User Guide

dentCreate!®

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Introduction

This documentation gives an introduction to the dentCreate! Dental CAD platform.

- It is targeted at dental technicians and dentists. You need know-how in the dental field in order to understand the terminology used here.
- It is targeted at users familiar with Windows applications.

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Modifications/improvements/additions (including, but not limited to, translations) should be performed online on the dentCreate documentation wiki at http://wiki.exocad.com (with the exception of small documentation modifications related to customer-specific versions that do not apply to the dentCreate software in general)

The most recent version is the one available online; printed or PDF versions may not include the latest additions.

Bochum, 29th September 2010.

Icons

- Useful tips in the documentation are marked by the yellow „Tip“ icon.
- This icon warns of pitfalls regarding production/fitting/stability of constructions.
- The hotkey icon points you to useful hotkeys which can accelerate your work.
Dental DB-Module

The entry point to the CAD/CAM platform is the DentalDB module. Here, you define your job (dentist, patient, technician, the type of constructions and the materials). All the tasks you will perform to finalize your CAD/CAM work are started from here: Scanning, construction, upload of construction data or milling.

After startup, the following screen is presented to you:
Defining job details

To define your job, proceed as follows:

- Select the customer (dentist) [1]. You can either select the customer number or the customer name; the respective other field will update accordingly.
  - To add a new customer to the database, click the „Edit“ button [2] – a dialog will open that allows you to view your list of dentists.

- Select the name of the patient [2]

You can also type in a new patient name in the field [3] – the new name will automatically be added to the database as soon as you save your job.

- Select technician (the same way as you select the customer)
- Select the restorations and materials by clicking on the tooth bows [6] – see „Choosing tooth restoration types“ for details. Colors are used to mark different types of restoration in the tooth bow; an index is available [14].
- To use an antagonist scan, select „Antagonist“ for at least one tooth in the jaw part opposing your restorations, and define the type of antagonist scan using [8]
- Define connectors using the toggle buttons [7].
  - Green: A connector will be created between the teeth
  - Grey: A connector will not be created between the teeth (click to toggle)
  - Red: A connector may not be created, because the material of the adjacent teeth differs
  - No toggle button present: One of the selected types does not permit connectors
    By default, connectors will be defined automatically whenever you define a pontic. So in practice, you will use this feature mostly to add connectors between adjacent crowns or copings.
- You may also select tooth shade [4] or other job details (depending on your configuration, options like express shipping from the milling center may be available).
- If desired, add notes into the field [9].
Saving and starting actions

Once your job is defined, click the „Save“ button in the button bar [10] to save your job. This will add the job details to the database, and create a project folder which will hold all the data (scans, constructions, project file) related to this job.

Once the job has been saved, additional buttons in the button bar [10] become available. You may now start the scanning process using the „Scan“ button, and then start the CAD construction using the „CAD“ button, or print job details using „Print“.

Note that content of the button bar, as well as the icons for the various actions, may vary depending on your exact configuration.

Buttons for:

- **duplicating a job** (copying job information/scan data/construction data and saving it in a new project)
- **importing jobs** (e.g. project directories you have received from a partner lab)
- **uploading a job to the production center** (once the construction has been completed)
- **launching the CAM module or the machine control software**
- **other features offered by your system vendor may be available on your setup**

The red/green indicators [12] give you an overview which actions have already been performed. Green color means that this stage of the process (Scanning, CAD, etc) has been completed. To open the respective project directory in Windows Explorer, click the „Open in Explorer“ button [13].

Loading saved jobs

To load a job, click "Load" in the button bar [10]. See the "Loading Jobs" section for details.

The image preview pane

For saved jobs, an image preview panel [11] is available. After the scan process, preview photos of the models will be visible here.

You can use Drag & Drop functionality to add additional images of your choice. E.g. you can drag and drop patient photos from a digital camera or from your email client directly here [11]. Double-click an image thumbnail to open it in your favorite image viewer, right-click it to access its context menu (the same menu that is available for the image in Windows Explorer).

Changing user interface language and tooth numbering scheme

Button [15] opens a configuration dialog which allows you to change the language of the user interface, and switch between FDI tooth numbering (11-48) or Universal Numbering System (1-32, US).
Defining jobs for individual teeth

By clicking on a tooth in the DentalDB main window, you can select the type of restoration that will be designed for this tooth. The following dialog will appear:

The restoration types

First, select the type of restoration on the left [1]. The following types are available (the list may vary depending on your configuration and the add-on modules you have purchased):

- **Anatomic coping** - A coping which is made from the full anatomic shape (using cutback to create space for ceramic). First, the anatomic shape is designed; then, it is shrunk to create the coping. The „Shrinking“ controls the amount of cutback. In other CAD systems, this type of restoration is sometimes referred to as „Clinical coping“.
- **Anatomic crown** - A full crown
• **Offset coping** - A simple coping with a fixed thickness above the preparation. It is deprecated to use this; „Anatomic coping“ is usually the better choice, as it gives support to the cusps from the framework. Use only if your customer specifically requests this, or if the operator does not have significant dental know-how to design a proper anatomic coping for the respective patient situation.

• **Pressed crown** - A two-part restoration, where the framework will be designed as an anatomic coping; additionally, a second part is created, which contains the chewing surface of the restoration – to be milled in wax/PMMA, later to be burned out („overpress“)

• **Reduced pontic** - A pontic framework – the full anatomic shape is designed first, the framework is created by shrinking the surface (cutback).

• **Anatomic pontic** - A full anatomic pontic without cutback

• **Pressed pontic** - Two-part restoration („overpress“)

• **Inlay** – an Inlay, Onlay or Veneer restoration (full anatomic)

• **Offset inlay** – a framework for an inlay with a fixed thickness

• **Primary telescope** – primary part for a removable structure (telescopic crown)

• **Waxup** – replication of a scanned part by digital copy milling

• **Waxup reduced** – creation of a framework from a scan of a full anatomic wax modellation (digital copy milling with cutback).

• **Missing tooth** – a tooth that is missing and is not to be restored. You need to define this in order to be able to place connectors between teeth that are „normally“ not next to each other. E.g. to create a bridge with teeth 14-16-17, define 15 as „Missing tooth“.

• **Adjacent tooth** – a healthy tooth that is to be scanned, but not to be restored in any way

• **Antagonist** – define this in the opposing jaw of your restorations to use an antagonist scan.

**Note that you also need to define the antagonist scan type (Bite impression scan, or scan of two stone models – [8] in the main window)**

Very often, one job contains several restorations of the same type. You don't need to open the above dialog for each separate tooth – just define the details for one tooth, close the dialog, then **hold <CTRL> and click other teeth to apply the same settings.** Hold <SHIFT> and click to apply the same settings to several teeth at once (similar to marking files in Windows explorer)

**Selecting production method**

Next, select the production method [2]. Typically, you can chose between 3/4-axis milling or 5-axis milling/laser melting. The main difference is that for 3/4 axis milling, a unique insertion axis is enforced for all elements of a bridge. The exact descriptions in the drop-down box [2] may vary depending on your configuration; e.g. the options may allow you to choose between in-house production and outsourced production via a milling center. In some configurations, the selection box [2] may be absent altogether.

**Material selection**

Now, select the material [3]. This will adjust production parameters (including their minimum and maximum values) to match the material's specifications. Note that list of
materials available depends on the type of construction [1] and the production method [2].

Do not change the material if you have already finalized the construction, or plan to use a previously saved CAD scene, as the output data will then not take into account the changed material parameters.

Setting further options (implant type, additional scans)

Once you have selected the material, the right part of the dialog gives you the possibility to adjust additional details:

- „Separate Situ scan“ [4] (Yes/No): Chose whether you'd like to use a situation model scan for this tooth
- „Implant type“: Chose whether this is an implant-based reconstruction, and of which type.
  - None: Normal preparation or scanned abutment – no implant-specific functionality
  - Custom Abutment: A custom abutment will be designed, in addition to the selected restoration (e.g. the coping).
  - Screw Retained: The construction will be screw-mounted on the implant, without using an abutment.
    Note that the latter two options require the purchase of the implant module.
- Separate gingiva scan (Yes/No): Chose whether you'd like to use an additional scan for the gingiva mask

Values you changed, so that they differ from the standard setting, are displayed with **light blue** background.

Setting numeric parameters, storing dentist-specific default values

Furthermore, numeric parameters can be adjusted. **All adjustments to numeric parameters that you make here in the DentalDB module will become the default values for the selected dentist/material/construction.** E.g. if the default value for cement gap is 0.05mm, but one of your clients prefers a more loose fit, adjust it to a higher value like 0.08mm, and this will become the new default value whenever this combination of construction/material is used for the currently selected dentist in the future. To make this behavior more obvious, a color coding is used for the background of the slider:

- **Red** background (as shown in the screenshot above): You have **just changed** this parameter and it will become the new default value
- **Yellow** background: This value was **previously changed** and you are now using the **stored default value**
- **White** background: The value displayed is the **global default value** and not a dentist-specific setting
To adjust parameters for just one construction, without affecting dentist-specific default values, adjust the respective value during the CAD process, and not in the DentalDB module.
To clear all stored default values for a specific dentist, use the „Clear client-specific defaults“ in the Edit dialog (click [2] in the main DentalDB screen to access this dialog).

Closing the dialog

To apply your settings, click „Save“ [9]. To abort without applying your changes, click „Cancel“ [8]. To delete a tooth selection you made erroneously, click „Delete“ [7], then „Save“.
Loading jobs

When clicking the „Load“ button in the button bar in the main window [10], a dialog with the list of saved jobs will be displayed:

![Image of the Load job dialog]

Jobs are color-coded depending on their age (exact color coding may vary according to your configuration – a color index is found at the upper right of the dialog).

- **To load a job, select it in the job list [1] and click „Load“ [7] to load.**
- Selecting a job will activate the preview panel in the lower left of the dialog.
- Type any text in the „Search“ field [2] to filter the job list for your search term. To clear the search term, click the „X“ in the right of the search field (it appears as soon as you start typing). To restrict the search to certain fields, uncheck one or more of the checkboxes right of the search field.
- To load imported treatments (as opposed to treatments that were locally defined), switch to the „Imported jobs“ tab in the upper left of the dialog.
- To close the dialog without loading a job, click „Close“ [8].

Different actions (like scanning, CAD, milling) can be performed on different computers. E.g. you can use one machine for scanning, save the job there, and then load the job on a different machine and do the CAD design there. This requires both the database file (DentalDB.sqlite) and the project directories to reside on a network drive accessible on both PCs. Ask your network administrator to set up the network drive and to reconfigure the DentalDB module to use a database file from a network location.
Deleting jobs

To delete a job, select it and click „Delete“ [3]. It will then be hidden and disappear from the list. To undelete a job deleted by accident, check the „Display deleted data sets“ check box [5]. Deleted jobs will then appear in the list, with a red background. Select the job to undelete, then click „Recover“ [4]. To permanently purge all jobs marked as deleted, check [5] and then click „Destroy deleted data sets“ [6].

CAD-Module

Navigating in 3D space with the mouse

You may navigate in 3D space using your mouse:

- Use the right mouse button (hold and drag) to rotate the view
- Use the mouse wheel to zoom and unzoom
- Use both mouse buttons (hold both and drag) to move the view. Alternatively, you can use the keyboard arrow keys
- Press the mouse wheel (middle mouse button) to center the point you clicked, and define this point as the new rotation center

Hotkeys

Summary of hotkeys for Dental Database Application

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl+Left Mouse Button</td>
<td>In the tooth selection: Apply last selected settings to another tooth</td>
</tr>
<tr>
<td>Shift+Left Mouse Button</td>
<td>Apply last selected settings to all teeth from the last selected tooth to the clicked tooth</td>
</tr>
</tbody>
</table>

Summary of hotkeys for Dental CAD Application

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Mouse Button</td>
<td>Rotate View</td>
</tr>
<tr>
<td>Right+Left Mouse Button</td>
<td>Move View</td>
</tr>
<tr>
<td>Cursor Keys</td>
<td>Move View</td>
</tr>
<tr>
<td>Middle Mouse Button</td>
<td>Center view &amp; set new rotation point</td>
</tr>
</tbody>
</table>
**Press Wheel Button** | Center view & set new rotation point  
**Scroll Wheel Button** | Zoom in & out  
**POS1** | Center view & set new rotation point  
**Ctrl+Shift+F3** | Optimize for Remote View by Teamviewer/Netviewer/Remote Desktop/VNC etc.  
**ALT** | Press to temporarily show all objects. Release ALT to return to previous state.

More hotkeys specific to certain features (e.g. free forming) are available. Please see the documentation for the respective feature for details.

### Alternative navigation methods

A 3Dconnexion 3D mouse is also supported for navigation. On Windows 7 systems, multi-touch monitors are supported for 3D navigation (including pinch-to-zoom functionality, known from popular smart phones).

### Showing/hiding objects in the viewer

The „Show/Hide groups“, as the name suggests, allows you to show or hide objects (like scan data, constructed parts), by using the checkboxes left of the group description. Objects are grouped by type. For a more fine-grained selection, unfold a group by clicking on the little arrow left of the checkbox.

As you proceed with the construction, the list will become more and more populated. A menu is available by right-clicking on a group (E.g. right-click on „Anatomic shapes“). **Among other things, this allows you to toggle transparency for an entire group of parts** – a frequently used feature.

Unfold the "Teeth" expander to switch visibility on a per-tooth basis. Unfold the "Hidden" expander to see what parts are currently hidden. Use the "Show all" button to show all parts available.

Instead of using the "Show all" button, you can also hold down the <ALT> key to temporarily show all parts.
The context menu

Context menus are available to help you explore what functions are available at a particular stage in the construction.

If you're new to this software, you will not need to use the context menu at all. But as you get more familiar with the software, you will appreciate the options found there.

You can use the context menu to apply a certain function to:

- All teeth (the 'root' context menu)
- Just one tooth (the 'tooth-specific' context menu)
- A group of previously selected teeth

You can open the 'root' context menu by right-clicking on the background of the CAD window. Functions you select here will be applied to all suitable parts of the construction. The 'root' context menu also gives you access to some advanced dialogs, found in the 'View' submenu.

By right-clicking on an individual tooth in the viewer, you can open the 'tooth-specific' context menu. Items you select here will be applied only to the tooth you clicked on.

To apply a context menu function to a group of teeth (but not to all), hold <CTRL> and click on the teeth to mark (note that the teeth will change color). Then right-click on the background to see the context menu specific to the marked teeth.

The context menu will adapt itself to the current state of the construction, so the menu entries you see vary during the course of the design. So if you're looking for a particular feature, it's always a good idea to explore the context menu. But note that while the wizard is running, only a stripped-down version of the context menu is available.

Some of the most-used menu entries from the context menu are also available though the button bar, which appears when the wizard is closed.

The wizard

After starting the CAD module, a „wizard“ window will open, which will guide you step by step through the construction. Explore the options presented to you in each wizard screen, and click ‘Next’ to proceed to the next step. Of course, you can always use the ‘Back’ button to return to previous steps in the wizard. The wizard will present you reasonable default values (depending on the type of construction and the material selected) for all construction parameters. You are free to change them; any parameters you change in the wizard will be applied to all teeth in the construction.
Advanced users often choose to close the wizard window at some stages in the construction, and use the context menu instead – this gives you the option to apply specific parameters to specific teeth. Note that while the wizard is running, only a simplified version of the context menu is displayed – so by closing the wizard, you get access to all the options available at this particular stage. To restart the wizard once it is closed, right-click on the background, and choose „View-Wizard“. The wizard will then start at the next step in the construction.

The wizard will guide you step by step through the construction. The exact sequence of construction steps depends on the type of restoration. For a typical construction (bridge with anatomic copings/reduced pontics, featuring an antagonist scan), the steps are:

- Detect / edit margins
- Setting Insertion axis
- Designing the inside of the crown
- Placement of library teeth
- Free forming
- Adaptation to antagonists / approximal adaptation
- Creating the framework from the anatomic shape (Shrinking/Cutback)
- Saving restorations
Detect / edit margins

Margin line detection

The first step in the construction is the preparation margin detection. The wizard will prompt you to click on the margin line for a specific tooth [1].

As you move the mouse over the scan data, a bubble will pop up to show you a sectional 2D view of the area below the mouse pointer. This helps you to find the correct position for clicking. For crowns and related restorations, a single click will typically suffice – the automatic margin line detection will start after the first click. For inlays, four points must be selected for the detection to start.

Adjusting the light source to help you see the margin

You can rotate the object so that you look at it from the insertion axis, and then click button [4] to adjust the virtual light source so that it comes from this viewpoint. If you look at the margin from the side afterwards, the shadows will help you see the margin.
Dealing with misdetected margin lines

In some cases, especially when working with non-optimal preparations, the margin line may not be detected correctly. You can help the algorithms by clicking on one or more additional points on the margin line (the 'Add point' mode, [2]). E.g. on the graphic on the right, the user has set an additional point (the purple dot) after the initial misdetection. After setting one or more points, click „Start“ [5] to relaunch the detection, which will now take advantage of your additional points.

![Graphic showing additional point](image)

💡 Typically, adding a single point will be enough; in difficult cases 2-4 points may be required. Setting large amounts of points is unnecessary.

If you have erroneously clicked on a point which is not actually on the margin, switch to the „Remove point“ mode [3] and click on points to remove. Switch back using button [2] to add points again.

Clearing and starting over

If you have clicked on the wrong tooth, or outside of the margin, use the „Clear“ button [7] to start over again.
Editing the margin line

You can edit or manually draw the margin line by clicking on the "Correct/Draw" tab, [8] in the margin detection dialog. The detected margin line changes to green color, and now features little dots, which grow as the mouse approaches them. These are the control points that help you edit the margin.

Different modes for editing the margin line are now available:

- **Move mode [1]**: Here, you can drag and drop individual control points
  - Add new points by clicking on the green line
  - Remove points by clicking them with both mouse buttons (first hold the left mouse button on a point, and while holding it, click the right mouse button – the point will disappear
- **"Up/Down" mode [2]**: Drag and drop the mouse near the margin. Control points will move up or down, as if the mouse pointer was magnetic
- **"Draw" mode [3]**: Draw a portion – or the entire margin – freely. If a margin has been previously set, start drawing close to the existing margin, and add points by clicking on the object. When done, click "Accept drawing changes“ [4] to merge the newly drawn section with the existing margin line.
You can move the entire margin using the „Move margin up or down“ feature. Set the offset [5] to a **nonzero** value (positive to move up, negative to move down), and click „Move“ [6] one or more times to move the margin step by step.

No matter how you're editing the margin line – you can always go back one or more steps by using the „Undo/Redo“ feature.

When done with the margin line editing, click „Next“ to continue to the next step.

**Use <PageUp> and <PageDown> keys to rotate, to inspect the margin line from all sides.**
Setting insertion axis

You will not always get prompted for the insertion axis. The software can accurately autodetect the proper insertion axis in the vast majority of cases. You will be asked to check the detected insertion direction in the following cases:

- **When constructing bridges for 3-axis or 4-axis milling**
  - For 3-axis milling, it is required - due to production constraints - that all teeth within a bridge share the same insertion axis. The detected insertion common axis is shown to the user, who can then help to optimize this sometimes difficult decision.

- **When the software has doubts about the insertion axis it auto-detected**
  - Even for single crowns/copings, or for bridge elements in 5-axis milling, you are sometimes prompted to verify/correct the detected insertion axis. This is usually the case when dealing with dubious preparations (e.g. when the margin line lies within an undercut area).

- **For all inlay constructions**
Checking/editing the insertion axis

The software will present you its auto-detected insertion axis, by adjusting the viewpoint so that you look onto the preparation(s) in the direction of insertion. Additionally, undercut areas will be marked with a color scale.

Setting a new insertion axis

To change the insertion axis, rotate the view so that you look onto the preparation(s) from your desired insertion direction. Then, click button [2] to set this as new insertion axis. The undercut visualization will be updated.

Applying a common insertion axis for several constructions

In 5-axis or laser melting mode, the software allows different insertion directions for parts within a bridge. To enforce the same insertion axis for several parts, click on the respective tooth within the tooth selection control. For example, in the above screenshot – which prompts you for the insertion axis of tooth 23 – click on the tooth symbol 24 to ensure that teeth 23 and 24 share the same insertion axis. Click on 24 again to undo.

Check „unique insertion direction for bridges“ to enforce a common insertion axis for all parts of the currently edited bridge (default in 3-axis mode).

⚠️ In 3-axis mode, uncheck this box only if you really know what you're doing.

Click „Next“ when done, to proceed to the next step.
Designing the inside of the crown

This step covers the design of the inside of the crown/inlay – the part that will be in contact with the preparation. This part of the construction, and the parameters involved, are crucial for proper fitting. In case you are not happy with the fitting of the produced part, it’s here where you should look for possible parameter changes.

Der Zement Spalt

You can define the thickness of the cement gap using the control [1]. It will be preset to the value defined in the DentalDB module. Changes you make here will apply only to the current construction (as opposed to changes in the DentalDB module, which will be saved as the new default values for the selected dentist). Move slider [1] to change the thickness of the cement gap – changes will be applied in real-time, so you can instantly see the effect of your actions. Slider [2] defines the start of the cement gap relative to the margin line, in millimeters. That is, if you chose a value of 1, the area [8] that is within 1mm of the margin line will not have a cement gap. The same way, you can change the end of the cement gap using slider [3], to create an area on top of the crown which has no cement gap [10]. The arrow [11] once again shows the insertion axis.
### Additional spacing

By unfolding the „Additional spacing“ expander, you will get access to options [4] and [5] which allow you to add additional spacing.

- Additional spacing is also applied in the area where there is no cement gap
- Additional spacing is applied in addition to the cement gap in area where there is a cement gap

The higher the values here, the looser the fitting. You can also use negative values here, to create a tighter fitting. However, trying to improve fitting by changing the „Additional spacing“ values is a workaround, not a solution. A properly tuned CAM system should be able to achieve good fittings with zero additional spacing.

### Designing the crown border

The second tab of the „Crown Bottoms“ dialog gives you access to parameters that define the shape of the crown border. The graphic [5] gives an illustration of meaning of the sliders [1-4].

1. Defines the horizontal crown border width. Typically, material properties enforce certain limits here; e.g. for Zirconia, a common minimum value is 0.2mm.
2. Defines the length of the angled part of the border. This may commonly be set to zero.
3. Defines the angle of the angled part.
4. Defines an additional vertical border. Commonly this is also set to zero.
Dealing with undercuts

The third tab in the „Crown bottoms“ dialog gives you access to undercut-related options and milling parameters.

Undercuts in the preparation are blocked out by default, unless you specifically chose not to do so, by checking checkbox [1].

A certain (small) angle may be applied for blocking out undercuts, as defined by [2]. By default, a value of zero is used, meaning that undercuts are blocked out „straight down“.

Slider [3] defines an „untouchable zone“ around the preparation margin, where the crown is never blocked out, even if it should be (due to undercuts being present above).

We will further elucidate the effect of this option with an example. Consider the two images below (for this tooth, we have intentionally set an incorrect insertion axis to illustrate the problem).
The graphic on the left shows the behavior with “Don't block out zone near prepline” set to 1mm. Observe how the upper part is blocked out, but as soon as the untouchable zone is reached, the crown bottom will go back to the preparation (note that it is not possible to produce this kind of restoration with 3-axis milling). The graphic on the right shows behavior with “Don't block out zone near prepline” set to zero. As you can see, the crown will not be in contact with the preparation around the margin. In both cases, the result will be non-optimal and the restoration will need manual work (either by manual milling, or by adding ceramic) for a proper fit. It is up to the operator to decide which option may be better in the particular clinical case.

If at this point in the construction, you find that the insertion axis is not optimal, you can still easily change it:
Right-click on the tooth for which you'd like to change the insertion axis, and chose „Set insertion direction“. You can then change the insertion direction by orienting the view to the insertion direction and clicking „Set current view as insertion axis“.

In the third tab of the „Crown bottoms“ dialog, you can also change the parameter for tool diameter compensation. If you have selected a material that is to be milled, the „Anticipate milling“ check box [4] is checked by default. Under [5], you can chose the diameter of the tool to be used for milling. It is beneficial to chose a value slightly higher than the diameter of the actual tool you're using, e.g. chose 1.2mm when milling with a 1mm tool.
Consider the diameter of the smallest tool used. The diameter of the roughing tool is of no interest here.

Any parameters you change in this screen will not be applied in real time, as these are computing-intensive operations. Click „Apply“ [8] to see the effect of your changes. To visualize undercuts which remain (e.g. due to usage of „Don't block out zone near preline“), click the „Show undercuts“ button [7].

When done, click „Next“ to proceed to the next step.

### Placement of library teeth

The software will load library teeth and place them automatically. In this step, you have the possibility to manually optimize the placement of the model teeth, by moving, rotating, and scaling. Switch between these modes using buttons [1-3]. Then, simply drag and drop the mouse on the teeth to make your adjustments.

Note that the tooth models are displayed in yellow – this means that they are responsive to mouse clicks. Whenever objects are displayed in yellow in the viewer, they will react to clicking and/or dragging the mouse.

For crown preparations, don't be overly worried about positioning accuracy at this point – a rough placement will be enough; you can always do fine-tweaking later in the „Free forming“ step. It doesn't matter if the model tooth doesn't properly fit the preparation (see [7] for an example) – as long as the tooth model is positioned somewhat reasonably in relation to the preparation, the software will adapt the library tooth automatically in the next step.

For inlay preparations, accurate positioning is crucial already at this point. The closer you position the model tooth to the prepared tooth, the better the result will be, so it is worth to invest a little time here.
A semi-transparent display of the model teeth might help you see both the prepared tooth and the model tooth, thus facilitating accurate placement. Right-click on „Anatomic shapes“ in the „Show/Hide groups“ window to toggle transparency for all library teeth – for details, see the „Showing/hiding objects in the viewer“ section.

A light red color (for example [6]) marks an area where the tooth model is placed so close to the preparation that it lies within the material's minimum thickness. The software will automatically fill these areas during the adaptation of the tooth models. So, in the area marked by [6], once the tooth is adapted to the preparation, the fissure will not be as deep as in the original model tooth, due to the restriction enforced by the minimum material thickness.

Instead of using the mouse for switching between modes [1-3], you can also leave button [1] pressed and use hotkeys to quickly toggle modes – this will save you a lot of time: Hold <CTRL> to switch to rotation, <SHIFT> to switch to scaling. Note that whenever hotkeys are available, they will be displayed in a „tool tip“ for the respective button. So, in this case, you can simply move the mouse over button [1], and a help bubble will appear which reminds you of the available hotkeys.

When placing tooth models, it may be helpful to visualize intersection with the antagonists, if you have performed an antagonist scan („View → Distance to antagonists“ in the context menu). See the section „Visualizing intersections/distance to antagonists or anteriors“ for details.

Restricting movements

In some cases, it may be useful to restrict possible movements to certain directions. Especially novice users who are not yet used to navigation in virtual 3D space will appreciate the options [4] which allows you to limit movements/scaling only to:

- Mesial/distal direction only
- Buccal/lingual direction only
- Occlusal direction („up and down“) only
- Mesial/distal and buccal/lingual direction only („move to all sides, but keep height“)

Moving all teeth simultaneously

You can move all teeth simultaneously by checking checkbox [5]. This is useful e.g. when all teeth are positioned too low or too high in the software's initial set-up suggestion. When done with the adjustments, click 'Next' to proceed to the next step. The model teeth will then be adapted to the preparations.
Freeforming

The „Freeforming“ screen gives you access to the following features:

- Anatomic forming: Changing the shape of the tooth anatomy, while taking advantage of the intelligent library models
- Virtual wax knife - adding or removing material, smoothing
- Adaptation of pontics to the gingiva

Anatomic forming

Click & drag on the tooth to change its shape.

Use buttons [1]-[4] to change the area that you’re editing:

- „Cusps“ [1] edits individual cusps. Note that this only works properly for restorations based on model teeth (anatomic crowns/copings, anatomic inlays, etc), for offset copings or waxups, the software cannot know the location of the cusp.

- „Tooth parts“ [3] edits the mesial, distal, buccal, lingual side, where ever you click on. Useful e.g. for adjusting approximal contacts.

- „Entire tooth“ [2] edits the entire tooth. Useful hotkeys are available in the „Entire tooth“ mode. Hold <CTRL> to switch to rotation, <SHIFT> to switch to scaling. This way, you can rotate or scale the tooth, while it still stays attached to the preparation margin. As always, the software will remind you of the available hotkeys if you move the mouse over the respective button [2].

- Ridge” [4] is for fine-tuning of ridges/bulges.
You can also drag and drop the bottom of a pontic when in „Anatomic“ forming mode.

By unfolding the „Advanced options“ expander, you can get access to options that allow you to restrict the movement in certain ways. Using [5], you can restrict movement to occlusal direction (up/down) only. Using [6], you can hold certain parts of the tooth fixed: either the cusp tips or the equator. A useful example how you can take advantage of this option: To create deeper or flatter fissures, switch to „Entire tooth“ [2], then check „Cusp tips“ [6]. Now, you can simply drag and drop fissures to make them more or less pronounced, without overly changing the rest of the tooth shape.

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The “Free” tab – adding or removing material, smoothing

Click on the “Free” tab to switch to the „Virtual Wax knife“, which allows you to add or remove material. You can toggle between adding/removing material and smoothing/flattening using buttons [1] and [2].

Adding / removing material:

To add material, click on the tooth and hold the mouse button. The longer you hold it, the more material will be added.

Hold <SHIFT> to remove material.

Smoothing:

Activate Smooth mode [2], click and hold the mouse button on the parts you’d like to smooth.

Hold <SHIFT> to flatten (super-smoothing)
Hold <CTRL> for a more shape preserving smoothing
You can also use the smoothing option to remove certain artefacts (e.g. due to bad scan data when doing digital copy milling).

Adjusting the brush

Using slider [3], you can adjust the speed at which material is added or removed while you hold the mouse button (or the amount of smoothing when in „Smooth/Flatten“ mode). Slider [4] controls the brush size, that is, the area that is affected around the mouse pointer.

You can switch to a different virtual tool using [5]. For example, the „Point of knife“ tool is useful for carving fissures.
Adapting pontics to the gingiva

Using the „pontics“ tab, you can adapt pontics to the gingiva.

The „Distance“ slider [1] controls the distance to the gingiva after the adaptation:

- A negative value means that the pontic will intersect the gingiva scan (that is, the physical pontic will apply pressure on the gingiva)
- A positive value means that there will be a gap between gingiva and pontic
- A zero value (default) means that the pontic will be in direct contact with the gingiva

Check the „Pull down to gingiva“ box [2] if the gingiva is so low that the pontic doesn't intersect it to begin with. This will pull down the pontic towards the gingiva during the adaptation (Alternatively, you can pull the pontics down to the gingiva manually by dragging on the bottom while the „Anatomic“ tab is active).

When designing reduced pontics, the „Freeform“ screen will appear twice, once before and once after the reduction. Therefore it's your choice whether to perform the pontic adaptation on the full anatomic or on the reduced shape. To make sure that the exact distance value [1] is respected in the final restoration, perform the adaptation after the reduction.

Finally, click „Adapt to gingiva“ [3] to perform the actual adaptation.
Adaptation to antagonists / approximal adaptation

This screen allows you to adapt restorations to the antagonist (if scanned), and to the adjacent teeth.

If you have used the Virtual Articulator feature (available as an add-on module; requires supported scanner), you may choose between static or dynamic occlusion [1].

You can define a desired distance to the antagonist (for anatomic and reduced parts) using the slider(s) [4].

For the actual adaptation, you have the choice between a smart shape-preserving adaptation [3], which will try to preserve the tooth morphology, or simply cutting intersections with the antagonist [2].

Use a combination of both – first the shape-preserving adaptation [3], which will keep small intersections, then cut intersections [2].

To adapt to anterior teeth, switch to the „Approximal“ tab [5].

When done, click ‘Next’
Creating the framework from the anatomic shape (Shrinking/Cutback)

If your construction contains anatomic copings, reduced pontics/waxups, or overpress parts, the wizard will present you the „Shrinking“ dialog. This screen allows you to reduce the anatomic shapes in order to create the framework. Note that we are talking about cutback for applying ceramic here.

This has absolutely nothing to do with the zirconia shrinking that occurs during the sintering process.

You may change the minimum thickness of the framework using [1], within the margins defined for the material you selected. Slider [2] controls the amount of cutback – that is, the thickness of the ceramic layer you plan to apply on the framework. Note that the minimal thickness will always be enforced, which means that in areas where the material thickness does not allow it, the cutback will be less than what is specified by [2].

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**Partial shrinking**

You may exclude certain parts from the shrinking, which will then be kept in full anatomic shape. This is useful e.g. for creating lingual bands, or for designing a metal chewing surface if you don’t have enough space for ceramic on the occlusal side. Check [3] – observe how the teeth then turn yellow; they are now responsive to mouse actions. Drag and drop the mouse on the teeth to mark areas that will be excluded from the shrinking.

Hold `<SHIFT>` to erase.

Slider [4] controls the thickness of the brush used for marking.

In some cases, it may be beneficial to have less reduction on the lingual side. You can achieve this result by setting slider [5] to a value below 100%. E.g. if you have set a depth of 1mm [2], and set [5] to 60%, then the shrinking will be just 0.6mm on the lingual side. By default, this lowered value is only applied to anterior teeth; to apply it to all teeth, uncheck [6].

Click „Apply“ [7] to perform the shrinking without switching to the next wizard screen, or click „Next“ to shrink and move on.
Generating connectors

Connectors will be generated wherever it has been previously defined in the database module.

You can customize connectors in various ways. The minimum size of the connector may be defined either by its cross-sectional area, or by its height/width – toggle between the two modes using radio buttons [1], and perform your adjustments using slider(s) [2]. You may also switch between different predefined shapes [3]. To apply your changes, press [4].

Any changes you make will be applied to all connectors. To apply different parameters/shapes to specific connectors in the construction, close the wizard, and use the context menu (right click on the connector, chose „Connectors...“. Alternatively, you can customize the connectors using the „Free“ tab, as explained below.

To change its position, simply drag and drop the connector using the mouse. It will readapt itself to the teeth once you drop it at its new position.
Dragging the connector will change its position on both sides – to change the docking place of the connector only on one side, hold <CTRL> and click on the tooth to change the position of the docking point [5].

When generating connectors, the software tries to enforce the minimum cross-sectional area, or the minimum height/width. In some rare cases, this may fail, due to space restrictions. The connector will then be displayed in red. This situation needs manual work to be resolved – try changing the location of the connector (by dragging & dropping it, or by repositioning the docking points), or use the connector freeforming as described below.

Customizing connectors – the „Free“ tab

Switch to the „Free“ tab to further customize your connectors, or to visualize connector thickness.

You can now edit connectors by moving control points ([1], [2], [3]). When you move the mouse close to one of the control points, it will grow and spawn arrows.

- Drag and drop the control point itself for free movement in all directions
Drag and drop one of the arrows for movement that is restricted to the direction of the arrow.

To insert additional control points, hold <CTRL> and click on the green line in the center of the connector, at the location where you'd like to insert the new control points. The more control points you add, the more freedom in designing complex connectors you have. To move several control points at once, hold <SHIFT> while dragging one of the green control points.

With great power comes great responsibility – since you are free to shape the connectors as you desire, you can also make the connectors thinner than specified by the material parameters. If you design the connector substantially thinner than specified, the software will mark the approximate area which is too thin in magenta. Whenever you see a partially magenta-colored connector, do change its shape to make it thicker – unless you are willingly taking the risk of designing construction that may not be stable enough.

Saving restorations

The last step in the wizard is the "merging and saving", which will:

- Combine (merge) all the individual elements you designed (copings, connectors, etc) into one or more mesh(s) suitable for milling or laser melting. For each physical element you plan to produce, one mesh will be created.
- Saving those meshes in STL format
- Writing additional information (preparation margin, insertion axes, and much more) into the .constructionInfo file, which will be read by supported CAM applications

The saved files (.STL+.constructionInfo) will be located inside the respective project dir (the directory that opens when you use the „Open in explorer“ button in DentalDB.

Merging and saving will start as soon as the dialog opens. The progress indicator [1] will show current progress. To abort the process, click „Cancel merging“ [3]. Once the merging and saving has finished, the resulting output files will displayed in the box [6].

You can use drag & drop operations here: e.g. you can drag and drop files directly from this dialog [6] into a directory of your choice, onto your CAM software, in an email composition window, or on an FTP server.
Understanding the difference between output for milling and selective laser melting (SLM)

If your constructions are to be produced using selective laser melting (SLM, often incorrectly referred to as „laser sintering”), the output data must be a „watertight“ mesh with certain specific characteristics:

- No holes or open edges; completely interconnected mesh
- No inner surfaces or self-intersections

The figure above shows a sectional view of the junction between connector and pontic, with SLM optimization (left) and without SLM optimization (right).

For milling, it is not mandatory that these special requirements are met. The post-processing for SLM involves time-consuming calculations, which is why the SLM optimizations (controlled by checkbox [5]) are only performed by default when a laser-melted material is selected in the DentalDB module.

- If checkbox [5] is unchecked, resulting bridges can not be produced using selective laser melting
- If checkbox [5] is checked, the resulting output is still suitable for milling

Even if not using laser melting for production, it is helpful to enable the optimization for laser melting, if you plan to perform additional freeforming on the finished construction. To switch on SLM optimization once you already have saved output files for milling, click „Remove existing merged parts“ [4], then „Restart Merging“ [2].
Click “Finish” to close the wizard. You're done now, you may close the CAD window and proceed to the next job. Alternatively, you can still perform additional modifications to the construction by closing the wizard and using the context menu. See section “Changing a finished reconstruction” for details.

Visualizing intersections/distance to antagonists or anteriors

To visualize distance to (or intersection with) antagonists, use the context menu by right-clicking on the background, and chose „View → Distance to antagonists“. An antagonist visualization window will appear, and intersections with antagonists will be marked on your constructions.

Using drop-down box [1], you can switch between visualization of intersections and visualization of distance. The number [2] indicates the distance to the antagonist (or intersection, if the value is negative) at the mouse position. [3] indicates the maximum intersection (or closest distance) of the tooth currently under the mouse. Slider [4] controls the color scaling, visualized in the false-color bar above. Using checkboxes [5], you can enable/disable visualization both for antagonist intersection/distance and intersection/distance to anterior teeth.

Tip: You can also visualize distance/intersection on healthy teeth (that is, on scan data), by unfolding combo box [1], and checking the „Include healthy teeth“ checkbox which appears in the dropdown.

To disable all visualizations, simply close the „Distance to antagonists“ window.

Advanced options

Changing a finished construction

In some cases, you may still want to change a construction even the wizard has already finished. You have two options to do this: a) Freeforming on the finished mesh (the „merged part“ that was created in the final wizard step). This option is available in the context menu once you have finished constructing a bridge with the wizard. b) Editing
individual parts (e.g. changing a preparation margin, adding or removing connectors).
This requires the „merged part“ to be discarded first.

**Freeforming merged construction**

Right-click on the background once the wizard has closed. Select „Freeform merged reconstruction“. You may now freeform on the entire bridge.

This freeforming mode allows you to make connectors thinner than specified. Therefore, it is recommended to check connector thickness using the „Visualize connector thickness“ button in the „Free“ tab. Add material to increase connector thickness if the thickness visualization contains magenta color.

Freeforming the merged construction works best if the output mesh has been optimized for selective laser melting. Otherwise, gaps between the connectors may appear during the freeforming process. To switch from milling output to SLM output, use the context menu and select „Save Restorations“, then „Remove existing merged parts“; check „Optimize for Selective Laser Melting“, then click „Restart merging“.

As soon as you click „OK“ in the „Freeform merged“ dialog, the software will ask you whether you'd like to save your changes.

**Editing individual parts**

To unlock the options for editing individual parts, right-click on the background, and chose „Delete constructed parts“ in the context menu. Make sure „Merged parts“ is selected in the drop-down box, and click OK. If all your constructions appear to be gone now, don't worry – they're just hidden; use the „Show/hide groups“ to make them visible again. The context menu will now contain additional options, e.g. the tooth-specific context menu for crowns/copings will contain the option to edit the preparation margin. When done editing, select „Save restorations“ from the context menu to save your changes.

**Measuring thicknesses or distances**

You may measure thicknesses or distances on the mesh using the „Space ruler“, which is available through the context menu („View → Space Ruler“). Toggling between full anatomic and reduced reconstructions In some cases, you may want to switch an anatomic part to reduced, to allow shrinking – or vice versa. E.g. you may have constructed a temporary bridge (plastic material) in full anatomic shape, and later on you wish to load the scene and shrink the construction. To toggle between „full anatomic“ and „reduced“ (e.g. switch a tooth that you have marked as „Anatomic Pontic“ in the DentalDB to „Reduced Pontic“), use „View → Change reconstruction types“ in the context menu.
Toggling between full anatomic and reduced reconstructions

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Mesh registration

A mesh registration tool, which allows 3-point registration and best fit matching, is available („View → Register Meshs“).

This is useful for positioning situation model scans, if they haven't already been correctly positioned by the scanner software.

Finishing the CAD process; saving and restoring „scenes“

When finished with the CAD design, simply close the CAD window. You will be prompted to save the „scene“. This allows you to restore the current state of the CAD module at a later point, including the possibility to perform additional modifications.

When you save a scene in the project folder, the next time you start the CAD for this job, you are asked if you'd like to load the scene, or restart construction from scratch.

You may also save the scene without closing the CAD window, of course – simply use the context menu, or the „Save“ button. Scenes should be saved when the wizard is closed and no editing dialogs are open.