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exocad

Instruction Manual

Creating Implant Libraries for DentalCAD

exocad.com

Instruction Manual by exocad GmbH

Contact

Julius-Reiber-Str. 37
64293 Darmstadt
Germany

phone: +49-6151-629489-0
fax: +49-6151-629489-9

info@exocad.com
exocad.com

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In your own interest, please do not leak this documentation to end users. Having end users tamper with complex configuration options may cause additional support overhead.

Content

exocad MKTIM-005-1801, 01-18

1 Introduction

This document covers the process of creating an implant library for exocad from previously generated STL files and gives instructions for all necessary steps.

The exoImplantEditor is an editor for exocad's `config.xml` implant library format, with an additional mesh analysis functionality. In order to use exoImplantEditor, you need an exocad dongle which is activated to work with exocad DentalCAD Engine Build 4652 or later.

After creating an implant library, we strongly recommend to have it signed by exocad (see Chapter 9). This ensures the correctness and compatibility of the library.

2 Input Data and Requirements

You need a complete set of suitable implant geometries as STL files to be able to use the exoImplantEditor. Please see the document *Instruction Manual – Creating Implant Geometries For exocad* (customer.exocad.com/exocad_Instruction_Manual_Creating_Implant_Geometries-en.pdf) for details on requirements for the implant geometries.

If you have problems generating suitable geometries using your industrial CAD software, the exoImplantEditor will not solve these for you. However, the exoImplantEditor's automatic mesh analysis / reporting functionalities can help you troubleshoot and understand what exactly are the issues.

2.1 Filename Conventions for STL Meshes

All STL files for mandatory and optional meshes you load in the exoImplantEditor must fit the following filename conventions.

Allowed	Not allowed
small/capital Latin letters	special letters, e.g. umlauts, ß, à, ç, etc.
numbers	blank spaces
_ and -	?, !, (,), =, °, etc.
.	,
	special characters/symbols, e.g. trademark/copyright symbols

Table 1: Filename conventions for STL meshes

3 Launching the exoImplantEditor

Step 1: Download the exoImplantEditor from the Documentation&Tools section in the Secure Area of our website exocad.com/secure-area/documentation-tools.

Step 2: Unpack the exoImplantEditor zip file in a directory of your choice.

Step 3: Run the `ExoImplantEditor.exe` file.

4 The exoImplantEditor Window

Figure 1 shows the exoImplantEditor window.

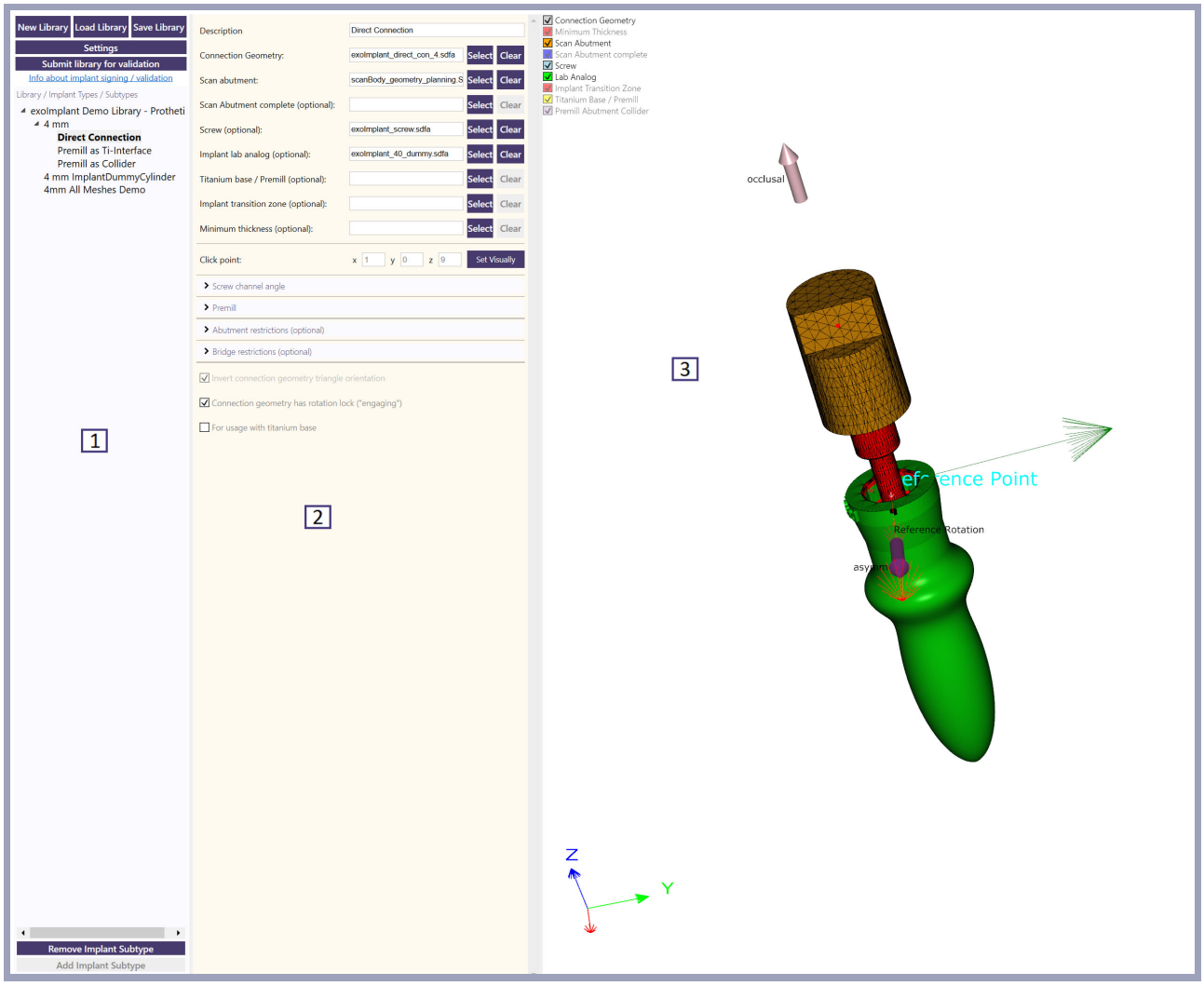


Figure 1: exoImplantEditor startup window

The window consists of three parts:

- **Actions/Hierarchy Section [1]:** Action icons and hierarchical list of the library with its types and subtypes.
- **Information Section [2]:** Section to enter and display information/parameters for the library, the types, and the subtypes.
- **View Section [3]:** Display of objects, e.g. geometries. See Chapter 4.1.

4.1 The View Section

The View Section displays objects (geometries) and coordinate systems. Figure 2 shows implant geometries in the View Section.

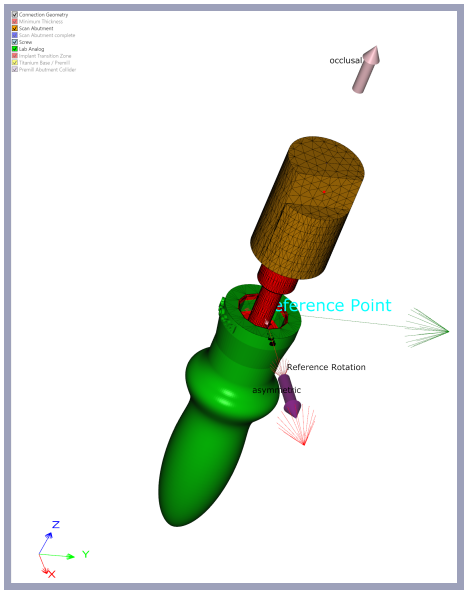


Figure 2: View Section with implant geometries

4.1.1 View Functions

Function	Description
Scroll mouse wheel	Zoom in/out (zoom center = mouse position).
Hold right mouse button and drag	Rotate the view around the rotation center (object center by default).
Right-click outer frame and drag	Rotate the view using the view axis around the rotation center (object center by default).
Click middle mouse button / mouse wheel	Center the view and set a new rotation center.
Hold both mouse buttons and drag	Move the view freely.

4.1.2 Showing/Hiding Geometries

In the upper left corner of the View Section, possible geometries are listed, each with a checkbox in the color of their visual representation (see Figure 3). Available geometries are active. Show/hide these geometries by checking/unchecking the corresponding checkboxes.

Figure 3: Show/hide checkboxes in View Section

4.1.3 Context Menu

Access the context menu by right-clicking an object.

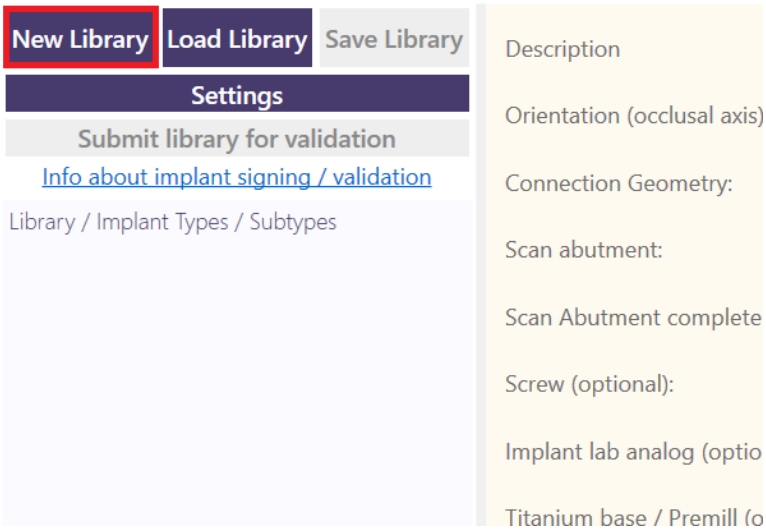
Figure 4: Context menu

Function	Description
Zoom to Object	Zoom to the selected object.
Visual Properties	Set visual properties for the object: ● Hide this Object: Hides the object. ● Wireframe: Shows the triangle grid of the object. ● Outline: Shows the outlines of the grid. ● Point Cloud: Shows the object as point cloud. ● Flat Shading Only: Activated by default to visualize the flat areas of a geometry. Deactivation changes the illumination angle, allowing a more realistic visualization of round forms. ● Opaque values: Transparency settings. ● Line Thickness: Only available if Wireframe and/or Outline is activated. Allows you to define the thickness of lines.
About...	Displays software information (version, engine build, copyright information). You can also access this information by right-clicking the background.

5 How to Create a New Implant Library

5.1 Step 1: Save the config.xml File

Step 1: Click NEW LIBRARY in the Actions/Hierarchy Section of the exoImplantEditor window.



Step 2: In the now appearing file explorer window for saving the `config.xml` file, create a new folder for the new implant library in a directory of your choice. Ensure to follow the **naming conventions for implant library folders:**

- The folder name must contain the manufacturer and the name of the implant system. If applicable, you can also add the implant system subtype.
- The folder name must be machine-readable (no special characters, no umlauts, etc.).
- Do not use any filling words (e.g. *System*, *Type*, *Body*).
- The name must not contain any blankspaces. For separation, use underscores _.
- Do not add any body or platform diameter information to the folder name.
- Do not add version information to the folder name. You can include version information in the library's DESCRIPTION field (see Chapter 5.2).

Example for an implant library folder name: `exocad_Demosystem`
(manufacturer_name of implant system)

Step 3: Save the file `config.xml` in the library folder. Do not change this filename!

Do not change the folder name once the library is being used or was signed by exocad. If you want to update an already existing implant library, store it with the same folder name or create a new library with a new folder name.

5.2 Step 2: Enter the Library Description

In the Information Section of the exoImplantEditor window, enter the library identifier into the field DESCRIPTION (see Figure 5). This is what will appear in the user interface of the exocad DentalCAD software as implant library title. The implant identifier will also be displayed in the Action/Hierarchy Section of the exoImplantEditor window.

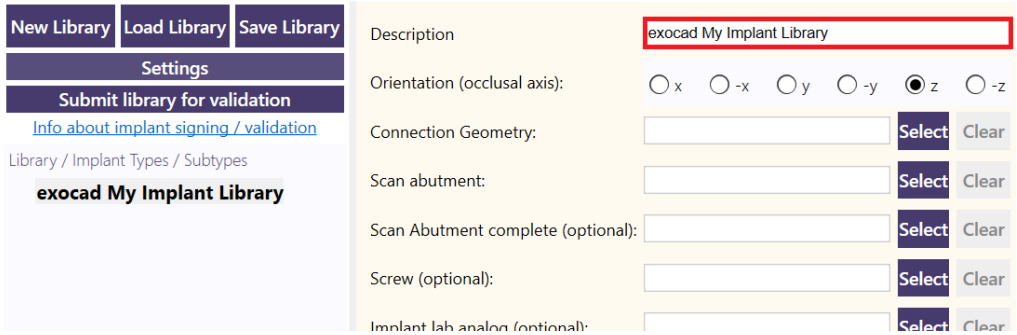


Figure 5: Library identifier in DESCRIPTION field

Naming conventions for library identifiers:

- The library identifier should contain the manufacturer and the name of the implant system. If applicable, you can also add the implant system subtype.
- The library identifier can contain spaces.
- The library identifier must not contain any special characters (also no underscores _), but you can include umlauts and trademark symbols (upper-case letters).
- Do not use any all-capatilized words (e.g. EXOCAD).
- Use abbreviations for compatible implant systems. exocad provides a list of these abbreviations on request.
- Strict "no compatible brand names" policy.
- You can include version information, e.g. `exocad Demosystem NB RP revA`.

Example for a library identifier: `exocad Demosystem NB RP`

5.3 Step 3: Select the Connection Geometry File

Step 1: Click the SELECT button next to the field CONNECTION GEOMETRY (see Figure 6).

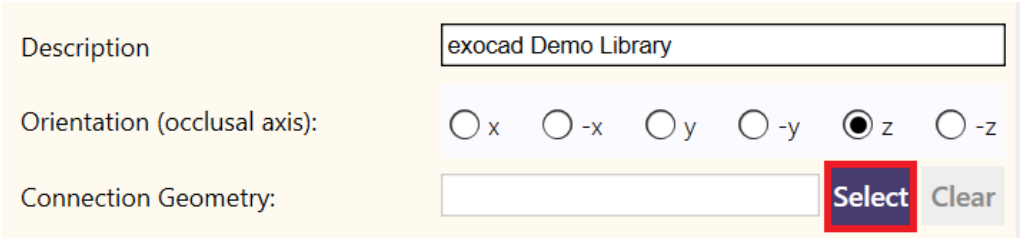


Figure 6: Select connection geometry

Step 2: In the appearing file explorer window, select an STL file. The STL file must precisely meet

- the connection geometry specifications (SB01-SB09, as well as AP01-AP03) defined in the document *Instruction Manual - Creating Implant Geometries for exocad* (download link see Chapter 2), and
- the filename conventions for input meshes (see Chapter 2.1).

If you are prompted to copy the STL file to the library directory, click YES.

Troubleshooting: Mesh characteristics

The exoImplantEditor will perform basic checks of mesh characteristics. If the mesh you have selected is unsuitable or broken, this will usually be detected automatically. In this case, the exoImplantEditor will display an error message, usually along with a visualization of the problem. Libraries with incorrect geometries cannot be integrated. To resolve the situation, please read the error message carefully. Then, correct the mesh so that it meets all requirements specified in the *Creating Implant Geometries for exocad* manual (download link see Chapter 2).

5.4 Step 4: Select the Scan Abutment File

Step 1: Click the SELECT button next to the field SCAN ABUTMENT (see Figure 7).

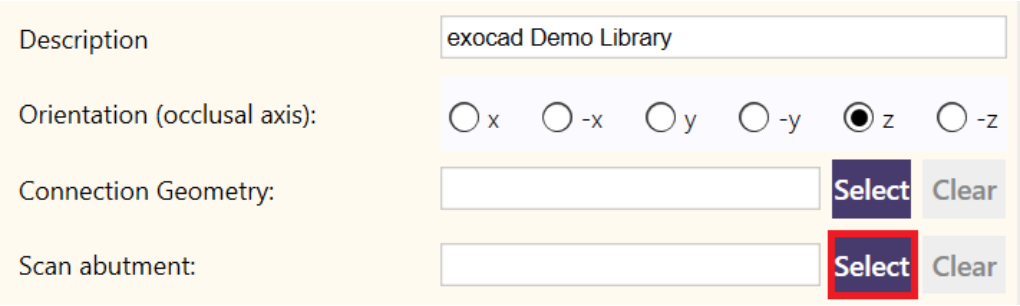


Figure 7: Select scan abutment

Step 2: In the appearing file explorer window, select an STL file that precisely meets the scan abutment specifications (SA01-SA02, as well as AP01-AP03) defined in the document *Instruction Manual - Creating Implant Geometries for exocad*. If you are prompted to copy the STL file to the library directory, click YES.

Troubleshooting: Mesh characteristics & triangle orientation

As for the connection geometry, basic checks of mesh characteristics will be performed automatically by the exoImplantEditor. The most common issue is too long triangles (SA02), so please ensure that your scan abutment mesh is triangulated according to our specifications.

If the outside of the scan abutment is displayed in red, the triangle orientation of the scan abutment is incorrect. You can fix that easily, e.g. by using the free software *Meshlab*.

For details on mesh characteristics and triangle orientation, see the *Creating Implant Geometries for exocad* manual (download link see Chapter 2).

5.5 Step 5: Defining the Axis Orientation

Select the implant geometry's orientation from the ORIENTATION (OCCLUSAL AXIS) radio buttons (see Figure 8). The axis you define reflects the occlusal axis of your selected implant data.

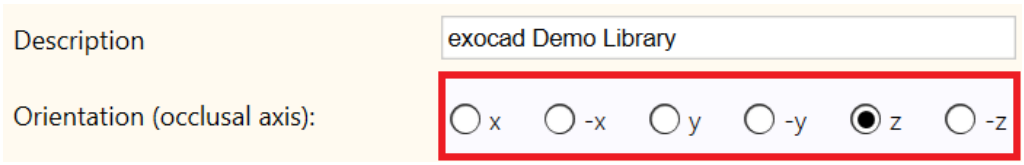
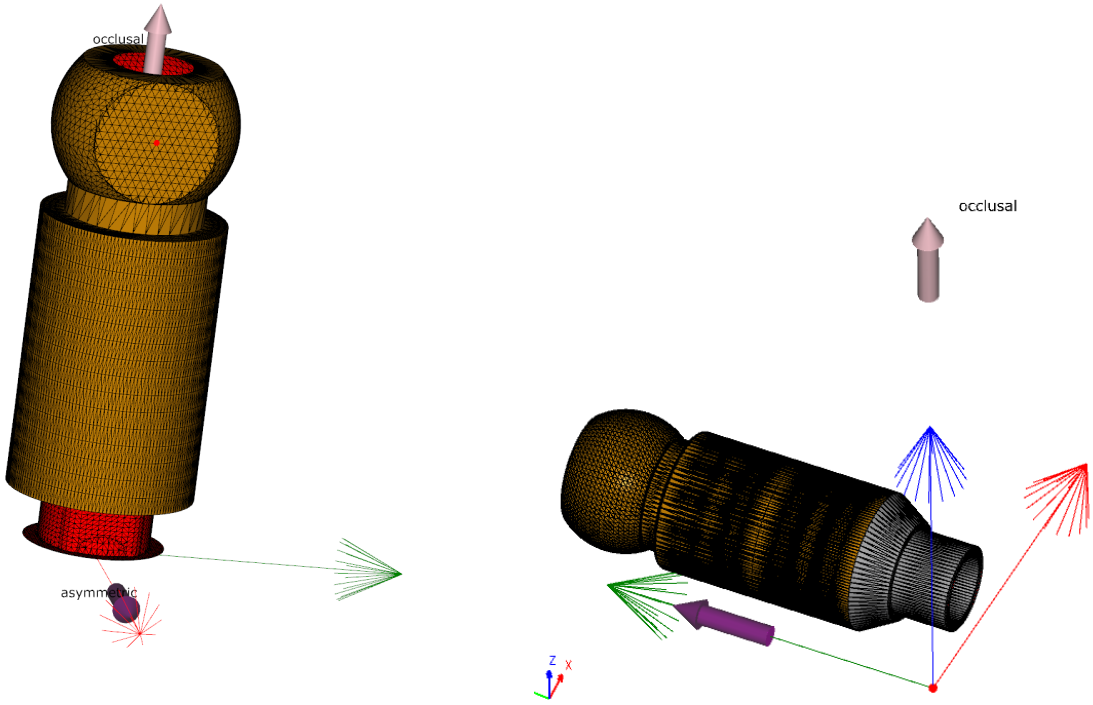


Figure 8: Select orientation

In the View Section, the rose-colored arrow OCCLUSAL must point to the same direction as the insertion direction of your implant geometry. Figure 9 shows examples for a correctly and an incorrectly defined orientation.



(a) Correct: aligned to (occlusal) axis

(b) Incorrect: not aligned to an axis

Figure 9: Correctly and incorrectly defined (occlusal) orientation

5.6 Step 6: Set a Click Point (for Registration)

Step 1: Click SELECT VISUALLY in the CLICK POINT line (see Figure 10).

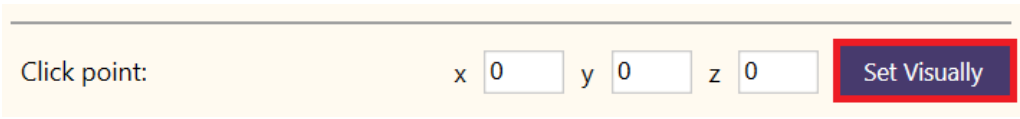
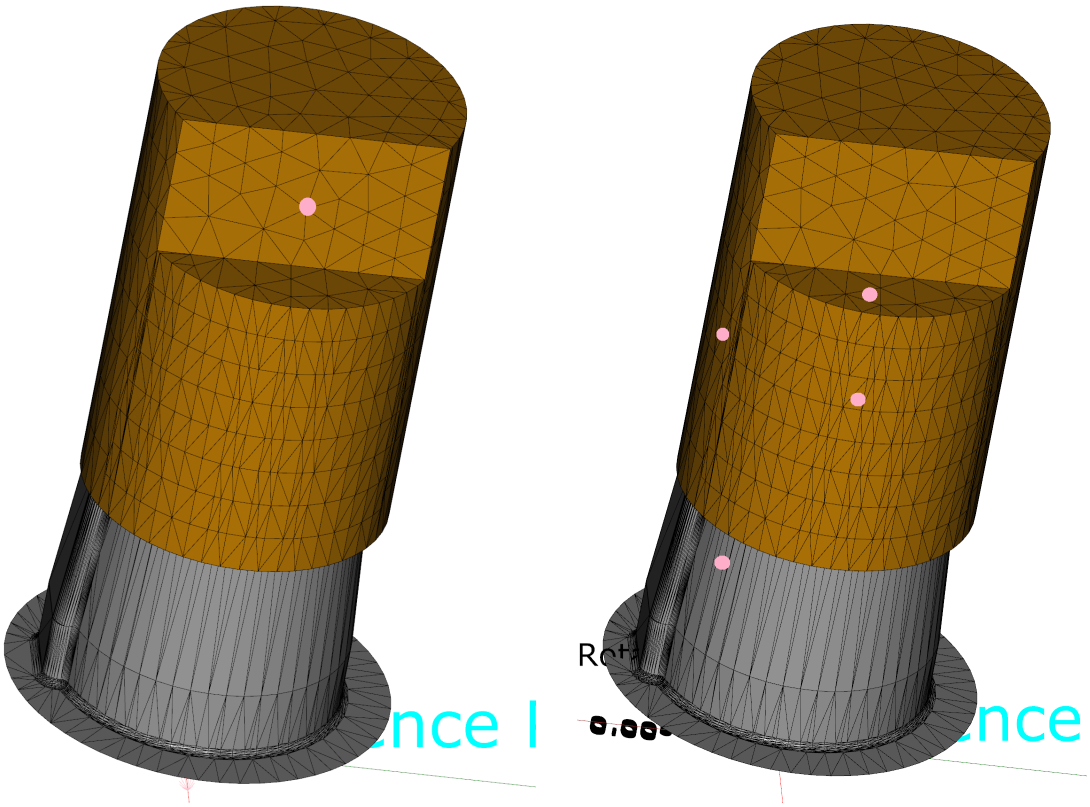


Figure 10: Set click point

Step 2: In the View Section, click a characteristic point at the side of the scan abutment. If the scan abutment has a flat side, set the click point on this side. This will be the point the user must click for performing the one-click registration in the exocad DentalCAD software.



(a) Correct (b) Incorrect

Figure 11: Click point on scan abutment

Once you have set the click point, the ASSYMETRIC arrow will be added automatically orthogonal to the click point position at implant connection level.

5.7 Step 7: Check/Uncheck "Invert connection geometry triangle orientation"

The checkbox INVERT CONNECTION GEOMETRY TRIANGLE ORIENTATION (see Figure 12) defines the orientation of the surface normals.

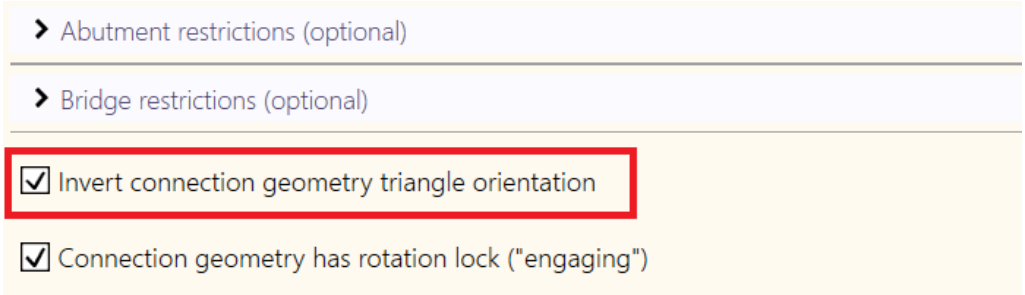
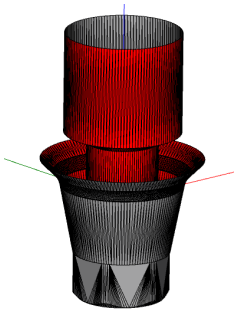
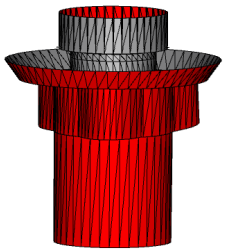
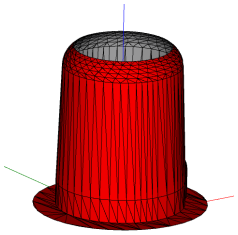
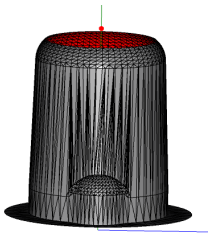


Figure 12: INVERT CONNECTION GEOMETRY TRIANGLE ORIENTATION checkbox

It is crucial to set the INVERT CONNECTION GEOMETRY TRIANGLE ORIENTATION checkbox correctly, so that the software knows which part of the mesh is the 'inside' and which part is the 'outside'. To find out the correct setting, view the geometry in the View Section and select the setting according to the table below.

Type	Appearance in View Section	Sample picture	Correct setting of checkbox
Direct-to-implant	Screw channel appears red, lower side of the implant geometry appears gray		☑
Direct-to-implant	Screw channel appears gray, lower side of the implant appears red		☐
Direct-to-implant	Both sides appear red, or both sides appear gray	Geometry is broken and cannot be used or must be fixed first.	N/A
Using titanium base	Outside of titanium base hull appears red, inside appears gray		☑
Using titanium base	Outside of titanium base hull appears gray, inside appears red		☐
Using titanium base	Both sides appear red, or both sides appear gray	Geometry is broken and cannot be used or must be fixed first.	N/A

If you do not set the INVERT CONNECTION GEOMETRY TRIANGLE ORIENTATION checkbox correctly, any attempt to use the implant library will lead to broken output data (holes in screw channel in output files).

The INVERT CONNECTION GEOMETRY TRIANGLE ORIENTATION setting is global, and will be applied to all types/subtypes of the implant library. As a result, if you combine several geometries in one library, the orientation of their triangle normals must be consistent.

5.8 Step 8: Check/Uncheck Rotation Lock Checkbox

If your geometry has a rotation lock, check CONNECTION GEOMETRY HAS ROTATION LOCK ("ENGAGING").

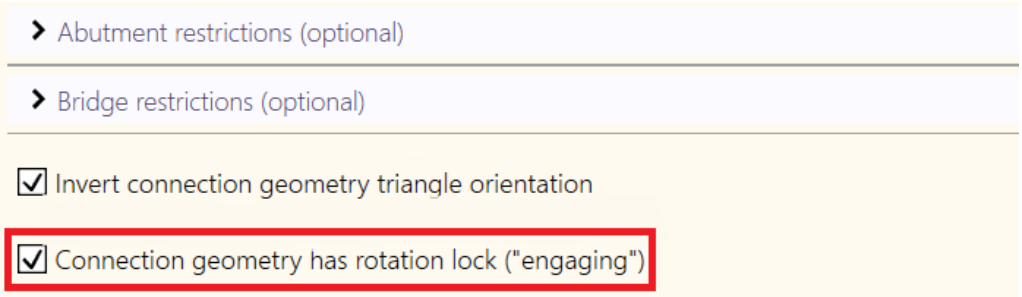


Figure 13: Rotation lock checkbox

5.9 Step 9: Define Titanium Base

If your geometry is supposed to be used with a titanium base, check FOR USAGE WITH TITANIUM BASE.

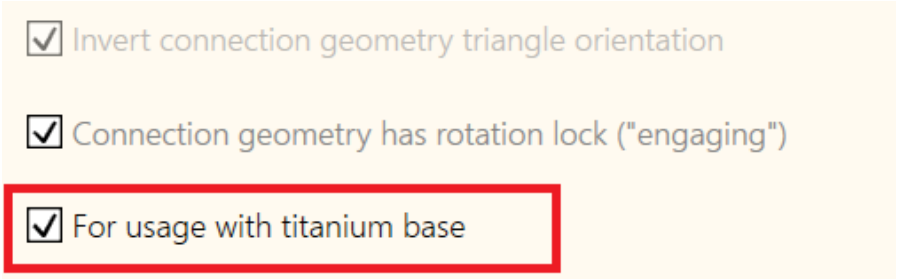


Figure 14: Titanium base checkbox

For visualization purposes, you can load a mesh of the titanium base. To load a titanium base mesh, select the corresponding stl file for TITANIUM BASE / PREMILL (OPTIONAL). The mesh will be displayed in yellow in the View Section.

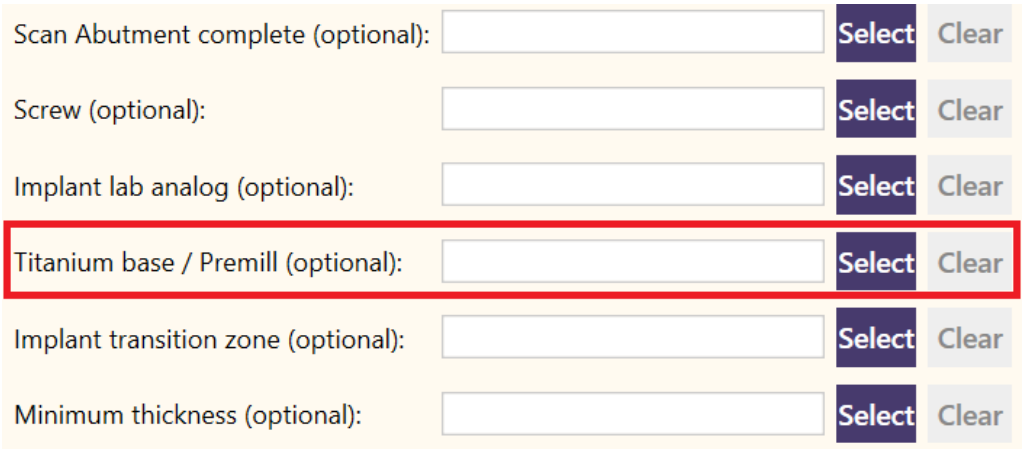


Figure 15: Load titanium base mesh

5.10 Step 10: Define Premill

5.10.1 For Visualization Purposes

To load a premill mesh for visualization purposes, select the corresponding stl file for TITANIUM BASE / PREMILL (OPTIONAL) (see Figure 15). The mesh will be displayed in yellow in the View Section.

If you are using a premill, uncheck FOR USAGE WITH TITANIUM BASE (see Figure 14).

INFORMATION

For visualization, you cannot load/visualize a titanium base mesh **and** a premill mesh, only a titanium base mesh **or** a premill mesh.

5.10.2 For Collision Detection

If you want to use a premill for collision detection, load the premill mesh by selecting the corresponding stl file for PREMILL ABUTMENT COLLIDER (OPTIONAL) in the PREMILL section.

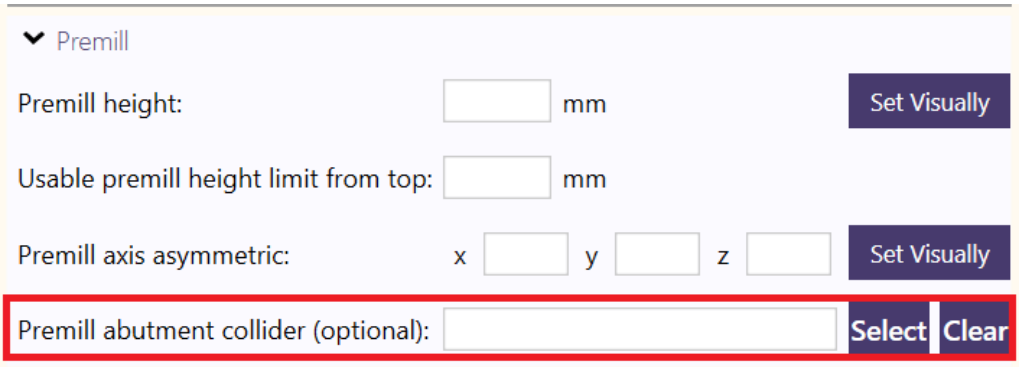


Figure 16: Premill section

INFORMATION

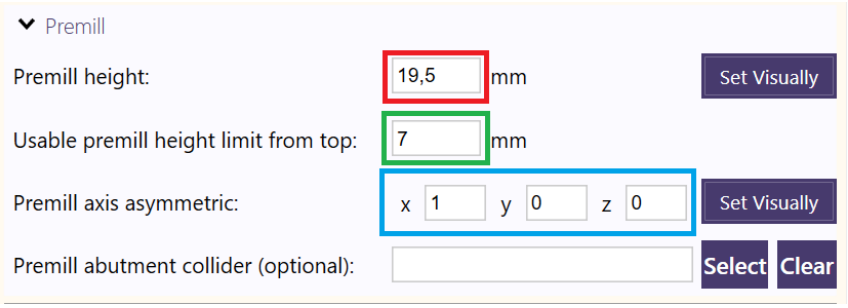
If you use premill collision detection, you can load a titanium base mesh in addition to the premill collision mesh.

INFORMATION

Possibly, certain settings in exocad DentalCAD are necessary to enable collision detection. If you want to use premills for collision detection, please inform us when sending the library.

5.10.3 Optional Information

In the PREMILL section, you can enter optional premill parameters.



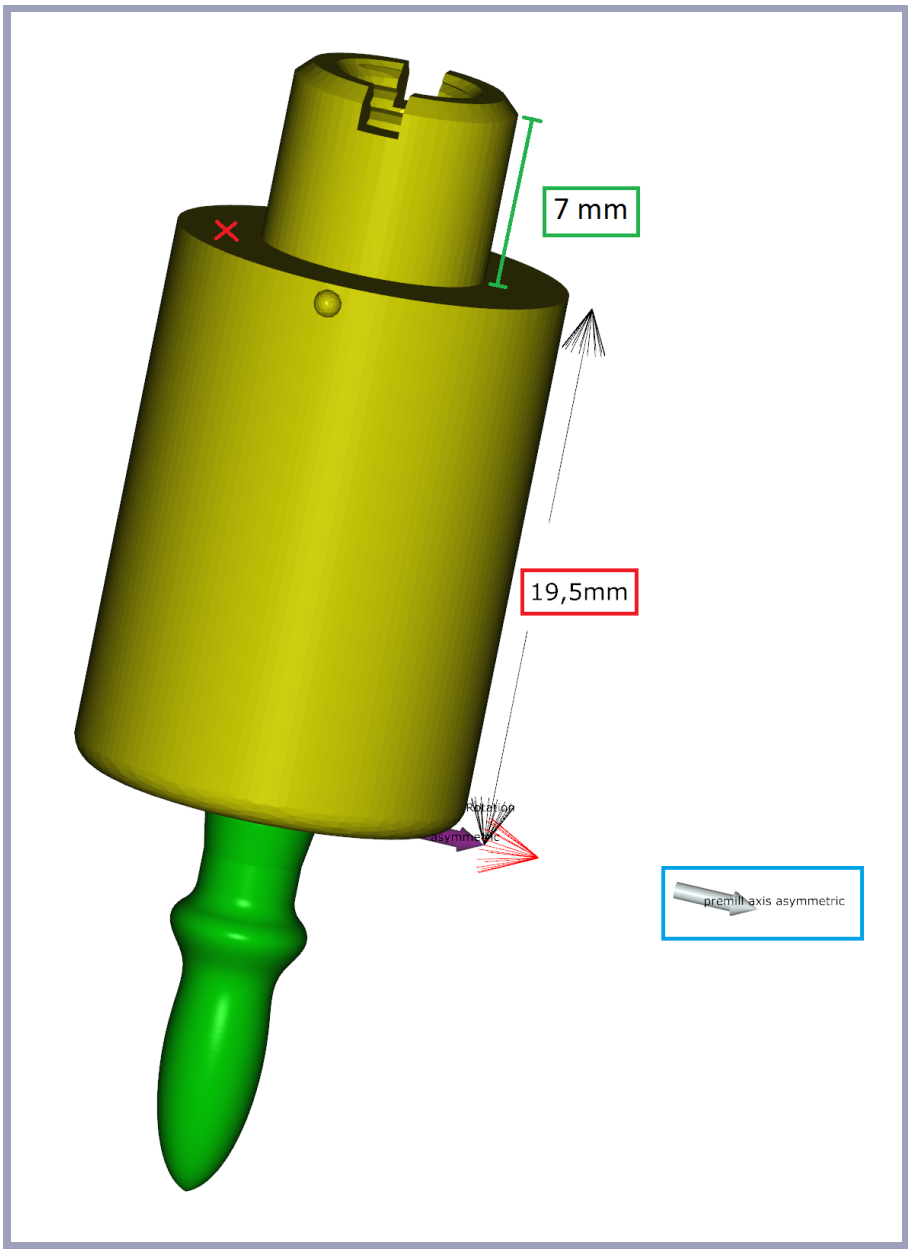


Figure 17: Premill parameters

- Premill height (optional): Defining (typing in) this value is only necessary if the premill has a holder at the top, as shown in Figure 17, which means that not the overall height of the premill can be used for milling. If the implant connection at the bottom is used for mounting the premill in the milling machine, do not define a value.
  To set the premill height visually, click Set visually and then a point on the platform between main premill part and holder (x).
- Usable premill height limit from top (optional): Only define (type in) this value if you have set a premill height. This is the length of the premill holder which cannot be used in milling. If you define a value here, the premill visualization mesh (yellow part) will be displayed "shorter" in the DentalCAD to visualize only the usable part of the premill.
- Premill axis asymmetric (optional): Only set this value if you have defined a premill height, which means that the premill has a holder at the top. If the premill is asymmetric, e.g. has a flat side, define the premill axis by typing in values in the X, Y, Z fields. Alternatively, click Set Visually and click on the flat surface of the premill holder in the View Section.

5.11 Step 11: Enter Supplier and Legal Information (Mandatory)

Enter supplier and legal information for the library in the bottom part of the Information Section (see Figure 18):

- Supplier Name: Name of the implant supplier
- Supplier Link: URL of the supplier's website (or of the website where the implant can be purchased)
- Legal Information: Optional legal information (e.g. copyrights)
- Warranty Information: Default warranty information text (editable)

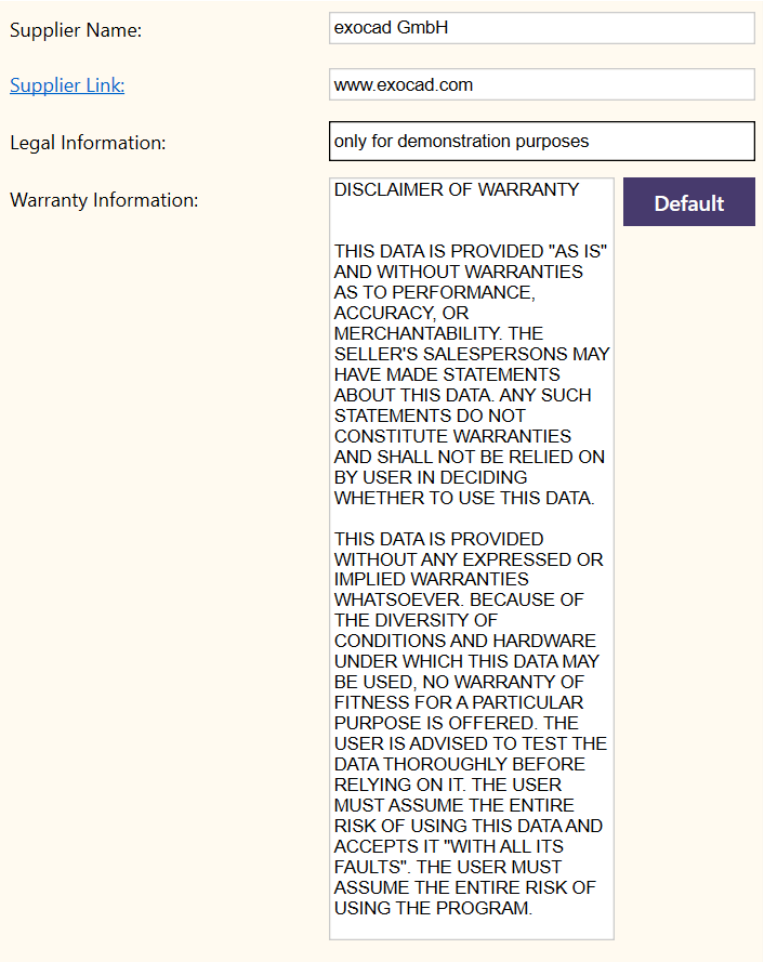
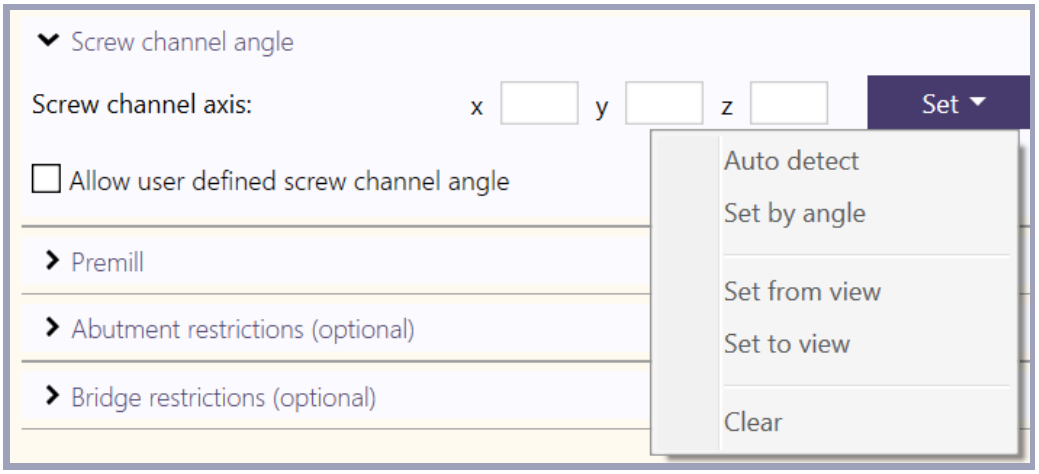


Figure 18: Supplier and legal information

5.12 Step 12: Set Screw Channel Angle



You can define the angle by setting the screw channel axis' position. To do this, type in the screw channel axis' coordinates in the fields X, Y, and Z.

Alternatively, you can use one of the options in the SET dropdwon menu:

- AUTO DETECT: the screw channel is automatically detected as a direct extension of the hole in the connection geometry of the abutment.
- SET BY ANGLE: opens a window where you can define the desired angle and the rotation axis.
- SET FROM VIEW: sets the screw channel in current view direction.
- SET TO VIEW: this is a visualization option and does not change the current screw channel definition. Sets the view to the screw channel direction.
- CLEAR: clears the screw channel.

5.12.1 Allow User-Defined Screw Channel Angle

Using the option ALLOW USER DEFINED SCREW CHANNEL ANGLE, you can define hard limits for screw channel angulation. In the DentalCAD application, the user cannot define screw channels beyond these limits.

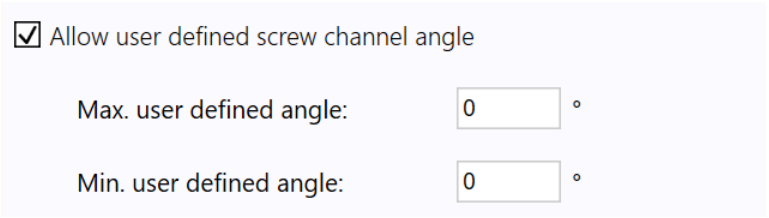


Figure 19: Angle limits for screw channel design

Activating ALLOW USER DEFINED SCREW CHANNEL ANGLE expands fields to enter the minimum and maximum angle allowed during screw channel design in the DentalCAD.

INFORMATION

If you do not check ALLOW USER DEFINED SCREW CHANNEL ANGLES, the user cannot change the angle by default. However, if you do not define a hard limit here, expert users can still allow a user-defined screw channel angle in the DentalCAD configuration.

5.13 Step 13: Define and Load Optional Meshes

See Chapter 7 for a list of possible optional meshes. Load optional meshes, if applicable.

5.14 Step 14: Save the Library

Click Save Library in the Actions/Hierarchy Section of the exoImplantEditor window (see Figure 20).

To test the library in exocad DentalCAD, you can copy the directory to `DentalCADApp\library\implant` in your exocad DentalCAD installation.

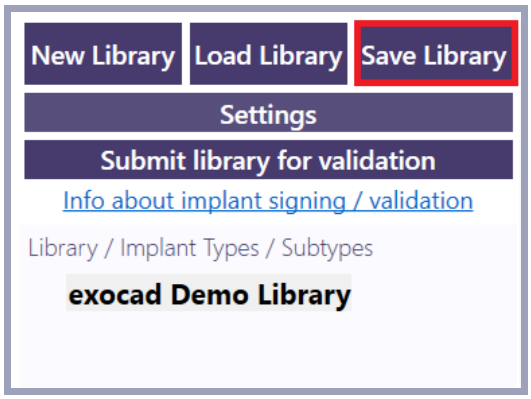


Figure 20: Saving the library

6 How to Create Implant Libraries with Multiple Entries

You can add implant types and implant subtypes to create a library with multiple entries. The hierarchic library structure with types and subtypes is displayed in the Actions/Hierarchy Section (see Figure 21).

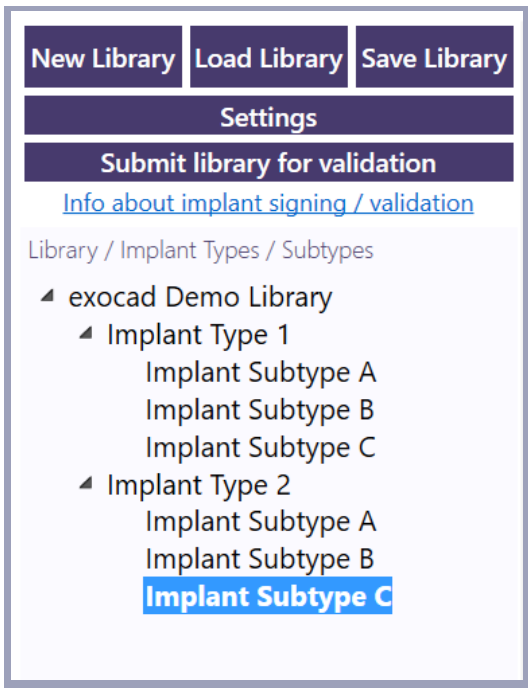


Figure 21: Example library with multiple entries

The behavior of common parameters, which are present on all levels, depends on where you define the parameters:

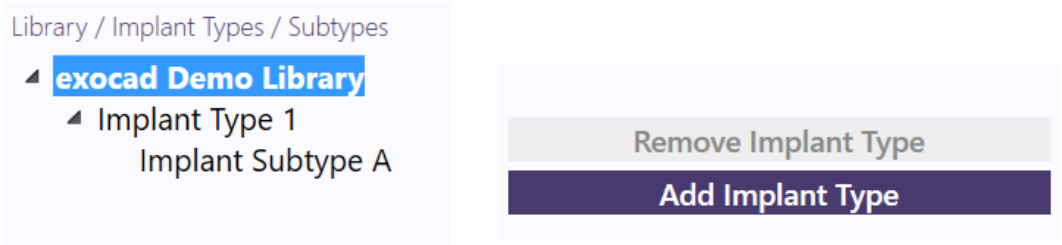
- **Parameters are transfered from the higher to the lower levels**. This means, if you define a common parameter on library level, it is automatically set for the types and subtypes as well. If you define a common parameter on type level, it is automatically set for the subtypes of this type as well. You can still edit transfered parameters within the level it has been transfered to.
- **If you define a parameter on type/subtype level, it will not be overwritten if you enter a different parameter on a higher level.**

6.1 Add an Implant Type

exocad recommends to use the platform diameter as implant type.

Step 1: Select the implant library in the Actions/Hierarchy Section.

Step 2: At the bottom of the Actions/Hierarchy Section, click ADD IMPLANT TYPE.



6.2 Add an Implant Subtype

Step 1: Select an implant type in the Actions/Hierarchy Section.

Step 2: At the bottom of the Actions/Hierarchy Section, click ADD IMPLANT SUBTYPE.

To delete an implant type/subtype, click REMOVE IMPLANT TYPE/SUBTYPE.

Enter parameters for the implant library/type/subtype in the corresponding Information Sections.

INFORMATION

You can store multiple scanbodies for an implant type using subtypes. For example, if you want to store an intraoral scanbody and a desktop scanbody, create two subtypes for an implant type. Load the scan body meshes using the SCAN ABUTMENT field (see Chapter 5.4).

7 Optional Information

7.1 Optional Meshes

You can load the following optional meshes:

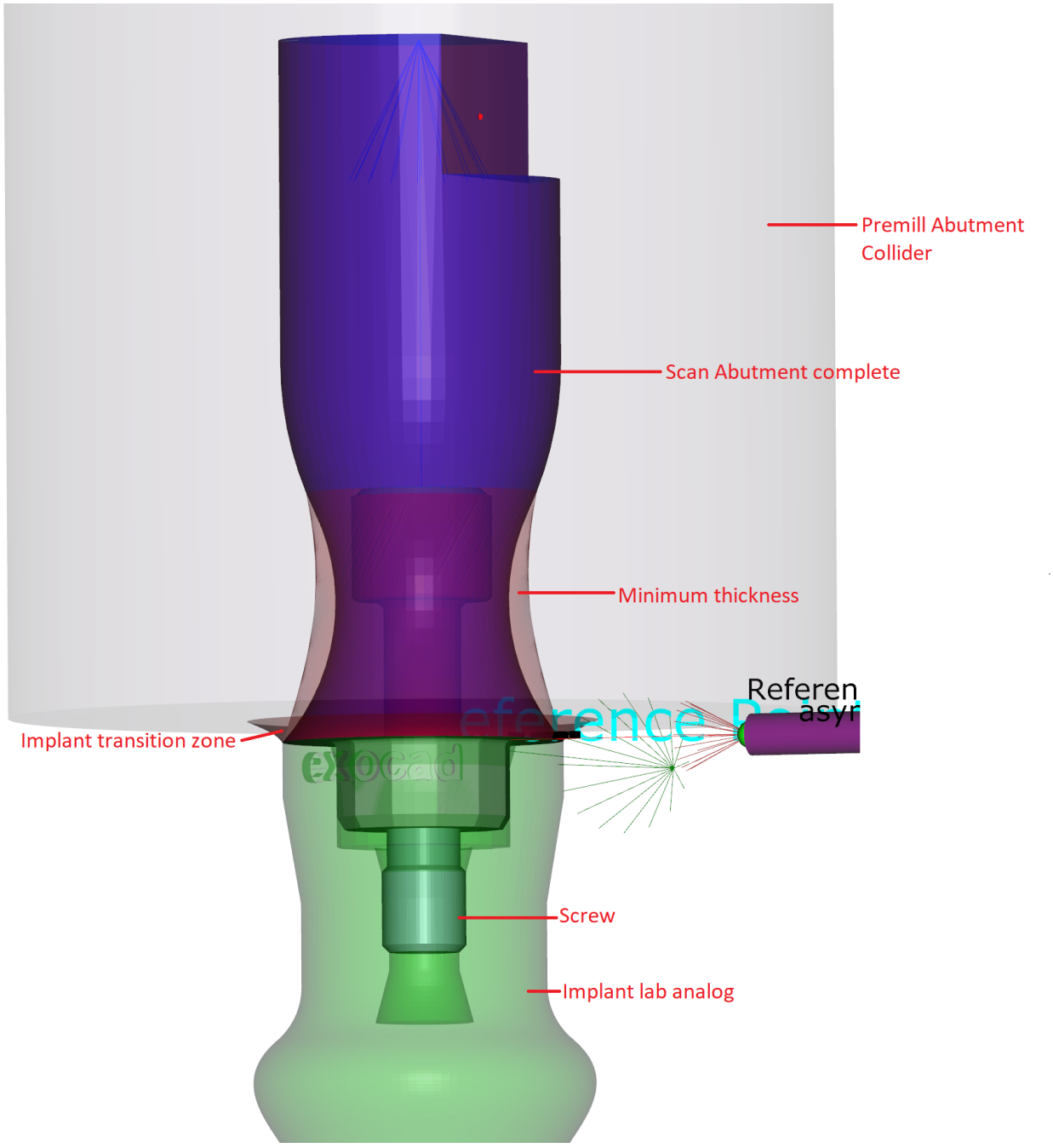
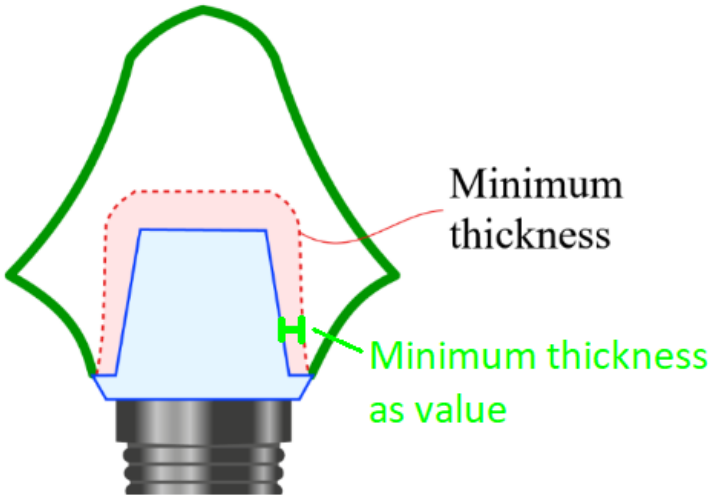


Figure 22: Optional meshes

- Scan Abutment complete: volumetric mesh of the scan body (blue visualization), which allows you to implement the real geometry of the scan body, in contrast to the scan abutment mesh defined in Chapter 5.4.
- Screw: mesh of the screw (gray visualization).
- Implant lab analog: mesh of the implant lab analog or of the real implant geometry (green visualization).
- Titanium base / Premill (see Chapters 5.9 and 5.10)

- Implant transition zone: collision mesh for keeping the emergence profile and abutment shape inside a predefined transition zone (e.g. inside a premill).
  REQUIREMENTS: Surface mesh with two open contours to connect platform level and premill.
  KNOWN LIMITATION: This can only be used if NO premill abutment collider is specified. As a workaround, include the implant transition zone in the premill abutment collider for now.
- Minimum thickness: collision mesh for keeping the wall thickness of the abutment above a specified minimum.
  REQUIREMENTS: Surface mesh with one open contour that connects to platform level.



- Minimum thickness as value: Only required if a minimum thickness mesh is specified. This value should approximate the minimum thickness represented by the minimum thickness mesh. You can type in a value or measure the minimum thickness value visually.

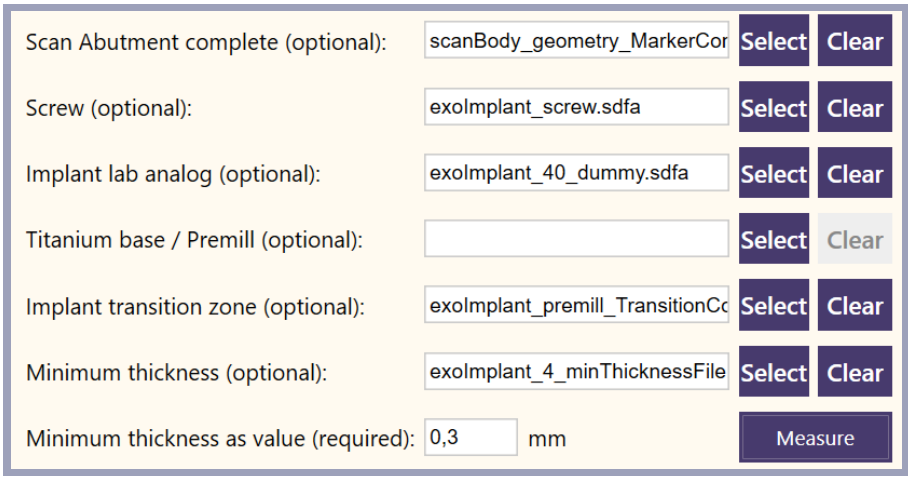


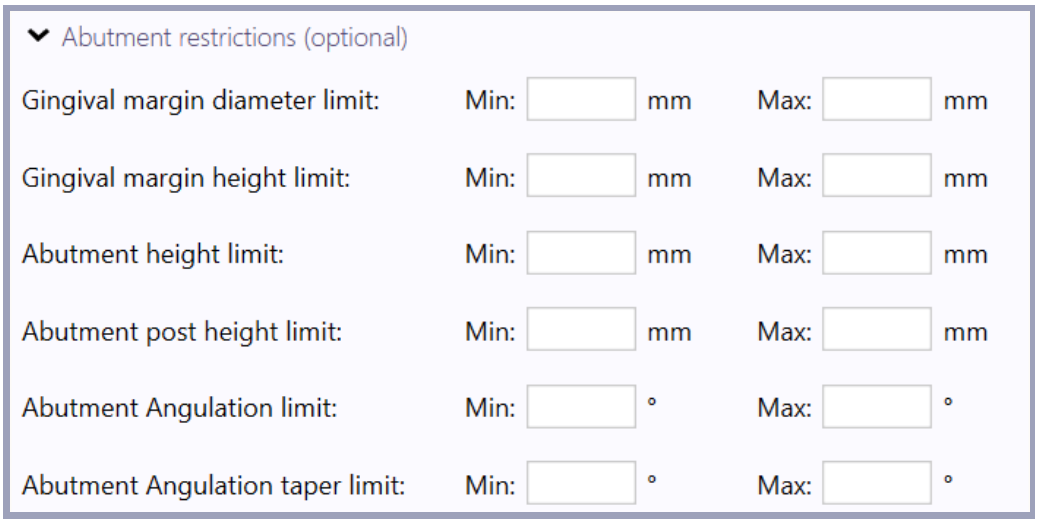
Figure 23: Options to load optional meshes

To load a mesh, click SELECT. Select the stl file you want to load in the file selection window. To clear a loaded mesh, click CLEAR.

7.2 Abutment Restrictions (Optional)

You can define restrictions for abutments connected to the top of the implant, in order to avoid misfitting or damages to implants and/or abutment parts. In the DentalCAD application, the user cannot design abutments beyond those limits. For setting abutment restrictions, the reference point coordinates must be the origin of the coordinate system (0,0,0). If this is not the case, you cannot set abutment restrictions.

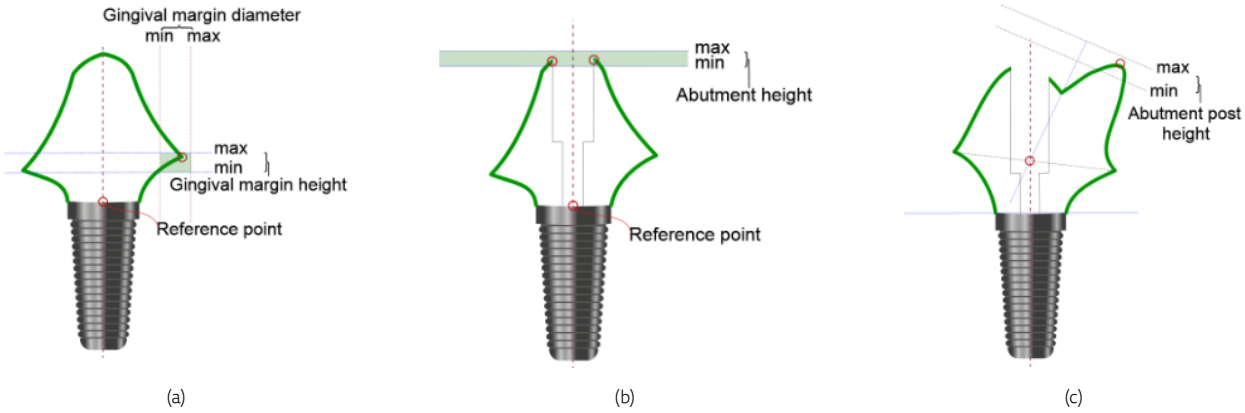
You can define abutment restrictions on any level, depending on if you want to define restrictions for all implant types and subtypes (library level), for specific implant diameters (implant type level), or for specific implant lenghts (implant subtype level).



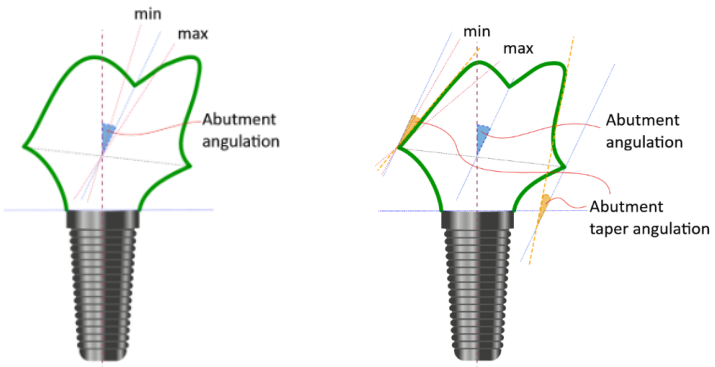
For the following abutment measures, you can set a minimum and/or a maximum value:

- Gingival margin diameter limit: Horizontal measure from reference point (origin) to the abutment's outer edge.
- Gingival margin height limit: Vertical measure from reference point (origin) to the gingiva's highest point.
- Abutment height limit: Height of the abutment.
- Abutment post height limit: Vertical measure from the top of the abutment to the abutment shoulder.
- Abutment angulation limit: Possible angulation of the abutment.
- Abutment angulation taper limit: Possible angulation of the abutment post taper.

Figure 24 illustrates these measures. The graphics are also displayed when you hover the mouse over the corresponding value text.



(a) (b) (c)



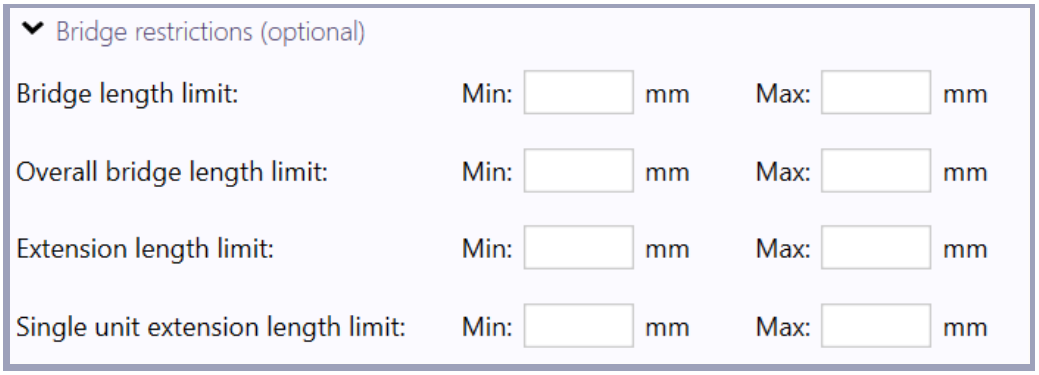
(d) (e)

Figure 24: Abutment restriction measures

7.3 Bridge Restrictions (Optional)

You can define hard limits for bridge constructions. In the DentalCAD application, the user cannot design bridges / bridge parts beyond those limits.

You can define bridge restrictions on any level, depending on if you want to define restrictions for all implant types and sub-types (library level), for specific implant diameters (implant type level), or for specific implant lenghts (implant subtype level).



For the following bridge measures, you can set a minimum and/or a maximum value:

- Bridge length limit: Measure from one implant to the next implant in a bridge.
- Overall bridge length limit: Measure of the complete bridge including extensions.
- Extension length limit: Extension length if the bridge is supported by two or more implants.
- Single unit extension limit: Extension length if the bridge is supported by only one implant.

Figure 25 illustrates these measures. This graphic is also displayed when you hover the mouse over the value texts.

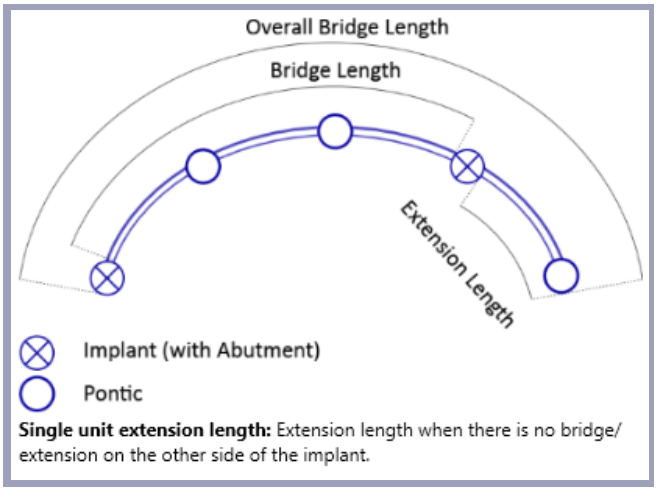


Figure 25: Graphic showing bridge restriction measures

INFORMATION

A bridge extension is the free-hanging part of the bridge which is not supported by an implant on both sides. Free extensions can have a stronger leverage effect on the implant.

8 Loading an Implant Library

To load an implant library, click LOAD LIBRARY (see Figure 27) in the Actions/Hierarchy Section. Select the `config.xml` file of the desired library in the appearing file selection dialog.

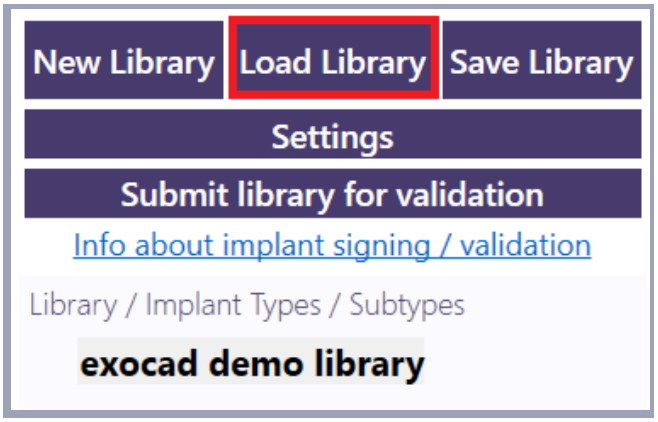


Figure 26: Loading an implant library

Alternatively, drag and drop the `config.xml` of the desired library onto the exoImplantEditor window.

9 Signing a Library

To send your library to exocad for signing, click SUBMIT LIBRARY FOR VALIDATION in the Action/Hierarchy section of the exoImplantEditor window.

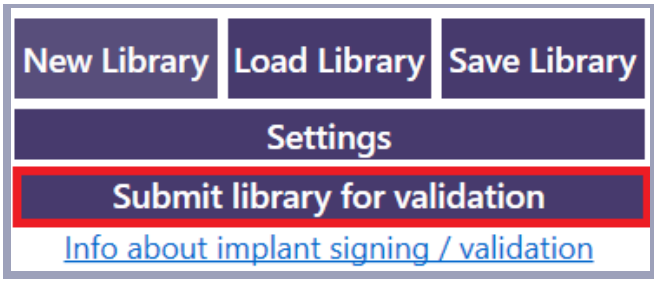


Figure 27: Signing an implant library

This opens a new email in your email program. The library data is zipped automatically, and attached to the email. Subject line, addressee, and a body text are automatically predefined. You can edit all these entries. However, ensure sending the library to the correct address support@exocad.com.

For more information on the library signing and validation process, click *Info about implant signing / validation*. This link leads to our webpage exocad.com/implantdata.

IMPORTANT

Ensure that your library is correct regarding implant files and parameters before sending it for signing to exocad. The more accurate your material, the faster and easier the signing process will be.

As result of the signing process, you receive an encrypted and signed library compatible with the exocad software by any means.

IMPORTANT

We strongly recommend not to use libraries which have not been checked and signed by exocad. If you use libraries which have not been signed, this happens at your own risk. exocad only guarantees the compatibility of signed libraries.

10 Support

exocad provides third-level support to its partners in case of technical questions/issues related to its products, usage of the software, exoportal, or similar. You can also request online demonstrations of new product features from exocad software trainers.

As an ISO 13485-certified company, exocad documents each support case and resulting resolution/outcome. To contact the exocad support team, send an email containing the details of your query to the corresponding email address of your region. Your email will automatically create a ticket in the exocad support system and you will receive an automated confirmation email with a ticket number shortly afterwards. The exocad support team will then contact you by email or telephone to process your query.

A convenient way to chase an outstanding query is to reply to the automated information email sent by exocad. When chasing your query using another form of communication, always have the ticket number ready. exocad cannot handle your request without a ticket number. Thank you for your understanding.

IMPORTANT

To resolve your issue quickly and smoothly, please:

- Send a separate email for each issue. Do not introduce other unrelated topics to an existing email thread!
- Do not modify the subject line of the support reply email!
- Provide all necessary data (project file, scan data, construction files) and additional information (software build number, operating system, etc). Without this data, exocad cannot reproduce your issue (technical or usage) and will reject your request!

To view the support contact details of your support region, visit **exocad.com/secure-area/support**.

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