e. the mandible or maxilla. The wizard will automatically create the cutting procedure, but the user can fine-tune and adjust the plan.

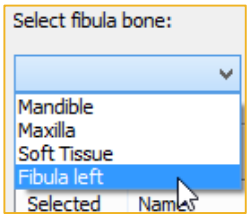
4.9.1 Create New Reconstruction

First choose the reconstruction you would like to work on in the "*Select reconstruction*" list:

- *New* – To create a reconstruction from scratch.
- *Reconstruction N* – When multiple reconstructions are available, one can be selected from the list to make it visible for further modification.

4.9.2 Select Fibula Bone

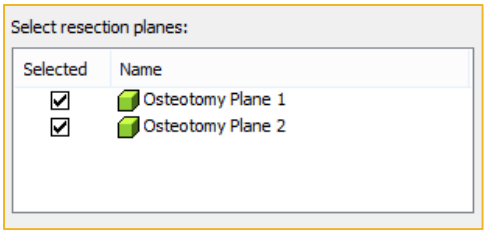
This dropdown allows you to define the fibula to be used for the reconstruction:

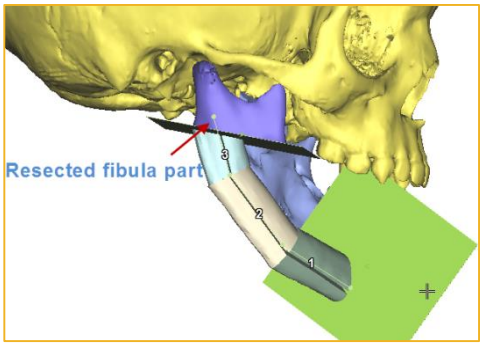


- If the case does not contain any fibulas yet, click "*File/Import 3D objects…*" to import objects from another project.
- The fibula selected, will be shown in the Fibula view (bottom view).
- A new reconstruction will be created each time a fibula is selected.
- Depending on the name of the fibula object the object will be recognized as 'Left' or 'Right' fibula and will be showed by default from the lateral side.
  - If name contains the letter 'R' then it will be recognized as 'Right' fibula
  - If name doesn't contain the letter 'R' then it will be recognized as 'Left' fibula
- By visualizing for example a 'Tibia' object it is possible to review the orientation of the fibula.

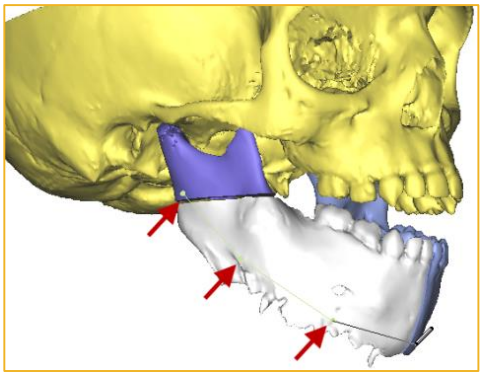
4.9.3 Automatic Osteotomy

Optionally, select in the "*Select resection planes*" list, osteotomy planes which were used for resectioning prior to the reconstruction planning. Fibula parts will automatically be cut along the selected planes to assure alignment of the reconstruction with the remaining mandible/maxilla.
If there are no resection planes in your planning yet, they can be created in the "*Osteotomy Wizard*".





4.9.4 Curve Indication



Once the fibula is selected, you can define the path and the shape of the desired reconstruction by drawing the curve segments in the "*3D*" or the "*Axial*" view. The curve that you draw will determine how the fibula parts will be cut and positioned in the defect and it will be the center line of the new reconstruction.
Note that:

- The first point indicated will correspond to the proximal part of the fibula.
- The number of points will determine the number of fibula parts.

The following controls can be used to indicate a curve:

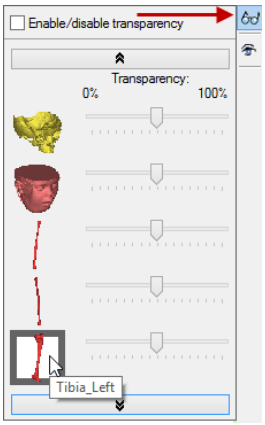
- Left mouse click to add points (first click will start indication).
- Press and hold down the left mouse button over a point, and drag the mouse to move a point.
- Left mouse click on curve to add an extra point.
- Right mouse click on a point to remove that indicated point.
- Double-click the left mouse button to finish curve indication.

Once the curve is drawn, the reconstruction planning will be created automatically. Further adjustment of the plan can be made to achieve the best result.

4.9.5 Planning Adjustment

<u>Show Additional Objects in the Fibula View</u>

Use the "*Toggle Transparency*" menu (at the right top corner of "*Fibula*" view) to show or hide extra objects on the Fibula scene. For instance, for viewing the related tibia or arteries.



<u>Curve Adjustments</u>

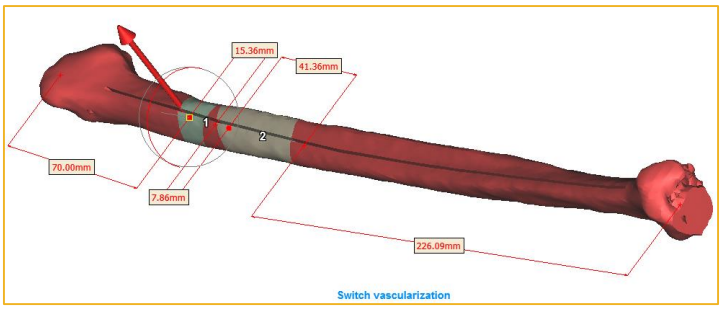
The curve can be adjusted after indication, all changes will be applied in real time:

- Press and hold down the left mouse button over a point, and drag the mouse to move a point.
- Double-click with the left mouse button on the curve to add an extra point.
- [RMB] on a point to remove that indicated point.
- If curve is selected on 3D view, pressing the [Delete] key will remove the existing curve and restart planning from scratch.

Wedge Adjustments

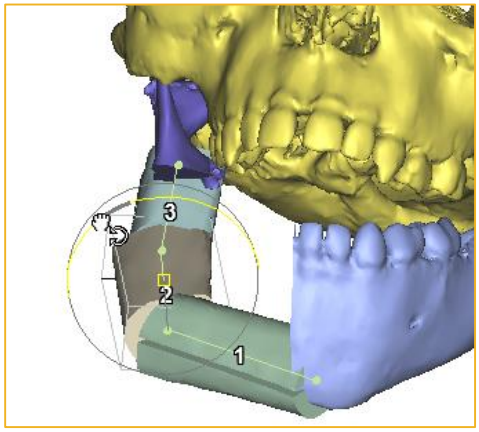
You can fine tune the orientation and position of the reconstruction segments:

- Click on the red arrow and rotate it to change the orientation of all segments simultaneously. The side the arrow points to will be used as the buccal side.
- Drag the red points to move the reconstruction segments along the fibula.
- Click "*Switch Vascularization*" to change the sequence of the reconstruction segments (switch between vascularization from the left or from the right).



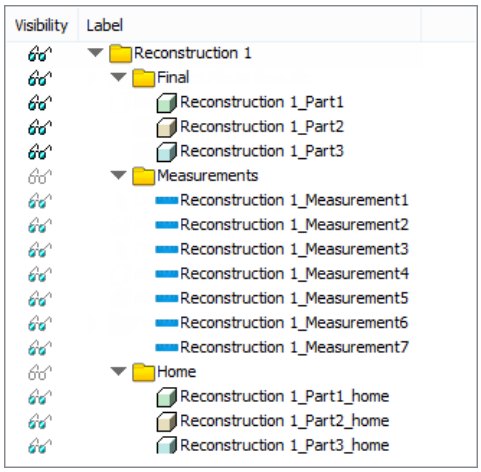
Rotate Fibula Parts

Click the *rotate icon* to individually rotate each reconstruction segment. A left mouse click in the 3D view on a fibula part will activate rotation circles in both views. Drag along the circles to choose the best orientation for the selected part.



Reconstruction Objects

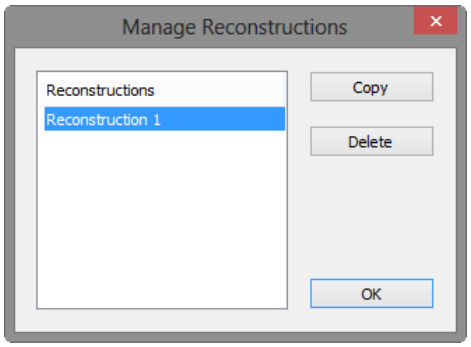
All reconstruction objects and measurements – grouped in a folder – will be available in the "*Object List*". Note that these objects are only the output of the reconstruction plan and that they will be recalculated automatically whenever the plan is changed.



4.9.6 Reconstruction Manager

Managing the different reconstructions created for a case is possible by clicking "*Reconstruction Manager*":

- *Copy* – To create an adjusted planning based on an existing one. Afterwards, the adjusted planning can be compared with the original planning.
- *Delete* – To delete redundant reconstructions.



Making copies of reconstructions
Copying fibula parts in the object list does not copy reconstruction functionality and behavior.
Only copying in the "Reconstruction Manager" will allow copying of reconstruction functionality and behavior.

4.9.7 Learning Mode

When you use the "*Reconstruction with Fibula Wizard*" for the first time, a "Learning Mode" will appear. This interactive tutorial will guide the user– by using of text balloons – through the steps to plan a reconstruction case. Experienced users can choose to skip or deactivate the tutorial.

4.10. Orthognathics

The Orthognathics module in PROPLAN CMF Software allows you to plan Orthognathics surgeries. Several modules in the "*Orthognathics Wizard*" will guide you step-by-step through the planning. You can skip steps by clicking on the title bar of the step in which you want to proceed to.

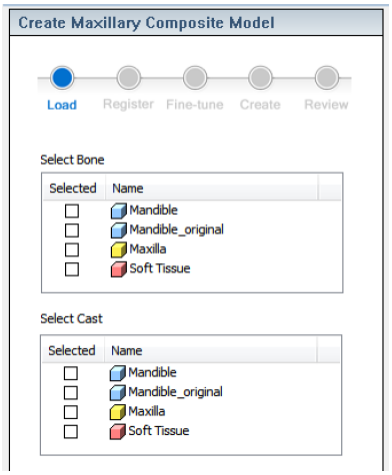
4.10.1 Prepare for Planning

Create Maxillary Composite Model

This step allows you to combine highly-detailed information of the teeth from maxillary and mandibular casts with upfront segmented mandibular and maxillary bones. The resulting 3D objects – including the segmented parts and teeth information from the casts – are called composite models.

Load

Select the maxilla bone and corresponding maxillary cast.

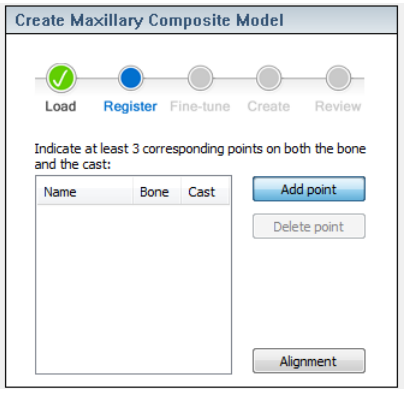


Register

Indicate at least three corresponding points between the bone and the cast model or use "*Alignment*".

The "*Add point*" button will be toggled by default in this sub-step. Move the mouse cursor to a reference location on the bone model constructed from CT images, and click on it. A checkmark will appear in the CT column of the points list.

On the cast model, mark the corresponding location with a second mouse click. Another checkmark will appear in the "Model" column of the points list.



When three corresponding points are set, the provisional registration result will be shown in the lower preview pane. Additional corresponding points can be added if improvement on the registration is needed.

To move an indicated point, un-toggle the "*Add Point*" button and move your cursor to the indicated point. The indicated points on the bone and cast model can be moved by the click- and drag- action.

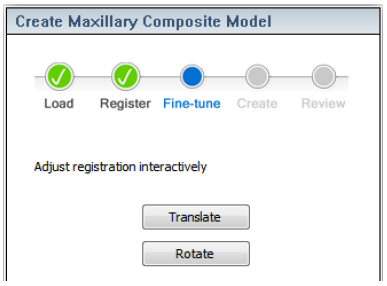
To delete an indicated point, click on a point in the points list, then click "*Delete Point*". The selected point in the "Points List" will be removed.

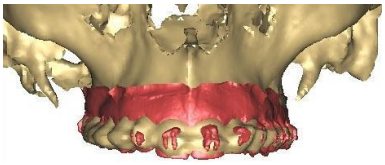
Fine-tune

In this sub-step, cast registration can be fine-tuned in 2D and 3D views.

Enter the interactive translation/rotation mode for the cast model by clicking “*Translate*” or “*Rotate*”.

Use the contours of the objects in the 2D image views as a reference.



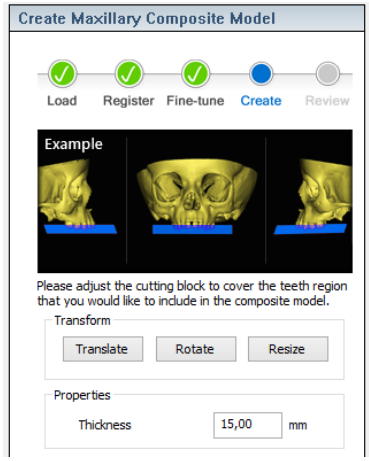


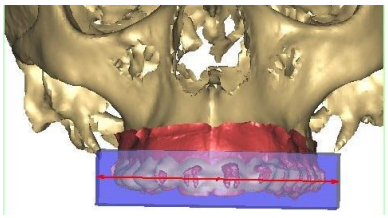
Create

In this sub-step, a cutting block (blue block) will be generated around the teeth region. Some slight adjustments are required to cover the teeth region with this cutting block in order to create a composite model.

Enter the interactive translation/rotation/resize mode for the cutting block by clicking “*Translate*”, “*Rotate*”, or “*Resize*”.

Change the thickness of the cutting block in the “Thickness” field under “*Properties*”. Thickness of the cutting block is set at 15mm by default.



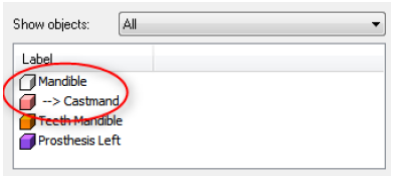


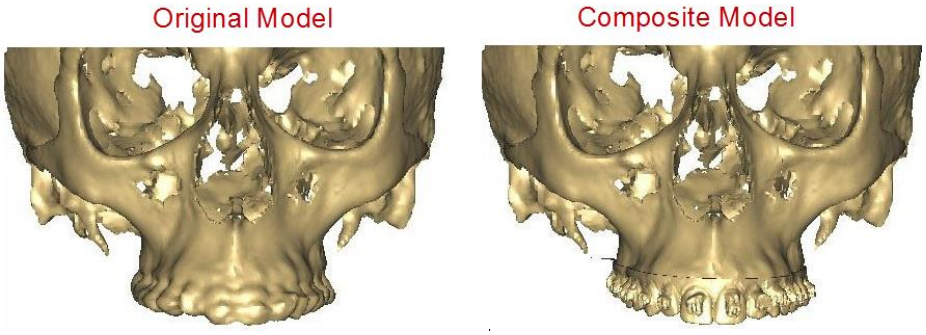
Review

The last sub-step allows you to review the generated composite model. If you need to fine-tune the composite model, click “*Back*” to go back to the previous step and readjust the cutting block.

If you are satisfied with the generated composite model, click “*Finish*” to go to the next step. The registered cast will be automatically linked to the generated composite model.

The linkage between the cast model and composite model will be indicated by the symbol “-->” in the “3D Object List” (as depicted in the example to the right). Any repositioning and osteotomy performed on the bone model will be applied to the cast model automatically via the linkage.





Create Mandibular Composite Model

In the *Create Mandibular Composite Mode step*, sub-steps are identical to that in the *Create Maxillary Composite Model step*, except that the focus is on creating a Mandibular Composite Model from a Mandible and Mandible Cast.

Set Horizontal Reference

If it is necessary, the axial slice orientation can be adjusted using the *Set Natural Head Position* feature. More details can be found in section 4.3

4.10.2 Cephalometry

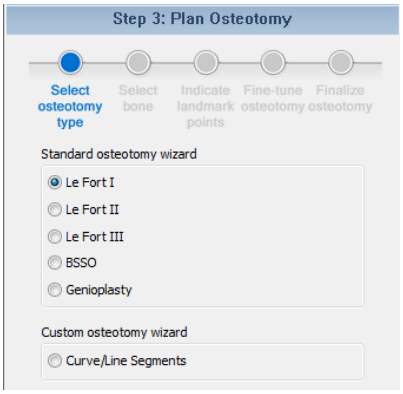
Please refer to the CEPHALOMETRY section of this document for more information about this module.

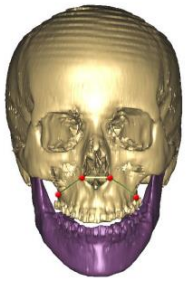
4.10.3 Plan Osteotomy

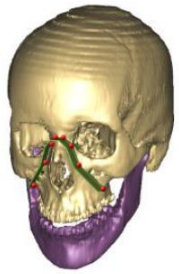
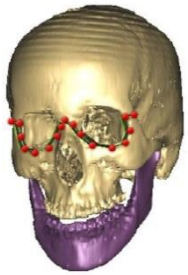
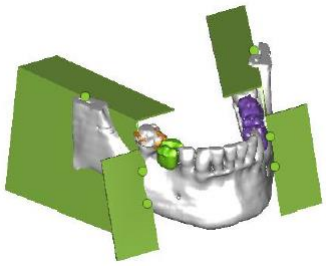
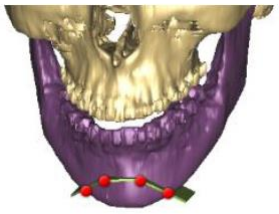
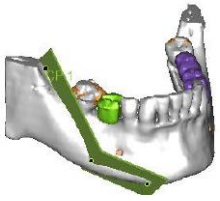
This step allows you to perform osteotomy simulation according to existing standards:

Select osteotomy type

Select the desired “Osteotomy Wizard” by clicking on the corresponding radio button:



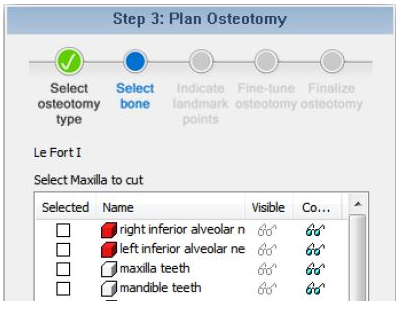
Le Fort I cutting path is based on four landmark points on the maxilla. PROPLAN CMF Software will automatically generate linear measurements for this osteotomy type for impaction analysis after successful osteotomy planning.	

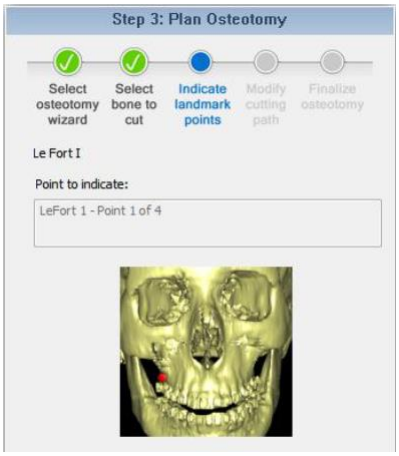
Le Fort II cutting path is based on eight landmark points on the maxilla. PROPLAN CMF Software will automatically generate linear measurements for this osteotomy type for impaction analysis after successful osteotomy planning.	
Le Fort III cutting path is based on 17 landmark points on the maxilla.	
BSSO Bilateral Sagittal Split Osteotomy (BSSO) cutting paths are based on six landmark points at both the left and right side of the mandible.	
Genioplasty cutting path is based on four landmark points on the mandible. PROPLAN CMF Software will automatically generate linear measurements for this osteotomy type for impaction analysis after successful osteotomy planning.	
If a desired cutting path cannot be achieved by the standard “Osteotomy Wizard”, it can be created by using the **Curve/Line segments** osteotomy.	

Select bone

Select the bone model(s) that you wish to use in the osteotomy. Click on the empty box to select the bone model. The selected bone model will have a tick mark symbol under the “Selected” column.

Linked cast will automatically be selected if you select its linked bone. However, you can deselect the cast if you wish to exclude it from the osteotomy.



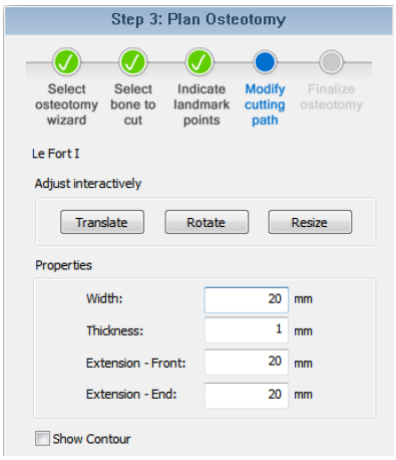


Indicate landmark points

If you choose "*Standard osteotomy wizard*" in the first sub-step, you are required to indicate all landmark points for the selected analysis in this sub-step. During this sub-step, you can click on the bone model to indicate required landmarks points, it will auto-proceed from the first point to the last point.

If you wish to re-indicate a certain point, click the *left arrow* or *right arrow icon* to scroll to that point, and then indicate again by clicking on the bone model.

If you choose "*Custom osteotomy wizard*" in the first sub-step, you are required to indicate the osteotomy plane on the bone model. In this sub-step, you can indicate the osteotomy plane by clicking on the bone model, and finish the cutting path by double- clicking the left mouse button.



Modify cutting path

Adjust cutting plane by using reposition controls and parameters:

To translate an osteotomy plane, click "*Translate*" to enter the translation mode.

Three translation axes will be displayed on the 2D and 3D views. Select and drag one of the axes with the left mouse button to translate the osteotomy plane along the axis. You can also select and drag the yellow square (the origin of the axes) to translate the osteotomy plane without any restriction.

To rotate an osteotomy plane, click "*Rotate*" to enter the rotation mode. Four rotation circles will be displayed on the 2D and 3D views. Select and drag one of the circles with the left mouse button to rotate the osteotomy plane along an axis. You can also select and drag the yellow square in the middle of the circles to translate the rotation center.

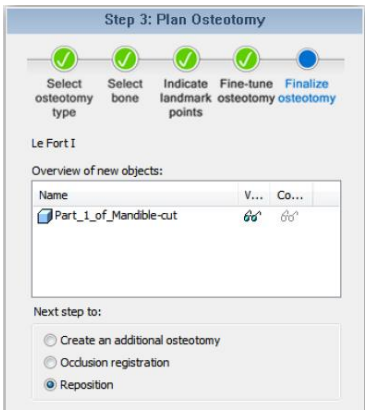
To resize the width of the osteotomy plane, click "*Resize*" to enter the resize mode. Select and drag the big arrowhead to change the orientation of the plane or the double arrows to resize the width of the osteotomy plane.

You can change the properties of the selected osteotomy plane in the "*Properties*" box:

- Width - Change the width of the defined cutting path.
- Thickness - Change the thickness of the defined cutting path.
- Extension - Front - Adjust the cutting path before the first point.
- Extension - End - Adjust cutting path after the last point.

Check the "*Show Contour*" checkbox if you want the contour of the cutting path to be displayed on the 2D view panes.

Finalize osteotomy

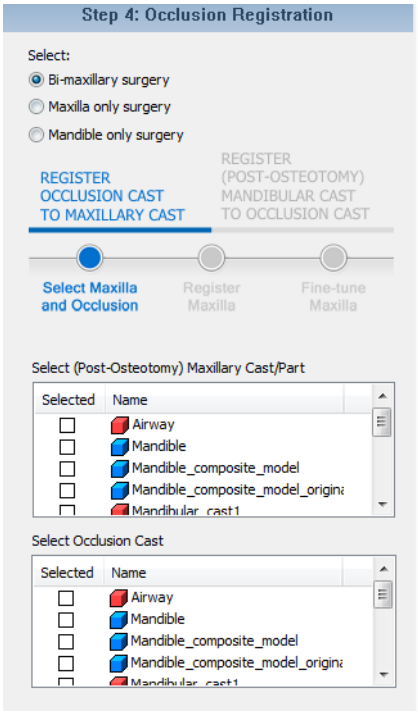


All new 3D objects generated after the osteotomy can be viewed in this final sub-step. Choose one of the following actions:

- Create an additional osteotomy.
- Go to Step 4: Occlusion Registration.
- Go to Step 5: Reposition step.

If the 3D object involved in the osteotomy has a linked cast, the new cast parts will be automatically linked to the corresponding new 3D objects from osteotomy. In the event of failed automatic linking, manual linking between 3D objects and casts may be required.

4.10.4 Occlusion Registration



This wizard will guide you through the steps to perform an occlusion registration for both maxilla and mandible, together with an occlusion cast.

First select the surgery type:

- Bi-Maxillary Surgery,
- Maxilla only surgery
- Mandible only surgery.

Based on the selected surgery type the wizard will ask for either the maxilla or the mandible in the sub steps. Selecting Bi-maxillary or Mandible only surgery will start with the maxilla and the Maxilla only surgery will start with the mandible.

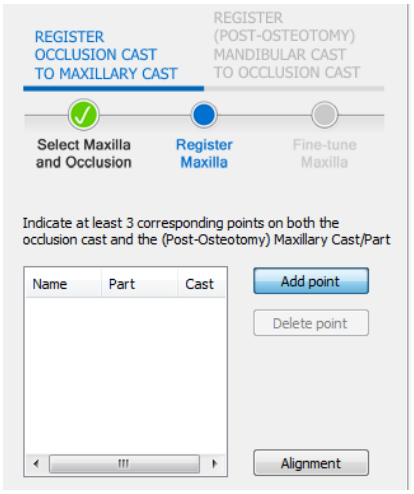
In the first sub-step, the maxilla/mandible and occlusion cast is chosen prior to the registration. The second and third sub-step involves point-to-point registration between the maxilla/mandible and occlusion cast, and fine-tuning the registration. After this, you will select the mandible/or maxilla in the fourth sub-step and continue with point-to-point registration and fine-tuning the mandible/maxilla and occlusion cast in the fifth and sixth sub-step.

Register Occlusion cast to Maxillary/Mandibular cast

Select Maxilla/Mandible and Occlusion

Select a (post-osteotomy) maxillary/mandibular cast/part (from the "*Osteotomy Wizard*") and an occlusion cast for the first part of the occlusion registration.

Register Maxilla/Mandible



In this sub-step, corresponding points between the maxillary/mandibular cast/part and the occlusion cast can be made (or use Alignment). At least three corresponding points must be indicated before entering the next sub-step.

The "*Add Point*" button will be toggled by default in this sub-step. Move the mouse cursor on the maxillary/mandibular cast/part, and then click on it. A check symbol will appear in the Part column of the points list.

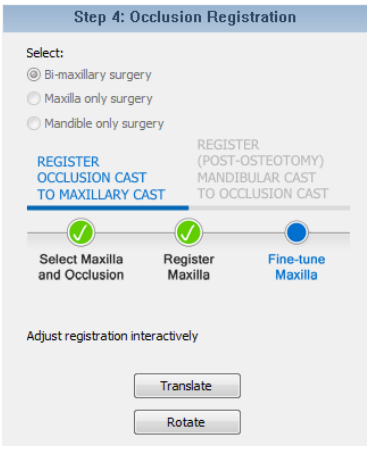
On the occlusion cast, mark the corresponding location with a second mouse click. Another check symbol will appear in the "Cast" column of the points list.

When three corresponding points are set, the provisional registration result will be shown in the lower preview pane. Additional corresponding points can be added if an improvement of the registration is needed.

To move an indicated point, un-toggle "*Add Point*" and move your cursor to the indicated point. The indicated points on the bone and cast model can be moved by a click-and-drag action.

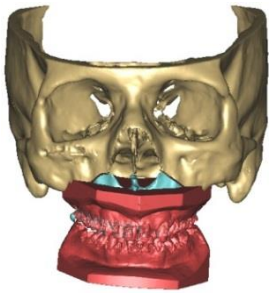
To delete an indicated point, click on a point in the points list, then click "*Delete Point*". The selected point in the points list will be removed.

Fine-tune Maxilla/Mandible



In this sub-step, interactively fine-tune the registration.

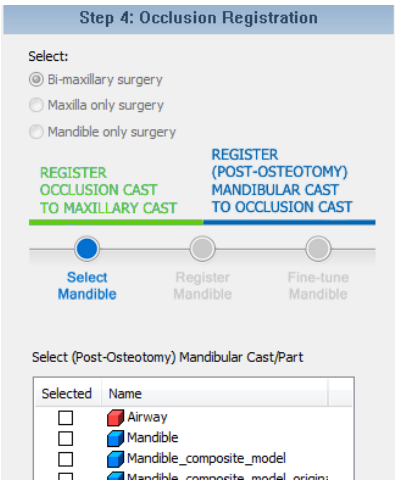
Click "*Translate*" or "*Rotate*" to enter the translation/rotation mode for the occlusion cast. The translation arrows/rotation circles in both 2D and 3D views can be used to perform the translation /rotation on the occlusion cast.



Register (Post-Osteotomy) Mandibular/Maxillary Cast to Occlusion Cast

Select Mandible/Maxilla

Select a mandibular/maxillary cast/part for the second part of the occlusion registration. The selected occlusion cast in the first sub-step will be automatically used in this sub-step.



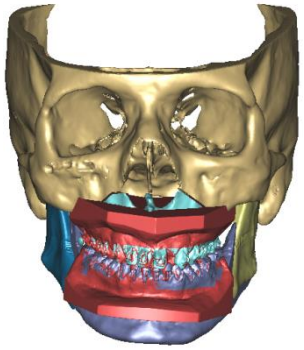
Register Mandible/Maxilla

Similar to *Register Maxilla/Mandible*, the second sub-step.

In this sub-step, corresponding points between the occlusion cast and mandibular cast/part can be made (or use “Alignment”). At least three corresponding points must be indicated before entering the next sub-step.

Fine-tune Mandible/Maxilla

Similar to *Fine-tune Maxilla/Mandible*, the third sub-step.



4.10.5 Reposition

Please refer to DESIGN TOOLS, 4.6, of this document for more information about this module.

4.10.6 Soft Tissue Simulation

Please refer to SOFT TISSUE SIMULATION, 4.5, of this document for more information about this module.

4.10.7 Splint Design

Please refer to SPLINT DESIGN, 4.11, of this document for more information about this module.

4.11. Splint Design

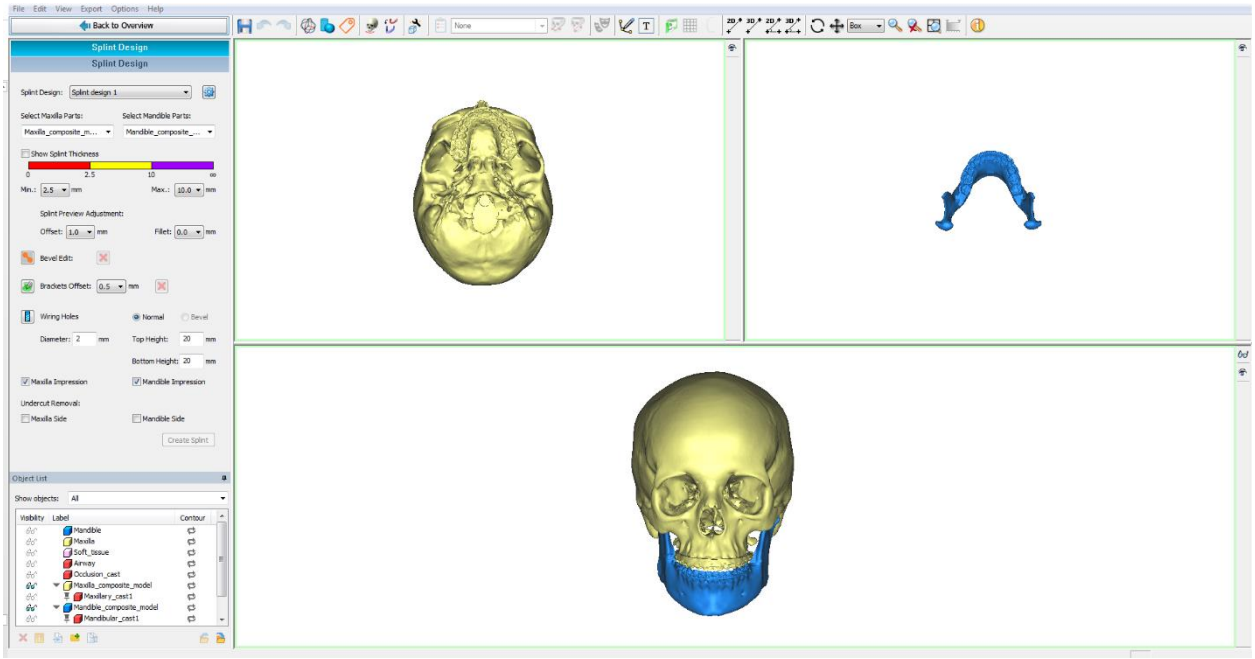
The *Splint design* module allows you to design dental splints that can be used with orthognathic surgery. With the wizard both intermediate and final splints can be created. The algorithm will automatically determine the splint shape and size, but the user can fine-tune and adjust the design with: wiring holes, bracket offset, fillet, bevel, teeth impressions and undercut removal.

4.11.1 Select Maxilla and Mandible parts

The first step is to select the maxilla and mandible parts that will be used for the splint design. Using the dropdown list, select the parts to be used. At least 1 part should be in each drop down list.

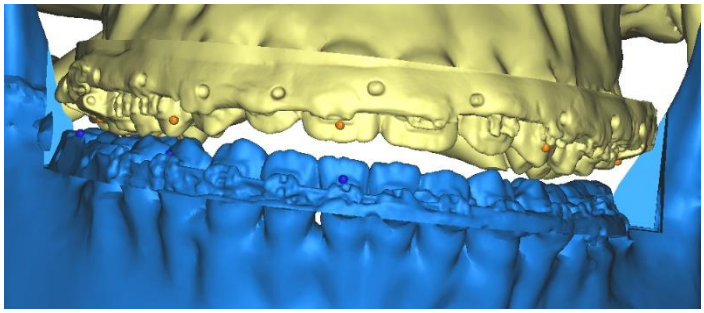
The maxilla parts will appear in the top left view, and the mandible parts in the top right.

The bottom view shows all parts in 3D and is used to show the splint preview.



4.11.2 Create splint preview

To create the splint preview, place minimal 6 points in the bottom 3D view, at least 3 on the maxilla and 3 on the mandible. The bottom view can be enlarged via [Space]. To place points use [LMB]. Already placed points move with [LMB+drag]. To delete a point use [RMB].

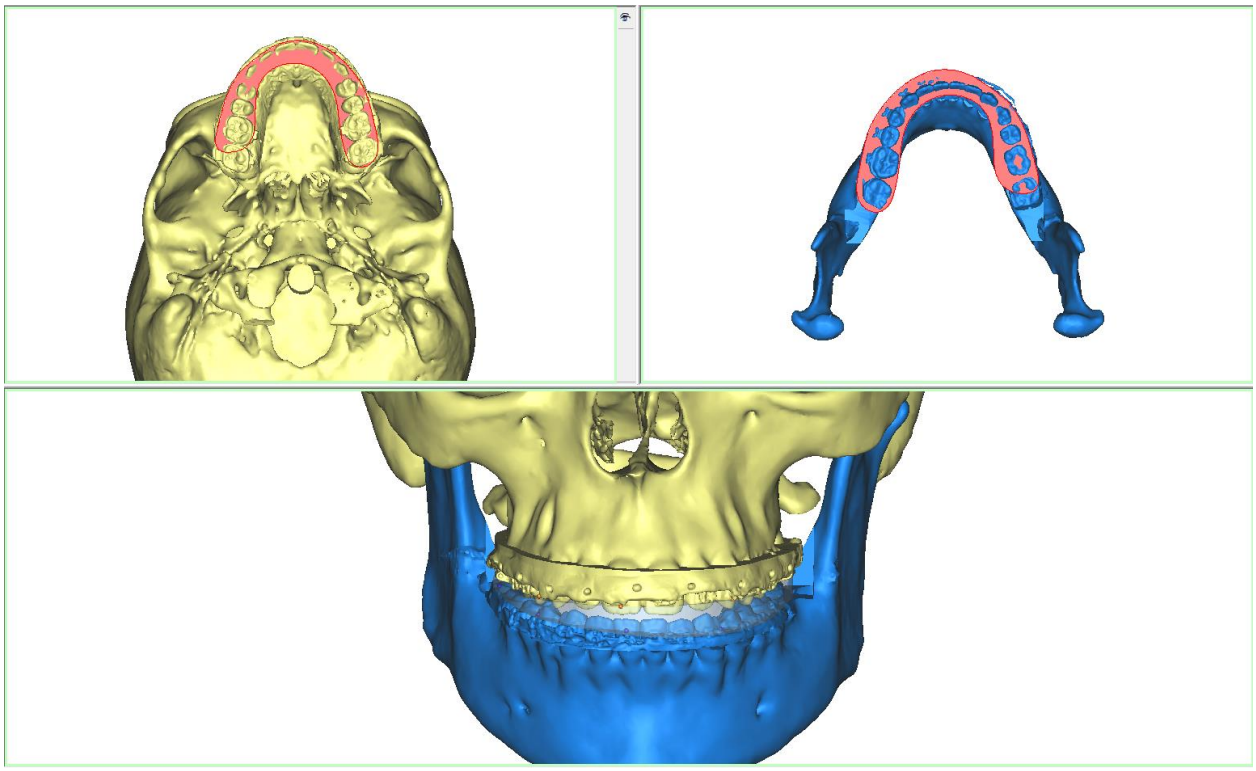


It is advised to place the points on the teeth, just below/above the brackets. This will determine the thickness of the splint.

Once atleast 6 points are placed PPCMF will start with calculating the splint preview. While calculation is ongoing points can still be placed.

The splint preview will be shown in 2 ways:

In the 3D view in a grey transparent splint, and in the top 2 windows with a red contour.



4.11.3 Check thickness

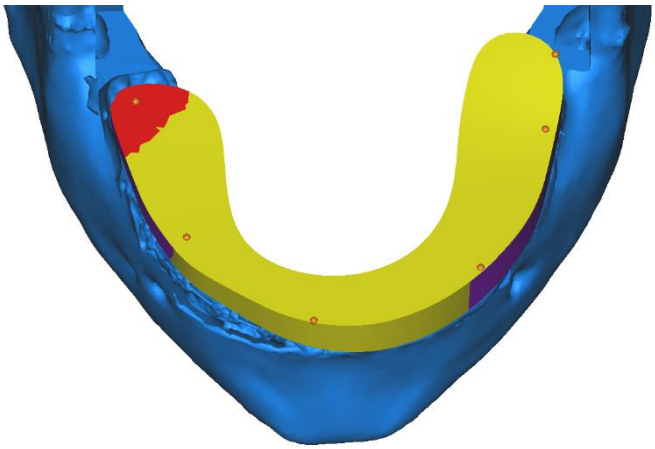
Certain 3D printer materials require a minimum splint thickness in order be printable and to produce usable splints. The splint thickness can be checked via the “Show Splint Thickness” checkbox.

Once this checkbox is selected the 3D splint preview will be colored according to the thickness and color bar settings: red between 0 and Min, yellow between Min and Max, and purple everything above Max.

Note: As the thickness is calculated perpendicular to the surface, the sides of the splint are also colored, showing the splint width and length, not thickness.

To see the thickness of the splint, hide the maxilla and/or mandible parts from the 3D view.

To adjust the splint thickness, drag the splint creation points to another location.

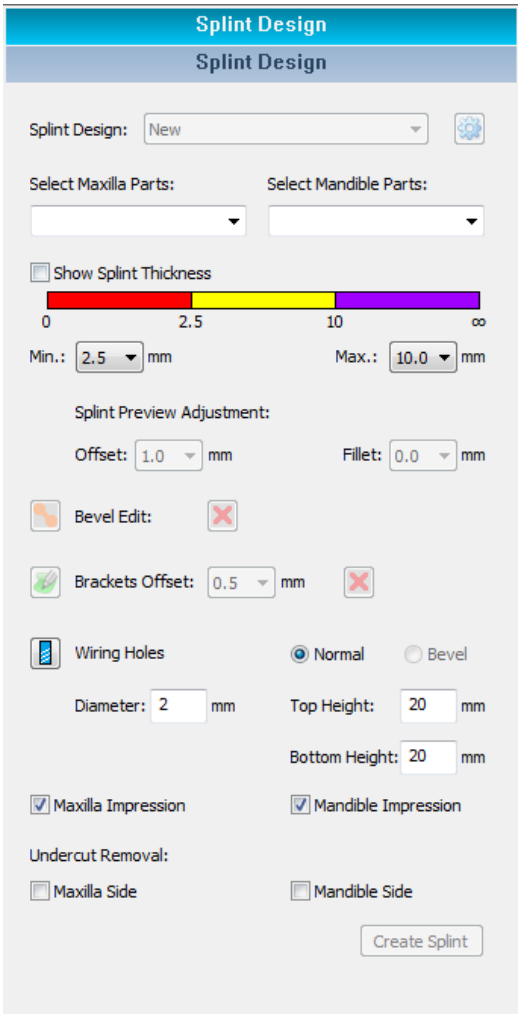


4.11.4 Adjusting the splint preview: Offset, Fillet, Bevel and Contour,

The splint preview can be adjusted in several ways.

Adding splint calculation points

To place points use [LMB]. Already placed points move with [LMB+drag]. To delete a point use [RMB].Adding points will initiate a recalculation of the splint preview.



Adding offset

By changing the offset parameter an offset can be added to make the splint wider, and create room for wiring holes for example. The default parameter for the offset is 1 mm. This can be increase in 0.5 mm steps up to 5 mm. Changing the offset will initiate a recalculation of the splint preview.

Adding fillet

To add rounding to the edges of the splint the value for fillet can be set. A higher value will result in more rounded edges.

Adding bevel

By pressing "*Bevel Edit*" a bevel can added. Click the *Bevel Edit* button  , and select 2 points to indicate the bevel. The splint will be recalculated. If adjustments of the bevel points are needed after placing them they can be dragged to the correct location. Bevel points will always try to "stick" to the surface of the maxilla or mandible. They can be easily be dragged into free space by using [Ctrl+LMB drag].

To remove the bevel click the  behind Bevel Edit.

Adjusting the contour

Final edits can be made by adjusting the contours in the top views. As contour adjustments are reset every time the splint is recalculated, these adjustments should only be made once Points, Offset, Fillet and Bevel are set.

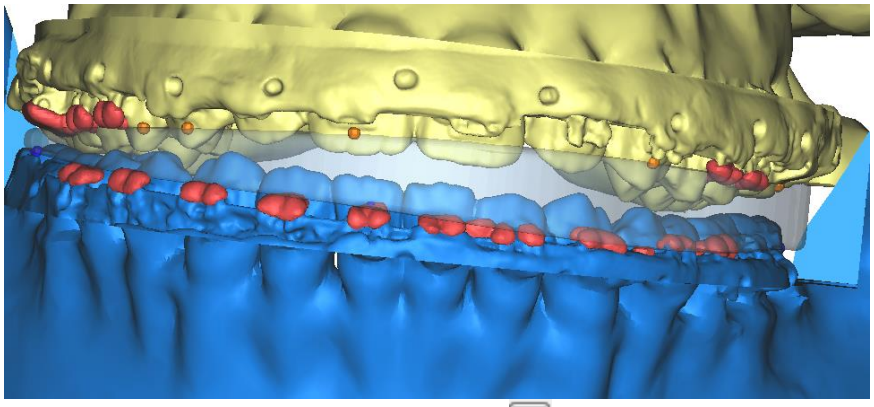
To make local contour edits, select the contour in one of the op 2 views, and drag it to adjust. Pressing Alt while dragging up/down will make the region of the contour that will be adjusted smaller or larger. The splint preview will be updated with the adjusted contours.

4.11.5 Brackets Offset

When creating the final splint, brackets and teeth will be taken into account to create the teeth impressions. Because brackets are difficult to segment, often a bracket offset is applied to the brackets that intersect with the splint surface.

To apply the bracket offset, select Brackets Offset  , and mark the brackets that should be taken into account with the left mouse button. To unmark, use [Ctrl+LMB].

The thickness of the offset can be set via the dropdown list. All marked brackets will get the same offset. Changing the offset thickness after marking will change the offset for all marked brackets.

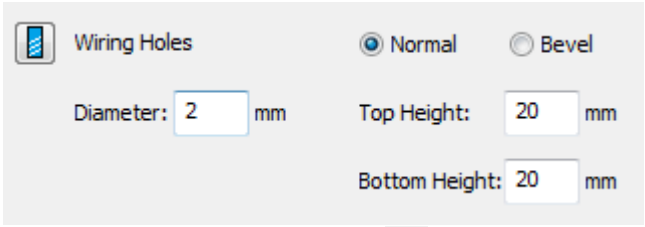


To remove all marking, press the "*Unmark All*" button .

At the moment the splint created the marked brackets offset will be saved as separate objects in the object list, linked to the object they were marked on.

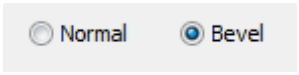
4.11.6 Wiring holes

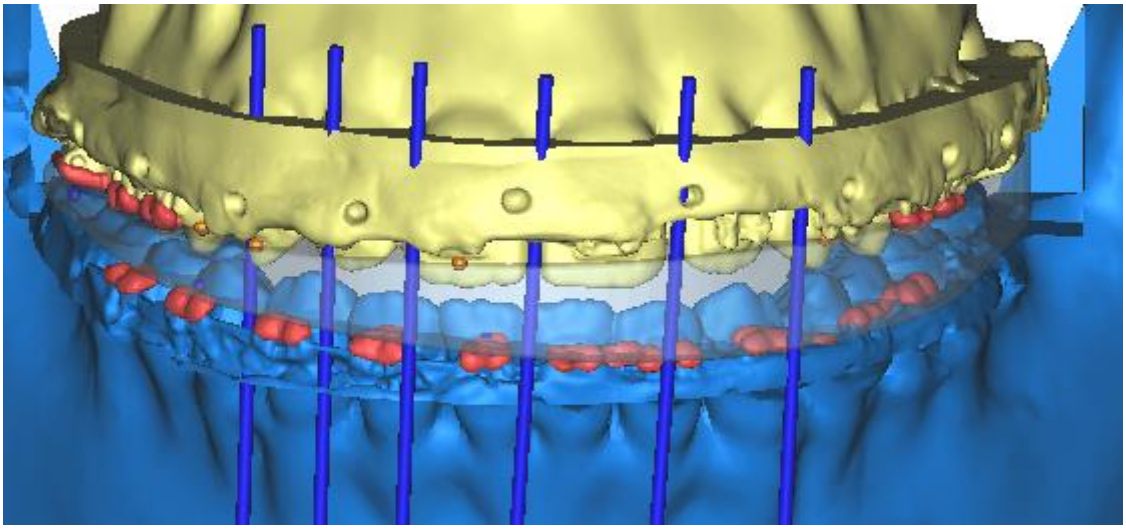
If wiring holes are needed in the splint these can be added by placing cylinders on the splint. All cylinders that are visible in the preview and on the splint when creating the splint will automatically result in a wiring hole.



To place the cylinders select the Wiring holes button . You can set the diameter of the wiring holes, by setting the cylinder diameter. Cylinders will by default be perpendicular to the surface they are place on. Use the left mouse button to place the cylinders. Place the cylinders on the top or bottom surface of the splint.

In case a bevel was applied to the splint it might be needed to have the wiring holes follow the bevel angle. This can be done by changing the setting from normal to bevel.





4.11.7 Create Splint

User the create splint functionality to create a splint according to the preview, and holes will be added on the location of the visible cylinders. The splint will be added to the object list.

Use the Maxilla and Mandible impression selection boxes to included teeth impressions (and corresponding bracket offset) in the splint.

Splint STL's are automatically fixed by the fixing algorithm. See preferences to disable this functionality

To add a label to the splint use the labelling tool.

4.11.8 Undercut removal

To apply undercut removal to the teeth impressions (and bracket offset) when the splint is created, select the Maxilla or Mandible Side checkbox. Undercut removal uses a standard vector of 45 deg for the mandible and 5 deg for the maxilla.

Undercut Side can only be selected if the corresponding Impressions are selected

4.11.9 Splint design management

The first time the splint design wizard is started a new splint design is created and saved. This design will be used, until a new design is created. Switching the Maxilla and/or Mandible parts will not create a new splint design.

To create a new splint design select new from the dropdown list. All settings will be reset to default, and the Select Maxilla and Mandible parts list will be empty.

To create a modification to a previous design use the Manage splint designs Dialog. Select the original splint design and select *copy.* Splint designs can be deleted via this dialog.

5 Shortcuts

5.1. General Shortcuts

[Ctrl+G] – Calls “Import images” dialog

[Ctrl+O] – Open file/project

[Ctrl+S] – Save file/project

[Ctrl+W] – Close file/project

[Ctrl+T] – Import 3D object

[Ctrl+Y] – Redo last action

[Ctrl+Z] – Undo last action

[Ctrl+Shift+F] – Calls preferences

[F1] – Help

[F2] – Rename an object

5.2. Navigation Shortcuts

[Space]– Toggle between 1 and 4 views

[↑] – Switch to next slice in 2D views or rotate up in 3D view

[↓] – Switch to previous slice in 2D views or rotate down in 3D view

[←] – Rotate left in 3D view

[→] – Rotate right in 3D view

[Shift+←↑→↓] – Precise panning

[PageUp] – Switch 5 slices in 2D views or rotate up in 3D view

[PageDown] – Switch 5 slices down or rotate down in 3D view

[Home] – Rotate left in 3D view

[End] – Rotate right in 3D view

[Shift+Home] – Quick Left panning

[Shift+End] – Quick Right panning

[Tab] – Toggle between standard views

Mouse scrolling – Switching slice-by-slice in 2D views or zoom in/zoom out in the 3D view

[RMB+drag] – Adjust gray scale in 2D views or interactive rotation in 3D view

[Shift+RMB drag] – Pan

[Ctrl+RMB drag] – Zoom in/zoom out

[Ctrl+L] – Show/Hide Intersection lines

Left mouse click on 2D/3D – All 2D views will display the indicated position.

5.3. Screenshots/Video

[Ctrl+H] – Export Screenshot

[Ctrl+Shift+P] – Save a screenshot of the active view to project folder

[Ctrl+Shift+PrintScreen] - Copy a screenshot of the active view to the clipboard

[Ctrl+Shift+M] – Opens the “Movie Export” dialog

5.4. Wizard specific Shortcuts

[Alt+LMB drag] – Change Brush size

[Ctrl+LMB drag] – Unmark

[Alt+X] – Drag X-ray Ceph points along Sagittal line

[Alt+Y] – Drag X-ray Ceph points along Coronal line

[Alt+Z] – Drag X-ray Ceph points along Axial line

[Ctrl+LMB drag] – Allow bevel points to easily move in free space

[Esc] – End point indication

[Delete] – Delete panoramic view curve

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